APPENDIX A- REFERENCE DOCUMENTS **NO. OF PAGES**

Note: Borehole log and Bathymetry survey are for information only. Contractor is responsible to verify all site conditions.

Basic Impact Analysis

Old Slys Locks 26 & 27 Masonry Repairs
Rideau Canal
Smiths Falls, Ontario

July 2018

Environmental Impact Assessment Version Control

This section serves to control the development and distribution of revisions to the Environmental Assessment.

Document Number	Amendment Number	Date	Brief Description of Change
1	0	2018-07-31	Original

1. PROJECT TITLE & LOCATION

Old Slys Locks 26 and 27 Masonry Repairs. Old Slys Lockstation is located in Smiths Falls, Ontario with access just off of Old Slys Road. By water, Old Slys Lockstation is approximately 1.3 km downstream of Combined Lockstation and 2.4 km upstream of Edmonds Lockstation.

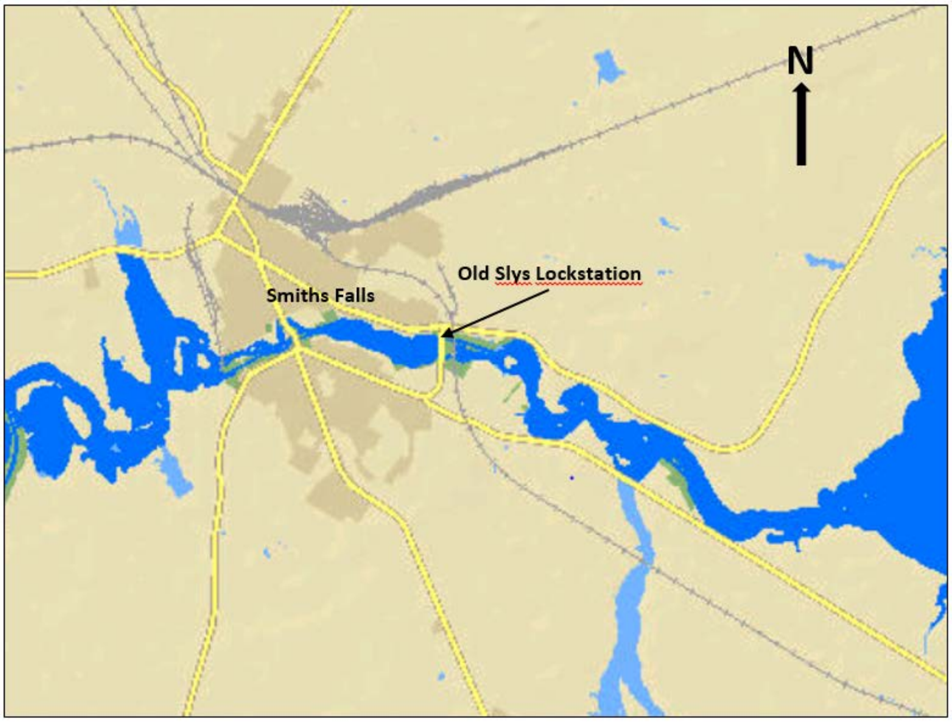


Figure 1. Location of Old Slys Lockstation relative to Smiths Falls, Ontario (ESRI, 2018).

Figure 2. Aerial overview of Old Slys Lockstation (ESRI, 2018).

2. PROPONENT INFORMATION

Jean-Francois Charron, Parks Canada Project Lead
Parks Canada, Rideau Canal
34 Beckwith Street South
Smiths Falls, ON K7A 2A8

3. PROPOSED PROJECT DATES

Planned commencement: Fall 2018
Planned completion: Spring 2020

4. INTERNAL PROJECT FILE # EA: RIC-2018-003 (I); RPA 872

5. LAND OWNERSHIP

The project will take place entirely on or over areas (both land and the bed of the canal) within the jurisdiction of the Parks Canada Agency (PCA), with one exception. An access road on PCA land to the lower wharf will be accessed via the entrance road to the Smiths Falls Waste Water Treatment Plant (see Figure 2). An agreement has been established with the Town of Smiths Falls to allow use of this entrance road for the duration of the project.

6. NOTE ON BASIC IMPACT ASSESSMENT DOCUMENT

The environmental constraints, best management practices and mitigation measures outlined within this Basic Impact Analysis (BIA) shall be adhered to and implemented accordingly. The information presented within this document may be appended to subsequent future BIA(s) for similarly-scoped projects, or for possible future amendments to this BIA to address changes in the scope of work of this project. Additional prescribed mitigation within the future BIA(s) are to be adhered to and implemented in conjunction with that of this (the Initial) BIA, with the exception of mitigation measures which are detailed to supersede specific mitigative measure outlined within (this) the Initial BIA.

7. PROJECT DESCRIPTION

Old Slys Lockstation is a double lock, with each lock chamber being composed of two original masonry walls. Lock 27 has 15 courses of stone and Lock 26 has 12 courses of stone. The capstones and skyward surfaces are generally stone, except at the winches, which are bolted to concrete at some locations. The downstream wing walls are also original masonry (Archaeological Overview Assessment, 2018 – Appendix 4). An overview of the project site including staging areas and access roads can be seen in Figure 3.

The objective of this project is to repair Old Slys Locks 26 & 27 and to improve asset condition from poor to good. A number of concerns with the Old Slys locks will be resolved with this work. Currently water penetrates through open joints in the lock walls (in particular the southern walls), which makes it difficult to hold water in the locks. There are voids behind the walls that have been created by this water movement through the walls. Many areas of masonry are fractured and deteriorated.

The land on the west side of the locks is a de-commissioned landfill that is a registered contaminated site. A risk assessment report, entitled 'Risk Assessment and Environmental Monitoring, Old Slys Lockstation, Smiths Falls, Ontario', as well as a report amendment entitled '*Total Suspended Solids Limit For Construction Site Water, 2018'* has recently been created for the site. Please refer to Sections 8 and 9 for discussion on the report outcome.

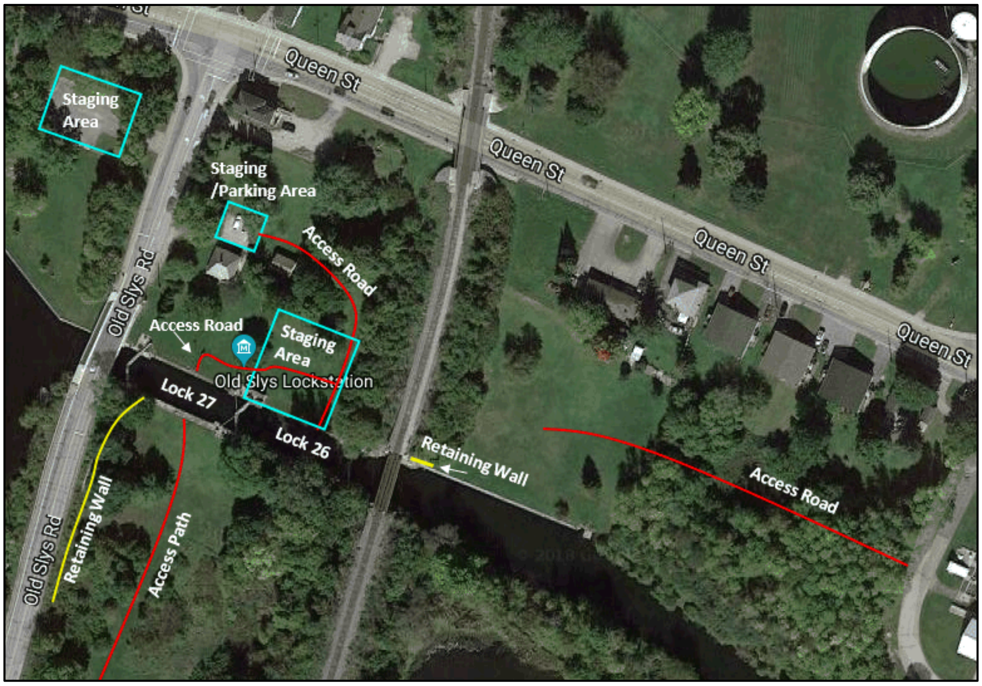


Figure 3. Aerial overview of projected locations of staging areas and access roads (ESRI, 2018).

The main components of the project are heritage stone masonry rehabilitation, including solving leakage through the lock walls, and repairs to the approach walls, wing walls, breast walls, and sluice tunnels. Repairs to part of the retaining wall along Old Slys Road (south of the crab on the southwest side of Lock 27; see Figure 3) and the retaining wall on the western side of the railway bridge are also part of the scope. The following section offers more detail on the scope of work and project schedule.

Two cofferdams will be required to complete this project, one upstream of Lock 27 to repair the stones and concrete at the log gains, and the other downstream of Lock 26 to enable work on the masonry approach walls that extend past the stop logs. The upstream cofferdam is to be constructed between the concrete bridge abutments. The downstream cofferdam to be constructed between the concrete retaining wall of the lower wharf on the northern side and the stone wall on the southern side (see Photos 1 and 2). The installation of cofferdams may require the removal of up to 600 mm of sediment upstream and 900 mm downstream.

Scope of Work – Phase 1 (September 2018-May 2019)

- Create a new access road from the Smiths Falls Waste Water treatment Plant to the lawn by the lower wharf to facilitate the installation of the downstream cofferdam. This road is estimated to be 100 m in length.
- Install cofferdams upstream and downstream beyond extend of masonry to allow work on the approach walls.
- Dewatering of project area.
- Removal of debris from floor of lock chambers.
- Low-pressure cleaning of gates, lock walls and approach walls to remove zebra mussels,

plant life and soil.

- Construct scaffolding and winter protection enclosure(s).
- Focus on masonry repairs on the approach walls, between the cofferdams and log gains.
- Stone repointing and repairs on stone retaining wall.
- Grouting of voids behind approach walls as required.
- Dismantle cofferdam no later than March 14th; install stop logs in gains in order to continue masonry repairs inside lock chambers.
- Landscaping

Phase I Schedule

September 4th, 2018 ---------------Mobilization to site. The Contractor will not be allowed to interrupt public use of the lock during navigation season, which continues through to the Thanksgiving weekend.
March 14, 2019----------------------Cofferdams to be removed.
March 15-April 27, 2019---------- Work inside the lock chambers.
April 28-May 10, 2019------------- Site clean-up and landscaping.
May 10th, 2019-----------------------Demobilization.

Scope of Work – Phase 2 (September 2019-May 2020)

- No cofferdams are required for this phase of work.
- Stop logs installed into log gains.
- Dewatering of lock chambers.
- Repairs to masonry lock walls, sluice tunnels, vent shafts and stone/concrete cap. Mortar joints will be raked out and re-pointed with conventional heritage lime based mortar. Isolated stones will be replaced either wholly or with partial (Dutchman) type repairs using compatible stones tooled and finished to blend with the existing weathered stone.
- Grouting of masonry walls, sluice tunnels and vent shafts.
- Concrete repairs to the aprons.
- Excavate contaminated soil from behind the south wall of the lock chambers, from an area 1200 mm deep and 900 mm wide, along the back of the south wall for the full length of both locks. The wall will be cleaned and all exposed joints raked out and repointed. The trench will be backfilled with new material.
- Repair of the masonry retaining walls, one adjacent of Old Slys Road (see Photo 3) and one on the western side of the railway bridge.
- Landscaping.

Phase II Schedule

September 3, 2019------------------Mobilization to site. The Contractor will not be allowed to interrupt public use of the lock during navigation season, which continues through to the Thanksgiving weekend.

October 15-April 27, 2020-------- Work inside the lock chambers.
April 28-May 8, 2020---------------Site clean up and landscaping.
May 8, 2020--------------------------Demobilization

8. VALUED COMPONENTS LIKELY TO BE AFFECTED

The following section identifies valued components in the study area that will potentially be impacted by the proposed works.

Soil and Landforms

This section of the Rideau Canal passes through the Smiths Falls Limestone Plain, characterized by shallow soil and exposed limestone. Soils and landforms surrounding the Lockstation have been disturbed by development including the building of canal infrastructure, residential development, transportation infrastructure, agriculture and manicured parkland (Photo 4).

Contamination

A Detailed Quantitative Human Health and Ecological Health Risk Assessment was conducted in 2017-18 by AEL Environmental for the registered contaminated site on the south side of Locks 26 & 27 (see Figure 2). The Site operated as a landfill in the mid-1960's, and potential environmental concerns at the Site were identified in previous reports due to the presence of buried landfill materials. Previous investigations concluded that contaminants of concern include metals and polycyclic aromatic hydrocarbons (PAHs) in soil, metals and polychlorinated biphenyls (PCBs) in groundwater, and metals in sediment and surface water.

The Risk Assessment used analytical results from new samples of soil, sediment, groundwater and surface water, as well as the results of previous investigations. The assessment also included a benthic invertebrate study, to assess the health of benthic invertebrate communities on the project site, in comparison to upstream and downstream benthic communities. Analytical Results of new sampling are detailed in AEL Environmental's *Risk Assessment and Environmental Monitoring, Old Slys Lockstation, Smiths Falls Ontario* (Appendix 5) and summarized below:

Soil: Exceedances in surface and subsurface soil were found across the Site and are likely related to the placement of impacted fill. Exceedances included VOCs (Ethylbenzene, Toluene, Total Xylenes), PHCs F2, F3, F4 and F4 Gravimetric; PAHs (Methylnaphthalene, 2-(1-), Naphthalene, Phenanthrene), and Metals and Inorganics (Antimony, Arsenic, Cadmium, Copper, Lead, Nickel, Tin and Zinc).

Groundwater: Variable distribution of impacts across the site suggest impacts are associated with the nature of fill materials used for infilling. Exceedences include PHCs F3, F4 and F4 Gravimetric, PAHs (Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Fluoranthene, Naphthalene, Phenanthrene, Pyrene), and Metals and Inorganics (Arsenic, Barium, Cadmium, Chloride, Cyanide and Iron).

Sediment: Exceedences include PAHs (Acenaphthene, Acenaphthylene, Benzo(a)anthracene, Benzo(a)pyrene, Chrysene, Dibenz(a,h)anthracene, Fluoranthene, Phenanthrene, Pyrene) and Metals and Inorganics (Arsenic, Cobalt, Cyanide, Lead, Mercury, and Nickel).

Surface Water: Variable distribution of metals and inorganics impacts suggest impacts are associated with the Site, and specifically from surface runoff of contaminated surface soil, groundwater seepage of contaminated groundwater and/or leaching from buried infill materials. Exceedences include Metals and Inorganics (Cyanide and Total Un-ionized Ammonia).

The results of the human health and ecological health risk assessment are discussed in Section 9.

Terrestrial Vegetation

Old Slys Lockstation is located in the St. Lawrence Lowlands Ecoregion and has a vegetation community that is representative of disturbed sites in this region.

The lockstation area is heavily influenced by past and present human development and activities. With the exception of the new access road area from the east, the project area is predominantly manicured with some mature trees (see Photos 4 and 5).

Mature trees recorded within the project area include:

- American Elm (*Ulmus americana*)
- Ash (*Fraxinus* sp.)
- Black Walnut (*Juglans nigra)*
- Eastern White Cedar *(Thuja occidentalis)*
- Black Locust (*Gleditsia triacanthos*)
- Manitoba Maple (*Acer negundo)*
- Red Maple (*Acer rubrum*)
- Silver Maple (*Acer saccharinum*)
- Sugar Maple *(Acer saccharum)*
- Trembling Aspen (*Populus tremuloides)*
- White Oak *(Quercus alba)*

Understory vegetation noted onsite includes: Riverbank Grape (*Vitis riparia*), Virginia Creeper (*Parthenocissus quinquefolia*), and Wild Red Raspberry (*Rubus idaeus*).

It should be noted that **Poison Ivy** is recorded to be present on site, particularly surrounding a Buckthorn adjacent to the lower wharf. Its recommended that the contractor add the presence of Poison Ivy to their Health and Safety Plan so that the workers are aware of its presence on the site.

A vegetation survey of the site recorded the following species at the lockstation:

- Common Lilac *(Syringa vulgaris)*
- Common/European Buckthorn (*Rhamnus cathartica*)
- Garlic Mustard (*Alliaria petiolata)*
- Tartarian Honeysuckle (*Lonicera tatarica)*

The Early Detection and Distribution Mapping System (2018) also lists Wild parsnip *(Pastinaca sativa) as being* reported within 3 km of the project site, however this plant was not recorded during the vegetation survey.

Where possible, invasive species within the project area will be excavated completely to ensure that they do not return post-construction, improving the sites overall ecological condition.

It is possible that some mature trees may be required to be removed from the southern side of the locks, due to their proximity to the excavation zone. These are potentially a large Trembling Aspen, a Manitoba Maple, and one Black Locust (which is a non-native species). The feasibility of retaining these trees will be ascertained on site in summer/fall 2018. Photo 10 shows the view of the southern side of Lock 27 where trenching will occur. The Lockmaster has asked to retain the majority of Black Locusts as they add shade to the southern side of the locks, which will be especially important after the Trembling Aspen is removed.

The laydown areas and access roads make use of hardened surfaces (parking lots) and existing routes through the lockstation grounds (see Figure 3 and Photos 6, 7 and 8). It is anticipated that only selective de-limbing will be necessary in these areas.

The exception to the above is the new access road that will extend from the Smiths Falls Waste Water Treatment Plant to the lawn adjacent to the lower wharf (see Figures 2 and 3 and Photos 8 and 9). Here there is currently a thick patch of secondary growth. The tree species recorded in this area are: Sugar Maple, Manitoba Maple, White Oak, Ash sp. and European Buckthorn.

Water Quality

Although the in-water work area for these sites will be isolated and/or dewatered for the construction season, some water, resultant from leakage of isolation barriers may pass through this area. By this, there is potential for contamination of water from spills and/or leaks from equipment. Also, potential of reduced water quality and clarity due to increased erosion, sedimentation and transport of debris, (e.g. discharge of waters).

Baseline water quality measures have been taken in the project areas prior to initiation of construction in order to get an accurate picture of background levels. Additional water quality measurements will be taken prior to the commencement of construction activities. This information will form the baseline for the mitigations measures outlined in this assessment.

Table 2: Baseline Water Quality for Old Slys Lockstation

Quality Component	**Upstream**			**Downstream**		
	July 2017	**June 2018**	**Average**	**July 2017**	**June 2018**	**Average**
Temperature	24.3	20.6	22.5	22.9	19.4	21.2
pH	7.9	8.4	8.2	7.8	8.3	8.1
Turbidity (NTU)	0.6	0.9	0.8	0.7	1.1	0.9

Aquatic Resources

The Rideau River has a diverse coolwater fish community. During fish community sampling as part of the Rideau River biodiversity project conducted in 1999-2000, thirty-five fish species were identified within the river (Canadian Museum of Nature, 2001), twenty-two species in the section from Smiths Falls to Burritts Rapids, which includes Old Slys Lockstation. Species found in this reach include:

- Northern Pike (*Esox lucius*)
- Largemouth Bass (*Micropterus salmoides*)
- Smallmouth Bass (*Micropterus dolomieu*)
- Common Carp (*Cyprinus carpio*)
- Yellow Perch (*Perca flavescens*)
- Greater Redhorse (*Moxostoma valenciennesi*)
- Silver Redhorse (*Moxostoma anisurum*)
- Brown Bullhead (*Ameiurus nebulosus*)
- Black Crappie (*Pomoxis nigromaculatus*)
- Central Mudminnow (*Umbra limi*)
- Brassy Minnow (*Hybognathus hakinsoni*)
- Golden Shiner (*Notemigonus crysoleucas*)
- Blacknose Shiner (*Notropis heterolepis*)
- Mimic Shiner (*Notropis volucellus*)
- Bluntnose Minnow (*Pimephales notatus*)
- Banded Killifish (*Fundulus diaphanus*)
- Brook Silverside (*Labidesthes sicculus*)
- Rock Bass (*Ambloplites rupestris*)
- Pumpkinseed (*Lepomis gibbosus*)
- Bluegill (*Lepomis macrochirus*)
- Tessellated Darter (*Etheostoma olmstedi*)
- Logperch (*Percina caprodes*)

Habitat surrounding the lockstation likely provides spawning, nursery, rearing, migration and feeding habitat for a variety of bait and sport fish species; however, the habitat is not rare or limited in the Rideau system and would occur outside the lock and its approach walls. No critical habitat for at risk fish has been identified adjacent to the Old Slys Lockstation.

Freshwater mussels found in the Smiths Falls to Burritts Rapids reach include:

- Eastern Elliptio (*Elliptio complanata*)
- Eastern Lampmussel (*Lampsilis radiata*)
- Floater (*Pyganodon sp.*)
- Fluted Shell (*Lasmigona costata*)
- Black Sandshell (*Ligumia recta*)
- Elktoe (*Alasmidonta marginata*)

A variety of aquatic plants are found in the Rideau River (Canadian Museum of Nature, 2001). The most common species include fragrant water lily (*Nymphaea odorata*), Common waterweed (*Elodea Canadensis*), Northern Water Milfoil (*Myriophyllum sibiricum*) and Eurasian Water Milfoil (*Myriophyllum spicatum*).

Wildlife

The area surrounding Old Slys lockstation is likely utilized by a variety of aquatic and terrestrial wildlife including frogs, muskrat, mink, rabbits, fish and turtles. Migratory birds also utilize the vegetation adjacent to the lockstation and waterfowl can be found on the water as well and on the lockstation grounds.

As the designated construction area is mainly restricted to a manicured area, use by wildlife in this area would likely be transient in nature for most local and migratory species. The exception is the access road to be built on the eastern side of the site that extends through a secondary forest patch. No animals or birds were observed here during a site visit in spring 2018.

Species at Risk

The Federal *Species at Risk Act* (*SARA*) provides protection to all Species at Risk (SAR) listed under Schedule 1 of the Act. The study area for this project lies within zone of identified Critical Habitat for the

Eastern Whip-poor-will (*Caprimulgus vociferous),* classified as Threatened under the Species at Risk Act (SARA).

Additional species at risk that may be found in the study area, bother federally listed species and species listed under the Ontario Endangered Species Act (ESA), have been identified using the Natural Heritage Information Centre (NHIC) database, the Atlas of Breeding Birds of Ontario and the Ontario Reptile and Amphibian Atlas. These species can be found in Table 1.

Basic habitat characteristics for each species have been included in Table 1 and an assessment given as to the likelihood of that species using habitat within the study area. For SAR that do not have critical habitat described in a recovery strategy, mitigation measures will be employed to ensure that individuals and their habitat are protected.

Table 2: Federally and Provincially-Ranked Species with Potential to be found within the Project Area.

Common Name	Scientific Name	COSEWIC	SARA Status	ESA Status	Preferred Habitat	Habitat Potential on Project Site	Likelihood to be Found on Project Site
BIRDS							
Bald Eagle	*Haliaeetus leucocephalus*	Not at Risk	No Status	Special Concern		Low	Unlikely
Barn Swallow	*Hirundo rustica*	Threatened	Threatened	Threatened	Nest almost exclusively on man-made structures (bridges, culverts, barns). Barn Swallows are long-distance migrants and fly from North American breeding grounds to wintering areas in Central and South America. Southbound fall migration may begin by late June in Florida or early July in Massachusetts. They return as early as late January in southern California to mid-May at Alaskan breeding sites. In southern Canada, adults start to return in the spring by the end of April and the first week of May, but the main influx occurs in mid-May, tailing off in early June. Breeding in Ontario typically takes place between May and August, with Nest construction starting in mid-May in Ontario.	**Moderate; no nests observed**	**Possible**
Black Tern	*Chlidonias niger*	Not at Risk	No Status	Special Concern	Shallow marshes, generally comprised of cattails. Breeding in Ontario typically takes place between early May and mid-August. In winter months Black Tern migrate south to central-America, the Atlantic coast and Mexico.	Low	Unlikely
Bobolink	*Dolichonyx oryzivorus*	Threatened	No Status	Threatened	Bobolink nest in tallgrass prairie and other open meadows, including hayfields. Breeding in Ontario typically takes place between mid-May and mid-July.	Low	Unlikely
Cerulean Warbler	*Setophaga cerulean*	Endangered	Endangered	Threatened	Associated with large tracts of mature deciduous forest with tall trees and an open	Low	Unlikely

Common Name	Scientific Name	COSEWIC	SARA Status	ESA Status	Preferred Habitat	Habitat Potential on Project Site	Likelihood to be Found on Project Site
					understory. They are found in both wet bottomland forests and upland areas.		
Common Nighthawk	*Chordeiles minor*	Threatened	Threatened	Special Concern	Open, vegetation-free habitats (dunes, beaches, recently harvested forests, burnt-over areas, rocky outcrops, rocky barrens, grasslands, pastures, peat bogs, marshes, lakeshores, and river banks)	Low	Unlikely
Eastern Whip-poor-will	*Caprimulgus vociferus*	Threatened	Threatened	Threatened	Semi-open forests or patchy forests with clearings, such as barrens or forests that are regenerating following major disturbances. Eastern Whip-poor-wills migrate to Mexico and Central America for the winter	**Moderate**	**Possible**
Eastern Wood-pewee	*Contopus virens*	Special Concern	Special Concern	Special Concern	Edges of mixed or deciduous forests, intermediate-aged mature forests. The Eastern Wood-pewee is a long distance migrant, wintering in the tropics.	Low	Unlikely
Golden-winged Warbler	*Vermivora chrysoptera*	Threatened	Threatened	Special Concern	Regeneration areas (old fields, hydro right-of-ways) surrounded by mature forest. The Golden-winged Warbler is a long-distance migrant and migrates south mainly through a corridor of states east of the Mississippi River and west of the Appalachians, with peak movement in September. They begin to return on spring migration in April, during which month they are still regularly recorded in Costa Rica as well as in Texas and Kentucky.	Low	Unlikely
Henslow's Sparrow	*Ammodramus henslowii*	Endangered	Endangered	Endangered	It nests in abandoned farm fields, pastures, and wet meadows. It tends to avoid fields that have been grazed or are crowded with trees and shrubs. Open fields, prefers undisturbed areas.	Low	Unlikely
Least Bittern	*Ixobrychus exilis*	Threatened	Threatened	Threatened	The Least Bittern breeds strictly in marshes dominated by emergent vegetation	Low	Unlikely

Common Name	Scientific Name	COSEWIC	SARA Status	ESA Status	Preferred Habitat	Habitat Potential on Project Site	Likelihood to be Found on Project Site
					surrounded by areas of open water. Most breeding grounds in Canada are dominated by cattails, but breeding also occurs in areas with other robust emergent plants and in shrubby swamps. Breeding habitats are occupied from mid-May to mid-September. In winter months Least bitterns migrate to the southern United States, Mexico and Central America.		
Peregrine falcon	*Falco peregrinus*	No at Risk	Special Concern	Special Concern	Cliff ledges or crevices, preferably 50 to 200 m in height, but sometimes on the ledges of tall buildings or bridges, always near good foraging areas.	Low	Unlikely
Red-shouldered Hawk	*Buteo lineatus*	Not at Risk	Special Concern	Not at Risk	Deciduous or mixed-wood forests containing shade-tolerant hardwood trees close to wetland areas. Large woodlots (10 to 100 hectares) can sustain viable Red-shouldered Hawk populations.	Low	Unlikely
Wood Thrush	*Hylocichla mustelina*	Threatened	Threatened	Special Concern	Mature mixed or deciduous forests, often moist, well-developed undergrowth, large forest stands. The Wood Thrush is a long-distance migrant, wintering in southern America and Mexico.	Low	Unlikely
Eastern Meadowlark	*Sturnella magna*	Threatened	No Status	Threatened	Nest in moderately tall grasslands, such as pastures and hayfields, but also nest in alfalfa fields, weedy borders of croplands, roadsides, orchards, shrubby overgrown fields, or other open areas.	Low	Unlikely
REPTILES AND AMPHIBIANS							
Blanding's Turtle[1]	*Emydoidea blandingii*	Endangered	Threatened	Threatened	Blanding's Turtles can be found in several types of freshwater environments, including lakes, permanent or temporary pools, slow-flowing streams, marshes and swamps. They will travel long distances	Moderate potential for nesting in lockstation grounds	Possible

Common Name	Scientific Name	COSEWIC	SARA Status	ESA Status	Preferred Habitat	Habitat Potential on Project Site	Likelihood to be Found on Project Site
					overland (>410m) for basking and nesting sites. Blanding's Turtles are spring nesters, laying eggs anywhere from May to late June-early July. They may use sand and gravel banks along waterways, road shoulders, fissures in rocky shorelines and freshly dug gravel and soil. Eggs generally hatch between late August and late October.		
Eastern Milksnake	*Lampropeltis triangulum*	Special Concern	Special Concern	Not Listed	Found in a wide variety of habitats, from prairies, pastures, and hayfields, to rocky hillsides and a wide variety of forest types. Often in close proximity to water. The milksnake hibernates underground, in rotting logs or in the foundations of old buildings.	**Moderate**	**Possible**
Eastern Musk Turtle	*Sternotherus odoratus*	Special Concern	Special Concern	Special Concern	Eastern Musk Turtle require shallow water with little or no current, and soft earth to bury into when they hibernate. Nesting habitat is variable, but it must be close to the water and exposed to direct sunlight. Eastern Musk Turtle prefer to lay eggs in rotting vegetation.	**Moderate potential for nesting on lockstation grounds**	**Possible**
Eastern Ribbonsnake	*Thamnophis sauritus*	Special Concern	Special Concern	Special Concern	Along the edges of shallow ponds, streams, marshes, swamps, or bogs bordered by dense vegetation that provides cover.	Low	Unlikely
Gray Ratsnake	*Pantherophis spiloides*	Threatened	Threatened	Threatened	Gray Ratsnake inhabit a wide variety of habitats, with a preference for a mosaic of forest and open habitats, such as fields and rocky outcrops. In winter, they hibernate underground in communal hibernation sites which provide protection against freezing and dehydration. Individuals show strong fidelity to hibernacula. During summer, snakes seek refuge in snags, hollow logs,	Low	Unlikely

Common Name	Scientific Name	COSEWIC	SARA Status	ESA Status	Preferred Habitat	Habitat Potential on Project Site	Likelihood to be Found on Project Site
					rock crevices and under rocks to shed and to escape from extreme heat and predators.		
Midland Painted Turtle[4]	*Chrysemys picta marginata*	Special Concern	No Status	No Status	Inhabits ponds, marshes, lakes and slow-moving creeks that have a soft bottom and provide abundant basking sites and aquatic vegetation. Hibernates on the bottom of waterbodies.	**Moderate potential for nesting on lockstation grounds**	**Possible**
Northern Map Turtle[2,5]	*Graptemys geographica*	Special Concern	Special Concern	Special Concern	The Northern Map Turtle inhabits both lakes and rivers, showing a preference for slow moving currents, muddy bottoms, and abundant aquatic vegetation. Northern Map Turtles are spring nesters, laying eggs anywhere from May to late June-early July. They may use sand and gravel banks along waterways, road shoulders, fissures in rocky shorelines and freshly dug gravel and soil. Eggs generally hatch between late August and late October	**Moderate potential for nesting on lockstation grounds**	**Possible**
Snapping Turtle	*Chelydra serpentina*	Special Concern	Special Concern	Special Concern	Usually found in large bodies of water, but will sometimes inhabit small ponds. Rarely leave water except to nest and migrate to overwintering habitat. Snapping Turtles are spring nesters, laying eggs anywhere from May to late June-early July. They may use sand and gravel banks along waterways, road shoulders, fissures in rocky shorelines and freshly dug gravel and soil. Eggs generally hatch between late August and late October	**Moderate potential for nesting on lockstation grounds**	**Possible**
Spotted Turtle	*Clemmys guttata*	Endangered	Endangered	Endangered	Shallow, slow-moving ponds, bogs, Aquatic habitats are characterized by soft muddy soil, sphagnum moss, sedge tussocks, cattails, water lilies and water-loving shrubs.	Low	Unlikely

Common Name	Scientific Name	COSEWIC	SARA Status	ESA Status	Preferred Habitat	Habitat Potential on Project Site	Likelihood to be Found on Project Site
Western Chorus Frog	*Pseudacris triseriata*	Threatened	Threatened	Not Listed	Marshes or wooded wetland areas; it is found on the ground or in low shrubs and grass	Moderate	Unlikely in project area
INSECTS							
Monarch Butterfly	*Danaus plexippus*	Endangered	Special Concern	Special Concern	Monarchs can be found wherever milkweed and wildflowers grow. This includes abandoned farmland, along roadsides, and other open spaces. Monarch butterflies are not able to survive the cold winters of Canada and most of the United States so they migrate south and west each autumn to escape the cold weather. The monarch migration usually starts in about September to October but may initiate earlier if the weather turns cold sooner than that. The monarch butterflies will spend their winter hibernation in Mexico and some parts of Southern California.	**Moderate**	**Possible**
MAMMALS							
Eastern Small-footed Bat	*Myotis leibii*	Not Assessed	Not Assessed	Endangered	Often found hibernating in same locations as Little Brown Myotis and Northern Myotis, but they tend to occupy cooler, drier areas of the cave. In summer they forage at night and roost in a variety of habitats, including in or under rocks, in rock outcrops, in buildings, under bridges, or in caves, mines, or hollow trees.	Low	Unlikely
Little Brown Myotis	*Myotis lucifugus*	Endangered	Endangered	Endangered	Little Brown Myotis hibernate from October or November to March or April, most often in caves or abandoned mines that are humid and remain above freezing. In	Low	Unlikely

Common Name	Scientific Name	COSEWIC	SARA Status	ESA Status	Preferred Habitat	Habitat Potential on Project Site	Likelihood to be Found on Project Site
					summer they forage at night and roost in trees and buildings during the day.		
Northern Myotis[5]	*Myotis septentrionalis*	Endangered	Endangered	Endangered	Similar habitat preferences to Little Brown Myotis - they bats hibernate from October or November to March or April, most often in caves or abandoned mines. Northern Myotis often roost under loose bark or in tree cavities.	Low	Unlikely
Tri-coloured Bat	*Perimyotis subflavus*	Endangered	Endangered	Endangered	Often found hibernating in same locations as Little Brown Myotis and Northern Myotis – abandoned mines and caves. Relatively rare species in Canada.	Low	Unlikely
FISH							
Greater Redhorse	*Moxostoma valenciennesi*	No status	No status	No status	Typically found in clear, relatively fast-moving rivers and in both shallow and deep waters in some lakes.	**Moderate**	**Possible**
VEGETATION							
Butternut[5]	*Juglans cinerea*	Endangered	Endangered	Endangered	In Ontario, Butternut usually grows alone or in small groups in deciduous forests. It prefers moist, well-drained soil and is often found along streams. It is also found on well-drained gravel sites and rarely on dry rocky soil. This species does not do well in the shade, and often grows in sunny openings and near forest edges.	Low	Unlikely

[1]COSEWIC Draft Critical Habitat Mapping
[2]NHIC
[3]Atlas of Breeding Birds of Ontario
[4]Ontario Reptile and Amphibian Atlas
[5]Field Observation

Critical Habitat identified in 10km x 10km square

Potentially found on the site

Cultural Resources

As the general landscape and viewscape are considered character defining elements of Old Slys Lockstation. A ‘Statement of Cultural Resource Impact Analysis’ (SCRIA) is being developed for this project but is not currently available. Please see general mitigations for cultural resources in Appendix 2. Mitigations specific to the project are being developed as part of the SCRIA.

Archaeology

An archaeological overview assessment was completed by Parks Canada archaeologists to determine the existing conditions in the proposed work areas (see Appendix 4). Limited terrestrial archaeological investigations have occurred in proximity of the project area. A Stage 2 archaeological assessment of two areas (one on the north bank of the Rideau Canal and one on the south bank) indicates that these specific areas do not retain heritage value or interest. However, historical documentation indicates that a multitude of historical structures existed within the project area throughout the years, and evidence of earlier occupations may still exist below the ground (see Figures 5-6 in Appendix 4).

9. EFFECTS ANALYSIS

The following section outlines the potential impact of the proposed works on valued components in the study area.

Soil, Landforms and Air

The use of heavy machinery increases the risk of soil contamination if there is a spill or leak of a hazardous material (i.e. fuels, hydraulic fluids); however, this risk will be minimized through the implementation of appropriate mitigation measures.

The short-term use of machinery/equipment will generate exhaust and smoke emissions that could affect air quality. However, these types of disturbances are temporary and not foreseen to be a threat to local flora, fauna, and people with appropriate mitigation measures in place.

Contamination

Contamination found in the soil, groundwater, sediment and surface water has the potential to have adverse effects on human health and the environment. As such, it is imperative that appropriate health and safety measures are taken to ensure the safety of workers and that additional measures are taken to ensure that contamination found in the sediment is minimally disturbed, is not introduced into the water column, and is not transferred off site during dewatering.

The Detailed Quantitative Human Health and Ecological Health Risk Assessment assesses potential risk to a number of human receptors, including construction workers involved in this specific project. Results indicate that risk management measures are not required for construction workers, with the exception of wearing the appropriate personal protective equipment, specifically:

“Personal Protective Equipment (PPE), above the ministry of labour mandated construction site PPE, should be worn to be protective of workers in surface water or working with groundwater given conservative working average times as provided by Parks Canada as follows on site:

- Construction workers who come into contact with subsurface groundwater should wear gloves, long pants, and sleeves to minimize dermal contact with groundwater in areas containing PHCs.
- Construction workers acting as divers contacting sediment during repairs should wear a wet suit while submerged in the lock water body to minimize dermal contact with sediment”.

The above is included in the list of mitigation measures in Appendix 2, as well as a stipulation for off-site disposal of excavated soil and sediment. It is recommended that risk management measures be input into a contractor’s site specific health and safety plan.

The results of the ecological risk assessment suggest the possibility of some adverse effects on plants and soil invertebrates in the vicinity of one groundwater sampling location (outside the project area) due to the presence of naphthalene in surface soil. Otherwise, the risk assessment indicates that risk management measures are not required for the protection of terrestrial ecological receptors. Likewise, risk management measures are not required for the protection of aquatic ecological receptors, as the results of the benthic invertebrate survey indicate that it is unlikely the de-commissioned landfill has impacted the benthic invertebrate community in the vicinity of Old Slys Lockstation.

Despite the potential effects of project activities, with the proper implementation of mitigation measures to protect against sedimentation, to protect against spills, to reduce the risk of introducing contamination into the water column and to ensure work does not occur during sensitive timing windows, it is not anticipated that there will be residual negative impacts to aquatic resources.

AEL Environmental developed an amendment to their risk assessment entitled *Total Suspended Solids Limit for Construction Site Water* (AEL Environmental, 2018a) in order to better understand and assess the potential impacts of a release of turbid water during the course of construction activities. The typical environmental thresholds of 8 NTU/25 mg/l was examined to determine if this threshold is capable of protecting the environment from the potential effects of predicted contaminants concentration values. Based on this evaluation, setting the TSS limit for construction site water to 25 mg/L is considered to be protective of aquatic life in the Rideau River. Based on an assumed TSS-turbidity relationship of 3:1 (CCME, 2002), the equivalent turbidity value is 8 NTU. TSS and turbidity limits are intended to be compared directly to measured values in site water prior to discharge, and not increased by river background at the time. Above this threshold, seven contaminants had predicted concentrations in surface water above the long-term Water Quality Guidelines at varying levels of TSS concentrations:

• ≥ 50 mg/L TSS : Barium, Cadmium, Copper, Lead, Zinc, Copper and Lead

• 100 mg/L TSS: The above contaminants and Cobalt

Any water leaving the project site must thus be no more than 8 NTU leaving the project site, or an assumed equivalent of 25 mg/L of TSS, notwithstanding the background turbidity level.

Should there be a large release of turbid water from the project site, there is an unknown level of risk associated with the possibility of water intake pipes in the downstream reach (between Old Slys and Edmonds). There are an estimated 20 waterfront residences in the downstream reach, with the closest being approximately 960 m away. These residences are outside the Town limits and its currently unknown whether they are on a municipal water supply or draw water from the Rideau River. There are no known municipal water intakes downstream. A shoreline survey for water intake pipes is planned for August 2018.

Terrestrial Vegetation

Project activities, in particular the creation of the new access road, will require the removal of terrestrial vegetation. The new access road is estimated to cover 392 m^2 (98 m in length by 4 m in width). The vegetation to be removed is a mix of native and non-native trees common to the area. No species at risk vegetation was noted. The removal of vegetation will occur in fall 2018, at a time when the impact will be minimized. This patch of secondary growth is thought to have been heavily disturbed in past decades. Growth is very thick, there is a high degree of dead limbs and snags. The access road will be used during the 2018-19 construction period. Once the project is complete a layer of topsoil will be applied over the granular base (the base will be left in case required for future use) and left to re-generate. It is expected that this will happen quickly come spring 2019.

It is recommended that exotic invasive species (Common/European Buckthorn and Garlic Mustard) be completely excavated from the project area to reduce the risk of them re-growing.

In addition to the access road, there are a small number of trees that may need to be removed in order to facilitate trenching behind the south walls of the lock chambers. The trees in proximity to the wall are common native species (Trembling Aspen and Manitoba Maple) and non-natives (Black Locust). The Trembling Aspen is a large specimen. As this species is not typically long-lived (it is estimated at 30-50 years) it is assumed that it would be nearing the end of its life span. It is understood that a tree planting plan will be developed by the contractor to replace trees removed for the project at a 3:1 ratio. While there will be some temporary effects from the loss of mature trees, there will likely be an overall positive impact to the site due to the replacement of exotic and invasive species with native species. The contractor will submit the plan to PCA for review and acceptance.

It is likely that a minor amount of aquatic vegetation will be lost or affected due to the in-water work; however, aquatic vegetation generally re-establishes during the next growing season so the loss will be temporary.

Aquatic Resources

The potential environmental effects of project activities on fish and fish habitat include interference with biological time periods (i.e., migration or spawning), the addition of suspended solids to the water column through erosion and sedimentation, potential stranding of fish during dewatering and direct mortality of fish.

The cofferdam will be installed in October 2018 (with dewatering also occurring at this time) and will remain in place through March 2019. The area of canal bed within the footprint of the cofferdam will be unavailable to fish during this time, however this time of the year is not generally not a sensitive time period for warm water fish species and the temporary displacement of fish from the project area is not thought to be detrimental to local populations. The canal bed between the approach walls (just outside of the lock chambers) is considered poor quality habitat for fish and is unlikely to be highly used or occupied. The dewatered work area will be altered during construction but it will be restored to pre-construction conditions before being re-watered.

Erosion and sedimentation events may occur as a result of project activities, potentially increasing the amount of suspended solids in the water column. Such events can cause increased sediment loads potentially harming fish by altering foraging behaviour and causing physical damage to gills and scales.

Increased sediment loads can also smother benthic invertebrates (a primary food source for many fish species) and cover/infill course spawning habitat as silt settles.

Spills of fuels or hydraulic fluid from construction equipment could negatively impact surface water quality, however these risks can be overcome with application of appropriate mitigation measures (see Appendix 2).

Use of concrete is part of the project scope and concrete leachate can quickly raise the pH level of water, causing it to be highly toxic to fish and other aquatic life. Work will be carried out in the dry to prevent the risk of concrete, in any form, entering the watercourse. The implementation of appropriate mitigation measures will reduce the risk of concrete entering the aquatic environment.

Despite the potential effects of project activities, with the proper implementation of mitigation measures to protect against sedimentation, to protect against spills, and to ensure work does not occur during sensitive timing windows, it is not anticipated that there will be residual negative impacts to aquatic resources.

Wildlife

Birds

Migratory birds, their nests and eggs are protected under the Migratory Birds Convention Act (1994). Project works that are potentially disruptive activities to nesting birds, such as vegetation clearing, should be avoided during the nesting period. The Old Slys Lockstation project site is located within Environment Canada nesting zone C2. For open habitats within this zone, the nesting period may begin as early as the end of March and last as long as until the end of August. However, the majority of nesting takes place between early May and late July. This project will commence during early autumn (September) and continue through the fall and winter, thus vegetation clearing will occur outside of the nesting window. Should active nests be found, a buffer must be established and vegetation cannot be cleared within the buffered area until the nest is no longer in use.

Removal of vegetation for the new access road, and possibly on the south side of the lock chambers, will result in habitat loss for migratory birds; however, the habitat loss is considered small when compared to the treed/forested areas at the lockstation and nearby region. The potential loss of trees south of the lockstation will be short-term in nature as they would be re-panted at a 3:1 ratio. Construction activity/disturbance has the potential to displace foraging birds from around the project site, but the displacement will be temporary in duration and cover a very small footprint. Further, construction activity will occur between October and September of each year when birds are less likely to be present.

Other Wildlife

Project activities will take place outside of reptile and amphibian nesting season. However, reptiles and amphibians may still be found on site as they migrate to overwintering habitat in the case of turtles, or as they forage in the case of snakes. Mitigation measures that will be employed to reduce the risk of turtles from entering the site will also work to reduce the risk of snakes from entering the site. Foraging opportunities for wildlife will be limited by the disturbance on site during construction, but the disturbance will be temporary and the habitat type being disturbed is widespread on the landscape outside the area of disturbance.

With the proper implementation of mitigation measures, there should be no residual negative impact to wildlife.

Species at Risk

Effects on Individuals

As identified in Table 2, ten species at risk have the potential to be present within the project area: Barn Swallow, Eastern Whip-poor-will, Eastern Musk Turtle, Blanding's Turtle, Snapping Turtle, Midland Painted Turtle, Nothern Map Turtle, Eastern Milksnake, Monarch Butterfly and Greater Redhorse. Of these species, only Eastern Whip-poor-will has potential Critical Habitat on and around the project site. For other species listed in Table 2, either the planned works will not impact individuals and /or habitat, or mitigation measures will be employed to protect individuals and their habitat.

On a daily basis, an inspection or sweep of the work area shall be performed prior to commencement of project works and activities to ensure that snakes, turtles, and any other wildlife are not present in the work area. Species at risk training will be required for all employees before they begin work on site. Such material can be incorporated as part of the Environmental Management Plan to be provided to PCA. Employees must be able to identify species at risk with potential to be present on the site and know the proper procedures to follow should a species at risk be encountered.

Barn Swallows commonly nest on bridge and under dam decks. In Ontario, this species has egg laying dates ranging from the 10th of May to the 21st of August. Barn Swallows may use nests from previous years. Because of the timing of cofferdam installation and removal under the swing bridge (October/November and March), negative impacts to individuals are not anticipated.

Eastern Whip-poor-will typically nest on leaf litter within a forest edge environment. They are a migratory bird and commonly begin their nesting period in May. The mostly likely location that the individual birds may interact project activity is within the small patch of secondary forest where the new access road will be created. As the road is required to install/remove the downstream cofferdam, and as the cofferdam will be removed in March, it is not anticipated that the road will be used in May and thus direct impacts to individual Whip-poor-wills as a result of project activities are unlikely.

Turtles are spring nesters and have variable nesting habits. Blanding's Turtle and Snapping Turtle lay eggs anywhere from May to late June-early July. They typically use sand and gravel banks along waterways, road shoulders, fissures in rocky shorelines and freshly dug gravel and soil. The Midland Painted Turtle nests in late May to mid-July, and nests are typically dug is sandy, loam soil, in gravel banks or farmer's fields, but not a long distance from water. The Eastern Musk Turtle nests from early June to late July. Nesting sites include decaying vegetation, in beaver/muskrat lodges, between tufts of grass in beach areas, on shallow gravel and soil-filled rock crevices. The Northern Map Turtle nesting period begins in early to mid-June. Northern Map Turtles prefer soft sand or soil and full sunshine in areas within 35 m of the water.

The timing of the construction (October to May) means that the highest likelihood of turtles entering the construction site is May when individuals begin travelling to find suitable nesting sites. It is expected that soil excavation, stock piling of materials and other forms of landscape disturbance have the potential to attract turtles to the area for nesting.

Similarly, the greatest likelihood of encountering Eastern Milksnake (which typically hibernates from October to mid-April and lays eggs beginning from late May) is within the month of May. Therefore, project mitigations will consider the potential for turtles and snakes to enter the construction site for the purpose of nesting / egg laying. Sediment/exclusion fencing should be installed completely around gravel and soil stockpiles and other disturbed areas, in order to prevent egg laying by turtles and snakes within the project area. Should any suspected turtle nests or turtle/snake eggs be encountered, Parks Canada staff should be notified. Additional mitigations are outlined in Appendix 2.

Use of the aquatic areas immediately upstream and downstream of Old Slys by turtles is anticipated to be limited. There are no basking sites here except rocks that may exposed when the water level is reduced in the fall. It is understood that there is limited sediment immediately downstream due to the water flow generated from the downstream lock/sluices, and therefore little potential for overwintering in proximity to the downstream lock gates. The upstream cofferdam will be placed very close to the lock gates where there is also little potential for overwintering turtles. Further downstream from the lock gates sediment depth increases, making it potentially more conducive to overwintering, however this area does not provide quality overwintering habitat for turtles as it's within a man-made channel of relatively shallow depth (2-6 ft of water depth at summer navigation levels, likely less after the fall drawdown). It is thus estimated that installation of the cofferdams and dewatering will not impact overwintering turtles The cofferdams will not create a barrier to turtle movement due to the timing of the project (October to May). With mitigations in place and with surveillance, the project is not expected to negatively impact individual turtles.

No milkweed plants on or adjacent to the site have been observed, therefore any occurrence of Monarch Butterfly on the site is expected to be incidental. The month of October is the only time that individuals may be seen crossing the project site. In southern Ontario, Monarchs reproduce two or three times between June and October, with the latter generation leaving Canada to migrate south.

Greater Redhorse is not a species at risk, but is provincially tracked. With mitigations in place to safeguard fish from negative effects (e.g. fish salvage before dewatering, upper turbidity thresholds for water quality), negative effects to individuals are not anticipated.

Effects on Critical Habitat Under the Species at Risk Act (SARA)

The project site lies within a zone identified as containing *SARA* critical habitat for the Eastern Whip-poor-will. Since the 10 km x 10 km grid square that contains Old Slys Lockstation was identified as potential Eastern Whip-poor-will habitat in the recovery strategy, it is understood that the habitat occupancy requirement for the identification of critical habitat is satisfied.

The recovery strategy for Eastern Whip-poor-will (Environment Canada, 2015) identifies both nesting and foraging critical habitat, nesting-only critical habitat, and foraging-only critical habitat.

- For nesting and foraging habitat, any forest habitat that exhibits the appropriate biophysical attributes and is 3 ha or larger within the 10 km x 10 km grid square is considered to be critical habitat.
- For nesting-only habitat (must be adjacent to foraging habitat), all forest habitat that exhibits the appropriate biophysical attributes up to 30 m on the interior side of the forest edge is considered to be critical habitat. Nesting habitat includes most types of forest at early stages of succession (or edges of forests with a dense tree cover but showing a similar structure at the ground level), rock or sand barrens with scattered trees, savannahs, old burns, as well as sparse conifer plantations.
- For foraging-only habitat (must be adjacent to nesting habitat), all forest habitat or agricultural land that exhibits appropriate biophysical attributes within 1250 m of nesting habitat is considered to be critical habitat. Foraging habitat include prairies, wetlands with shrubs, regenerating clear-cuts as well as agricultural fields and other habitats with low tree cover and availability of foraging perches as these conditions favor the localization of prey by lunar light as well as foraging efficiency.

Much of the forest and wetland habitat located within approximately 1 km to the east, northeast and southeast may meet the physical attributes for nesting and foraging habitat, foraging-only habitat and nesting-only habitat (Figure 4). The lockstation itself has pockets of dense tree cover, open areas with scattered trees and fringe wetland.

Figure 4. Forest, wetland and agricultural habitat surrounding Old Slys Lockstation (ESRI, July, 2018).

Although the biophysical attribites for critical foraging habitat may be met, the planned works will not lead to the destruction of foraging-only critical habitat. There are some open areas with scattered trees that will be temporarily used for staging areas, with no long-term change to these areas being predicted. There are potentially a handful of trees that will be removed from a semi-open forested area in order to faciliate access to the southern side of Locks 26 & 27, however this amount of vegetation is negligible comparred the area available for foraging in the surrounding area (Figure 4). In additional, site disturbance is limited to October-May. It is not anticipated that project activities will impact the ability of the project area to support foraging.

Nesting-only critical habitat and nesting and foraging critical habitat could be affected by the creation of the new access road through a secondary forest patch. Because the patch is small (approximately 6,000 m^2) almost the entirety of it is considered edge habitat by the definition given in the recovery strategy (first 30 m). The area of the access road is estimated at 392 m^2, which is approximately 6.5% of the area of the forest patch.

It is estimated that nesting-only and nesting and foraging critical habitat will not be detroyed as a result of this project, based on the following points:

- The loss of vegetation for the creation of the access road will be temporary in nature and work will occur outside the breeding bird window over the winter months. Once the road is no longer required for the project the granular base will be overlain with topsoil and left to regenerate. It is expected that this will occur quickly given the amount of availabel seed stock in the surrounding forest patch.

- Within the description of activities likely to cause the destruction of critical habitat outlined in the recovery strategy, Forest Management activities (e.g. clearing of shrubs to install tubes in a sugarbush; maintenance in plantations) are not considered to be destruction of critical habitat if the amount of forest cover in the 10 x 10 km^2 square has 25% or less of forest cover and the loss is permanent, or if biophysical attributes would become unavailable or available in insufficient amounts at the time they are needed by the species. Extrapolating to the creation of the access road, there is >25% forest cover in the applicable 10 x 10 km^2 square and the loss of habitat is temporary. There would be sufficient biophysical atttributes available elsewhere in the immediate region and within the 10 x 10 km^2 square when they are needed by the species.
- Within the description of activities likely to cause the destruction of critical habitat outlined in the recovery strategy, Maintenance of Linear Infrastructures (e.g., utility rights-of-way, energy corridors) are not considered to be habitat destruction if conducted outside of the breeding season, and the recovery strategy also suggests that activities such as these may assist in maintaining partial shrub cover. Extrapolating to the creation of the access road, the clearing of vegetation is linear and will be conducted outside of the breeding season. As the area will be allowed to regenerate it is expected that a layer of shrubs and saplings will establish quickly.

It should additionally be noted that it appears unlikely that Eastern Whip-poor-will uses the project area. Two evening surveys (July 11 and July 13, 2018) for the species were conducted by PCA staff following the 2018 Canadian Nightjar Survey Protocol. None were heard at the project site however the species was heard calling the same evenings at a reference site where they are known to occur (approximately 35 km away), therefore environmental conditions were conducive to vocalization. Based on the points laid out above, the summary of this assessment is that there will be no negative impact to critical habitat or individual Eastern Whip-poor-will.

Cultural Resources

A 'Statement of Cultural Resource Impact Analysis' (SCRIA) is being developed for this project but is not currently available. Please see general mitigations for cultural resources in Appendix 2. Mitigations specific to the project are being developed as part of the SCRIA.

Archaeological Resources

An Archaeological Overview Assessment (Appendix 4) was completed by Parks Canada archaeologists to determine the existing conditions in the proposed work areas. While much of the project area is not projected to impact potential archaeological resources, there are some areas that have been highlighted for attention. The blue hatched area (Figure 7 in Appendix 4) indicates an area on the south side of Lock 27 by Old Slys Road that should not be subject to excavation, staging or road access due to the presence of a historical dam. Figure 7 also highlights additional areas proposed as staging areas/access routes that require protection in the form of a base of geotextile overlain by wood chips/granular. Refer to Appendix 4 and the archaeological mitigations in Appendix 2 for additional detail.

If significant archeological resources (i.e., artifacts pertaining to the construction of the canal, structural remains) are encountered during construction, work should cease, the findings photographed and Parks Canada's Terrestrial Archaeology section contacted for advice and assessment of significance, which will in turn determine what will be required to mitigate impacts on the find.

10. MITIGATION MEASURES

See Appendix 2 for Mitigation Measures.

11. PUBLIC/STAKEHOLDER ENGAGEMENT & ABORIGINAL CONSULTATION

11 a) Indicate whether public/stakeholder engagement was undertaken in relation to potential adverse effects of the proposed project:

☒ No

☐ Yes (describe the process to involve relevant parties and indicate how comments were taken into consideration).

11 b) Indicate whether Aboriginal consultation was undertaken in relation to potential adverse effects of the proposed project:

☒ No

☐ Yes (describe the process to involve relevant parties and how the results were taken into consideration).

The proposed works is the maintenance and rehabilitation of existing assets. There will be no substantial alteration to the assets or change in water management. For this reason public and Indigenous consultation was not conducted.

12. SIGNIFICANCE OF RESIDUAL ADVERSE EFFECTS

The creation of the new access road will create a loss of trees and any associated habitat, however this residual adverse effect is not expected to be significant as the road will be allowed to regenerate and thus the loss of trees is temporary. No additional significant residual adverse effects are anticipated with the proper implementation of mitigation measures.

13. SURVEILLANCE

☐ Surveillance is not required

☒ Surveillance is required (provide details such as the proposed schedule and the focus of inspections)

An Environmental Assessment Officer will visit the site regularly during construction to ensure that mitigation measures are in place, working as anticipated and are effective at preventing adverse effects to natural and cultural heritage features.

14. FOLLOW-UP MONITORING

Follow-up monitoring is:

☒ not required

☐ legally required (e.g. under the *Species at Risk Act* or *Fisheries Act)*

☐ required in accordance with the *Parks Canada Cultural Resource Management Policy*

15. SARA NOTIFICATION

Notification is:

☒ not required

☐ required under the *Species at Risk Act* (outline the nature of and response to any notification).

16. EXPERTS CONSULTED

Include Parks Canada experts. Add as many entries as necessary for the project.

Department/Agency/Institution: Parks Canada Agency	Date of Request: April 1, 2017
Expert's Name & Contact Information: Andre Miller and Barbara Leskovec	Title: Federal Infrastructure Investments Archaeologist
Expertise Requested: Archaeological assessment of the work area at Old Slys	
Response: Planned work area has been previously disturbed so archaeological potential is low in most areas. One zone is not to be disturbed and other areas slated for access roads must be appropriately protected. Work to halt if archaeological artifacts are encountered.	

Department/Agency/Institution: Parks Canada Agency	Date of Request: July 6, 2018
Expert's Name & Contact Information: Joanne Tuckwell	Title: Species Conservation Specialist
Expertise Requested: Approach to assessing SAR Critical Habitat	
Response: Provided clarity to assessing critical habitat in general, and the habitat of Eastern Whip-poor-will in particular.	

Department/Agency/Institution: Parks Canada Agency	Date of Request: April 1, 2017
Expert's Name & Contact Information: Nathalie Desrosiers	Title: Policy Advisor, Cultural Resources Management
Expertise Requested: Cultural resource impact assessment	
Response: Not yet available	

DECISION

Taking into account implementation of mitigation measures outlined in the analysis, the project is:

☒ not likely to cause significant adverse environmental effects.

☐ likely to cause significant adverse environmental effects.

18. RECOMMENDATION AND APPROVAL

(Add additional blocks as required)

Prepared by (EIA Author): Hillary Knack, Resource Management Officer	Date: 2018-07-31
Signature: Hillary Knack	
Recommended by: Valerie Minelga, Environmental Assessment Scientist	Date: 2018-08-01
Signature:	
Recommended by (Functional Manager of Project): Jean-Francois Charron, Parks Canada Project Lead	Date: 1/08/2018
Signature:	
Approved by (Director of Ontario Waterways): Jewel Cunningham, Director, Ontario Waterways	Date: Aug 2, 2018
Signature: Jewel Cunningham	

19. ATTACHMENTS

Appendix 1 - Environmental Impact Analysis Tool: Effects Identification Matrix
Appendix 2 – Mitigation Measures
Appendix 3 – Site Photos
Appendix 4 – Archaeological Overview Assessment
Appendix 5 – Risk Assessment and Environmental Monitoring Report (AEL Environmental, 2018a)
Appendix 6 - Total Suspended Solids Limit for Construction Site Water (AEL Environmental, 2018b)

20. NATIONAL IMPACT ASSESSMENT TRACKING SYSTEM

☐ Project registered in tracking system

☒ Not yet registered *(CEAA 2012 requires PCA submit a report to Parliament annually. EIAs must be entered in the tracking system by the end of April to enable reporting.*

References

AEL Environmental, 2018a. Risk Assessment and Environmental Monitoring, Old Slys Lockstation, Smiths Falls, Ontario. Unpublished report. 92 pp + appendices.

AEL Environmental, 2018b. Total Suspended Solids Limit for Construction Site Water. Unpublished report. 31 pp + appendices.

Cadman, M.D., D.A. Sutherland, G.G. Beck, D. Lepage, and A.R.Couturier (eds). Atlas of the Breeding Birds of Ontario, 2001-2005. Bird Studies Canada, Environment Canada, Ontario Field Ornithologists, Ontario Ministry of Natural Resources, and Ontario Nature, Toronto, xxii + 706 pp.

Canadian Museum of Nature, 2001. A Multidisciplinary, Community-Based Study of the Environmental Health of the Rideau River: Final Report. Unpublished. 46 pp.

Early Detection and Distribution Mapping System, 2018. Accessed online: https://www.eddmaps.org/ontario/

Environment Canada. 2015. Recovery Strategy for the Eastern Whip-poor-will (*Antrostomus vociferus*) in Canada [Proposed]. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa, v + 59pp.

ESRI, 2018. Spatial information from ESRI's Geographic Information System (GIS) web-based Portal system.

Ontario Invading Species Awareness Program, 2018. Acessed online: http://www.invadingspecies.com/eurasian-water-milfoil/

Appendix 1 - Environmental Impact Analysis Tools: Effects Identification Matrix

Section A *focuses on direct effects of the project and* ***Section B*** *on indirect effects that are caused by changes to the environment.*

A. Direct Effects									
			Valued components potentially directly affected by the proposed project						
			Natural Resources					Cultural Resources	
			Air	Soil & landforms	Water (surface, ground, crossings, etc.)	Flora (specify, including SAR)	Fauna (specify, including SAR)	Old Slys Lockstation Landscape	Old Slys Cultural Resources of National Significance
	Phase	Examples of Associated Activities							
Project Components	Preparation / Construction / Operation / Decommissioning	Supply and storage of materials	☐	☐	☒	☐	☐	☐	☐
		Burning	☐	☐	☐	☐	☐	☐	☐
		Clearing	☐	☒	☐	☒	☒	☒	☐
		Demolition	☒	☐	☐	☐	☐	☐	☒
		Disposal of waste	☐	☐	☒	☐	☐	☐	☐
		Blasting/ Drilling	☐	☐	☐	☐	☐	☐	☐
		Dredging	☐	☐	☐	☐	☐	☐	☐
		Drainage	☐	☐	☐	☐	☐	☐	☐
		Excavation	☐	☒	☒	☐	☐	☒	☐
		Grading	☐	☒	☐	☐	☐	☒	☐
		Backfilling	☐	☐	☐	☐	☐	☐	☐
		Use of machinery	☒	☒	☒	☐	☐	☐	☐
		Transport of materials/ equipment	☐	☐	☐	☐	☐	☐	☐
		Building of fire breaks	☐	☐	☐	☐	☐	☐	☐
		Use of Chemicals	☐	☐	☐	☐	☐	☐	☐
		Set up of temporary facilities	☐	☐	☐	☐	☐	☐	☐
		Other…	☐	☐	☐	☐	☐	☐	☐

A. Direct effects continued

	Phase	Examples of Associated Activities	Air	Soil & landforms	Water (surface, ground, crossings, etc.)	Flora (specify, including SAR)	Fauna (specify, including SAR)	Old Slys Lockstation Landscape	Old Slys Cultural Resources of National Significance
			Valued components potentially affected by the proposed project						
			Natural Resources					Cultural Resources	
Project Components	Preparation / Construction / Operation / Decommissioning	Waste disposal	☐	☒	☒	☐	☒	☐	☐
		Wastewater disposal	☐	☒	☒	☐	☐	☐	☐
		Maintenance	☐	☐	☐	☐	☐	☐	☐
		Use	☐	☐	☐	☐	☐	☐	☐
		Use/Removal of temporary facilities	☐	☐	☐	☐	☐	☐	☐
		Use of Chemicals	☐	☐	☐	☐	☐	☐	☐
		Active fire stage	☐	☐	☐	☐	☐	☐	☐
		Prescribed burn cleanup	☐	☐	☐	☐	☐	☐	☐
		Planting	☐	☐	☐	☐	☐	☐	☐
		Culling	☐	☐	☐	☐	☐	☐	☐
		Vehicle Traffic	☐	☐	☐	☐	☐	☐	☐
			☐	☐	☐	☐	☐	☐	☐

B. Indirect Effects (all phases)							
		Impacts as a result of changes to the environment					
		With respect to non-Aboriginal peoples:	With respect to Aboriginal peoples:		With respect to visitor experience		
		Health and socio-economic conditions	Health & socio-economic conditions	Current use of lands and resources for traditional purposes	Access & services	Recreation & accommod'n opportunities	Safety
Phase	**Natural resource components affected by the project**						
Preparation /construction operation/implementation/decommissioning	Could impacts to air lead to adverse effects on…	☐	☐	☐	☐	☒	☐
	Could impacts to soils and landforms lead to adverse effects on…	☐	☐	☐	☐	☐	☐
	Could impacts to water (e.g. surface, ground water and water crossings) lead to adverse effects on…	☐	☐	☐	☐	☒	☐
	Could impacts to flora (including SAR) lead to adverse effects on…	☐	☐	☐	☐	☐	☐
	Could impacts to fauna (including SAR) lead to adverse effects on…	☐	☐	☐	☐	☐	☐
		☐	☐	☐	☐	☐	☐

Appendix 2: Mitigation Measures

General

1. Inform the Departmental Representative and PCA's Environmental Authority (Environmental Officer, Rideau Canal in Smith Falls) regarding any changes to project plans and/or scheduling. Any changes not assessed under this BIA will require approval from PCA and may require further mitigation measures.
2. Contractor is required to submit an Environmental Management Plan (EMP) to the Department Representative and Parks Canada that outlines all the measures to be implemented by the contractor on the project site to eliminate or reduce environmental effects and address mitigation measures outlined in this BIA. In order to allow for the timely commencement of project activities, the EMP can be submitted as separate components as project details become available. The EMP, or its components, will be submitted in writing prior to implementation of project activities and must be accepted by Parks Canada and the Departmental Representative.
3. It is recommended that an environmental professional(s) prepare the EMP or its component plans incorporating guidance found in PCA's Environmental Standards and Guidelines - Ontario Waterways (2017). The EMP will detail frequency of monitoring and list high-risk construction activities where an environmental professional must be onsite. Monitoring and testing should be adaptable to changing site conditions and will capture any event/incident for the length and scope of that event.
4. Parks Canada Environmental Authority will outline all the following mitigation measures in a construction start-up meeting with the contractor, to ensure awareness and understanding of these measures.
5. The contractor is to ensure that all on-site personnel are aware of, and comply with the prescribed mitigation measures within this BIA and any measures outlined within subsequent amendments to this BIA.
6. Should conditions at the work site indicate that there are negative impacts to fish, fish habitat, wildlife, cultural or visitor experience resources, all works shall cease until the problem has been corrected and Parks Canada's Environmental Authority staff have been consulted. The Parks Canada has the right to require that work be altered or ceased immediately.
7. As per the Historic Canal Regulations applicable to lands administered by the Rideau Canal National Historic Site of Canada, a permit signed by Parks Canada's Ontario Waterways Director will be required to authorize the project work prior to commencement of the project.
8. All machinery and equipment shall be clean, free of leaks, in optimal working condition.
9. Use well-maintained heavy equipment and machinery, preferably fitted with fully functional emission control systems/muffler/exhaust baffles, engine covers, etc.; machines shall not be left to unnecessarily idle in order to avoid emissions.
10. Maintain equipment to avoid leakage of fuels and liquids. Ensure measures are in place to minimize impacts of accidental spills.

11. Operate machinery from stable location;
12. Spill control and emergency plans will be in place prior to initiation of construction; an emergency spill kit shall be kept on-site and employed immediately should a spill occur.
13. In the event of a spill, Parks Canada and the Ontario Spill Action Centre (1-800-268-6060) shall be notified immediately; remediation will be conducted immediately to contain and clean up in accordance with **federal regulatory requirements <u>AND</u> to the satisfaction of Parks Canada**; documentation of remediation, testing and results will be provided to Parks Canada.
14. Store all oils, lubricants, fuels and chemicals in secure areas on impermeable pads.
15. Refuelling of equipment and maintenance shall be conducted off slopes and away from water bodies on impermeable pads to allow full containment of spills.
16. A designated re-fueling depot will minimize the potential for extensive impacts at the site due to accidental releases of substances; proper spill management equipment shall be in place for fueling.
17. Drip trays shall be placed under fuel-powered equipment.
18. There shall be no discharge of chemicals and cleaning agents in or near aquatic habitats; all such substances shall be disposed of at a facility licensed to receive them.
19. No tools, equipment, temporary structures or parts thereof, used or maintained for the purpose of this project, shall be permitted to remain at the site after completion of the project.

<u>Erosion and Sediment control</u>

20. Submission of an Erosion and Sediment Control Plan, as part of the EMP, demonstrating:
    - A focus on erosion control primarily and sediment control secondary;
    - Erosion and sediment controls will be tailored to the type of sediment found onsite (e.g. if clay is present, additional controls are necessary).
    - The area to be controlled. In addition to the construction site, it is necessary to identify adjacent areas that could be negatively impacted by construction activities;
    - Drainage areas and patterns based on pre-construction topography and construction design;
    - The EMP will have as a principal to reduce the amount of sediment laden water produced. A focus on separating offsite and infiltrating water into the construction site from construction activities and sediment sources.
    - How clean storm run-on will be diverted around the site and away from exposed areas;
    - How sediment-laden run-off will be directed to detention or retention facilities on-site. Large drainage areas can produce a significant amount of run-off, resulting in a need for large detention or retention structures;
    - Consideration of project schedule in selecting, designing and laying out environmental controls;

- o Consideration of seasonal requirements (for longer-term projects); select and design controls and practices for controlling erosion and sedimentation including shutdown periods.

21. The size of particles present in the sediment is a key consideration for selecting the appropriate sediment treatment option(s):
- If the sediment consists primarily of gravel or sand, which are relatively large particles, a single treatment using a more basic technology, such as a sediment trap or sediment bag, may be adequate.
- If the sediment consists of silt and/or clay, which are relatively small particles, the effluent will most likely need a more advanced technology, such as a filter press or chemical treatment with anionic flocculent and a filtration method.
- If the sediment consists of a large spectrum of particle sizes, the water may need primary treatment to remove larger particles, followed by secondary treatment to remove finer particles.

22. All erosion and sediment control measures shall be inspected daily to ensure they are functioning properly and are maintained and/or upgraded as required to prevent entry of sediment into the water. If erosion and sediment control measures are not functioning, the sediment and/or erosion problem must be addressed to the satisfaction of Parks Canada.

23. Erosion and sediment control measures shall be left in place until all areas of the work site have been stabilized.

24. All disturbed areas of the work site shall be stabilized immediately and re-vegetated as soon as conditions allow. All exposed areas should be covered with erosion control blankets or other measures to keep the soil in place and prevent erosion until vegetated in the spring.

25. Upon completion of the work all debris shall be completely removed and the area restored to its original state or better. Repair all damages to property due to project activities.

26. Sediment control measures and exclusion fencing must be removed in a way that prevents the escape or re-suspension of sediments.

27. A turbidity curtain will be maintained in the water around all working areas during construction to contain and control the suspension of fines. If water levels/conditions do not permit the flotation of a turbidity curtain, other measures as approved will be implemented.

28. Turbidity curtains should be placed as close to the coffer dam as possible to minimize area of potential impact of sedimentation.

29. Turbidity curtains should not be used as a primary or secondary settling area for dewatering activities. Supplementary sediment and erosion control measures should be installed prior to construction activities and should be added upon/reinforced as necessary.

30. The contractor will provide a marine grade turbidity curtain - Medium Duty Turbidity Curtain Specification US DOT Type 2 - across all areas where sediments can enter the watercourse. Turbidity curtains are to be anchored or weighted down along its length to form a continuous seal on the river bed with adequate flotation at water surface to prevent over spills of turbid water.

31. Flow dissipaters and/or filter bags, or equivalent, shall be placed at water discharge points to prevent erosion and sediment release.

32. Silt or debris that has accumulated around the temporary cofferdams shall be removed prior to their withdrawal. All cofferdam material will be removed from the watercourse upon decommissioning.

33. The contractor will maintain a standby supply of pre-fabricated sediment fence barriers, or an equivalent ready-to install sediment control devices.

34. Avoid activities that could lead to erosion during excessively wet weather conditions; monitor forecasts for heavy rainfall watches & warnings.

35. Environmental protection measures shall be checked after each extreme weather event.

<u>Contamination</u>

36. The EMP is to address the contaminants and issues identified in this BIA and those identified with regard to surface water, groundwater, soil and sediment quality in the following reports: Risk Assessment and Environmental Monitoring, Old Slys Lockstation, Smiths Falls, Ontario (AEL Environmental, 2018a; Appendix 5) and Total Suspended Solids Limit for Construction Site Water (AEL Environmental, 2018b; Appendix 6).

37. Workers are expected to wear personal protective equipment (PPE) above the Ministry of Labour mandated construction site PPE, in order to minimize potential exposure to contaminated media in project area. Construction workers who come into contact with subsurface groundwater should wear gloves, long pants, and long sleeves to minimize dermal contact with groundwater in areas containing PHCs. In addition, the wearing of water-proof/chemical-resistant footwear is recommended. In the event that divers are used (e.g., to anchor turbidity curtains), the equipment used (e.g., wetsuit, face mask) should minimize bare skin exposure to the work zone. The Contractor must provide appropriate wash stations to remove adhered soil and sediments from PPE, as well as hand-wash stations. The wash-off material must be contained and disposed of offsite. Wash water must not be allowed to enter the canal either directly or through a storm sewer. Contractors are also expected to be familiar with applicable health and safety requirements for workers in regards to the contaminants identified.

38. Once the cofferdams are dewatered, it is recommended that worker interaction with sediment (canal substrate) be minimized through the creation of defined walkways and work zones that are isolated from the bed.

39. Material removed from the canal bed, soil removed from land, and material removed during water treatment will be disposed of at an off-site facility capable of handling identified contaminants. Do not stockpile onsite where contaminant escape is possible. The Contractor will return the grade to the pre-work elevation. Material imported to the site for this purpose must be free of contaminants of concern.

40. Existing groundwater monitoring wells located on the south sides of the locks shall be appropriately marked and protected such that excavation does not compromise the wells.

Fish/Water Quality

41. No in-water work is permitted between March 15th and June 30th of any year to protect fish populations during their spawning and nursery periods. Should work be required within this window, additional permissions and mitigation measures may be required based on site-specific characteristics. Work beyond March 15th must be approved by PCA prior to work occurring, and my not be granted if conditions do not allow it.

42. Fish (and reptiles/amphibians if encountered) shall be rescued from areas that are going to be dewatered. Rescued fish shall be released back into the Rideau Canal.

- Parks Canada's Environmental Authority shall be advised 24 hours prior to fish rescue.
- Minimize the length of time fish are out of the water.
- Use appropriate equipment to remove any stranded fish in the dewatered area. As water levels drop in the work area monitor the deeper pool areas where fish are congregating. If safe to do so, Seine nets or Dip nets can be operated by field staff to remove the fish.
- Contact PCA EA staff should there be any issues with fish removal.
- Any fish found within the dewatered coffer dam areas will be documented by species, counted and removed and placed downstream if found in the downstream coffer dam and upstream if found upstream.
- Round gobies or other invasive species found during dewatering activities shall be euthanized and not returned to the water system; this shall be reported to Parks Canada.
- Sediment/turbidity curtains shall be deployed in a manner - e.g. moved in a direction from close to shore/structures outward - that prevent entrapment of fish inside the curtain.

43. Ensure that there is a fish screen that complies with DFO Freshwater Intake End-of-Pipe Fish Screen Guideline when pumping in fish-bearing water to prevent impingement or entrainment of fish.

44. Should conditions at the work site indicate that there are negative impacts to fish or their habitat, all work shall cease until the problem has been corrected and Parks Canada EA staff has been consulted.

45. A Dewatering Plan shall be submitted to the Departmental Representative for review and accepted by Parks Canada prior to any dewatering.

46. Any water containing a high level of silt or sediment will be treated by discharging to settling basins, vegetated areas or sediment traps prior to release to streams (to be identified in a Dewatering Plan). Water quality downstream of construction activities and turbidity curtain should not exceed recommended Canadian Council of Ministers of the Environment (CCME) guidelines on water quality for the protection of aquatic life – Total Particulate Matter (see http://ceqg-rcqe.ccme.ca/download/en/217)..

47. Ontario Drinking Water Quality Guidelines cannot be exceeded (beyond parameters that currently exist) due to project activities.

48. At the discharge point into the watercourse, Maximum increase of suspended sediment concentrations of 25 mg/L during any short-term exposure period (e.g., 24-h). For longer term exposure (e.g., > 24 h), average suspended sediment concentrations shall not be increased by more than 5 mg/L over background levels, up to a maximum of 25 mg/L. If elevated turbidity beyond 25 mg/L is observed during in-water activity, Parks Canada will assess potential impact to the aquatic environment. Additional mitigation measures may be required.

49. At the discharge point into the watercourse – i.e. the interface between the work site and the natural waterbody – Maximum increase of 8 NTU for a short-term exposure (e.g., 24-h period). Maximum average increase of 2 NTU from background levels for a longer term exposure (e.g., >24 h period), up to a maximum of 8 NTU. If elevated turbidity beyond 8 NTU is observed during in-water activity, Parks Canada will assess potential impact to the aquatic environment. Additional mitigation measures may be required.

50. Discharges from the Work Area must be undertaken in such a way that scouring of the canal bed outside the Work Area does not occur.

51. Only the working end of machinery shall directly enter the water. The working end of machinery will be clean and maintained free of leaks. Complete the in-water activity as quickly as possible to minimize the time equipment is in the water; do not leave equipment in water during breaks in work activity.

52. Dewatering is staged such that clean is pumped back to the system and turbid water is managed through a waste water system.

53. Only clean material free of fine particulate matter shall be placed in or near water where it has been previously planned and authorized.

54. In the event of a significant silting or debris caused by construction activities, the contractor will take appropriate measures to contain and mitigate the problem including the installation of additional downstream turbidity curtains.

55. Any stockpiled materials shall be stored and stabilized a safe distance away from any watercourse, drainage course or swales to prevent erosion and subsequent entry into the water body OR removed from the site, in accordance with all federal, municipal and provincial regulations.

56. Salt and other road chemicals should be properly stored in designated areas only, preferably in dry sheds to prevent infiltration of leachate to the water table and surface runoff.

57. Accumulated snow that may be contaminated with salt should be disposed of only at approved dumpsites or designated areas.

58. Snow containing salt or sand should never be dumped in, or allowed to melt and run off into watercourses.

59. Ice laden with sediment shall be removed from the project site or stored within an isolated area, with meltwater being treated for turbidity as necessary.

60. All concrete, sealants, or other compounds used for this project shall be utilized according to the appropriate Product Technical Data Sheet, stating guidelines and methods for proper use, and provided by the manufacturer of the product.

Concrete Usage

61. Unless specified and approved in contract documents, ensure that all works involving the use of concrete, cement, mortars, grout and other Portland cement or lime-containing construction materials are not deposited, directly or indirectly into any watercourse. Concrete materials cast-in-place must remain inside the formed structure. Containment facilities shall be provided for the wash-down of concrete equipment including concrete delivery trucks, concrete pumping equipment and hand tools. All concrete wash water will be captured and disposed of off-site in a location where it will not enter subsurface drains, waterbodies or storm drains. Water that contacts uncured or partly cured concrete shall be prevented from entering any watercourse or stormwater system. Use only non-toxic biodegradable form stripping agents.

62. Concrete leachate is alkaline and highly toxic to fish and aquatic life. Measures must be taken to prevent any incidence of concrete or concrete leachate from entering the watercourse. Maintain complete isolation of all cast-in-place concrete and grouting from fish-bearing waters for a minimum of 48 hours if ambient air temperature is above 0°C and for a minimum of 72 hours if ambient air temperature is below 0°C or until significantly cured to allow the pH to reach neutral levels.

63. At the discharge point into the watercourse, pH will be maintained between 6.5 and 9.0. Water with pH > 9 cannot be released directly back into the watercourse, but must be treated prior to release. Water with a pH ≥ 12.5 is considered toxic and treated as a hazardous waste under Ontario Regulation 347 of the Environmental Protection Act and wastewater in this condition must be removed from the site.

64. Ensure that all works involving the use of concrete will not deposit, directly or indirectly, sediments, debris, concrete, concrete fines, wash or contact water into or about any watercourse.

65. Concrete debris and dust generated as a result of various concrete work shall be removed in a way that will ensure material does not enter the waterway. All debris including unused aggregate/concrete rubble shall be completely removed and area restored to original state upon completion of work.

66. Concrete debris shall be placed into an enclosed container daily, or more frequently if required, in order to ensure that no debris escape or remain at the site.

67. In the event of a release of concrete or grout, Parks Canada and the Ontario Spill Action Centre (1-800-268-6060) shall be notified; remediation will be conducted immediately contain and clean up in accordance with federal regulatory requirements **AND to the**

satisfaction of Parks Canada; documentation of remediation, testing and results will be provided to Parks Canada.

68. Wash equipment away from water and provide containment facilities for the wash-down water from concrete delivery trucks, concrete pumping equipment, and other tools and equipment.

69. Geotextile or membranes (filter fabric) will consider the grain size characteristics of concrete sediment and shall be designed around the principals of maintaining sufficient hydraulic flow and prevention of particle movement through the material.

70. Monitoring of downstream areas, well outside the project site, during potential rock fissure grout injection will be required throughout the entire operation.

71. Additional environmental mitigation measures for concrete pours in a wet environment or in contact with a water body:

- Ensure concrete forms are tight and no flow is occurring.
- Isolate area with curtain or impermeable material specified for concrete particulates; ensure fish exclusion is followed.
- Isolated area should be the minimum size required to complete task.
- A CO_2 system must be installed and operating along the entire length of the isolated area. The tank shall be used to release carbon dioxide gas into an affected area to neutralize pH levels. Ensure sufficiently sized tanks for the concrete volumes used.
- Workers shall be familiar with the use of the system.
- Use of neutralizing acids is not permitted.
- pH monitoring conducted immediately downstream of the isolated concrete pour.

<u>Wildlife</u>

72. Site clearing/commencement of construction should be planned to occur outside of sensitive nesting times - April 1 to August 31. If this is not feasible, then the site must be inspected by a biologist prior to clearing, to check for the presence of nests.

73. The EMP must demonstrate procedures for avoiding disturbance/harm to wildlife and nesting birds.

74. Should conditions at the work site indicate that there are unforeseen negative impacts to wildlife, all works shall cease and Parks Canada EA Officer should be contacted immediately. The Rideau Canal has the right to require that work be altered or ceased immediately.

<u>Vegetation removal</u>

75. Disturbance of vegetation must be limited to what is required for allowing reasonable completion of the project with minimal environmental impact.

76. All disturbed areas of the work site shall be stabilized immediately with erosion protection. All exposed areas should be covered with erosion control blankets or other measures such as mulch to keep the soil in place and prevent erosion until vegetated in the spring.

77. Trees, shrubs and vegetation which are to remain throughout construction should be properly identified and delineated.

78. Where practical, the branches of the large trees should be trimmed back as the first option rather than cutting the entire tree.

79. When feasible, alter riparian vegetation by hand. If machinery must be used, operate machinery on land and in a manner that minimizes disturbance to the banks of the water body.

80. Should any vegetation require chipping/mulching, the after product will be stored onsite for the duration of the project to supplement erosion and sediment control methods when required.

81. Grubbing should not be conducted unless a suitable planting plan and Erosion and Sediment Controls are in place. Discuss with EA officer for suitable plans.

82. Prune limbs close to the tree trunk. For a clean cut, make a shallow undercut first, then follow with the top cut. This prevents the limb from peeling bark off the tree as it falls. Do not use an axe for pruning.

83. If over half of a tree needs pruning, in most circumstances it will be best to cut it down instead of pruning. Cut trees off at ground level and do not leave pointed stumps.

84. Native species are to be used for tree planting and/or ground cover with mulch to prevent erosion and to help seeds germinate.

85. If there is insufficient time (at least four weeks) in the growing season remaining for the seeds to germinate, or at risk of germinating and being damaged by frost, the site shall be stabilized (e.g., cover exposed areas with erosion control blankets to keep the soil in place and prevent erosion) and vegetated the following spring. Frost can occur as early as August 31st and late as June 25th.

86. Root systems of trees identified to remain should be properly delineated and fenced off, so as to protect the root systems from being crushed and impacted by machinery.

87. In the event that the installation of root-protectant fencing is not possible and/or ideal, alternative measures, as approved by PCA, must then be implemented. Such measures must provide a sufficient amount of soil compaction prevention with regards to the highest level of activity to occur within the immediate area of protection.

- For areas of light-to-medium levels of traffic activity, a geotextile cloth shall be placed over the area of protection and covered with an 8 inch (at minimum) thick layer of mulch material.
- Pins or staples must be used to secure the geotextile material to the ground.
- For areas of medium-to-high levels of traffic activity, a geotextile cloth shall be placed over the area of protection and covered with an 8 inch (at minimum) thick layer of mulch material. The mulch material shall then by covered with 3/4 inch sheets of plywood.
    - The plywood will break down over time, and shall be replaced periodically to retain its effectiveness.

- ¾ inch laminated large sheets of plywood are recommended for use.
- Overtime, mulch material can degrade, move, or wash away. Mulch must be replenished as necessary in order to maintain a layer of 8 inch thickness at all times.
- Mulch material should not be permitted to pile against the trunk(s) or root flare(s) the tree(s), as this may lead to unwanted bark rot and oxygen deprivation, subsequently leading to the death of the tree(s).

88. Alternative methodology for soil-compaction prevention may be utilized (ex. blast mats), as reviewed and approved by PCA.

89. The success of all vegetative plantings shall be assessed by the contractor through visual site inspections conducted at least once each spring and each fall for the first year following planting. If at any time during the monitoring period any plantings are found dead or failing, mitigation measures shall be implemented to reduce the risk of future failure and the plants shall be replaced by the contractor and monitored accordingly.

90. Native grasses, shrubs, etc. should be planted to match existing species growing on the sites.

Invasive Species

91. To reduce the risk of introducing invasive species, all equipment must be thoroughly cleaned prior to coming to the site. Any machinery that appears to have not been cleaned will not be permitted on site. For additional information or guidance on how to properly clean equipment, see the Clean Equipment Protocol for Industry developed by the Ontario Invasive Plant Council and found here: http://www.ontarioinvasiveplants.ca/wp-content/uploads/2016/07/Clean- Equipment-Protocol_June2016_D3_WEB-1.pdf

92. Any equipment or vehicles which are to be used in water, should be thoroughly cleaned before and after use of any visible mud, vegetation, mussels, etc.:
- Vessels/equipment should be drained of standing water.
- Vessels/equipment should ideally be cleaned with hot water (>50 °C) at high pressure water (>250 psi).
- Vessels/equipment should be dried for 2 – 7 days in sunlight before transported between waterbodies.
- Cleaning of vessels/equipment should be conducted away from waterbodies at a recommended distance of at least 30 m from the shoreline.

93. Mud, dirt and vegetation should be cleaned from clothing and footwear prior to entering the work site, and prior to leaving the work site.

94. Should an invasive species be encountered (or at least suspected) not identified in this BIA, a photo and report of the specimen should be sent to Parks Canada’s EA Officer.

95. Use weed-free material (i.e. sand, gravel, etc.) for erosion control and stabilization.

96. Use weed-free seed and confirm that seed mix to be used for revegetation purposes does not (potentially) contain invasive plants.

97. Seed purchased commercially should have a label that states the following:
- Species;

- Purity: Most seed should be no less than 75% pure and preferably over 85% pure. The rest is inert matter, weed seed, or other seed;
- Weed seed content: The tag should state NO invasive plants are present. Only certified weed-free seed should be used; and
- Germination of desired seed: Germination generally should not be less than 50% for most species, although some shrubs and forbs will have lower percentages.

98. Move only weed/contaminate-free materials into non-infested areas. Moving materials from one infested location to another within a particular zone may not cause contamination, but moving materials from infested to non-infested areas could lead to the introduction and spread of invasive plants.

99. If removal of invasive species occurs, individuals will be disposed of appropriately, offsite to ensure no further propagation.

100. Workers should familiarize themselves with invasive species identified in this BIA that are potentially present within the work sit areas.

101. Follow the Ontario *Clean Equipment Protocol for Industry - Inspecting and cleaning equipment for the purposes of invasive species prevention*.

Species at Risk

102. The EMP must detail procedures (e.g. exclusion fencing) for preventing turtle and snake entry/nesting within disturbed project gravels/soils during all stages of project activity;

103. Temporary reptile fencing, such as polythene/ woven geotextile secured with timber stakes, or material of a similar nature/function, should be installed completely around gravel stockpiles to prevent turtle nesting / snake egg laying within the project area. For guidance on how to plan and install exclusion fencing, refer to the document titled Species at Risk Branch, Best Practices Technical Note, Reptile and Amphibian Fencing, Ver. 1.1, developed by the Ontario Ministry of Natural Resources and Forestry: http://files.ontario.ca/environment-and-energy/species-at-risk/mnr_sar_tx_rptl_amp_fnc_en.pdf

104. Synthetic plastic Erosion Control Blankets/Mats should not be utilized, particularly during nesting season, as they pose as an entrapment hazard to turtles. Fibre-based bio-degradable Erosion Control Blankets/Mats are only to be utilized.

105. Species at risk training shall be provided to all employees before they begin work on site (materials can be part of the Environmental Protection Plan). Employees must be able to identify potential species at risk and know the proper procedures to follow when they encounter a species at risk.

106. Should any suspected species at risk – snakes or turtles and/or eggs be encountered during construction - project staging, implementation or demobilization - work would halt immediately and Parks Environmental Assessment Staff would be notified. Stop work immediately and contact EA staff on how to proceed. Additional measures to avoid impacts may be required before work can restart. Stand back and allow the animal to leave the site.

107. Minimize the disturbed area of the work site; clearly mark the work space.

108. Park on roads or disturbed areas only.

Noise /Air

109. Adhere to local noise by-laws. Notify residents of planned activities that may cause disturbance and schedule them to avoid sensitive time periods.

110. Monitor and mitigate public complaints by keeping a record of complaints and addressing any issues raised by the public.

111. All on-site vehicles are expected to have a Drive Clean Emissions Report in compliance with O. Reg. 361/98: Motor Vehicles under the Environmental Protection Act, R.S.O. 1990, c. E.19. EA Officers may stop a vehicle if they believe the vehicle is emitting excessive exhaust smoke or suspect that emission control equipment has been tampered with or removed.

112. Use well-maintained heavy equipment and machinery, fitted with fully functional emission control systems/muffler/exhaust baffles, engine covers, etc.

113. Machines shall not be left to unnecessarily idle in order to avoid emissions.

Cultural Resources

114. Document the existing features that will be impacted by the project prior to their removal, restoration and/or rehabilitation.

115. Any removals where profiles, sizes, or materials finishes are to be replicated, the material being removed must be documented and templated accurately.

116. All removals are to be done in conformance with the drawings and specification documents.

117. Ensure that all personnel working on site undergo a heritage induction to clearly identify the value of the place and how to avoid inadvertent impacts on cultural and archeological resources (known and unknown).

118. Identify heritage components in the project area to ensure that inadvertent impacts do not occur.

119. If, in the course of investigation or work, a cultural resource or character-defining element is damaged, CRM should be consulted immediately via the Parks Canada Project Lead for advice on how to proceed.

120. When removing work for the purposes of replacement or repair, it is possible to uncover unanticipated materials or construction that may have historic significance or provide important evidence of previous construction techniques or materials. If unanticipated material or construction is discovered during work, the project lead should stop the work, take photos, and consult with CRM for advice on how to proceed.

121. When temporary structures and machinery are installed on a site, the contractor must safeguard the character-defining elements of the site (including landscape features). The contractor should bear in mind that at National Historic Sites, the recommended practice is to employ a minimal intervention approach, as defined in the Standards and Guidelines for the Conservation of Historic Places in Canada.

Archeological Resources

122. As depicted in Figure 7 of the Archaeological Overview Assessment (Appendix 4), no excavation, staging or road access is permitted in the blue hatched area, due to the a historical dam.

123. Refer to Figure 7 for specific mitigation measures for the staging areas and vehicular access routes proposed. Areas highlighted in green possess low to no archaeological concerns. Ensure equipment is set up to have minimal ground disturbance in areas identified by yellow. Areas highlighted in red require ground protection, such as such as geotextile protective mats with a wood chip lift or granular "A" gravel is required. All protective measures employed must be removed following construction and the area restored to a pre-construction state. Excavation is not permitted during installation or removal of protective covering.

124. If archaeological resources (i.e., artifacts pertaining to the construction of the canal, structural remains) are encountered, excavation should cease in the immediate area, photographs of the find(s) taken and the Parks Canada Project Lead be informed. The Project Lead should then contact Parks Canada's Terrestrial Archaeology section for advice and assessment of significance, which will in turn determine what will be required to mitigate the find.

<u>Waste Disposal</u>

125. Recyclable material and waste shall be removed from the site, in accordance with all federal, provincial and municipal regulations, to disposal facilities licensed to receive them;

126. Waste generated will be disposed according to regulations (i.e., O. Reg. 102/94 and O. Reg. 558/00, R.R.O. 1990, 347).

<u>Floods/Extreme or inclement weather/Ice formation</u>

127. Undertake construction under normal weather conditions, to the extent possible, and design the project worksite to withstand variable weather conditions.

128. Apply wet weather restrictions on construction activities to reduce surface run-off from exposed work areas and to minimize the risk of inundation.

129. The work area shall be stabilized against the impacts of high flow/heavy rainfall events at the end of each workday.

130. Work shall be suspended and the work area stabilized when there is a high probability of a rainfall event.

Appendix 3 – Site Photos

Photo 1. View of aquatic habitat downstream of the Lock 26, with the lower wharf on the left. The downstream cofferdam will likely be installed between the end of the wharf and the stone wall on the opposite side (June 2018).

Photo 2. Swing bridge at the top of Lock 27. The upstream cofferdam will be installed between the abutments (June 2018).

Photo 3. The retaining wall beside Old Slys Road (June 2018).

Photo 4. Overlooking Lock 27 and the northern side of the Old Slys Lockstation grounds (June 2018).


Photo 5. East side of Lock 26 (June 2018).


Photo 6. The parking lot behind the lockstation building will be one of the staging areas (June 2018).

Photo 7. Existing mowed path beside the lockstation building will become one of the access roads. This area has potential for archaeological interest and must be protected with geotextile and wood chips/granular (see archaeological mitigations (June 2018).

Photo 8. Lawn on north side of lower wharf which will become a staging area. The new access road to the Waste Treatment Plant will be cut through the secondary forest patch in the background (June 2018).

Photo 9. Interior of secondary forest patch where the access road will created. Dense growth with many young trees and deadfall (June 2018).

Photo 10. South side of Lock 27 where trenching will occur behind the lock walls. Note the mature Trembling Aspen (June 2018).

Appendix 4 – Archaeological Overview Assessment

PARKS CANADA AGENCY
ARCHAEOLOGY AND HISTORY BRANCH
INDIGENOUS AFFAIRS AND CULTURAL HERITAGE DIRECTORATE

ARCHAEOLOGICAL OVERVIEW ASSESSMENT
OLD SLY'S 26 & 27 – HERITAGE STONE MASONRY REPAIRS - RIDEAU CANAL NHS
FII PROJECT RPA nº 872

Andre MILLER and Barbara LESKOVEC
Terrestrial Archaeologists, IAHCD
National Office, Gatineau

ABSTRACT

Parks Canada has proposed to rehabilitate Old Sly's locks on the Rideau Canal National Historic Site of Canada. This Archaeological Overview Assessment will evaluate the archaeological potential of the Project Area and determine if an Archaeological Impact Assessment and/or mitigation measures are required for the Project.

PROJECT OVERVIEW AND ARCHAEOLOGICAL POTENTIAL

Parks Canada has proposed to rehabilitate the Old Sly's locks 26 and 27, Rideau Canal National Historic Site (NHS) of Canada (Figure 1). This project will include heritage stone masonry rehabilitation, including repointing, general stone repairs and solving leakage through lock walls, and the rehabilitation of the sluice tunnel, approach walls, wing walls, breast walls and retaining walls.

Old Sly's lockstation is a double lock located on the Rideau Canal, just east of Smiths Falls, Ontario. Each lock chamber is composed of two original masonry walls (Figures 2-3). The upstream lock walls have 15 courses of stone and the downstream lock has 12 courses of stone. The capstones and skyward surfaces are generally stone, except at the winches, which are bolted to concrete at some locations. The downstream wing walls are also original masonry. On the downstream side, the northwest wall is composed of a low masonry wall, located just beyond the masonry wing wall. A timber crib wharf is located beyond the low masonry wall. There is submerged masonry located at the downstream northeast wall. Other than the submerged masonry, there is no other structure beyond the wing wall at this location. On the upstream side, the southwest wall is a masonry and concrete wall. The capstone and the first course is stone masonry and the lower portion of the wall is concrete with faux-joint tooling. The southeast wall is a concrete wharf with stone capstones and a stone skyward surface.

Two cofferdams will be required to complete the Project, one upstream of Lock 27 and the other downstream of Lock 26. On the downstream side, a cofferdam is required to work on the masonry approach walls that extend past the stop logs. Upstream it is required to repair the stones and concrete at the log gains.

Limited terrestrial archaeological investigations have occurred within proximity of the Project Area. In 2011, Parks Canada archaeologists excavated two test pits adjacent to the lakeshore upriver from the locks prior to tree planting. These test pits revealed a rocky fill mixed with sediments. In one test pit a single horseshoe was uncovered. In 2012-2013, Stantec undertook a Stage 1-2 Archaeological Assessment of a 0.02 ha study area on part of Lot E, Concession 3, Geographic Township of South Elmsley, now Township of Rideau Lakes, United Counties of Leeds and Grenville; and part of Lot 29, Concession 3, Montague Township, Lanark County, Ontario. The Stage 2 assessment resulted in the identification of 226 artifacts from two areas, one on the north bank of the Rideau Canal and the other on the south bank. Given that the majority of the artifacts collected dated to the late 19th century or later and were recovered from disturbed contexts, the assemblage is not considered to retain cultural heritage value or interest. Therefore, no further archaeological assessment was recommended for that specific study area. However historical documentation indicates that a multitude of historical structures existed within the Project Area throughout the years, and evidence of earlier occupations may still exist below ground (Figures 5-6).

Assessment of Proposed Rehabilitation Impact and Archaeological Requirements

The proposed Project entails rehabilitation of the masonry walls at Old Sly's locks 26 and 27. Given that the construction activities, particularly those affiliated with the staging areas and vehicular access routes, could impact potential archaeological resources, the following mitigation measures are required to minimize Project impacts:

1. As depicted on Figure 7, no excavation, staging or road access is permitted in the blue hatched area, due to the presence of a historical dam.

2. Refer to Figure 7 for specific mitigation measures for the staging areas and vehicular access routes proposed. Areas highlighted in green possess low to no archaeological concerns. Ensure equipment is set up to have minimal ground disturbance in areas identified by yellow. Areas highlighted in red require ground protection, such as such as geotextile protective mats with a wood chip lift or granular "A" is required. All protective measures employed must be removed following construction and the area restored to a pre-construction state. Excavation is not permitted during installation or removal of protective covering.

3. If archaeological resources (i.e., artifacts pertaining to the construction of the canal, structural remains) are encountered, excavation should cease in the immediate area, photographs of the find(s) taken and the Parks Canada Project Manager be informed. The Project Manager should then contact Parks Canada's Terrestrial Archaeology section for advice and assessment of significance, which will in turn determine what will be required to mitigate the find.

References Cited

Cooke, John G. & Associates Ltd. 2018. Old Slys Lock 26 & 27, Heritage Stone Masonry Repairs. 99% Submission. On file with Parks Canada, Smiths Falls.

- 2016. Old Sly's Lock 26 and 27 Masonry Rehabilitation. RS 2.1.3 Design Concept Report. Dated December 2016. On file with Parks Canada, Smiths Falls.

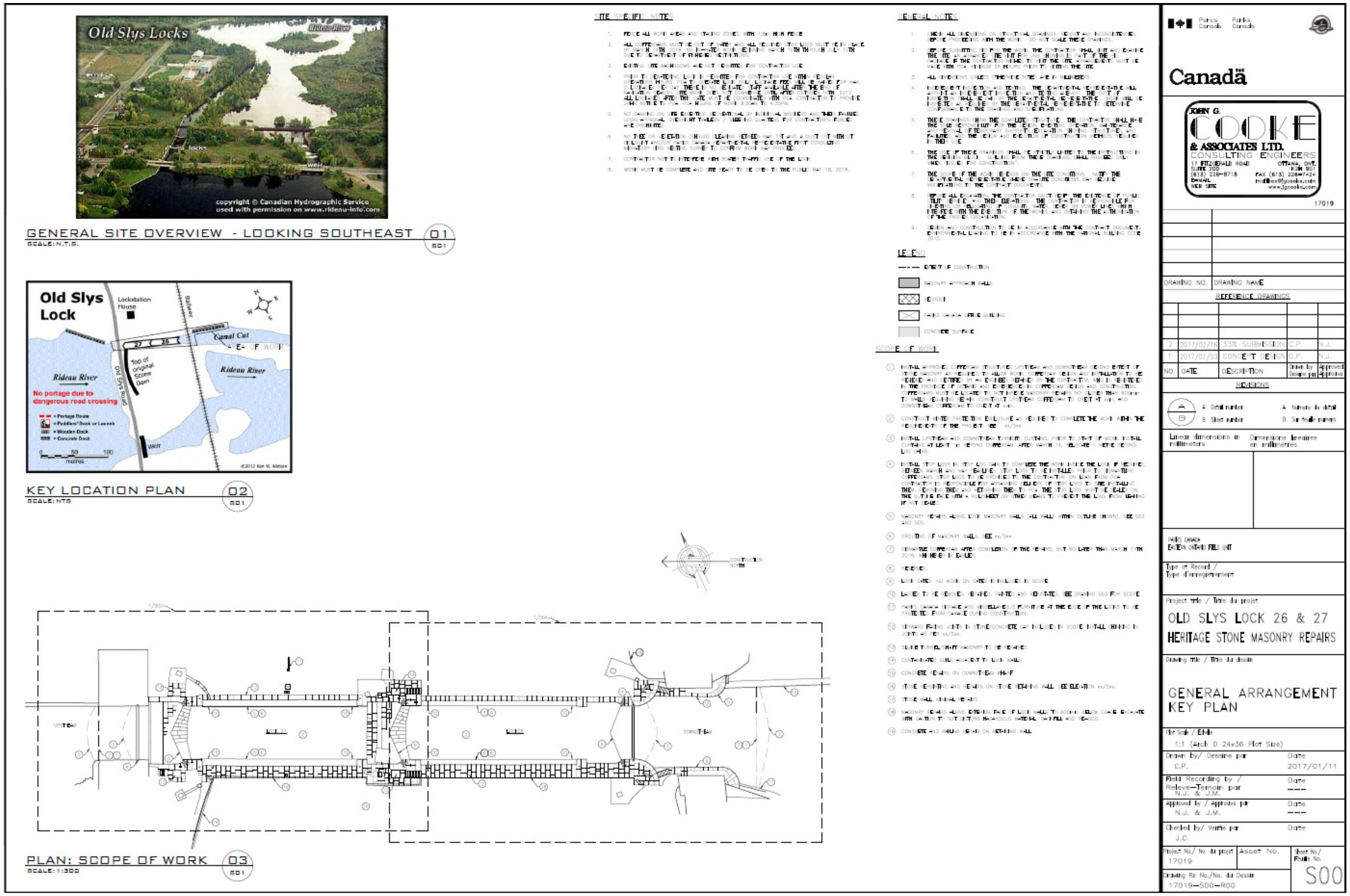


Figure 1. Location of Proposed Heritage Stone Masonry Repairs at Old Sly's Lock 26 & 27 (PCA Digital Files)

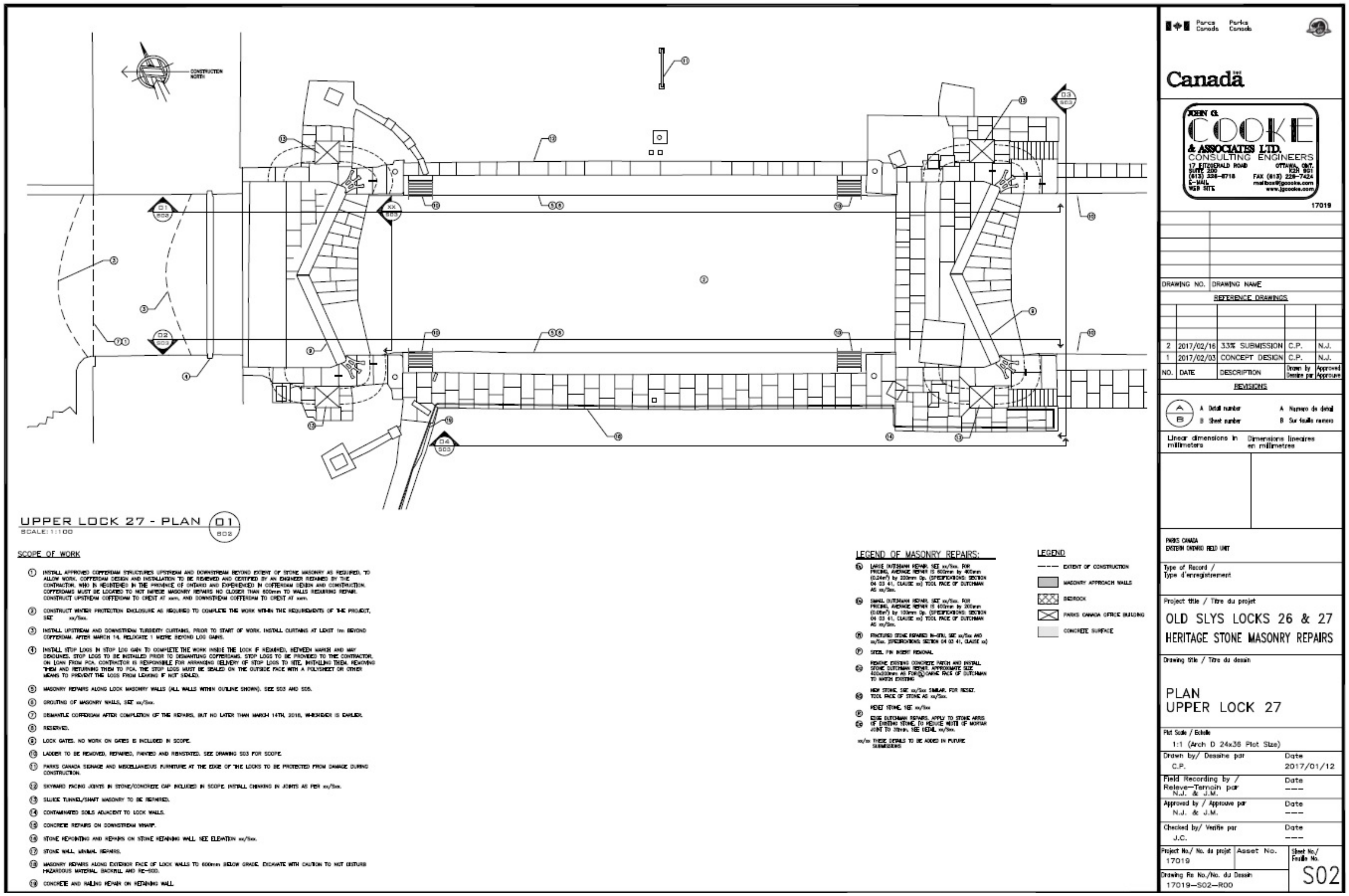


Figure 2. Location of Proposed Heritage Stone Masonry Repairs at Old Sly's Lock 27 (PCA Digital Files)

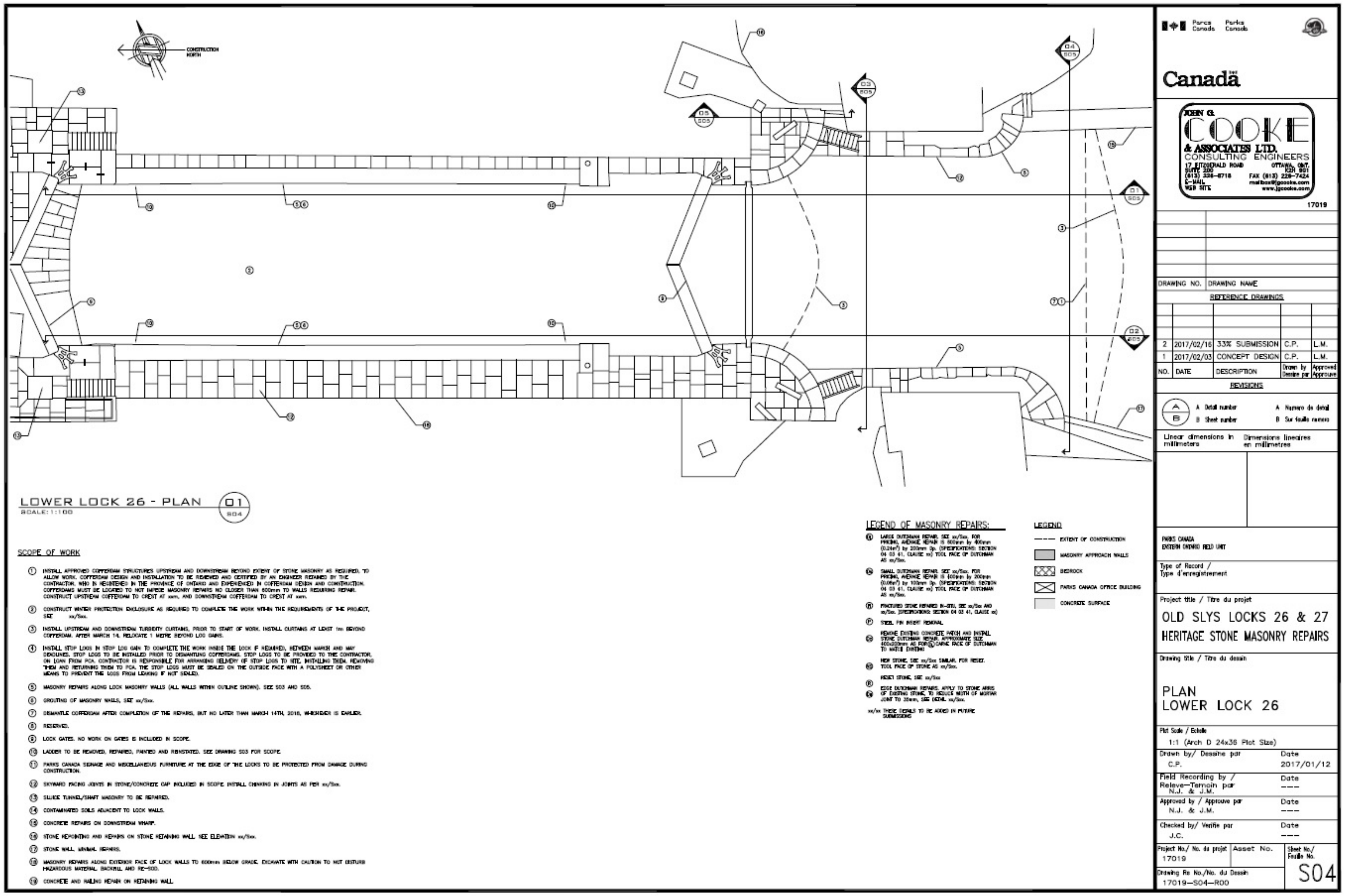


Figure 3. Location of Proposed Heritage Stone Masonry Repairs at Old Sly's Lock 26 (PCA Digital Files)

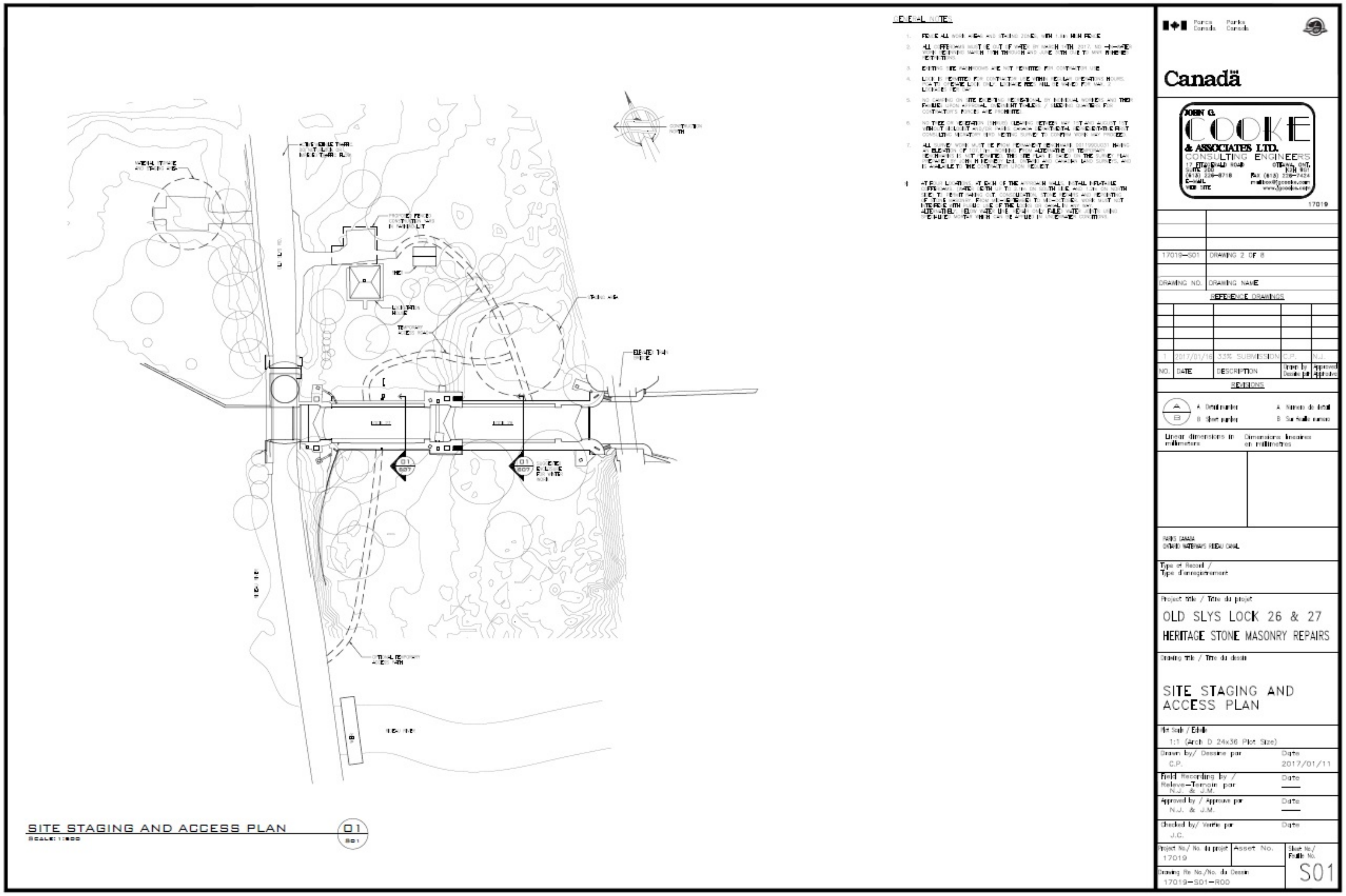


Figure 4. Location of Proposed Staging Areas at Old Sly's Lock 26 & 27 (PCA Digital Files)

Figure 5. Old Sly's Lockstations, Archaeological Resource Mapping (PCA Digital Files). Note location of former buildings situated to the north and south of the Project Area.

Figure 6. Old Sly's Lockstations, Note location of former buildings situated to the north of the Project Area (PCA Digital Files).

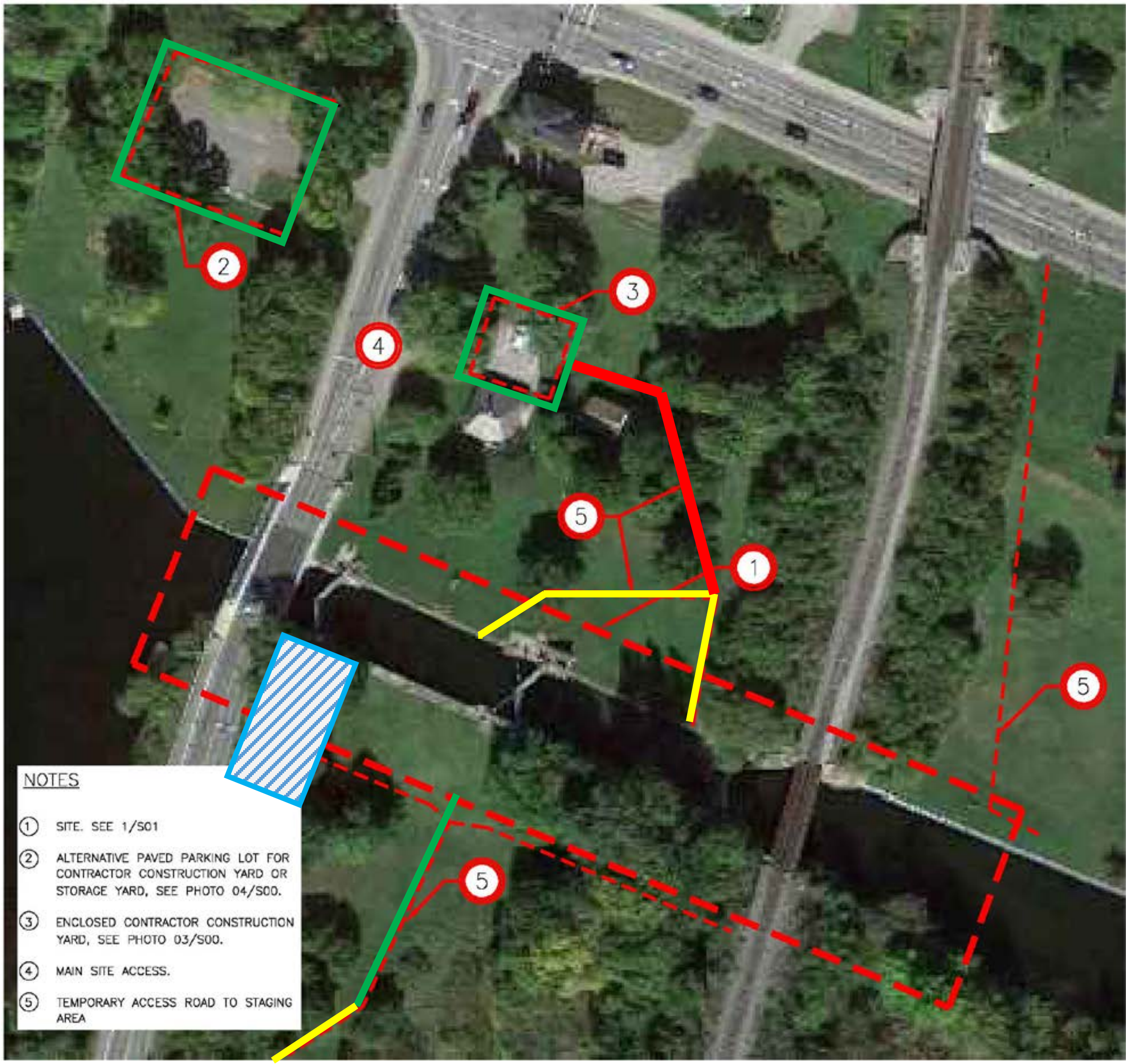


Figure 7. Map of areas for temporary staging and access roads. Areas in green have low to no archaeological concern. Ensure equipment is set up to have minimal ground disturbance in areas identified by yellow, and ground protection is required for areas in red. No excavation, staging or road access is permitted in the blue hatched area, due to the presence of a historical dam (modified from John G. Cooke & Associates Ltd. 2018).

Appendix 5 – Risk Assessment and Environmental Monitoring Report (AEL Environmental, 2018a)

Appendix 6 - Total Suspended Solids Limit for Construction Site Water (AEL Environmental, 2018b)

Environmental Standards and Guidelines Document
Ontario Waterways

July 2017



Parks Canada Parcs Canada

Canada

Environmental Standards and Guidelines Document – Ontario Waterways
Project # R.082719.007

Prepared by

SLR Consulting (Canada) Ltd.

For:

Parks Canada Agency

July, 2017

ACKNOWLEDGEMENT

This Environmental Standards and Guidelines Document was prepared by SLR Consulting (Canada) Ltd. (SLR) for Parks Canada Agency (PCA) under contract with Public Services and Procurement Canada (PSPC). SLR gratefully acknowledge the input and direction provided by PCA's Ontario Waterways Unit and the project management team at PSPC. SLR and PCA also gratefully acknowledge Van Osch Innovations Ltd. (VOI) for allowing the use of their "Erosion and Sediment Control" training participant's manual (2005) and other reference materials in the preparation of this document. Similarly, SLR acknowledges the many authors of the reference documents used in the preparation of this document.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

PART 1:

INTRODUCTION TO THE ENVIRONMENTAL STANDARDS AND GUIDELINES DOCUMENT, CONTEXT AND APPLICATION

1.0 INTRODUCTION

For more than a century, the Government of Canada, consistent with national and international commitments, has been involved in protecting and presenting places that represent the world's natural and cultural heritage. In support of this effort, Parks Canada Agency (PCA) plays a leading role in federal government activities related to recognizing places representative of Canada's natural heritage and places of national historic importance, and in protecting and presenting these places to the public. PCA is also responsible for erecting and maintaining a variety of heritage markers. As such, it operates within broad, changing and varied contexts. National parks, marine conservation areas, historic canals and sites are PCA's key assets to achieve its mission.

PCA owns, operates, maintains and repairs numerous water and land-based assets on the Trent-Severn Waterway and the Rideau Canal. Water-based assets include: breakwaters, dams, locks, marine walls, water retaining structures, wharves and docks. Land-based assets include: pedestrian and vehicular bridges, operations and public use building and parking areas, monuments and plaques, day-use grounds, and various access and service roads.

These assets are operated to ensure long-term commemorative integrity and navigation requirements while meeting a broad range of stakeholder needs including: tourism and recreation, water management (e.g., flood mitigation), municipal water supply, hydro power generation and environmental management.

To assist PCA in managing its assets, PCA has developed this Environmental Standards and Guidelines (ESG) document. The document provides clear and practical guidance and sets PCA's expectations regarding minimum standards to mitigate potential environmental effects during construction, maintenance and repair projects on Ontario Waterways. It is PCA's intent to avoid and reduce the potential for adverse environmental effects, manage costs and liabilities, and meet regulatory and public expectations regarding sustainable development. Being responsible for protecting and presenting nationally significant examples of Canada's natural and cultural heritage, PCA is held to the highest of standards.

This ESG Document will be useful to PCA staff, its agents and Contractors involved in various types of projects on Ontario Waterways. This document may also be used for those third party (non-PCA) projects such as those proposed by hydroelectric power generation proponents and private landowners.

1.1 Scope of the ESG Document

PCA undertakes, approves and/or oversees a wide variety of projects on Ontario Waterways. This document focuses on providing clear and practical guidance and setting PCA's expectations regarding avoidance or reduction of adverse environmental effects during a variety of undertakings including the following construction, maintenance and repair projects:

- Lock repairs and upgrades;
- Bridge repairs, upgrades and replacement;
- Earth dam repairs and upgrades;
- Retaining and approach wall repairs and replacements;
- Concrete dam repairs and upgrades;

- Concreate dam replacement (in-situ);
- Concrete dam replacement (rebuilds downstream or upstream); and
- Gravel roads.

The ESG Document may also provide guidance for other works and activities on Ontario Waterways.

Where relevant, the scope of this document provides information for the following works and activities:

Pre-Construction Works and Activities	**Construction Works and Activities**	**Post-Construction Works and Activities**
• Erosion Control • Sediment Control • Soil Stripping, Grubbing and Stockpiling • Tree Protection and Hording • Vegetation Clearing and Protection	• Abrasive Blasting • Blasting • Borehole and Rock Drilling • Chipping and Cutting • Concrete Pour Operations and Grouting • Dredging and Sediment Removal • Fish Exclusion, Salvage and Relocation • Fugitive Dust Control During Construction • Grinding and Welding • Installation and Removal of Coffer Dams and Isolation Structure • Invasive Species Management • Pile Driving • Refueling and Spill Management • Treatment of Discharge Waters • Use and Maintenance of Heavy Equipment • Vehicle and Equipment Washing and Cleaning • Wildlife and Species at Risk Protection During Construction • Winter Weather Stabilization and Operations	• Revegetation

1.2 Objectives of the ESG Document

In general, this ESG Document is intended to be used by PCA staff after the completion of an environmental impact assessment (EIA) but prior to the commencement of construction in developing contract specifications. It is intended to be used by Contractors in developing Environmental Management Plans (EMPs).

The specific objectives of this ESG Document are to:

- ✓ Establish PCA's Ontario Waterways Unit's Environmental Standards and Guidelines applicable to key works and activities undertaken as part of construction, maintenance and repair projects on Ontario Waterways;
- ✓ Encourage and facilitate consistency in the application of the environmental standards and guidelines across all projects undertaken on Ontario Waterways, and in the interpretation of key terms, concepts and requirements;
- ✓ Direct users of the ESG Document to other guidance documents, legislation or regulations where more specific information can be found;
- ✓ Identify the roles and responsibilities of PCA staff, its agents, Contractors and others potentially involved in the delivery of projects on Ontario Waterways;
- ✓ Describe PCA's environmental procedures and provide clear compliance processes;
- ✓ Offer a common and widely accepted reference point regarding the current legislative, regulatory and policy context that guides projects on Ontario Waterways; and
- ✓ Foster continuous improvement and learning.

While this ESG Document presents a broad set of standards and guidelines applicable to many projects undertaken on Ontario Waterways, it is not intended to:

- ✗ Address or provide guidance regarding the specific design or engineering aspects of project development;
- ✗ Address or provide guidance regarding issues related to the protection of historical, heritage or cultural resources;
- ✗ Replace information contained in other PCA guidance documents or external guidance materials;
- ✗ Remove discretion to adapt requirements for any specific project as information requirements will depend on the waterway, project type, environmental setting, etc. Discretion to adapt requirements for any specific project is essential and should be discussed with PCA;
- ✗ Serve as the definitive source for determining whether regulatory compliance will be, or has been, achieved for any particular project; or
- ✗ Impede or limit the possibility of using more site-specific, relevant or more up-to-date best practices, standards, guidelines or performance criteria.

2.0 ESG DOCUMENT ORGANIZATION

This ESG Document has been organized in two (2) parts with supporting appendices aimed at providing users with easy reference to key information. Throughout the document, “hot links” are provided to specific Standards and Guidelines via their unique *Identification Number*. This is intended to provide linkages between sections, linkages between standards and guidelines that are related and to improve navigation of the document.

Part 1: Introduction to the ESG Document, Context and Application

Section	Content
Section 1: Introduction	Provides a general introduction to the ESG Document and the general context for its development and application. It describes the scope and objectives of the ESG Document, including what the document is intended for and what it is not intended for.
Section 2: ESG Document Organization (this section).	Provides an overview of each section of the ESG Document.
Section 3: Ontario Waterways and Constraints to Construction	Provides background information regarding the environmental and socio-economic setting of the Trent-Severn Waterway and Rideau Canal and identifies the key constraints to project delivery and construction in these settings.
Section 4: PCA’s Project Delivery Process	Describes the key stages in the delivery of projects by PCA and the roles and environmental responsibilities of Contractors, PCA and others throughout this process.
Section 5: Environmental Management Plans	Describes the purpose and intent of Environmental Management Plans (EMP) in project delivery. It sets out PCA’s expectations regarding the overall structure and content requirements for EMPs, including general EMP requirements and those of its component plans.
Section 6: Introduction to Environmental Standards and Guidelines (Part 2)	Describes the typical projects undertaken by PCA on Ontario Waterways, including the identification of typical works and activities. It provides a general introduction to the information presented in Part 2 of this ESG Document.

Part 2: Environmental Standards and Guidelines

Category	Environmental Standards and Guidelines	Identifier
Pre- Construction Works and Activities	Erosion Control	ESG-1-Pre
	Sediment Control	ESG-2-Pre
	Soil Stripping, Grubbing and Stockpiling	ESG-3-Pre
	Tree Protection and Hording	ESG-4-Pre
	Vegetation Clearing and Protection	ESG-5-Pre
Construction Works and Activities	Abrasive Blasting	ESG-1-C
	Blasting	ESG-2-C
	Borehole and Rock Drilling	ESG-3-C
	Chipping and Cutting	ESG-4-C
	Concrete Pour Operations and Grouting	ESG-5-C
	Dredging and Sediment Removal	ESG-6-C
	Fish Exclusion, Salvage and Relocation	ESG-7-C
	Fugitive Dust Control During Construction	ESG-8-C
	Grinding and Welding	ESG-9-C
	Installation and Removal of Coffer Dams and Isolation Structure	ESG-10-C
	Invasive Species Management	ESG-11-C
	Pile Driving	ESG-12-C
	Refueling and Spill Management	ESG-13-C
	Treatment of Discharge Waters	ESG-14-C
	Use and Maintenance of Heavy Equipment	ESG-15-C
	Vehicle and Equipment Washing and Cleaning	ESG-16-C
	Wildlife and Species at Risk Protection During Construction	ESG-17-C
	Winter Weather Stabilization and Operations	ESG-18-C
Post-Construction Works and Activities	Revegetation	ESG-1-Post

Appendices

Appendix	Content
Appendix A: Glossary and Acronyms	Defines key terms and acronyms used throughout the ESG Document.
Appendix B: Policy and Legislative Context for Projects on Ontario Waterways	Provides a description of PCA policies and the federal and provincial legislation and regulations relevant to Projects on Ontario Waterways
Appendix C: Parks Canada Agency's Environmental Impact Assessment (EIA) Process	Describes the overall Environmental Impact Assessment process used by PCA in delivering projects on Ontario Waterways.
Appendix D: Typical Project Works and Activities	Describes the works and activities that are typically undertaken during project development.

3.0 ONTARIO WATERWAYS AND CONSTRAINTS TO CONSTRUCTION

In 2012, PCA management of the Rideau Canal and the Trent-Severn Waterway was consolidated into one group, now referred to as “Ontario Waterways” within PCA. The Ontario Waterways’ unit managing the Rideau Canal is headquartered in Smiths Falls, Ontario; and the unit managing the Trent-Severn Waterway is headquartered in Peterborough, Ontario. Figure 1 shows the locations of both these historic canals and the locations of PCA’s Ontario Waterways unit headquarters.

PCA manages its assets on the Rideau Canal and the Trent-Severn Waterway in accordance with their respective management plans. The most recent management plan for the Rideau Canada National Historic Site received ministerial approvals in 2005 and the management plan for the Trent-Severn Waterway National Historic Site of Canada received ministerial approval in 2000.

As shown on Figure 2, the Rideau Canal corridor extends 202 km from the City of Ottawa in the northeast to the City of Kingston in the southwest and is comprised of a chain of lakes, rivers and 19 km of constructed canals. Access to the Canal is possible at all of the Canal’s lock stations and by way of marinas, resorts, public boat launches, parks and conservation areas. The Tay Canal, which provides a navigation route between Lower Rideau Lake and the Town of Perth by way of Beveridges Lockstation, also connects to the Rideau Canal.

As shown on Figure 3, The Trent-Severn Waterway is a 386 km inland corridor of lakes and rivers in southern Ontario permitting continuous navigation from Lake Ontario in the south to Georgian Bay in the north. The Waterway follows the course of the Trent, Otonabee and Severn Rivers, which now connect a complex system of lakes, linked by artificial and improved river channels with levels controlled by dams and navigation locks. The drainage basins of the Trent and Severn Rivers cover approximately 18,600 km². The Murray Canal, which is an 8 km canal connecting the Bay of Quinte to Lake Ontario on the Trent-Severn Waterway is also managed by PCA.

PCA owns, operates, maintains and repairs numerous water-based and land-based assets in both canal corridors that are summarized in the following table.

Table 1: PCA's Assets in the Rideau Canal and Trent-Severn Waterway Corridor

Water Based Assets	Type of Asset	Rideau Canal Assets (#)	TSW Assets (#)
	Breakwaters	16	27
	Dams	105	176
	Locks	47	44
	Approach Walls	86	124
	Water Retaining Structures	2	11
	Wharves, Docks and Boat Launches	53	15
	Other Structures	20	13
Land Based Assets	**Type of Asset**	**Rideau Canal Assets (#)**	**TSW Assets (#)**
	Pedestrian Bridges	3	4
	Vehicular Bridges	27	38
	Operation, Administration and Utility Buildings	47	100
	Public Use Buildings	49	48
	Staff Housing	20	5
	Day-Use Grounds / Trails	43	54
	Monuments and Plaques	53	23
	Heritage Structures	4	4
	Parking Areas	29	43
	Other Grounds	10	31
	Access Roads to Visitor Facilities / Service Roads	4	18

3.1 Project Delivery Challenges and Constraints to Construction

The following describes some of the key challenges that PCA and Contractors face in delivering projects and constraints faced in undertaking major construction projects in the Rideau Canal and Trent-Severn Waterways corridors.

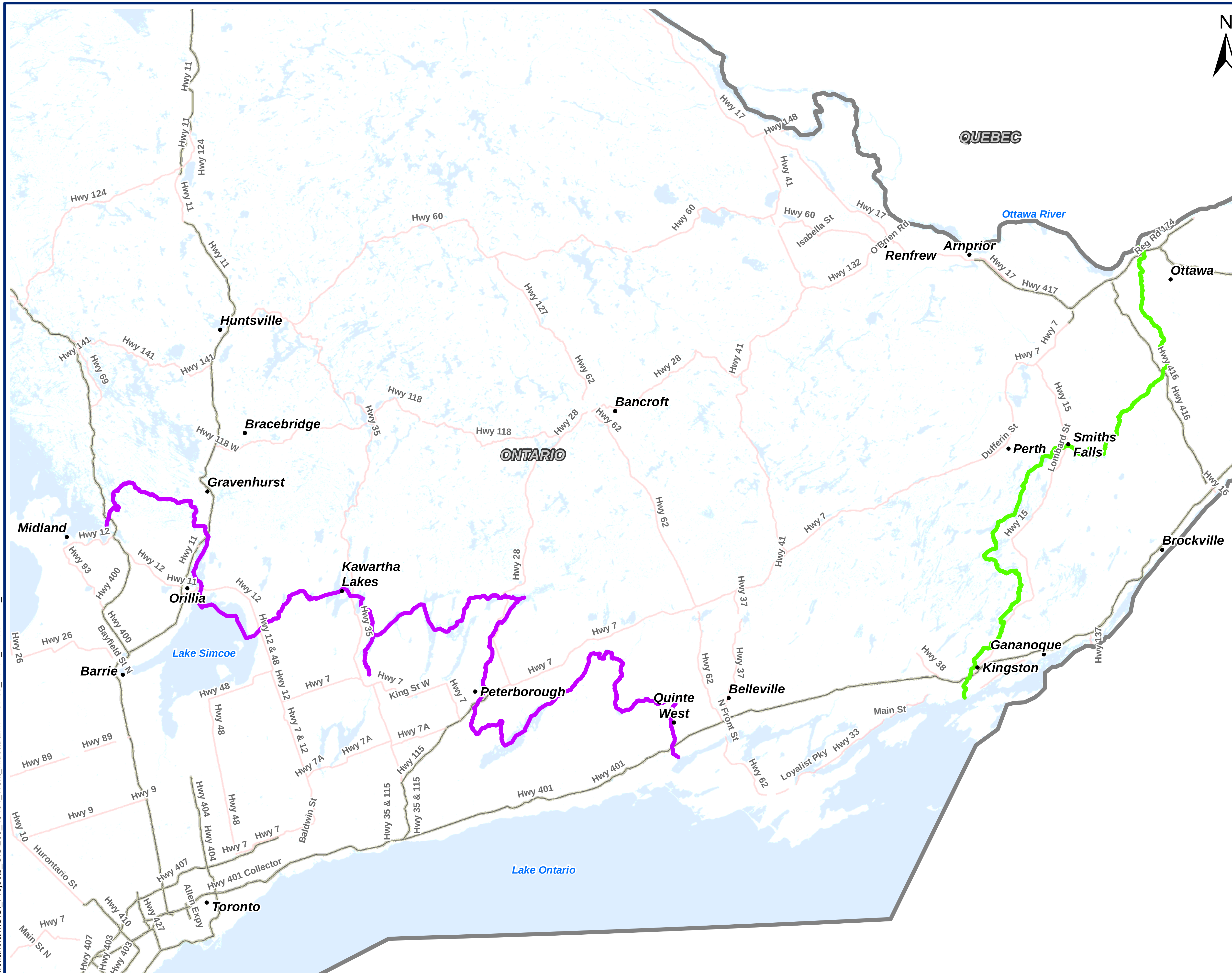
Construction in Water and/or Near Water

Construction projects within the corridors are often undertaken on small parcel(s) of federally owned terrestrial land and waterways which contain multiple assets or large aquatic parcels covering larger system. Although the aquatic parcels are quite large, construction will only occur on small portions at one time. In addition, what happens at a project site can have implications both upstream and downstream. Contractors will need to plan their activities carefully to minimize their construction site's footprint and encroachment and/or damage of nearby assets on-site, upstream and downstream. Most importantly, any project on Ontario Waterways will be undertaken in water and/or near water. Project works and activities will need to be undertaken to the highest standards to maintain adequate flows and protect riparian habitat and water quality. In some instances, new or unique technologies might need to be employed to avoid and minimize potentially adverse effects to water quality and aquatic life.

Protection of Historic Sites

The Rideau Canal is the oldest continuously operated canal in North America. The Canal was first commemorated as a National Historic Site in 1926 and designated as a UNESCO World Heritage Site in 2007. The Trent-Severn Waterway is considered one of the most important National Historic Sites in Canada. Its many unmodified canal structures, particularly in the Lake Simcoe-Balsam Lake section of the Waterway, dating from the construction era of 1900-1907, are specified as being nationally significant.

National Historic Sites, by their very nature, are irreplaceable. Construction projects will need to be undertaken in a manner that avoids damage to these assets and maintains their commemorative integrity.



N

LEGEND

- Trent-Severn Waterway
- Rideau Canal
- Waterbodies

0 5 10 20 Kilometers

SCALE: 1:1,125,000
WHEN PLOTTED CORRECTLY AT 11 x 17
NAD 1983 UTM Zone 17N

NOTES

This map is for conceptual purposes only and should not be used for navigational purposes.

Basedata:

PARKS CANADA AGENCY

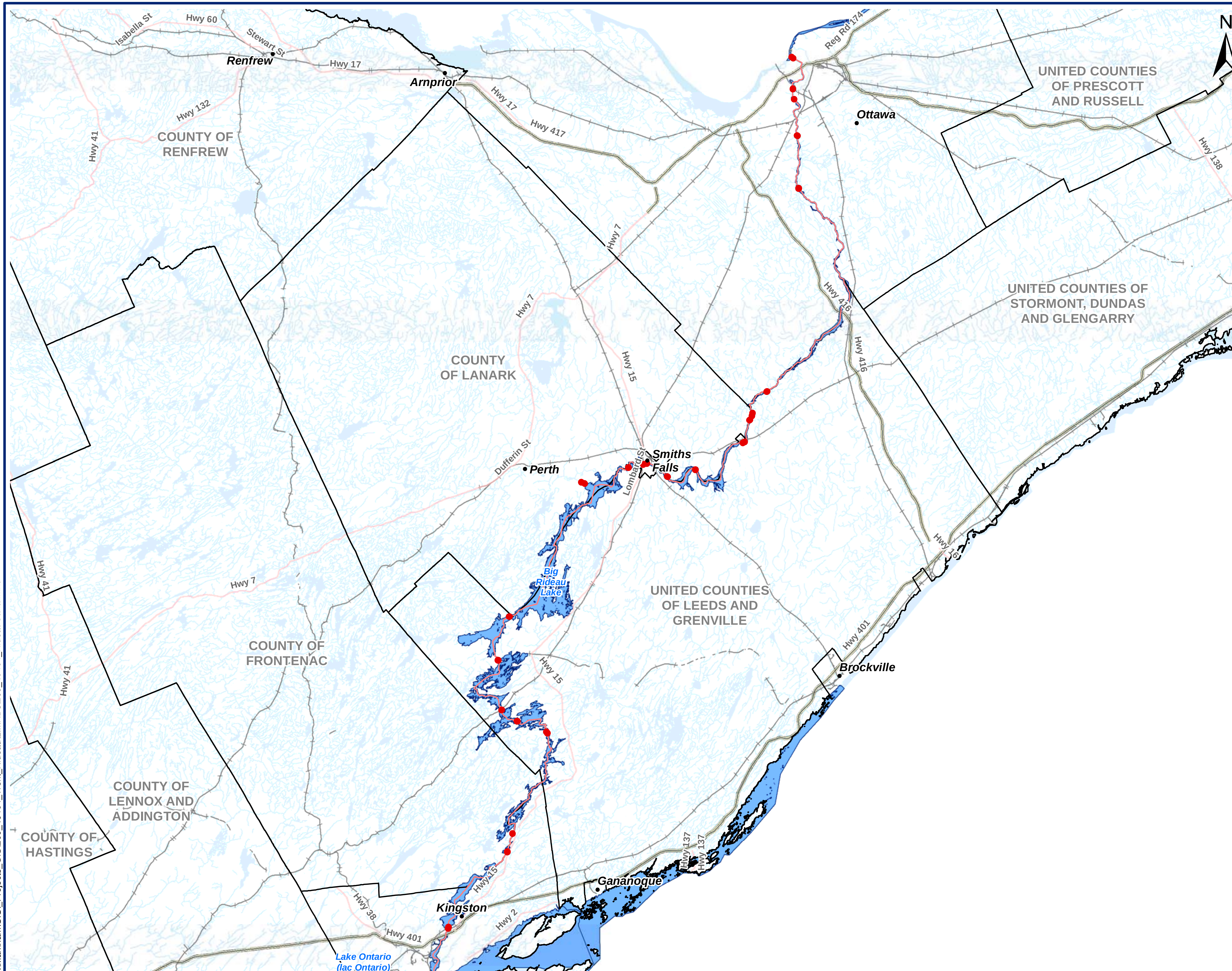
ENVIRONMENTAL STANDARDS AND GUIDELINES DOCUMENT

TRENT-SEVERN WATERWAY AND RIDEAU CANAL

June 30, 2017	Rev	0.0	Figure No.
Project No.	209.40404.00000		1

SLR global environmental solutions

N:\Markham\GIS_Projects_GIS\209_40404_Trent_Rideau\1.MXDs\209_40404_RideauTrent_SOnt.mxd



LEGEND

- Lock Locations
- Rideau Canal
- Municipalities
- Waterbodies in Canal System
- Watercourse
- Waterbodies

0 5 10 20 Kilometers

SCALE: 1:550,000
WHEN PLOTTED CORRECTLY AT 11 x 17
NAD 1983 UTM Zone 17N

NOTES

This map is for conceptual purposes only and should not be used for navigational purposes.

Basedata:

PARKS CANADA
AGENCY

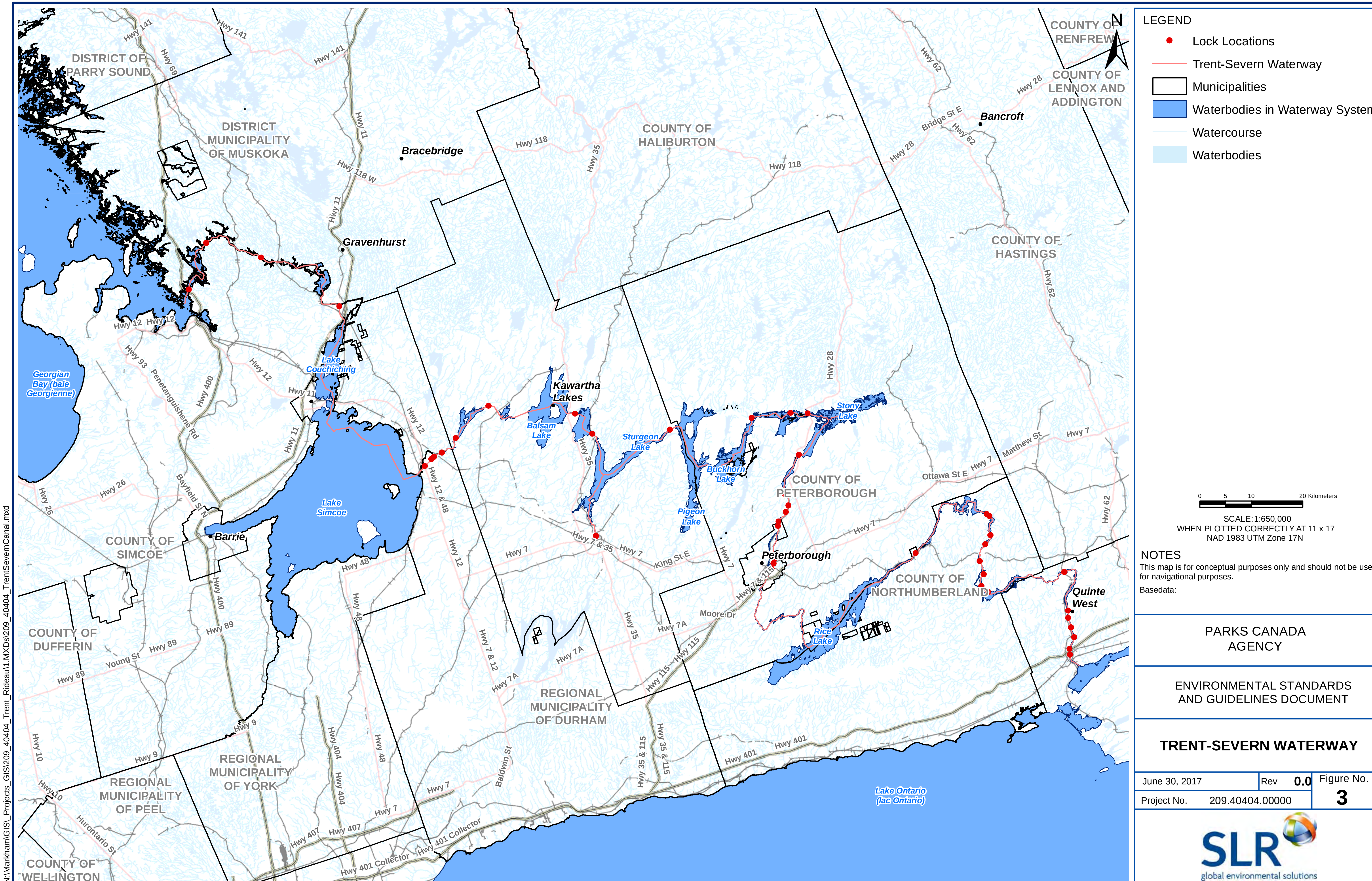
ENVIRONMENTAL STANDARDS
AND GUIDELINES DOCUMENT

RIDEAU CANAL

June 30, 2017	Rev 0.0	Figure No.
Project No. 209.40404.00000		2

SLR
global environmental solutions

N:\Markham\GIS_Projects_GIS\209_40404_Trent_Rideau\1.MXDs\209_40404_RideauCanal.mxd


LEGEND
Lock Locations
Trent-Severn Waterway
Municipalities
Waterbodies in Waterway System
Watercourse
Waterbodies
N
0 5 10 20 Kilometers
SCALE: 1:650,000
WHEN PLOTTED CORRECTLY AT 11 x 17
NAD 1983 UTM Zone 17N
NOTES
This map is for conceptual purposes only and should not be used for navigational purposes.
Basedata:
DISTRICT OF PARRY SOUND
DISTRICT MUNICIPALITY OF MUSKOKA
COUNTY OF HALIBURTON
COUNTY OF RENFREW
COUNTY OF LENNOX AND ADDINGTON
COUNTY OF HASTINGS
COUNTY OF PETERBOROUGH
COUNTY OF NORTHUMBERLAND
COUNTY OF SIMCOE
COUNTY OF DUFFERIN
REGIONAL MUNICIPALITY OF DURHAM
REGIONAL MUNICIPALITY OF YORK
REGIONAL MUNICIPALITY OF PEEL
COUNTY OF WELLINGTON
Bracebridge
Gravenhurst
Bancroft
Kawartha Lakes
Barrie
Peterborough
Quinte West
Georgian Bay (baie Georgienne)
Lake Couchiching
Lake Simcoe
Balsam Lake
Sturgeon Lake
Pigeon Lake
Buckhorn Lake
Stony Lake
Rice Lake
Lake Ontario (lac Ontario)
Hwy 141
Hwy 69
Hwy 11
Hwy 118
Hwy 118 W
Hwy 35
Hwy 62
Hwy 28
Bridge St E
Hwy 12
Hwy 93
Penetanguishene Rd
Hwy 400
Hwy 26
Bayfield St N
Hwy 12 & 48
Hwy 7
Hwy 7 & 35
King St E
Ottawa St E
Matthew St
Hwy 7 & 115
Moore Dr
Hwy 7A
Hwy 115
Hwy 48
Hwy 89
Young St
Hwy 9
Hwy 10
Hurontario St
Hwy 404
Hwy 407
Hwy 401
Hwy 401 Collector
Hwy 7 & 12
Baldwin St
Hwy 35 & 115
PARKS CANADA AGENCY
ENVIRONMENTAL STANDARDS AND GUIDELINES DOCUMENT
TRENT-SEVERN WATERWAY
June 30, 2017
Rev 0.0
Figure No. 3
Project No. 209.40404.00000
SLR
global environmental solutions
N:\Markham\GIS_Projects_GIS\209_40404_Trent_Rideau\1.MXDs\209_40404_TrentSevernCanal.mxd

Respecting Indigenous People's Rights and Interests

The Rideau Canal and Trent-Severn Waterway lie within the traditional territories of several Indigenous communities and are within Treaty areas. For Contractors, sub-contractors and their employees this means that the work carried out will be subject to Treaty obligations. While these obligations stem from the nation to nation requirements found in the Treaties, work and actions by Contractors can play a direct role in ensuring that Treaty obligations are met. Many sites can be important for their Indigenous heritage values; including the protection and preservation of the natural and cultural environments, and ensuring the cultural history of the Indigenous peoples is not lost. Identification, protection and proper treatment of any such cultural resources that may be found at work sites is important to Parks Canada. This protection and preservation leads to reconciliation between Canada and the Indigenous peoples and is at the forefront of our collective work together.

Contractors will need to be aware and respectful of PCA's commitments arising from PCA's consultation and the need for ongoing communications, involvement of Indigenous peoples in their projects, and the implementation of various forms of accommodation. Although Contractors and their agents must not undertake any consultation with Indigenous communities or groups without prior authorization by PCA, Contractors and their agents may be called upon to support PCA management in further consultation in a variety of situations. Overall, any person or organization undertaking a project on Ontario Waterways must respect Indigenous rights and interests.

Protecting Ecological Integrity

The Rideau Canal Corridor is part of the Great lakes - St. Lawrence Lowlands ecosystem. The Canal crosses several major geological and physiographic regions and traverses the Rideau and Cataraqui watersheds. The Trent-Severn Waterway also crosses several major geological and physiographic regions. In the north, the Severn River and part of the Kawartha Lakes lie on the Canadian Shield. South of the Shield the Waterway traverses a zone of limestone plains passing through the Peterborough drumlin field and the east end of the Oak Ridges Moraine near the Bay of Quinte. Construction projects will need to be planned and designed in a manner that considers its unique physical and environmental setting. Construction technologies or activities used at one site may not be suitable at another.

Both the Rideau Canal and the Trent-Severn Waterway corridors are characterized by an extensive array of lakes and rivers; forested areas and unique terrestrial habitats; marshes, swamps and aquatic vegetation that are utilized by migratory and resident birds (particularly waterfowl and marsh birds), small mammals, amphibians, reptiles and several species of fish. Many Species at Risk (SAR) utilize these habitats for their various life-stages. Many sites contain critical habitat for SAR species.

Although many of the mitigation measures needed to protect these species and their habitats will have been identified during the Environmental Impact Assessment (EIA) process, Contractors will need to ensure that these mitigation measures are implemented and effective. Special attention will need to be given to the development of management plans that address vegetation, wildlife, fish and fish habitat protection (including SAR) and invasive species management. In most instances, projects schedules will need to abide by relatively stringent timing windows to protect fish during spawning and migratory birds during their nesting period. Construction schedules will need to be developed to ensure that key structures, facilities, equipment and systems critical to environmental protection have been installed and are functioning effectively.

Water Management

Water management has been an integral part of the operations of the Rideau Canal and the Trent-Severn Waterway for decades to meet the competing interests for the water in the system – navigation, flood control, recreation, water power, fish and wildlife, water supply and water quality. Water management is also undertaken in relation to water power generation facilities. There are twenty-six (26) water power facilities on lands or waters administered by PCA. PCA currently licences the occupation and operation of twenty (20) of these facilities on the Trent-Severn Waterway and the Rideau Canal under the authority of the *Dominion Water Power Act*. Typically, facilities that predate this *Act*'s establishment in June 6, 1919 are not subject to the *Act* and its Regulations. As such, six (6) water power facilities are not currently under licence.

Construction projects will need to be implemented in a manner that minimizes disruption to these important functions and interests. Management of water flow is paramount for both operational and environmental reasons. Projects undertaken during navigation season will need to ensure that works or activities do no impeded navigation in the waterways.

Regulatory Compliance

PCA, its Contractors or their agents must have regard for, and remain in compliance with all applicable federal, provincial and municipal legislative requirements throughout the duration of any project, from its initial design through construction, project completion / close-out.

Of particular importance is the Historic Canals Regulation[1] administered by PCA. The Regulation is intended to assist in the maintenance, management and protection of historic canals. Authorization for work to be completed in water and on land within historic canals is under the authority of PCA. Contractors and their agents will require a permit from PCA prior to mobilization to the site and the commencement of any physical works or activities on the Rideau Canada and/or the Trent-Severn Waterway. The permit will be based on the completed Environmental Impact Assessment (EIA), an accepted site-specific Environmental Management Plan (EMP) and a site-specific Health and Safety Plan. A Contractor's EMP will need to demonstrate their understanding of the legislative context and PCA's Environmental Standards and Guidelines, and how their proposed works and activities will be undertaken to ensure compliance. The regulation gives PCA the authority to issue a stop work order if the work fails to comply with the terms and conditions specified in the permit. Failure to fully disclose all works and activities and phasing, or failure to prepare an acceptable EMP may result in project delay.

In general, Provincial legislation is not applicable to projects undertaken on federal lands. Nevertheless, PCA, its Contractors or their agents should be aware and have regard for Provincial legislative requirements throughout the duration of any project, from its initial design through construction, project completion / close-out. There may also be circumstances where certain project works or activities are undertaken on non-federal lands (e.g., private or municipal leased properties, Provincial Crown lands). In such instances, Provincial legislative

[1] Historic Canals Regulations (SOR/93-220) (last amended June 5, 2015). Available from the Department of Justice Canada website: http://laws-lois.justice.gc.ca/eng/regulations/SOR-93-220/index.html

requirements would apply and permits and approvals required by the Province must also be included in the EMP.

While municipal requirements are not applicable on federal lands, there may be instances where a project requires municipal or private lands off federal property, where the project relies on municipal services (e.g., waste management, water and sewage, storm sewers, electric utilities, fire and emergency services, roads/transportation) or where project effects (e.g., noise, dust, traffic) extend off-site.

Table 2 lists the relevant federal and provincial legislation for project on Ontario Waterways. Appendix B provides further details regarding each of these *Act*s and/or regulations.

Table 2: Relevant Federal and Provincial Legislation for Projects on Ontario Waterways

Jurisdiction	Name	Responsible Agency
Federal Legislation	*Parks Canada Agency Act*	Environment and Climate Change Canada
	Canada National Parks Act	Parks Canada Agency
	Historic Canals Regulation	Parks Canada Agency
	Navigation Protect Act	Transport Canada
	Canadian Environmental Assessment Act, 2012	Canadian Environmental Assessment Agency
	Fisheries Act	Fisheries and Oceans Canada
	Species at Risk Act	• PCA on PCA lands and waters; • Environment and Climate Change Canada on land; and • Fisheries and Oceans Canada in aquatic environments.
	Migratory Birds Convention Act	Environment and Climate Change Canada
	Canadian Environmental Protection Act	Environment and Climate Change Canada
	Transportation of Dangerous Goods Act	Transport Canada
	Explosives Act	Natural Resources Canada
Provincial Legislation and Municipal Requirements	*Ontario Environmental Assessment Act*	Minister of the Natural Resources and Forestry
	Ontario Invasive Species Act	Minister of the Natural Resources and Forestry
	Lakes and Rivers Improvement Act	Minister of the Natural Resources and Forestry
	Ontario Water Resources Act	Minister of Environment and Climate Change
	Ontario Conservation Authorities Act	Minister of the Natural Resources and Forestry (Administered by Conservation Authorities)
	Ontario Municipal Act	Ministry of Municipal Affairs
	Municipal By-laws	Local municipality

Socio-economic Considerations

The Rideau Canal corridor and Trent-Severn Waterway are both extensive in size, diversity of land uses and opportunities and, as such, support a varied social and economic environment. Both the Rideau Canal and the Trent-Severn Waterway are popular recreation destinations and today, tourism and recreation are the most important economic activities on the Canal and the Waterway throughout the year. Access to the Canal and Waterway is possible at all of the Canal's lock stations and by way of marinas, resorts, public boat launches, parks and conservation areas. Users and land based visitors to PCA's facilities number in the millions per year.

Some construction projects will need to be undertaken with tourists and recreational users on-site or in the immediate vicinity. Contractors will need to plan their activities carefully to minimize their construction site's footprint and disruption to tourism and recreational activities, both on-site and off-site. Similarly, many project sites are within communities or near residential homes and business operations. Construction projects will need to be implemented in a manner that minimizes disruption to community character / aesthetics, people's use and enjoyment of property and business activity. Management plans will be needed to minimize noise and dust emissions, effects on drinking water supplies, etc.

Stakeholder Involvement

The ongoing management of the Rideau Canal and Trent-Severn Waterway is closely tied to the various governments and regulatory agencies involved in development approvals within the corridor. These include the surrounding municipalities, Provincial government departments and agencies (e.g., Ontario Ministry of Natural Resources and Forestry, Ontario Ministry of Environment and Climate Change, Conservation Authorities, etc.); Federal government departments and agencies (e.g., National Capital Commission, Fisheries and Oceans Canada, etc.). There are numerous Indigenous communities with interests in the corridor. There are also numerous private landowners residing or operating commercial and industrial operations within the corridor that require consideration in the management of the Canal. In this context, PCA's primary interests are the retention and enhancement of the natural, cultural and scenic values (heritage character) of the Canal waterfront lands. On federal lands, PCA will always be the principle point of contact when engaging stakeholders.

4.0 PCA'S PROJECT DELIVERY PROCESS

Figure 4 presents an overview of PCA's project delivery process. For the purposes of this ESG Document, the process is comprised of seven (7) key stages:

1. Project Initiation;
2. Concept Stage;
3. Planning and Design;
4. Construction Tendering;
5. Pre-Construction and Submittals;
6. Construction; and
7. Project Completion and Close-out.

This ESG Document applies primarily to stages three (Planning) to seven (Project Completion and Close-out) of PCA's project delivery process.

4.1 Contractors' Environmental Responsibilities in Project Delivery

In general, Contractors are retained by PCA (and/or Owner's Engineer) or the Contract Administrator to furnish of all labour, materials and equipment required to complete the project within the scope of their work. For some projects, Contractors may also be expected to obtain all necessary permits, authorizations and licences to perform work. In all cases, Contractors are expected to complete the project in accordance with its design and fulfill their environmental responsibilities in accordance with the requirements of the Historic Canal Regulation Permit, including their EMP.

4.1.1 Planning and Design

During the Planning and Design stage, project planners, engineers and Contractors should incorporate the information provided in this ESG Document into the EIA, project plans, designs and contract specifications. For example, coffer dams should be designed at this stage to a sufficient level of detail that would permit a review by PCA and/or DFO. PCA may choose to set general parameters or site-specific design constraints. PCA may also choose to impose site-specific prohibitions at this time (e.g., no loose aggregate is to be used for coffer dams).

4.1.2 Construction Tendering

During the Construction Tendering stage, Contractors are encouraged to have a Qualified Professional(s) provide input to the Contractor's bid taking into consideration known environmental and design constraints (e.g., PCA's EIA results and design assumptions), and PCA's Environmental Standards and Guidelines Document. This would help ensure that PCA's environmental requirements have been taken into consideration in project costing and scheduling.

Figure 4: PCA's Project Delivery Process Summary

1. Project Initiation

- Problems or opportunities requiring investment and physical works are identified.
- List or set of projects is identified for Concept Project Approval (CPA).
- CPA is given to a sub-set of projects.

2. Concept Stage

- Requests for Project Approvals (RPA) are prepared for a sub-set of projects.
- Projects may gain either Preliminary Project Approval (PPA) or Effective Project Approval (EPA).
- Statements of Requirements (SOR) are prepared with input from the PCA Environmental Authority.
- Need for Environmental Impact Assessment (EIA) identified.
- High level environmental requirements are set by PCA Environmental Authority

3. Planning and Design

- Project delivery method is selected. Options include:
  - *In-house PCA delivery by PCA;*
  - *PCA contracted delivery; or*
  - *PSPC delivery.*
- Contract Authority (i.e., PCA or PSPC) prepare:
  - *Project Design Brief;*
  - *Project Design Terms of Reference;*
  - *Statements of Work (as required).*
- Project design is procured.
- EIA process is initiated and completed (Refer to Appendix C).
- Engagement with Indigenous groups, partners and stakeholders (as required) is undertaken.
- High level environmental constraints are incorporated into Project design.
- Contract specifications including general environmental requirments are prepared prior to tendering.

4. Construction Tendering

- PCA sets out Environmental Management Plan (EMP) requirements.
- RPA is updated or resubmitted to gain EPA (if required) prior to tendering.
- PCA or PSPC undertakes tendering process and posts tender package that includes specifications, EIA and EMP requirements.
- PCA and/or PSPC select preferred contractor(s).

5. Pre-Construction and Submittals

- Contractor provides PCA with site-specific EMP
- PCA reviews and accepts Contractor's EMP
- PCA and/or Contractor secures all relevant permits, authorizations and licenses.
- PCA issues Historic Canals Regulations Permit to Contractor

6. Construction

- PCA and/or PSP Cadministers the construction contract.
- Contractors proceed with site preparation and construction in accordance with contract(s), applicable permits, authorizations and licenses as per EMP.
- PCA undertakes project surveillance monitoring.
- Contractor amends or revises EMP as required.
- Historic Canals Regulations Permit/EIA is amended by PCA if necessary.

7. Project Completion / CLose- Out

- Contractor completes construction and site restoration in accordance with contract(s), applicable permits, authorizations and licenses, & EIA and EMP.
- PCA undertakes project surveillance monitoring.
- PCA undertake post-construction follow-up monitoring.
- PCA and/or PSPC administers the construction contract to close-out.

This ESG Document primarily applies to steps the Construction Tendering, Pre-Construction/Submittals, Construction and Project Completion/Close-Out stages of PCA's project delivery process. This ESG Document can also be useful in the completion of an Environmental Impact Assessment during the Planning and Design stage.

4.1.3 Pre-Construction and Submittals

During the Pre-Construction and Submittals stage (after contract award), Contractors are required to have a Qualified Professional(s) prepare a site-specific EMP detailing all proposed structures, facilities, equipment and systems critical to environmental protection; all proposed mitigation measures, monitoring and follow-up activities; all relevant standards and guidelines; and, all performance criteria applicable to the project. Section 5 of this ESG Document provides PCA's requirements for a site-specific EMP.

The Contractor's site-specific EMP must be submitted to PCA's Environmental Authority and the Departmental Representative. The site-specific EMP must be reviewed and accepted by PCA prior to mobilization to the site and the commencement of any work. In addition, the Contractor will prepare a project-specific Health and Safety Plan (HASP). All employees working on the site must be suitably trained and experienced and the Contractor must fully comply with all federal and provincial health and safety standards.

4.1.4 Construction and Project Completion

During the Construction and Project Completion stages, Contractors must:

- Comply with all relevant legislative requirements and other requirements specified in the accepted EMP/EIA. In addition, Contractors must ensure that their workers and sub-Contractors are appropriately trained, supervised and have the necessary experience and competency to implement the requirements of the EMP/EIA;
- Review the EMP/EIA with their staff and sub-Contractors prior to commencing works and following incidents requiring corrective action;
- Cooperate with PCA's Environmental Authority, the Departmental Representative or designate (e.g., Environmental Monitor) appointed for the work;
- Comply with all written or verbal instructions with respect to conducting activities in compliance with the EMP/EIA; and
- Take corrective actions for any non-compliance issues upon direction from PCA's Environmental Authority or designate whether written or verbal. Corrections should be made as soon as reasonably possible, ideally within 24 hours of directions unless there is urgent/immediate action required due to serious and ongoing impacts to the environment.

Contractors are expected to be on site during execution of work and communicate directly to and be under the direction of the Departmental Representative or designate. It is required that the Qualified Professional(s) that prepared the EMP or relevant component plans be available on-site for the inspection, testing and maintenance of structures, facilities, equipment and systems critical to environmental protection in order to ensure compliance with the EMP/EIA. The EMP shall propose for PCA's acceptance, the frequency of monitoring and list "high-risk" construction activities where the relevant Qualified Professional(s) must be on-site. Examples of "high-risk" construction activities are:

- Installation and removal of coffer dams;
- Dewatering;

- Blasting;
- Pile Driving;
- Concrete pours (Tremie concrete pours in particular);
- Fish salvage and relocation; and
- Dam commissioning.

Qualified Professional(s) must also be on-site to address any SAR encounters during construction.

The Qualified Professional(s) should not only be on-site for scheduled monitoring or during "high-risk" construction activities, but should remain on-call during non-critical work periods to respond to emerging environmental issues.

Contractors must give PCA's Environmental Authority a minimum of 48 hours' notice before any "high-risk" construction activity is to be undertaken. Any 'high-risk" activities identified in the EMP will not be allowed to proceed unless notice requirements have been fulfilled. PCA may choose to be on-site or allow the work to proceed under the supervision of the Qualified Professional(s) on-site.

The Contractor must allow PCA's Environmental Authority or their designate access to the work site for surveillance and inspections. Contractors must comply with any direction regarding non-compliance identified by PCA's Environmental Authority or Departmental Representative and report compliance to PCA.

The Contractor must report any environmental incidents to the PCA's Environmental Authority and the Departmental Representative. An environmental incident is any event, act or omission that is, or has the potential to cause, a violation of any of the EMP/EIA provision, any environmental legislation, or provisions of any other permits, authorizations and approvals issued for the project. The works or activities causing the incident should be stopped and the environmental effects should be mitigated immediately once the incident has been identified. Examples of environmental incidents include, but are not limited to:

- Spills of oil, fuel, hazardous chemicals;
- Unauthorized discharges of deleterious substances (including sediment) into fish-bearing water bodies;
- Unauthorized alteration, disruption, or destruction of aquatic or terrestrial habitat (e.g., encroachment into prohibited areas, removal of vegetation during nesting periods);
- Alteration of, or damage to, heritage or archaeological resources (uncovering previously unknown artifacts);
- Fires related to construction activities; and
- Unauthorized release of air pollutants.

As outlined in Part 2 of this ESG document (see Refueling and Spill Management – ESG-13-C):

- Any spill into water, onto ice or in a dewatered area must be reported immediately to PCA's Environmental Authority, the Departmental Representative and the Ontario Ministry of Environment and Climate Change's Spills Action Centre (SAC).

- Any spill on land must be reported immediately to PCA's Environmental Authority and the Departmental Representative. Any spill on land meeting the criteria set out in Ontario's *Environmental Protection Act*, O. Reg. 675/98 must be reported immediately to the Ontario Ministry of Environment and Climate Change's Spills Action Centre (SAC).
- All areas affected by a spill must be cleaned up and demonstrated to be restored to pre-spill condition by a Qualified Professional(s).

4.2 PCA's Environmental Responsibilities in Project Delivery

PCA is ultimately responsible for the identification, design, tendering, construction and completion of its own projects. As the environmental regulator, PCA is also responsible for ensuring that its environmental procedures, standards and guidelines are implemented throughout project delivery.

4.2.1 Project Initiation and Concept Stages

During the Project Initiation and Concept stages, PCA identifies those projects that are proposed to be undertaken over the next several years and seeks Concept Project Approval (CPA). Potential projects can be identified in a variety of ways such as: ad hoc or formal inspections of assets by PCA staff, engineering inspections and studies, etc. PCA would then seek either Preliminary Project Approval (PPA) or Effective Project Approval (EPA). Prior to approval, PCA would consult with various subject matter experts, initiate consultation partners, stakeholders and Indigenous communities (as required). Often further studies and investigations are undertaken to better define the project, in terms of scope, budget, schedule. PCA's Environment Authority provides input into Concept Stage studies by identifying high level environmental constraints and requirements applicable to the construction activities at the project site.

4.2.2 Planning and Design

Depending upon the size and complexity of the project, PCA may undertake the work themselves or contract out the work. PCA may contract with an "Owner's Engineer" (i.e., the Contractor) who typically undertakes more detailed project planning, engineering design, project construction, supervision of construction sites and project completion in accordance with its contract.

For larger, more complex projects, PCA may involve Public Services and Procurement Canada (PSPC) to provide them with consulting services and/or taking on the role of the Departmental Representative and/or Contract Administrator. When required, the Departmental Representative or Contract Administrator typically manages all aspects of the project, including: initial tendering and contract award, project development through all phases of project development (i.e., site preparation, construction, site restoration); scheduling and financial matters. In this case, PCA will have a project leader assigned to the work to act as liaison between PCA and PSPC. In any event, PCA remains the Environmental Authority on all projects.

During the Planning and Design stage, PCA's environmental responsibilities include initiating and completing PCA's Environmental Impact Analysis process to ensure the project is not likely to result in significant adverse environmental effects, and/or public concern with respect to ecological integrity, the integrity of cultural resources or characteristics of the environment that are important to key visitor experience objectives. The EIA process is typically undertaken at the 33% to 66% (and finalized at 99%) project design level to understand how the design and project components may impact the VEC's identified in the EIA. This ESG Document should be used to identify key mitigation measures for inclusion in the EIA. PCA continues fulfilling its Indigenous community consultation requirements and engagement activities with its partners and stakeholders.

The EIA process will result in a set of environmental requirements (i.e., mitigation measures) that will form the basis of the Historic Canals Regulations Permit issued to the Contractor. These environmental requirements will also need to be incorporated into the Contractor's EMP and implemented by the Contractor for Construction, Project Completion and Close-out stages. The EMP is necessary to explain how the Contractor will achieve compliance with the EIA, provisions of any permits, authorizations and approvals issued for the project and PCA's Environmental Standards and Guidelines.

PCA may require follow-up monitoring if there is uncertainty regarding the prediction of adverse environmental effects or the effectiveness of mitigation measures, or in accordance with legislative requirements (such as species at risk monitoring under *SARA*). Follow-up monitoring may commence at any time following EIA approval and may continue after the construction is completed. This will be done by PCA. Appendix C provides an overview of PCA's EIA process.

Finally, during the Planning and Design stage, PCA's environmental responsibilities also include providing input into the tendering process by preparing its detailed environmental requirements or specifications.

4.2.3 Construction Tendering

During the Construction Tendering stage, PCA's environmental responsibilities include setting out its overall environmental requirements (including EMP requirements) for Contractors to follow in preparing their bids. PCA may attach the EIA and this ESG Document to the tender package that is made available to prospective Contractors and/or communicate its requirements to them by other means. This stage concludes with the selection of the preferred Contractor(s) by PCA and/or PSPC.

4.2.4 Pre-Construction and Submittals

During the Pre-Construction and Submittals stage, PCA would receive, review and accept a Contractor's site-specific EMP, ensuring that its environmental requirements or specifications as set out in the tender documents, the EIA, project approvals and permits, and this ESG Document have been incorporated adequately.

PCA and/or the Contractor would secure all relevant permits, authorizations and licenses to allow the project to proceed. As per the Historic Canal Regulations applicable to lands administered by PCA, a permit would be issued by a Parks Canada Director to authorize the project work prior to mobilization to site and the commencement of the Construction stage.

4.2.5 Construction and Project Completion

Throughout the duration of the Construction and Project Completion stages, PCA is typically responsible for the day-to-day management of the technical and engineering aspects of the project from its inception to completion. The PCA's project manager communicates regularly and works directly with the Contract Administrator, Public Services and Procurement Canada (PSPC), the Owner's Engineer and/or the Construction Contractors in project delivery. In addition, PCA will:

- Lead communication with regulatory agencies, local governments, interested and potentially affected Indigenous Groups, and public stakeholders, including property owners and local residents on federal land; and
- Audit compliance with the requirements of the EMP and EIA.

As the Environmental Authority, PCA typically assigns a staff person (or team) or external Consultant to the project whose role is to ensure that the Contractor complies with the project's design specifications and the requirements of the Historic Canal Regulation Permit, as well as the EMP and EIA.

This role can be fulfilled by PCA's Environmental Assessment Officer or designate (e.g., Environmental Monitor/Consultant) who is typically an engineer, applied scientist or technologist who is registered and in good standing with an appropriate professional organization or who, through demonstrated experience and knowledge relevant to the particular matter, may be reasonably relied on to provide advice within their area of expertise. Such a professional could be an ecologist / biologist, forester, geoscientist, engineer, or technologist. An Environmental Monitor operates independently of the proponent and Contractors.

The specific tasks to be completed by the PCA Environmental Authority, the Environmental Monitor/Consultant will depend on the project construction activities and will generally include, but not necessary be limited to:

- Confirming that construction personnel are aware of site-specific environmental issues and all environmental requirements set out by PCA, including requirements set out in EIA and relevant Environmental Standards and Guidelines. Contractors must keep records of all training activities undertaken with construction staff;
- Surveillance monitoring of construction activities and documentation of environmental concerns and environmental protection measures undertaken (see below);
- Completion of on-site meetings and review of specific EMPs with on-site Contractor and/or construction supervisor;
- Review of the working conditions of environmental protection measures (e.g., erosion and sediment control measures) to ensure that they have been installed, are being maintained and are functioning effectively;
- Identifying and communicating to the Contractor issues of non-compliance;
- Development of site-specific protocols or corrective actions for the management of selected issues of non-compliance; and
- Coordination and completion of surveillance monitoring reports, incident / non-compliance reports, and photo documentation of construction works.

4.2.5.1 PCA’s Surveillance Monitoring

As mentioned above, at any time, during the project’s implementation, PCA’s Environmental Authority or designate (e.g., an Environmental Monitor/Consultant) may undertake a site visit to undertake surveillance monitoring.

Contractors can expect that surveillance monitoring shall be undertaken at a frequency based on specific work tasks/procedures and the potential for adverse impacts to occur. At a minimum, surveillance monitoring would occur during “high-risk” construction activities. Contractors must give PCA’s Environmental Authority a minimum of 48 hours’ notice before any “high-risk” construction activity is to be undertaken. Any ‘high-risk” activities identified in the EMP will not be allowed to proceed unless notice requirements have been fulfilled.

Surveillance monitoring may also be conducted with greater frequency during or following periods of inclement weather (i.e., heavy precipitation, strong winds, ice storms).

Documentation of all site visits and discussions with proponents, Contractors or their agents is essential. Documentation of each surveillance monitoring event shall be undertaken according to PCA’s template that documents:

- Relevant project and inspection related information (e.g., location, inspection date and time, individual conducting and present at the inspection, work-site contact information and stage of project implementation and weather conditions)
- Site conditions and inspection methods, noting any specific focus of the inspection
- Surveillance results (i.e., observations, evidence and conclusions regarding whether relevant measures have been correctly implemented), including photos
- Recommendations for improvements (if any);
- Corrective actions required (if any); and
- Summary of identified issues, potential effects and actions.

Documentation of the site visit shall occur after each site visit.

4.2.5.2 Non-Compliance Procedures

Any cases of non-compliance noted during surveillance will be reported PCA’s Environmental Authority or designate (e.g., Environmental Monitor/Consultant) and to the Departmental Representative and the Contractor.

The Environmental Authority and/or the Departmental Representative may require the Contractor to take corrective actions and ensure completion of any such requirements. Corrective actions may be communicated direct to the Contractor by PCA’s Environmental Authority (or designate) or through the Departmental Representative for minor infractions or cases of non-compliance. In circumstances where immediate corrective action is required to prevent environmental or property damage and the Departmental Representative is not accessible, the corrective action requirements will be communicated directly to the Contractor/employees conducting the work.

PCA's Environmental Authority (or designates) or the Departmental Representative may stop work (i.e., of a specific activity where circumstances warrant) until satisfactory corrective action has been taken. Circumstances where a stop work order may be warranted include where there is:

- An imminent or clear contravention of legislative or regulatory requirements with the potential for a significant adverse effect from a project work or activity;
- An imminent or clear threat to human health and safety or contravention of a health and safety protocol; and
- Imminent or clear damage to property; or where the previously requested corrective action has not been taken to the Departmental Representative's satisfaction.

PCA's enforcement officers, such as Park Wardens, and other federal or provincial enforcement officers (e.g., Environment Canada, DFO, MOECC, and MNRF) can play an advisory role to PCA staff and assist with enforcement actions related to environmental legislation within their mandates and jurisdiction. Local police services are the primary enforcers of the Criminal Code. Assistance can be in the form of investigating complaints of non-compliance, taking enforcement actions, preparing files for court briefings, ensuring continuity of evidence, and undertaking consultations with the legal services.

4.3 Other Players and their Responsibilities

PCA works collaboratively with relevant federal, provincial and municipal government agencies throughout project planning, development and follow-up. Upon request by PCA, other government agencies can make available their specialists, expert information or knowledge that they possesses with respect to a project. This expertise may be used by PCA during any stage of project planning and environmental assessment, from the commencement of the project to the implementation of the mitigation measures or any follow-up program. In some instances (e.g., projects affecting non-federal lands or municipal infrastructure) other provincial and municipal governments may be required to grant an approval. All approvals granted must be provided to PCA and integrated into the Contractor's EMP.

Typically, Indigenous communities become involved on specific projects on Ontario Waterways during the Environmental Assessment process or earlier. Depending on the project and its environmental effects, their involvement may extend to working with PCA in follow-up and monitoring activities. PCA will be the lead in any communications with Indigenous communities.

The general public and other stakeholders become involved on specific projects on Ontario Waterways during the Environmental Assessment process or earlier. Public consultation is mandatory for Detailed Impact Assessments (DIA) and optional for Basic Impact Assessments (BIA). PCA and its Contractors endeavor to keep its neighbours and the general public notified of upcoming projects and the status of project development, particularly in cases where navigation, road use or access to private property is affected.

Contractors or their agents are prohibited from consulting with federal, provincial and municipal government agencies or Indigenous communities without prior approval by PCA for project components on federal lands. If leasing properties, then consultation with other relevant government agencies may be undertaken by the Contractor.

5.0 ENVIRONMENTAL MANAGEMENT PLANS

The Contractor is required to prepare and submit to PCA a site-specific EMP detailing all proposed methods, strategies, structures, facilities, equipment and systems critical to environmental protection; all proposed environmental protection and mitigation measures, monitoring and follow-up activities; all relevant standards and guidelines; and, all performance criteria applicable to the project. The Contractor's EMP must be prepared by a Qualified Professional(s), signed and submitted to PCA, for review and acceptance prior to mobilization to site and the commencement of work. An accepted EMP (accepted by PCA) is required prior to the release of the Historic Canals Regulations Permit issued to the Contractor.

An EMP is a project-specific and site-specific document, based on the site-specific EIA, that contains a set of over-arching EMP requirements plus a set of highly specific component plans that, when implemented collectively as a management system, are intended to avoid, eliminate or reduce the severity of adverse environmental effects. The site-specific EMP shall serve as a reference document for all project personnel, so that they are aware of their responsibilities and what is expected of them concerning environmental protection. The requirements included in the EMP will apply to any person, Contractor or subcontractor involved in the project. It is intended to be a "living" document that may require amendments as the project advances from design through construction. These amendments must follow the submittal and acceptance process to PCA, prior to any changes. For example, a dam commissioning plan may be conceptual during initial stages of construction, but would become highly specific prior to commissioning activities being undertaken. Failure to fully disclose all construction works and activities and phasing, or failure to prepare an acceptable in the EMP may result in project delay.

5.1 Overall EMP Requirements

The over-arching EMP document shall include a description of:

- The purpose and scope of the EMP;
- A project overview;
- A construction plan and schedules;
- The roles and responsibilities of the environmental management team;
- Environmental awareness, training and competency commitments;
- General communications and record keeping commitments;
- Environmental incident reporting procedures;
- Environmental monitoring and adaptive management summary; and
- EMP review and revision procedures.

As necessary, the over-arching EMP document should refer to relevant component plans (see Table 3) and other documents at higher or lower levels in the Contractor's management system. Higher level documents may describe environmental management policies and processes. Lower level documents may describe general procedures, specific operational procedures, activity specific work-procedures and work instructions, equipment manuals, environmental protection procedures.

5.1.1 Purpose and Scope of the EMP

The site-specific EMP shall include statements that describe its purpose and the scope:

- The purpose statements should demonstrate how the Contractor understands the relationship between the EMP, the legal requirements applicable to the Project, and the work to be completed.

- The specific Project works and activities to which the EMP will be applied, including any particular limitations such as Property boundaries (spatial scope); time (temporal scope); or limitations with respect to particular works or activities.

5.1.2 Project Overview

The site-specific EMP shall provide an overview of the project that includes:

- A description of the overall Project and its objectives;
- A location map that references the project location in relation to area municipality(ies), communities, transportation network and other local features (e.g., Provincial parks, conservation areas, etc.);
- A detailed Project site map that provides:
    - Property boundaries for all locations on which Project activities will be undertaken (including any leased properties),
    - Site entrance locations,
    - Locations of all PCA's assets,
    - Key environmental, socio-economic and culturally significant features[2], and
    - Site contours and expected drainage patterns.

5.1.3 Construction Plan and Schedules

The site-specific EMP shall provide a construction plan and schedules that include:

- A detailed description of all physical works, activities to be undertaken and materials to be used;
- A listing and rationale for any "high-risk" construction activities;
- An overall Project or construction schedule;
- Detailed supporting schedules and/or information that provides the following:
    - time periods / seasons identified as sensitive for environmental reasons (i.e., timing windows for fish, migratory bird nesting, Species at Risk, fire season, winter, etc.),
    - times where noise may be a nuisance to local residents or at a specialized land use (e.g., such as a hospital, school, retirement home) or when construction may create any parking, access and/or traffic problems,

[2] Key environmental, socio-economic and culturally significant features can be obtained from the Environmental Impact Assessment documentation prepared for the Project.

- the duration of specific physical works and activities (e.g., vegetation clearing, topsoil stripping, coffer dam installation and removal, concrete works, site restoration),
- timing of “high-risk” construction activities, key mitigation measures, including timing regarding the installation of key structures, facilities, equipment and systems critical to environmental protection,
- timing of any special studies or the submission of further EMP component plans,
- the Contractor’s site surveillance schedule by their Qualified Professional(s), linked to “high risk” construction activities, and
- a consultation schedule (if applicable).

5.1.4 Roles and Responsibilities of the Environmental Management Team

A site-specific EMP shall include a description of the organizational structure for the planned work or activities which clearly explains:

- Environmental management team members and their roles;
- Their relationship of each team member to each other;
- Their relationship to PCA personnel; and
- The contact information and position of the person(s) responsible for preparing the EMP and of the key persons responsible for implementing it.

Identifying the position(s) responsible for the EMP includes indicating who within the Contractor’s organization has responsibility and authority for its implementation, ongoing maintenance, performance monitoring and continuous improvement. The EMP shall describe, at an operational level, how the environmental management team and personnel will implement the EMP on a day-to-day basis. Reporting relationships and structures are most easily understood when represented in organization charts. The Contractor is encouraged to use organization charts to explain these relationships.

It is required for the Contractor to hire Qualified Professionals that can provide services thought the life of the project, particularly for monitoring of “high risk” construction activities.

5.1.5 Environmental Awareness, Training and Competency

The site-specific EMP shall refer to the policies, plans and procedures for communicating Project specific environmental protection matters within the Contractor’s organization and to Sub-Contractors entering the worksite. Task specific training will be provided to all Sub-Contractors or suppliers (e.g., Refueling standards and guidelines should be communicated to the supplier entering the site).

The EMP should also summarize and/or reference how environmental awareness training will be provided for all construction personnel, and should summarize and/or reference the procedures to ensure that personnel in environmentally critical roles are qualified and competent. This includes requirements for both training and competency assessments. Records of training must be given to PCA.

5.1.6 General Communications and Record Keeping

A communications protocol is required as part of the site-specific EMP. The EMP shall describe and/or reference:

- The environmental management team members that are authorized to communicate with PCA.
- The communication methods to be used to allow PCA to receive updates throughout the project to reflect changes in project scope, construction methods, scheduling, site conditions, and weather-related contingency measures. PCA must be informed of any proposed changes that may require an amendment to the EIA and/or EMP.
- The procedures for the reporting of all environmental incidents to the PCA Project Manager (or designate) for the investigation of all such incidents to find the underlying or root causes, and for the identifying of remedial actions to prevent future recurrence of the incident or similar incidents in the future.
- The types of records that are to be maintained to demonstrate environmental protection and compliance with the EMP and where to find these records for auditing purposes.

5.1.7 Environmental Incident Reporting

The site-specific EMP shall describe the reporting procedures for environmental incidents. At a minimum, the procedure would include commitments to:

- Report all environmental incidents to PCA's Environmental Authority and the Departmental Representative and any other regulatory authority if required by statute to be reported.
- Provide a written environmental incident investigation report that includes appropriate photo documentation and describes the:
  - Nature of the incident;
  - Approximate magnitude and duration of the incident;
  - Areas, resources or habitats affected;
  - Results of any sample analysis taken in conjunction with the incident (e.g., water samples);
  - Root cause(s) of the incident;
  - Immediate actions taken on-site to mitigate adverse environmental effects;
  - Recommended preventive and corrective actions to control or limit the activity or circumstances causing the incident, including a time frame for implementation;
  - Communications held with the Contractor's employees, PCA's Environmental Authority, the Departmental Representative and other regulatory agencies (if applicable).
- All environmental incidents shall be reported as soon as reasonably possible. Spills must be reported within 24 hours (see Refueling and Spill Management – ESG-13-C).

5.1.8 Environmental Monitoring and Adaptive Management Summary

Each site-specific EMP component plan shall include a description of monitoring and reporting requirements relevant to the specific component plan contents. These component plans shall:

- Define project and site-specific objectives (e.g., performance / compliance monitoring, effectiveness monitoring);
- List the applicable legislative and regulatory requirements;
- Tabulate applicable EIA commitments, terms and conditions of approval and relevant environmental standards and guidelines;
- Describe the scope of environmental monitoring, including:
    - Monitoring objectives,
    - Location(s) to be monitored,
    - Parameters to be monitored,
    - Methods, and
    - Duration and frequency of monitoring;
- Equipment to be used and its maintenance/calibration schedule;
- Describe reporting requirements (e.g., event reports, monthly reports, annual reports); and
- Provide cross-references to other component plans.

These monitoring plans and approaches to adaptive management shall be summarized within the over-arching EMP document.

Adaptive management is a planned and systematic process for continuously improving environmental management practices by learning about their outcomes. Adaptive management provides flexibility to identify and implement new mitigation measures or to modify existing ones during the life of a project. Adaptive management approaches shall be specific to relevant component plans and shall discuss (where appropriate) the following:

- Identification of key indicators that may serve as a gauge of ecological conditions within the area of the project;
- Identification of action thresholds to be used to indicate when environmental performance is approaching and/or below an acceptable level and requires corrective management action.
- Identification of testable predictions or hypotheses to provide a basis for understanding why change might be occurring in the environment and how to select adaptive management measures based on those conclusions.
- Identification of adaptive management options to demonstrate that there are a range of available options to adapt and manage the project should a mitigation measure not function as intended. These options should be technically and economically feasible.
- Conditions that would trigger the need for a revisions to the EMP and/or Historic Canals Regulations Permit.

Further guidance regarding adaptive management is available from the Canadian Environmental Assessment Agency (2009)[3].

---

[3] Canadian Environmental Assessment Agency, 2009. Operational Policy Statement- Adaptive Management Measures under the *Canadian Environmental Assessment Act.* Catalogue No.: 978-1-100-12062-1, ISBN: En106-83/2009E-PDF. Available on-line at:
https://www.ceaa-acee.gc.ca/Content/5/0/1/50139251-2FE4-4873-B6A1-A190C103333D/Adaptive_Management_Measures_under_the_CEAA.pdf

5.1.9 EMP Review and Revision

The EMP shall specify the procedures for the review and revision of the EMP during Project implementation and have a version control procedure. At a minimum, the site-specific EMP shall be reviewed by the Contractor to determine if an amendment or a major revision is warranted:

- At least once every six (6) months or on a seasonal basis;
- As a result of changes in the project or changes in the anticipated environmental effects of the project;
- After corrective actions have been taken in response to an environmental incident;
- after an adaptive management measure has been proposed by either the Contractor or PCA;
- After a material revision of the EMP has been proposed by either the Contractor or PCA. A material revision is one which would be relevant to the question of whether an adverse environmental effect is more likely to occur, or become more adverse, and be significant;
- After a material revision of the EMP is proposed that changes a commitment such as:
    - a reduction or increase of monitoring or reporting requirements; or
    - making a specification less stringent or more stringent.

Any proposed amendment or revision shall be provided to PCA by the Contractor in writing for acceptance prior to action. Amendments and revisions shall be tracked in accordance with an accepted version control procedure.

PCA may choose to modify its EIA and the Historic Canals Regulations Permit issued to the Contractor on the basis of the proposed amendment or EMP revision.

5.1.10 Component Plan Requirements

Where relevant, the following component plans are to be included in a site-specific EMP. Each component plan will be based on a set of project-specific and site specific objectives. A key requirement of each component plan will be a table that summarizes applicable EIA commitments, terms and conditions of approval and relevant environmental standards and guidelines. The information included in this ESG Document should be used to the extent possible and applicable to the Project. However, the component plans should not be limited to these measures. Contractors will need to augment these standards and guidelines with other measures that are unique to the Project or necessary to address the full range of anticipated Project effects. If there is insufficient detail for a component plan then there should be clear reference as to when the plan will be provided. Work will not commence until PCA acceptance of all relevant component plans.

Component Plan	Primary Objectives
Dust and Air Quality Management	• To minimize potential effects and disruption to residents, businesses, community facilities, recreational and tourist activities
Noise, Vibration and Ambient Light Management	• To minimize potential effects and disruption to residents, businesses, community facilities, recreational and tourist activities
Transportation Management	• To minimize disruption to traffic patterns and access to property.
Blasting	• To identify blasting procedures and timing, including safety, use, storage, and transportation of explosives.
Demolition	• To identify demolition procedures and timing.
Site Dewatering and Wastewater	• To control water takings from watercourses, waterbodies or from the ground from entering the construction site. • To prevent contaminated water resulting from the dewatering process and wastewater management from being discharged into the environment. • To isolate clean off-site water from contaminated construction water and to minimize the volume contaminated water.
Surface Water Management, Erosion and Sediment Control	• To control and mandate surface water from off-site and within the project area; • To minimize the amount of erosion on-site. • To control the amount of sedimentation occurring on-site. • To minimize the deposition of deleterious substances to surface waters and minimize sediment input to surface waters.
Dredging and Sediment Removal	• To identify the dredging and sediment removal procedures, including storage, transport and disposal of dredged materials. • To minimize disturbance and protect aquatic and terrestrial resources.
Vegetation Protection	• To minimize and phase disturbance and protect existing native vegetation
Wildlife Protection and Management	• To minimize disturbance to wildlife and hazards associated with wildlife.
Aquatic Resources Management	• To minimize disturbance and protect aquatic resources, including sensitive species and their habitat.
Species at Risk Protection	• To minimize disturbance and protect aquatic and terrestrial Species at Risk and their habitat.
Invasive Species Management	• To control the spread of existing invasive plant infestations and prevent new infestations from establishing in the Project area.

Component Plan	Primary Objectives
Waste Management	• To minimize the generation and need for disposal of hazardous and non-hazardous wastes. • To minimize risks to worker and public health and safety.
Hazardous Materials Management	• To identify the procedures for the transportation, storage and safe use of hazardous materials on-site.
Fuel Management	• To minimize the risk of accidents and malfunctions • To minimize risks to worker and public health and safety.
Spills Prevention and Emergency Response	• To minimize the risk of accidents and malfunctions. • To minimize risks to worker and public health and safety. • To minimize disturbance and protect aquatic and terrestrial resources. • To effectively respond to spills and other emergencies on-site.
Dam and/or Bypass Channel Commissioning	• To sets out the process, expectations and the methodology for successful commissioning of a dam. • To minimize the amount of sediment disturbance/transport and aquatic environments during
Site Restoration	• To minimize risks to worker and public health and safety; • To minimize long-term effects on aquatic and terrestrial resources. • To restore site aesthetics and minimize disruption to residents, businesses, community facilities, recreational and tourist activities.

Table 3 provides PCA's key requirements for each component plan. Table 4 provides links to the potentially applicable standards and guidelines included in Part 2 of this ESG Document that may assist in the preparation of each component plan.

Table 3: EMP Component Plans and Key Requirements

EMP Component Plan	Key Requirements
Dust and Air Quality Management	This component plan shall: • Define project and site-specific objectives. • List the applicable legislative and regulatory requirements. • Describe the key sources of dust and air emissions (e.g., equipment, works and activities) associated with the Project. • Identify the locations and provide a description of sensitive receptors. • List the key methods, strategies, structures, facilities, equipment and systems critical to dust and air quality management. • Describe approach to construction site winterization and/or winter operations. • Tabulate applicable EIA commitments, terms and conditions of approval and relevant environmental standards and guidelines (Refer to Part 2 of this ESG Document). • Describe the maintenance program for all structures, facilities, equipment and systems critical to environmental protection. • Describe the approach to adaptive management. • Describe monitoring and reporting requirements.
Noise, Vibration and Ambient Light Management	This component plan shall: • Define project and site-specific objectives. • List the applicable legislative and regulatory requirements. • Describe the key sources of noise, vibration and light (e.g., equipment, works and activities) associated with the Project. • Identify the locations and provide a description of sensitive receptors. • List the key methods, strategies, structures, facilities, equipment and systems critical to noise, vibration and ambient light management. • Describe approach to construction site winterization and/or winter operations. • Tabulate applicable EIA commitments, terms and conditions of approval and relevant environmental standards and guidelines (Refer to Part 2 of this ESG Document). • Describe the maintenance program for all structures, facilities, equipment and systems critical to environmental protection. • Describe the approach to adaptive management. • Describe monitoring and reporting requirements.

EMP Component Plan	Key Requirements
Transportation Management	This component plan shall: • Define project and site-specific objectives. • List the applicable legislative and regulatory requirements. • List relevant federal, provincial or municipal standards and guidelines related to transportation infrastructure to be affected. • Tabulate applicable EIA commitments, terms and conditions of approval and relevant environmental standards and guidelines (Refer to Part 2 of this ESG Document). • Describe approach to construction site winterization and/or winter operations. • Describe the routes to provide safe and efficient movement of vehicles. • Describe timing of road or bridge closures and detour routes. • Location and capacity of parking for staff and construction vehicles. • List policies for the movement of dangerous goods, oversized and regular loads. • List policies for movement of heavy loads on roadways with load restrictions. • Describe the communication protocols with provincial and municipal government and local police services. • Describe the maintenance program for all structures, facilities, equipment and systems critical to environmental protection. • Describe the approach to adaptive management. • Describe monitoring and reporting requirements.

Blasting	This component plan shall:
	• Define project and site-specific objectives.
	• List the applicable legislative and regulatory requirements.
	  o All blasting activities in or near water are required to follow the "Guidelines for the use of Explosives In or Near Canadian Fisheries Waters" (DFO 1998) to reduce particle velocities and pressure changes created by underwater explosives that can result in fish injuries and mortality.
	• Specify blasters name, company, copy of license, and statement of qualifications.
	• Describe the magazine type and locations for explosives and detonating caps (if on-site).
	• Describe typical rock type and geology structure (solid, layered, or fractured).
	• Specify the locations for blasting and volumes of materials to be removed.
	• For each location provide the following information:
	  o Proposed limits for Peak Particle Velocity;
	  o Explosive type, product name and size, weight per unit, and density;
	  o Delay type, sequence, and delay;
	  o Use of non-electrical initiation systems for all blasting operations;
	  o Stemming material and tamping method;

EMP Component Plan	Key Requirements
	o Hole depth, diameter, and pattern; o Explosive depth, distribution, and maximum charge and weight per delay; o Number of holes per delay; o Dates and hours of conducting blasting; o Distance and orientation to nearest aboveground and underground structures; o Measures for the Protection of aboveground and underground structures. • Describe the procedures for: o Storing, handling, transporting, loading, and firing explosives; o Fire prevention; o Inspections after each blast; o Misfires, fly rock, and noise prevention; o Stray current accidental-detonation prevention; o Signs and flagmen. • Describe warning signals prior to each blast and notification prior to blasting. • Plans for disposal of waste blasting material. Procedures for monitoring and reporting on blasting operations. • Describe approach to construction site winterization and/or winter operations. • Describe the maintenance program for all structures, facilities, equipment and systems critical to environmental protection.
Demolition	This component plan shall: • Define project and site-specific objectives. • List the applicable legislative and regulatory requirements. • List and describe the buildings and structures to be demolished. • Provide time schedule for demolition works. • For each building and structure to be demolished provide the following information: o Historical and/or heritage status; o Presence / absence of Species at Risk (e.g., bats); o Demolition waste types and volumes; o Presence and volumes of hazardous materials; • Describe the procedures for: o Installation and removal of coffer dams; o Noise abatement; o Fugitive dust control; o Treatment of discharge waters; o Demolition waste management; o Hazardous materials management.

EMP Component Plan	Key Requirements
	• Describe the approach to adaptive management (e.g., contingency plan in case of any emergency situation). • Describe approach to construction site winterization and/or winter operations. • Provide cross-references to other component plans. • Describe monitoring and reporting requirements.

Dewatering and Wastewater	This component plan shall:
	• Define project and site-specific objectives.
	• List the applicable legislative and regulatory requirements.
	    o Confirm the need for a Provincial permit to take water (PTTW) in accordance with the *Ontario Water Resources Act* (OWRA) and the Water Taking Regulation (O. Reg. 387/04) a regulation under the *Act*. Section 34 of the OWRA requires anyone taking more than a total of 50,000 litres of water in a day, with some exceptions, to obtain a Permit from a Director appointed by the Minister for the purposes of Section 34. The following water takings related to construction site dewatering and road construction may be eligible for registration in the Environmental Activity and Sector Registry (EASR):
	        ▪ Surface water takings related to specific road construction purposes; and
	        ▪ Ground water and/or storm water takings of more than 50,000 L/day but less than 400,000 L/day for the purposes of construction site dewatering.
	• Describe the purpose of dewatering, sources and amount of water taking / removal required.
	• Describe the proposed dewatering and wastewater management methods, strategies, equipment and materials to be used, including any controls (that is, settling tank, turbidity curtain, etc.) and method of effluent discharge.
	• Provide at time schedule for dewatering works and activities.
	• Specify the anticipated dewatering flow rate and total dewatering duration.
	• Specify the anticipated wastewater volumes.
	• Specify water quality discharge criteria.
	    o If dewatering conducted in a contaminated area, engineering specifications for dewatering effluent treatment and details for an analytical monitoring program to ensure that effluent will meet water quality discharge criteria.
	    o If wastewater is to be discharged, engineering specifications for treated effluent and details for an analytical monitoring program to ensure that effluent will meet water quality discharge criteria.
	• Specify the point(s) of discharge.
	• Describe the maintenance program for all structures, facilities, equipment and systems critical to environmental protection.
	• Describe the approach to adaptive management (e.g., contingency plan in case of any emergency situation).
	• Describe approach to construction site winterization and/or winter operations.

EMP Component Plan	Key Requirements
	• Provide cross-references to other component plans. • Describe monitoring and reporting requirements.
Surface Water, Erosion and Sediment Management	This component plan shall: • Define project and site-specific objectives. • List the applicable legislative and regulatory requirements. • Describe the key sources of emissions or discharges to surface waters (e.g., equipment, works and activities) associated with the Project. • Identify the key point and non-point sources of contaminants (e.g., equipment, material storage areas or stockpiles, waste management facilities, vehicle and equipment maintenance facilities). • Identify need for alternative equipment, material storage or stockpile locations off-site. • Provide at time schedule for in-water works. • Describe the soil types found on-site and their constraints with respect to: o surface water management; o erosion control; and o sediment control. • Describe the surface water drainage patterns on the project site as well as coming on to the site and areas sensitive to erosion and sedimentation during each phase of the work. • List the key methods, strategies, structures, facilities, equipment and systems critical to: o surface water management; o erosion control; and o sediment control. • Tabulate applicable EIA commitments, terms and conditions of approval and relevant environmental standards and guidelines (Refer to Part 2 of this ESG Document). • Describe approach to construction site winterization and/or winter operations for all structures, facilities, equipment and systems critical to: o surface water management; o erosion control; and o sediment control. • Describe the maintenance program for all structures, facilities, equipment and systems critical to environmental protection. • Describe the approach to adaptive management. • Describe monitoring and reporting requirements.

EMP Component Plan	Key Requirements
Dredging and Sediment Removal	This component plan shall: • Define project and site-specific objectives. • List the applicable legislative and regulatory requirements. • Identify the locations and volumes of dredged materials. • Identify locations for storage and/or disposal of dredged materials. • Provide time schedule for in-water works. • Identify the locations and provide a description of sensitive aquatic species and their habitat in vicinity of the dredging and sediment removal operations • List the key methods, strategies, structures, facilities, equipment and systems for dredging and sediment removal. • Tabulate applicable EIA commitments, terms and conditions of approval and relevant environmental standards and guidelines (Refer to Part 2 of this ESG Document). • Describe approach to construction site winterization and/or winter operations. • Describe the maintenance program for all structures, facilities, equipment and systems critical to environmental protection. • Describe the approach to adaptive management. • Describe monitoring and reporting requirements. • Provide cross-references to other component plans.
Vegetation Protection	This component plan shall: • Define project and site-specific objectives. • List the applicable legislative and regulatory requirements. • Describe the key Project works and activities with the potential to adversely affect native vegetation. • Provide a time schedule for vegetation removal and/or ground disturbing activities. • Identify the locations and provide descriptions of areas to be disturbed and areas to be left undisturbed, including sensitive features (e.g., wetlands, woodlands, grasslands, valley lands, areas with Species at Risk). • List the key methods, strategies, structures, facilities, equipment and systems critical to vegetation protection. • Tabulate applicable EIA commitments, terms and conditions of approval and relevant environmental standards and guidelines (Refer to Part 2 of this ESG Document). • Describe approach to construction site winterization and/or winter operations. • Describe the maintenance program for all structures, facilities, equipment and systems critical to environmental protection. • Describe the approach to adaptive management. • Describe monitoring and reporting requirements. • Provide cross-references to other component plans.

EMP Component Plan	Key Requirements
Wildlife Protection	This component plan shall: • Define project and site-specific objectives. • List the applicable legislative and regulatory requirements. • Describe the key Project works and activities with the potential to adversely affect wildlife. • Identify the locations and provide descriptions of any areas to be disturbed and areas to be left undisturbed, including sensitive features (e.g., Bat roosts, snake hibernacula, wildlife dens, bird nests, wildlife crossing areas, salt licks).Describe exclusionary measures (if required). • List the key methods, strategies, structures, facilities, equipment and systems critical to wildlife protection. • Tabulate applicable EIA commitments, terms and conditions of approval and relevant environmental standards and guidelines (Refer to Part 2 of this ESG Document). • Describe the approach to nuisance wildlife control. • Describe approach to construction site winterization and/or winter operations. • Describe the maintenance program for all structures, facilities, equipment and systems critical to environmental protection. • Describe the approach to adaptive management. • Describe monitoring and reporting requirements. • Provide cross-references to other component plans.
Aquatic Resources Management	This component plan shall: • Define project and site-specific objectives. • List the applicable legislative and regulatory requirements. • Identify the locations and provide a description of in-water works. • Provide a time schedule for in-water works. • Identify the locations and provide a description of sensitive aquatic species and their habitat. • List the key methods, strategies, structures, facilities, equipment and systems critical to aquatic resources management. • Tabulate applicable EIA commitments, terms and conditions of approval and relevant environmental standards and guidelines (Refer to Part 2 of this ESG Document). • Describe approach to construction site winterization and/or winter operations. • Describe the maintenance program for all structures, facilities, equipment and systems critical to environmental protection. • Describe the approach to adaptive management. • Describe monitoring and reporting requirements. • Provide cross-references to other component plans.

EMP Component Plan	Key Requirements
Species at Risk Protection	This component plan shall: • Define project and site-specific objectives. • List the applicable legislative and regulatory requirements. • Provide a time schedule for vegetation clearing and in-water works. • Identify Species at Risk to be protected. • Identify the locations and provide a description of Species at Risk critical habitat or other habitat areas to be protected. • List the key methods, strategies, structures, facilities, equipment and systems critical to wildlife and aquatic resources management. • Tabulate applicable EIA commitments, terms and conditions of approval and relevant environmental standards and guidelines (Refer to Part 2 of this ESG Document). • Describe approach to construction site winterization and/or winter operations. • Describe the maintenance program for all structures, facilities, equipment and systems critical to environmental protection. • Describe the approach to adaptive management. • Describe monitoring and reporting requirements. • Provide cross-references to other component plans.
Invasive Species Management	This component plan shall: • Define project and site-specific objectives. • List the applicable legislative and regulatory requirements. • List the invasive species of concern on the Project site (including area immediately surrounding the Project site. • Tabulate applicable EIA commitments, terms and conditions of approval and relevant environmental standards and guidelines (Refer to Part 2 of this ESG Document). • Describe the approach to adaptive management. • Describe monitoring and reporting requirements. • Provide cross-references to other component plans.

EMP Component Plan	Key Requirements
Waste Management	This component plan shall: • Define project and site-specific objectives. • List the applicable legislative and regulatory requirements. • Identify the locations and provide descriptions of waste storage, recycling and/or disposal facilities on-site. • Identify all off-site disposal facilities to be utilized and confirm their licensing status. • Describe site house-keeping procedures. • Describe the measures and procedures to minimize wildlife attraction to wastes. • Describe procedures for waste minimization, recycling, storage and disposal of hazardous and non-hazardous wastes, including wastes generated by: o vegetation removal; o earthworks (i.e., overburden stripping; o dredging and sediment removal. • Tabulate applicable EIA commitments, terms and conditions of approval and relevant environmental standards and guidelines (Refer to Part 2 of this ESG Document).
Hazardous Materials Management	This component plan shall: • Define project and site-specific objectives. • List the applicable legislative and regulatory requirements. • Identify the locations and provide descriptions of hazardous materials storage facilities on-site. • Identify all off-site disposal facilities to be utilized and confirm their licensing status. • Provide an inventory of hazardous materials that will be used on-site. • Provide MSDS for all hazardous materials in use or to be stored on-site. • Provide an inventory and location of spill equipment to be stored on-site. • List the personnel trained to handle hazardous materials. • Tabulate applicable EIA commitments, terms and conditions of approval and relevant environmental standards and guidelines (Refer to Part 2 of this ESG Document). • Describe approach to construction site winterization and/or winter operations. • Describe the maintenance program for all structures, facilities, equipment and systems critical to environmental protection. • Provide cross-references to other component plans.

EMP Component Plan	Key Requirements
Fuel Management	This component plan shall: • Define project and site-specific objectives. • List the applicable legislative and regulatory requirements. • Identify the locations and provide descriptions of facilities for fuel transfer and storage. • Describe the fuel handling, transfer and storage procedures. • Provide equipment refueling plans. • Provide an inventory and location of spill equipment to be stored on-site. • Tabulate applicable EIA commitments, terms and conditions of approval and relevant environmental standards and guidelines (Refer to Part 2 of this ESG Document). • Describe approach to construction site winterization and/or winter operations. • Describe the maintenance program for all structures, facilities, equipment and systems critical to environmental protection. • Provide cross-references to other component plans.

Spills Prevention and Emergency Response	This component plan shall:
	• Define project and site-specific objectives.
	• List the applicable legislative and regulatory requirements.
	• Describe the on-site roles and responsibilities for spills and emergency response.
	• Tabulate applicable EIA commitments, terms and conditions of approval and relevant environmental standards and guidelines (Refer to Part 2 of this ESG Document) with respect to spills prevention and emergency response procedures, including procedures for:
	  o reporting a spill;
	  o stopping the spill if possible;
	  o containing the spill;
	  o protecting the area of the spill; and
	  o removing the material to an approved location for storage or disposal.
	• Describe monitoring and reporting requirements.
	• Provide cross-references to other component plans.

EMP Component Plan	Key Requirements
Dam / By-pass Channel Commissioning	This component plan shall: • Define project and site-specific dam / by-pass channel commissioning objectives. • List the applicable legislative and regulatory requirements. • Describe the structures, systems or operations to be commissioned. • Tabulate applicable EIA commitments, terms and conditions of approval and relevant environmental standards and guidelines (Refer to Part 2 of this ESG Document). • Describe pre-commissioning activities for each structure, system or operation (e.g., inspections, site/structure preparation, performance or operational testing). • Describe commissioning activities and schedules for each structure, system or operation. • Describe the approach to adaptive management (e.g., contingency plan in case of any emergency situation). • Describe monitoring and reporting requirements. • Provide cross-references to other component plans.
Site Restoration	This component plan shall: • List the applicable legislative and regulatory requirements. • Provide a time schedule for site restoration works. • Identify areas to be restored and their respective restoration objectives • Describe the restoration methods, vegetation to be used, etc. • Tabulate applicable EIA commitments, terms and conditions of approval and relevant environmental standards and guidelines (Refer to Part 2 of this ESG Document). • Describe approach to construction site winterization and/or winter operations. • Describe the approach to adaptive management. • Describe monitoring and reporting requirements. • Provide cross-references to other component plans.

Table 4: Environmental Standards and Guidelines and Associated EMP Component Plans

Environmental Standards and Guidelines and Associated EMP Component Plans																								
	Pre Construction					Construction																		Post
	ESG-1-Pre	ESG-2-Pre	ESG-3-Pre	ESG-4-Pre	ESG-5-Pre	ESG-1-C	ESG-2-C	ESG-3-C	ESG-4-C	ESG-5-C	ESG-6-C	ESG-7-C	ESG-8-C	ESG-9-C	ESG-10-C	ESG-11-C	ESG-12-C	ESG-13-C	ESG-14-C	ESG-15-C	ESG-16-C	ESG-17-C	ESG-18-C	ESG-1-Post
	Erosion Control	Sediment Control	Soil Stripping, Grubbing and Stockpiling	Tree Protection and Hording	Vegetation Clearing and Protection	Abrasive Blasting	Blasting	Borehole and Rock Drilling	Chipping and Cutting	Concrete Pour Operations and Grouting	Dredging and Sediment Removal	Fish Exclusion , Salvage and Relocation	Fugitive Dust Control During Construction	Grinding and Welding	Installation and Removal of Coffer Dams and Isolation Structures	Invasive Species Management	Pile Driving	Refueling and Spill Management	Treatment of Discharge Waters	Use and Maintenance of Heavy Equipment	Vehicle and Equipment Washing and Cleaning	Wildlife and Species at Risk Protection during Construction	Winter Weather Stabilization and Operations	Revegetation
Dust and Air Quality Management																								
Noise, Vibration and Ambient Light Management																								
Transportation Management																								
Blasting																								
Demolition																								
Site Dewatering and Wastewater Management																								
Surface Water Management, Erosion and Sediment Control																								
Dredging and Sediment Removal																								
Vegetation Protection																								
Wildlife Protection and Management																								
Aquatic Resources Management																								
Species at Risk Protection																								
Invasive Species Management																								
Waste Management																								
Hazardous Materials Management																								
Fuel Management																								
Spills Prevention and Emergency Response																								
Dam and/or Bypass Channel Commissioning																								
Site Restoration																								

6.0 INTRODUCTION TO ENVIRONMENTAL STANDARDS AND GUIDELINES (PART 2)

PCA undertakes, approves and/or oversees a wide variety of projects on Ontario Waterways. This document focuses on providing clear and practical guidance and setting PCA's expectations regarding how best to avoid or minimize adverse environmental effects of the following construction, maintenance and repair projects:

- Lock repairs and upgrades;
- Bridge repairs, upgrades and replacement;
- Earth dam repairs and upgrades;
- Retaining and approach wall repairs and replacements;
- Concrete dam repairs and upgrades;
- Concreate dam replacement (in-situ);
- Concrete dam replacement (rebuilds downstream or upstream); and
- Gravel roads.

This ESG Document may also provide guidance for other works and activities on Ontario Waterways.

The potential environmental effects of construction projects are vast and varied and inevitably very site-specific (i.e., dependent on the nature of the local environmental and socio-economic setting) and project-specific (i.e., dependent on the nature, scale, timing and design of the project).

Most of the major projects listed above involve a common set of project works and activities that result in potential environmental effects that are predictable and well understood. Table 5 identifies the typical project works and activities undertaken for these projects. Appendix D provides more information about each of these works and activities.

Table 5: Typical Project Works and Activities on Ontario Waterways

Project / Activity Type	Typical Project Works and Activities
Site Preparation (All Projects on Ontario Waterways)	• Vegetation Removal (e.g., clearing, grubbing) and Protection • Earthworks (e.g., excavation, grading) • Installation and Removal of Erosion and Sediment Control and Water Quality Protection Measures • Dewatering • Installation and Removal of Cut-off Walls, Coffer Dams or By-Pass Channels • Fish Passage, Salvage and Relocation
Lock, Bridge, Retaining / Approach Wall or Concrete Dam Repair or Upgrade Project Construction	• Demolition and/or Dismantling • Concrete Removal • Concrete Application and Re-construction • Repair, Salvage and/or Reinstallation of Ancillary Equipment

Project / Activity Type	Typical Project Works and Activities
Earth Dam and Gravel Road Repair or Upgrade Project Construction	• Transport and Stockpiling of Earth, Aggregate and/or Clean Fill • Designated Vegetation Removal • Earth, Aggregate and/or Clean fill Placement
Concrete Dam Replacement Project Construction	• Demolition and/or Dismantling • Blasting or Drilling • Concrete Pouring and Dam Reconstruction • Installation of Ancillary Equipment
Site Restoration (All Projects on Ontario Waterways)	• Backfilling • Site restoration (including Invasive species management)

6.1 General Environmental Protection Procedures

General Environmental Protection Procedures provide direction and standards for many common elements of the design and construction activities for projects on Ontario Waterways. For these reasons, the standards and guidelines provided in this Section should be considered and where applicable, reflected in the EMPs for every project.

6.1.1 In-water Timing Windows and General Fish Protection Measures

The risk to fish habitat during construction is often reduced and controlled through the application of timing windows for in-water and near-water construction activities. Timing windows represent a period of opportunity for construction when the fish species known to occur in a particular waterbody are least vulnerable to potential impacts from construction based on their life history and habitat requirements.

All in-water and near-water construction or maintenance activities are to be conducted within the applicable in-water construction timing windows, as identified by MNRF, to protect the resident fishery life functions. Timing windows are typically identified in the EIA documentation and general windows can be found on the following DFO and MNR website:

http://www.dfo-mpo.gc.ca/pnw-ppe/timing-periodes/on-eng.html

In addition, these windows are subject to change where species at risk or migratory fish corridors exist. These timing windows must be identified in the construction schedule and EMP.

For the most part, it is preferred that in-water activities be performed in the "dry". For some activities (e.g., Tremie Concrete pours), this may not be possible. In such cases, additional mitigation measures and restrictions are typically required.

Working in the "dry" will require construction to occur behind water tight isolation barriers (coffer dam, cut-off walls, etc.) or within isolated dry work areas along active channels using dewatering and flow bypass methods. Specific environmental standards and guidelines are provided in Part 2 of this ESG Document.

Fish should be excluded from the work site to the extent possible before any work is conducted. Any fish stranded within the temporary in-water work zones should be salvaged and relocated using appropriate techniques by a Qualified Professional(s). A valid Historic Canals Regulations permit and/or Scientific Collector's Permit is required for fish salvage and relocation. Specific environmental standards and guidelines for fish exclusion, salvage and relocation are provided in Part 2 of this ESG Document.

6.1.2 Ground Disturbance Timing Windows

The risk to resident and migratory breeding birds, their eggs and nests during construction is often reduced and controlled through the use of timing windows for vegetation clearing and construction activities. Timing windows represent a period of when the bird species are known to breed in the area based on their life history and habitat requirements. In addition, these windows are subject to change where species at risk or migratory bird's corridors exist. Unlike timing windows for the protection of fish, these timing windows represent a period that restricts or prohibits construction activities.

Removal of natural vegetation or structures such as buildings and dams that may be used for nesting should take place outside of the breeding bird window in order to avoid disturbance of migratory breeding birds protected by the *Migratory Birds Convention Act* (1994). If vegetation or structures are proposed to be removed during these restricted periods, then either exclusionary mitigation measures need to be employed before nesting season or the vegetation or structure will need to be surveyed for active breeding by a Qualified Professional(s) and will require exclusion from vegetation removal activities.

Timing windows are typically identified in the EIA documentation and general windows for C2 and C3 zones applicable to projects on Ontario Waterways can be found on the following Environment and Climate Change Canada website:

http://www.ec.gc.ca/paom-itmb/default.asp?lang=En&n=4f39a78f-1#_fig01

6.1.3 Surface Water, Erosion and Sediment Management Principles

A detailed, site specific Surface Water, Erosion and Sediment Management Plan is required as part of an EMP for every project on Ontario Waterways. The primary objectives of this plan are to:

- Control and mitigate surface water from off-site and within the project area;
- Minimize the amount of erosion on-site;
- Control the amount of sedimentation occurring on-site;
- Minimize the deposition of deleterious substances to surface waters and minimize sediment input to surface waters.

As a secondary control measure if the first three are insufficient:

- Capture mobilized soil (sediment) as close to the source as possible; and
- Minimize the amount of surface water affected by sediment.

Specific environmental standards and guidelines relevant to Surface Water, Erosion and Sediment Management are provided in Part 2 of this ESG Document.

6.1.4 *Site Controls and Operational Constraints*

Site controls and operational constraints are important strategies for the protection of sensitive environments and habitats during construction. Such strategies often utilize avoidance techniques as a means of reducing or eliminating potential adverse effects. The following site controls and operational constraints are to be used as appropriate on all construction projects on Ontario Waterways:

- The construction access and work areas is to be confined to the extent required for the completion of project works and activities, and these areas are to be defined in the field using appropriately installed protective fencing or other suitable barriers prior to vegetation clearing or earthworks.
- Woody vegetation required for removal should be replaced with appropriate native species.
- Surface water runoff shall be managed throughout the site through stable ditches, drains, ponds, etc. Offsite water will be diverted before it enters the construction area, or separated to prevent contamination from construction activities (e.g., water infiltrating from cofferdams).
- Removal of riparian vegetation, particularly woody vegetation, will be kept to the minimum necessary for the project works. Every effort will be made to retain as much of the natural vegetation as reasonably possible to help ensure bank stability, control erosion and expedite the re-colonization of vegetative cover.
- Vegetation removal should be phased to construction activities (i.e., vegetation will only be removed when construction is occurring in that area).
- Only clean material that is free of particulate matter shall be placed in the water. This also includes material in sand bags or bulk bags.
- All activity will be controlled so as to prevent entry of any petroleum products, debris or other potential contaminants / deleterious substances, in addition to sediment as outlined above, to any waterbody.
- No storage, maintenance or refuelling of equipment will be conducted near any waterbody. Refuelling of equipment (e.g., pumps) and maintenance shall be conducted off slopes and away from water bodies on impermeable pads (drip tray) or buried liners to allow full containment of spills. Refuelling trucks are not to be within 30 meters of the waterbody. Some exceptions may apply and are described in Part 2 of this ESG Document.
- Any part of a vehicle and/or equipment entering the water shall be free of fluid leaks and externally degreased to prevent any deleterious substance from entering the water. Hydraulic fluids shall be vegetable based eco-friendly products.
- A Spill and Emergency Management Plan will be developed as part of the site-specific EMP. As outlined in Part 2 of this ESG document (see Refueling and Spill Management – ESG-13-C):
    - Any spill into water, onto ice or in a dewatered area must be reported immediately to PCA's Environmental Authority, the Departmental Representative and the Ontario Ministry of Environment and Climate Change's Spills Action Centre (SAC).

- o Any spill on land must be reported immediately to PCA's Environmental Authority and the Departmental Representative. Any spill on land meeting the criteria set out in Ontario's *Environmental Protection Act*, O. Reg. 675/98 must be reported immediately to the Ontario Ministry of Environment and Climate Change's Spills Action Centre (SAC).

6.1.5 Materials Stockpiling and Storage

Any temporarily stockpiled material, construction or related materials will be properly contained (perimeter control) in areas separated a minimum of 30 meters from any waterbody (if possible). If materials stockpiles are necessary within 30 meters of a waterbody, the Contractor shall describe relevant surface water protection, erosion and sediment control measures as part of its EMP. The EMP shall consider alternative stockpile locations on-site and off-site.

All excavated materials and debris shall be removed and deposited in an area above the high water mark of the shoreline and be contained behind properly installed and maintained sediment barriers or devices to prevent erosion and subsequent entry into the water body OR removed from the site, in accordance with all federal, municipal and provincial regulations.

6.2 Environmental Standards and Guidelines

Part 2 of this ESG Document provide specific Environmental Standards and Guidelines for projects on Ontario Waterways. Three types of Environmental Standards and Guidelines are presented, where applicable.

Best Practices are guidance tools for project planners, design engineers, Contractors and PCA staff. These Best Practices establish the *minimum required standard of care* while allowing the designers and Contractors latitude to determine the "how" a project will be constructed. As noted, it is not the objective of this ESG Document to address or provide guidance regarding the design or engineering aspects of project development.

Basic standards or "typicals" are provided that indicate how to construct, install and maintain a particular device. These basic standards provide the minimum requirements to achieve a particular outcome, although they may be adopted for use in PCA design and tender documents, provided site conditions are appropriate.

Performance Criteria are provided for a selection of standards and guidelines where related *regulatory limits* exist. Where applicable to a given activity or project, PCA expects the performance criteria to be achieved through project design and use of appropriate mitigation and abatement techniques. Examples of performance criteria included in this document are those associate with blasting activities in and near fisheries waters and water quality criteria relating to turbidity.

Table 6 identifies those ESG contained in Part 2 that are applicable to the typical project works and activities undertaken for projects on Ontario Waterways. Appendix D provides more information about each of these works and activities.

Table 6: Environmental Standards and Guidelines and Associated Project Works and Activities

Environmental Standards and Guidelines - Pre-Construction (Pre), Construction (C) and Post-Construction (Post)																									
	Pre Construction					Construction																			Post
	ESG-1-Pre	ESG-2-Pre	ESG-3-Pre	ESG-4-Pre	ESG-5-Pre	ESG-1-C	ESG-2-C	ESG-3-C	ESG-4-C	ESG-5-C	ESG-6-C	ESG-7-C	ESG-8-C	ESG-9-C	ESG-10-C	ESG-11-C	ESG-12-C	ESG-13-C	ESG-14-C	ESG-15-C	ESG-16-C	ESG-17-C	ESG-18-C	ESG-1-Post
	Erosion Control	Sediment Control	Soil Stripping, Grubbing and Stockpiling	Tree Protection and Hording	Vegetation Clearing and Protection	Abrasive Blasting	Blasting	Borehole and Rock Drilling	Chipping and Cutting	Concrete Pour Operations and Grouting	Dredging and Sediment Removal	Fish Exclusion , Salvage and Relocation	Fugitive Dust Control During Construction	Grinding and Welding	Installation and Removal of Coffer Dams and Isolation Structures	Invasive Species Management	Pile Driving	Refueling and Spill Management	Treatment of Discharge Waters	Use and Maintenance of Heavy Equipment	Vehicle and Equipment Washing and Cleaning	Wildlife and Species at Risk Protection during Construction	Winter Weather Stabilization and Operations	Revegetation
Site Preparation (All Projects on Ontario Waterways)																									
Vegetation Removal (e.g., clearing, grubbing)																									
Earthworks (e.g., excavation, grading)																									
Installation and Removal of Erosion and Sediment Control and Water Quality Protection Measures																									
Dewatering																									
Installation and Removal of Cutoff Walls, Coffer Dams or By-Pass Channels																									
Fish Passage, Salvage and Relocation																									
Lock, Bridge, Retaining / Approach Wall or Concrete Dam Repair or Upgrade Project Construction																									
Demolition and/or Dismantling																									
Concrete Removal																									
Concrete Application and Minor Re-construction																									

Table 6: Environmental Standards and Guidelines and Associated Project Works and Activities

	Environmental Standards and Guidelines Pre-construction (Pre), During Construction (C) and Post-construction (Post)																							
	Pre Construction					Construction																		Post
	ESG-1-Pre	ESG-2-Pre	ESG-3-Pre	ESG-4-Pre	ESG-5-Pre	ESG-1-C	ESG-2-C	ESG-3-C	ESG-4-C	ESG-5-C	ESG-6-C	ESG-7-C	ESG-8-C	ESG-9-C	ESG-10-C	ESG-11-C	ESG-12-C	ESG-13-C	ESG-14-C	ESG-15-C	ESG-16-C	ESG-17-C	ESG-18-C	ESG-1-Post
	Erosion Control	Sediment Control	Soil Stripping, Grubbing and Stockpiling	Tree Protection and Hording	Vegetation Clearing and Protection	Abrasive Blasting	Blasting	Borehole and Rock Drilling	Chipping and Cutting	Concrete Pour Operations and Grouting	Dredging and Sediment Removal	Fish Exclusion , Salvage and Relocation	Fugitive Dust Control During Construction	Grinding and Welding	Installation and Removal of Coffer Dams and Isolation Structures	Invasive Species Management	Pile Driving	Refueling and Spill Management	Treatment of Discharge Waters	Use and Maintenance of Heavy Equipment	Vehicle and Equipment Washing and Cleaning	Wildlife and Species at Risk Protection during Construction	Winter Weather Stabilization and Operations	Revegetation
Repair, Salvage and/or Reinstallation of Ancillary Equipment						■							■	■			■				■		■	
Earth Dam and Gravel Road Repair or Upgrade Project Construction																								
Transport and Stockpiling of Earth, Aggregate and/or Clean Fill	■	■	■	■	■		■	■			■		■			■		■	■	■			■	■
Designated Vegetation Removal	■	■											■						■	■		■	■	
Earth, Aggregate and/or Clean fill Placement	■	■											■					■	■	■			■	
Concrete Dam Replacement Project Construction																								
Demolition and/or Dismantling						■	■	■	■				■	■				■	■	■				
Blasting or Drilling							■	■					■					■	■	■				
Concrete Pouring and Dam Reconstruction										■	■		■		■		■	■	■	■				
Installation of Ancillary Equipment										■			■	■	■		■							
Site Restoration (All Projects on Ontario Waterways)																								
Backfilling	■	■			■								■					■	■	■				■
Site Restoration	■	■														■		■		■				■

PART 2:

ENVIRONMENTAL STANDARDS AND GUIDELINES

Category	Environmental Standards and Guidelines	Identifier
Pre- Construction Works and Activities	Erosion Control	ESG-1-Pre
	Sediment Control	ESG-2-Pre
	Soil Stripping, Grubbing and Stockpiling	ESG-3-Pre
	Tree Protection and Hording	ESG-4-Pre
	Vegetation Clearing and Protection	ESG-5-Pre
Construction Works and Activities	Abrasive Blasting	ESG-1-C
	Blasting	ESG-2-C
	Borehole and Rock Drilling	ESG-3-C
	Chipping and Cutting	ESG-4-C
	Concrete Pour Operations and Grouting	ESG-5-C
	Dredging and Sediment Removal	ESG-6-C
	Fish Exclusion, Salvage and Relocation	ESG-7-C
	Fugitive Dust Control During Construction	ESG-8-C
	Grinding and Welding	ESG-9-C
	Installation and Removal of Coffer Dams and Isolation Structure	ESG-10-C
	Invasive Species Management	ESG-11-C
	Pile Driving	ESG-12-C
	Refueling and Spill Management	ESG-13-C
	Treatment of Discharge Waters	ESG-14-C
	Use and Maintenance of Heavy Equipment	ESG-15-C
	Vehicle and Equipment Washing and Cleaning	ESG-16-C
	Wildlife and Species at Risk Protection During Construction	ESG-17-C
	Winter Weather Stabilization and Operations	ESG-18-C
Post-Construction Works and Activities	Revegetation	ESG-1-Post

Erosion Control (ESG-1-Pre)

Application to Ontario Waterways' Projects

Land based construction involving activities such as vegetation removal, topsoil stripping, excavation or soil stockpiling create the potential for soil erosion that can affect surface water quality or deposit fine sediment into adjacent wetlands and waterbodies. Protecting exposed soil from erosion and containing run-off to prevent off-site migration is a critical component of construction, maintenance and repair projects on Ontario Waterways. For this reason, industry accepted standard erosion control devices are extensively used on both major and small scale land based construction projects.

Description of Activity

Erosion controls for construction sites are intended to deal only with rainfall / snowmelt water within the site, and not for handling water from off the construction site. Construction site erosion control practices generally involve preserving existing vegetation, staged removal when possible, or stabilizing disturbed areas with exposed soils with temporary covers comprised of seeded vegetation or sod. Methods depend on the duration of soil exposure, the phase of the project, and/or the season in which the erosion control methods are being applied. The selection of appropriate erosion controls involves identifying the factors that influence the type and severity of potential erosion. Factors that influence the type of erosion control method to be used include climate, soil properties, soil cover, land management and topography.

Climate / Precipitation	• Duration and intensity of rainfall, snowfall and snowmelt regulates the amount of soil detachment and subsequent loss from the land. The greater or more intense the rainfall, snowfall and subsequent snowmelt, the greater the potential for erosion.
Soil Properties	• Soil texture (the proportion of clay, silt, and sand particles in a soil) influences infiltration of water as well as the ease of detachment. For example, sand and silt particles are most easily detached because they are small and do not easily form aggregates and are more easily eroded. In contrast, more calcareous soils tend to eroded more easily on steep slopes, while clay soils have low potential to erosion on steep slopes. However, sandy soils will tend to settle in water more quickly than silts and clays. For this reason, erosion controls are geared towards managing the finer sized particles that have the greatest potential to result in turbid waters.
Soil Cover	• Bare soil is exposed to the full erosive power of rain, snow and runoff / snowmelt water. Vegetative canopy helps stabilize soil and controls runoff. The vegetative canopy intercepts rain and reduces its erosive energy. Dense canopies that cover much of the soil surface intercept a large proportion of the rainfall. Soil covers comprised of seeded vegetation or sod also minimize the contact of runoff / snowmelt water with soil. Here, the roots of vegetation, such as grass, bind soil particles together to resist erosion.
Land Management	• Clearing, grading, and other activities disturb the soil surface, remove existing vegetation, and alter topography, thereby increasing erosion risk. Massive land clearing done by large construction equipment pulverizes the soil and clears all vegetation. This mechanical disturbance exposes the soil directly to the impact of rainfall energy. Highly disturbed soils have also lost much of the organic matter that glues them together. Also, the rate of water infiltration is usually decreased and water that does not soak into the soil runs off carrying sediment.

Topography / Slope Length	• The degree of steepness (percent slope), as well as the slope length, is important. Steep slopes have high runoff water velocity. This increases its erosive energy (i.e., the erosive energy of runoff is a function of runoff velocity and volume). When the slope is longer (length), surface area for water collection also increases and therefore increases the run-off volume.

Erosion controls require proper selection, installation and regular inspection and maintenance. Along with non-structural methods such as minimizing the amount of exposed soil at a site, erosion controls generally either dissipate energy or divert surface run-off.

Environmental Standards and Guidelines

Site-specific erosion controls (as part of an overall Surface Water Management, Erosion and Sediment Control Plan, shall be developed by a Qualified Professional(s) and included in the Contractor's EMP for review and acceptance by PCA. Timing and scheduling, staging, minimizing the amount of exposed soil, surface stabilization and directing surface water runoff away from exposed soil and managing water within the work zone must be considered in developing site-specific plans.

Timing and Scheduling

Developing a schedule and planning the project are the very first steps in developing an effective soil erosion control program. Erosion control strategies shall be undertaken and specific erosion control devices shall be installed prior to the undertaking of any ground disturbing activities and prior to winter operations.

Staging and Sequencing

Construction staging and sequencing shall be planned to minimize the duration of time that soils are disturbed and exposed to erosive forces prior to and following construction. The best form of erosion control is not to disturb soils unless absolutely required and only immediately prior to the required work. Project staging must be described in the Construction Plan of the site-specific EMP. Best practices in construction staging (VOI, 2005) are:

- Dividing the overall project site into a series of smaller work areas and implement construction progressively rather than simultaneously in all work areas. The erosion potential within each work area should be determined (see below) to assist in selecting appropriate erosion controls;
- Erecting barriers to restrict construction activities to within the identified work boundaries; and
- Maintaining existing vegetation or providing temporary vegetative cover in areas that are inactive.

Minimize Disturbance and Buffer Strip

The primary objective of buffer strips is to protect the riparian zone along wetlands and waterbodies, which is critical to the maintenance of a healthy aquatic environment. Where practical, the retention of vegetated buffer strips should be planned for works adjacent to all waterbodies and wetlands.

Surface Stabilization

Surface stabilization techniques must be considered and, if appropriate, described in the site-specific EMP. Surface stabilization is a process that protects exposed surface soils from wind and water erosion. Techniques can vary from roughening the surface soil, benching and contour furrows, applying an organic layer or covering, applying a tackifier, seeding or using soil erosion control blankets. In some cases using one or more of these techniques may be required. Techniques should be chosen based on duration of treatment (i.e., short term vs permanent).

Directing Surface Water Runoff Away From Exposed Soil

Surface water diversion techniques must be considered and, if appropriate, described in the site-specific EMP. Diversion structures redirect potentially erosive flow away from or around exposed soils and towards a well vegetated area for runoff deposition or into a treatment facility. Reducing the amount of water in the work zone will decrease effort in treating turbid and potentially contaminated water. These techniques include: slope drains, diversion berms, conveyance channels or diversion dykes. These techniques are often used in conjunction with surface stabilization on steep slopes and erosion prone soils.

Determining Erosion Potential

As discussed above, several factors can influence the erosion potential of soils within a work area. The risk of soil erosion is directly related to the slope and the soil properties within the work area. Runoff pathways, slope patterns and valley features will also influence the likelihood of runoff / snowmelt waters causing erosion. It is important to consider all potential sources of runoff, including snowmelt waters, groundwater seeps, etc.

- Steep slopes with a grade greater than 33% and consisting of sandy and light silty soils are at a very high risk of erosion.
- Moderate slopes with a grade between 17% and 33% with sandy and light silty soils or medium and calcareous soils have a high or moderate risk of erosion, respectively.
- Gentle slopes with a grade between 10% and 17% have a low to moderate risk of erosion for medium and calcareous soils; with clay till or heavy soils having a low risk of erosion on most slope.

As noted above, if the finer sediments such clays and silts get into suspension in a waterbody, they do not settle out or deposit as quickly as more coarse materials such as sands. Suspension is when material made up of very fine particles such as clay and silt are lifted as the result of turbulence and transported by flowing water. The faster flowing and more turbulent the water, the more suspended the material becomes

Selecting Erosion Control Measures

The selection of erosion control measures shall considered a variety of factors, including: the size of the work area, its erosion potential (see above), the extent of vegetation cover, degree of soil compaction, and the duration of treatment.

Areas with higher risk of erosion typically require multiple and more robust control measures. More robust measures are those that require the construction of facilities and structures such as diversion dikes, channels, swales and slope drains. The following provides suggested erosion control measures/devices and associated best practices.

Slope Texturing and Surface Roughening

Slope texturing, surface roughening uses tracked equipment or agricultural implements to leave the ground surface in a rough textured condition to reduce soil erosion or to prepare a seed bed. The measure reduces runoff velocity and increase infiltration. Best practices and limitations (VOI, 2005) include:

- Leaving slopes in rough condition when building fills, excavating cuts or reapplying topsoil.
- All slope texturing practices must be applied on-contour (i.e., across the slope).
- Slope texturing and surface roughening are not practical on short slopes or slopes steeper than 2H:1V.
- Roughness elements should be randomly sized and spaced, between 50 mm to 100 mm in height.
- When using tracked equipment or agricultural implements to roughen surfaces, limit the activity to one or two passes to minimize soil compaction.
- Narrow, gently (~ 1%) in-sloping soil benches should have an elevation change of <8 m. Design of benches should be undertaken by a Qualified Professional(s).
- Seeding should occur immediately following slope texturing or roughening.

Mulching and Compost

Mulching is the application of a protective layer of organics such as straw, woody fibres or other suitable organic material to temporarily stabilize bare and disturbed soil. Mulch can be applied most times of the year. Trees and shrubs removed from the construction site during clearing activities can be shredded and used as mulch on newly exposed surfaces. The application of mulch results in protection of surface soil from raindrop impact, increased surface water infiltration, conservation of moisture, prevention of soil compaction or crusting, and decreased surface water runoff. Mulching also fosters growth of vegetation by protecting the seeds from predators, reducing evaporation, and insulating the soil.

Hydromulching is a soil stabilization technique where a fibre mulch is applied to disturbed and exposed soil surfaces and is primarily intended to protect the soil surface from raindrop impact erosion. The fibre which may be wood fibre, straw, or compost is applied to the soil surface hydraulically in a slurry consisting of the fibre, water and a binding agent. Hydromulch is applied using a mechanical hydro seeder and can also be used as a tackifier for straw mulch or in combination with seeding. When applied correctly and when using the proper mulches and tackifiers, the hydromulch can be effective against soil erosion for over a year.

A compost blanket is a layer of compost applied to surface soil to prevent erosion, especially rills and gullies used for temporary or permanent erosion control and slope stabilization and vegetation establishment. Compost erosion control blankets act similarly to mulch products but provide organic nutrients that promote vegetation growth, even in areas where germination, moisture management and irrigation could be challenging. For these reasons, a compost blanket can be more effective at vegetation establishment, weed suppression and erosion control than an Erosion Control Blanket or hydroseeding. Compost blankets are typically applied to slopes with pneumatic blower trucks which make them easy to apply to slopes or hard to reach areas.

Best practices and limitations (VOI, 2005) include:

- Organic mulches can be applied to a range of slope gradients up to 1.5H:1V and most soil types.
- Should not be used as a stand-alone or long term (>1 year) erosion control measure but should be combined with other erosion control measures for optimal performance.
- Some mulches can inhibit or prevent vegetative growth, while others promote vegetation growth and establishment.
- Straw, woodchips, woodfibre and compost materials are preferred. Use of recycled paper (cellulose) requires review and acceptance by PCA prior to application.
- Mulches must be applied as recommended (see below) to be effective as an erosion control measure:

- Straw
  - Straw is applied evenly in a 20 – 40 mm thick layer in *areas that will be seeded*, at a bulk application rate of 3,300 – 4,500 kg/ha over 80 – 90% of the soil surface. Straw should be anchored through crimping or tackifiers.
  - Straw is applied evenly in a 40 - 60 mm thick layer in *areas that will not be seeded*, at a bulk application rate of 4,500 – 6,700 kg/ha over more than 90% of the soil surface. Straw should be anchored through crimping or tackifiers.
- Woodchips
  - Locally generated woodchips are applied evenly in a 50 – 75 mm layer, at a rate of 13,500 kg/ha mixed in a 30% woodchip to 70% soil ratio.
- Woodfibre
  - Woodfibre is applied hydraulically at a rate of 1,200 - 1,500 kg/ha mixed in a 20 kg of wood fibre to 500 litres of water (or in accordance with manufacturer's specifications)
  - Effective as a temporary erosion control measure on slopes less than 4H:1V.
- Compost
  - Compose is applied onto roughened or decompacted soils on slopes as steep as 1H:1V and 1 – 2 m back from slope crest
  - Compost blanket thickness varies with slope and anticipated rainfall over a 24 hour period.

Slope (H:V)	**Recommended Compost Erosion Blanket Thickness (mm)**		
	Rainfall = 16.5 mm	**Rainfall = 50 mm**	**Rainfall = 100 mm**
<4:1	12.5 to 50	25 to 50	50
4:1 to 3:1	12.5 to 50	25 to 50	50
3:1 to 2:1	25 to 50	25 to 50	25 to 50

Seeding, Hydroseeding and Sodding

Seeding is an important step in revegetating disturbed construction sites and will help reduce soil erosion issues. There are two approaches to seeding with the first being temporary seeding for short term exposed soils and long term seeding associated site revegetation. Seeding alone is not an erosion control method unless an erosion control blanket or Rolled Erosion Control Product is applied over top and secured in place.

Hydroseeding is the use of water as a medium to spray and spread seeds onto the seedbed. Hydroseeding is not an erosion control method unless a bonded fibre matrix is applied or an erosion control blanket or Rolled Erosion Control Product is applied over top and secured in place. Sodding offers a quick and relatively inexpensive method of establishing vegetation. Both of these techniques require frequent watering until roots become established. Best practices and limitations (VOI, 2005) include:

- Site soils must be prepared, decompacted (>300 mm) and amended for seeding and/or a suitable growth medium (see recommended topsoil thicknesses in Revegetation (ESG-1-Post)) be applied to support plant germination and growth. Soil pH should be >6.5. The type and amount of soil amendment (i.e., the fertilizer mix) shall be identified in the EMP.
- Dry seeding (i.e., by hand, rotary seeders, cyclone seeders, drill seeding) is preferred for small areas and/or longer term applications associated with site revegetation following construction.
- Hydroseeding is most appropriate for large areas where seedbed preparation is impractical and/or longer term applications associated with site revegetation following construction.

- Sodding is to be used for final landscaping purposes or for erosion control in very small areas (e.g., surrounding temporary buildings, along drainage ditches, etc.).
- Regular inspection and maintenance (once per week) is essential for successful seeding. Watering and multiple seeding / re-sodding operations may be required.
- Careful consideration must be given to timing, seed mixtures and application rates.
  - Timing
    - Seed areas immediately once the area is brought to final contour or would be left undisturbed for more than 30 days.
    - Seeding should occur on same day that the soil was prepared for seeding and preferably during spring or summer. Fall seeding is recommend for construction site winterization.
  - Seed Mixtures
    - Only seed mixtures native to Ontario, identified in the EMP and accepted by PCA shall be used.
    - Species will be appropriate for site conditions and habitat. Invasive species will not be used. A Qualified Professional(s) shall be consulted to assist with selection of seed mixture.
  - Application Rates
    - Apply seed mixes at recommended application rates (see Revegetation (ESG-1-Post)).
    - If hydroseeding is combined with hydraulic mulching in a single operation, seed application rates are increased by 25% – 30%.

Soil Binders / Tackifiers

Tackifiers are binding agents that act as a "glue" to hold soil particles together and are used to reduce soil erosion on loose dry soil. Tackifiers are also used to anchor straw mulch to the soil surface. Tackifiers can also protect seedbeds by holding the product to the soil surface and preventing movement. Tackifers are available in both organic and synthetic varieties for specific applications. Commonly used organic products are guar, psyllium and starch. Synthetic products include various polymeric compounds and resins. Chloride compounds are primarily used for unpaved roadway stabilization. Best practices and limitations include:

- The purpose, type(s) and amount of tackifiers to be used shall be identified in the EMP and accepted by PCA.
- Petroleum based tackifiers are prohibited.
- Organic tackifiers are preferred to synthetic varieties. Application of soil stabilizer is intended to be conducted with conventional hydraulic seeding equipment. Soil stabilizer may also be placed by dry spreading. Application rates for common organic tackifiers are:
  - Guar is a non-toxic and biodegradable product that should be stored, mixed and applied according to manufacturer's specification, but typically between 45 kg/ha for flat areas and up to 80 kg/ha for 1H:1V slopes.
  - Psyllium is a biodegradable finely ground coating of plantago seeds, and is applied as a dry powder or in a wet slurry to the surface of the soil. It should be stored, mixed and applied according to manufacturer's specification, but typically between 90 to 225 kg/ha. Note that this product requires a 12 to 18 hour drying time prior to a precipitation event.
  - Starch is biodegradable, cold water soluble granular cornstarch mixed with water and typically applied at the rate of 168 kg/ha requiring a drying time of between 9 to 12 hours.

- Additional important considerations for soil binders and tackifiers include the following.
    - They are easily damaged by traffic and lose their effectiveness more rapidly than organic mulches.
    - They decompose with varying times, some within 60 to 90 days.
    - Material safety data sheets for all synthetic products should be provided to verify that products are free of toxics and to ensure proper handling.
    - When using soil binders and tackifiers, seed must be sown separately from the time when the soil binder or tackifer is applied.
    - When soil binders or tackifiers are used on permanent slopes, an approved mulch should be applied as well to protect and facilitate germination of new seed.

Rolled Erosion Control Products (RECP) and Fibre Rolls

Rolled Erosion Control Products (RECP) are soil stabilization devices consisting of prefabricate layers of material that is laid on the soil to protect disturbed surface soil from raindrop impact erosion. They are carpet-like mats, installed and anchored to properly prepared soil surfaces along slopes or to unvegetated conveyance systems. RECPs also protect seed sites and provide protection and cover for vegetation to become established.

Fibre rolls are long tubes that act as barriers to sediment, allowing water to flow through. Fibre rolls help control erosion by intercepting sheet flow and creating ponding of runoff water and promoting suspended sediment to settle out of runoff water. They are installed across slopes to slow or stop the flow of surface runoff and installed across shallow ditches and drains to reduce the velocity of flowing water.

Best practices and limitations (VOI, 2005) include:

- The type(s) and proposed application of RECPs and Fibre Rolls shall be identified in the EMP and accepted by PCA.
- RECPs and Fibre Rolls composed of plastics are prohibited (e.g., plastic netting).
- Only open weave, biodegradable products are to be used:
    - Erosion control blankets or organic fibre rolls composed of processed natural fibres (e.g., cereal, straw, coir or coconut husk, wood strands);
    - Open weave textile composed of natural fibres; and
    - Mulch control netting composed of natural fibres.

- Appropriate RECPs shall be used depending on application (i.e., slope, ditch/channel and soil conditions).
- Disturbed soils must be prepared and seeded prior to RECP installation. Do no seed or reseed over a RECP.
- RECPs shall be installed according to manufacturer's specifications and as illustrated in the Figures below (VOI, 2014). RECP fasteners such as wooden or biodegradable stakes are preferred to wire stables, metal or plastic pins.
- RECPs shall be inspected weekly and following each rainfall or snowmelt event. Displaced or damaged RECPs shall be replaced. Rills that develop under the RECP must be filled with soil prior to replacement.

Temporary Diversion Ditches/Berms/Swales and Slope Drains

Diversion structures redirect potentially erosive flow away from or around exposed soils and towards a well vegetated area for runoff deposition. Diversion ditches, berms and swales are temporary barriers placed at the base of a slope or along the perimeter of construction areas to slow down the speed of runoff and reduce erosion potential. They are typically parabolic or trapezoidal in shape often constructed in association with dykes. Slope drains typically consist of flexible pipe that conveys water runoff down a hillside from one source toward a protected area or receiving waterbody. Temporary slope drains can also be constructed as open top drains or with plastic sheeting and geotextile fabric. These techniques are often used in conjunction with surface stabilization on steep slopes and erosion prone soils. Best practices and limitations (VOI, 2005) include:

- Diversion Ditches, Berms and Swales
    - The location and design of diversion ditches, berms and swales shall be identified in the EMP and accepted by PCA
    - Diversion ditches, berms and swales shall be designed by a Qualified Professional(s).
    - Temporary diversion ditches, berms and swales are not intended for diversion of a natural watercourse;
    - Individual structures are limited to small catchments of less than 2 ha.
    - Diversion ditches can be lined or armoured with a filter layer and rock. Berms and swales shall be stabilized immediately after construction.
    - Diversion ditches, berms and swales shall be installed as per design but generally as illustrated in the Figures below (VOI, 2014).

- Slope Drains
    - The location and design of slope drains shall be identified in the EMP and accepted by PCA.
    - Individual structures are limited to small catchments of less than 2 ha. A 2 ha catchment area would require a pipe diameter of approximately 760 mm. Smaller catchments require smaller sized pipes. If the catchment areas are greater than 2 ha, additional slope drains shall be installed.
    - Diversion ditches, berms and swales shall be installed as per design but generally as illustrated in the Figures below (VOI, 2014).

Inspection and Maintenance of Erosion Controls

- An inspection program (e.g., performance monitoring) that evaluates the integrity, functionality and effectiveness of erosion control methods shall be described in the EMP and accepted by PCA.
- Inspection of erosion controls within the construction area shall be undertaken weekly and following each rainfall or snowmelt event, and repaired as required. The inspections are intended to:
    - confirm erosion control methods and devices have been installed according to the contract plans and correctly according to installation standards;
    - confirm erosions control methods and devices are maintained and functioning as intended; and
    - identify deficiencies of selected measures based on observations of terrain, soils, or construction progress.

Related Environmental Standards and Guidelines

- General Environmental Protection Procedures
- Sediment Control (ESG-2-Pre)
- Soil Stripping, Grubbing and Stockpiling (ESG-3-Pre)
- Vegetation Clearing and Protection (ESG-5-Pre)

Related EMP Component Plans

- Dust and Air Quality Management
- Blasting
- Demolition
- Site Dewatering and Wastewater Management
- Surface Water Management, Erosion and Sediment Control
- Dredging and Sediment Removal
- Vegetation Protection
- Wildlife Protection and Management
- Aquatic Resources Management
- Invasive Species Management
- Spills Prevention and Emergency Response
- Dam and/or Bypass Channel Commissioning
- Site Restoration

Other Design and Environmental Considerations

- Timing of works should avoid seasonally high rainfall and snowmelt periods.
- Timing windows for in-water works shall be respected.

References

CISEC, 2014. Certified Inspector and Sediment and Erosion Control Training Manual. Revised Edition V6. 9520 Pine valley Drive, Woodbridge Ontario, Canada.

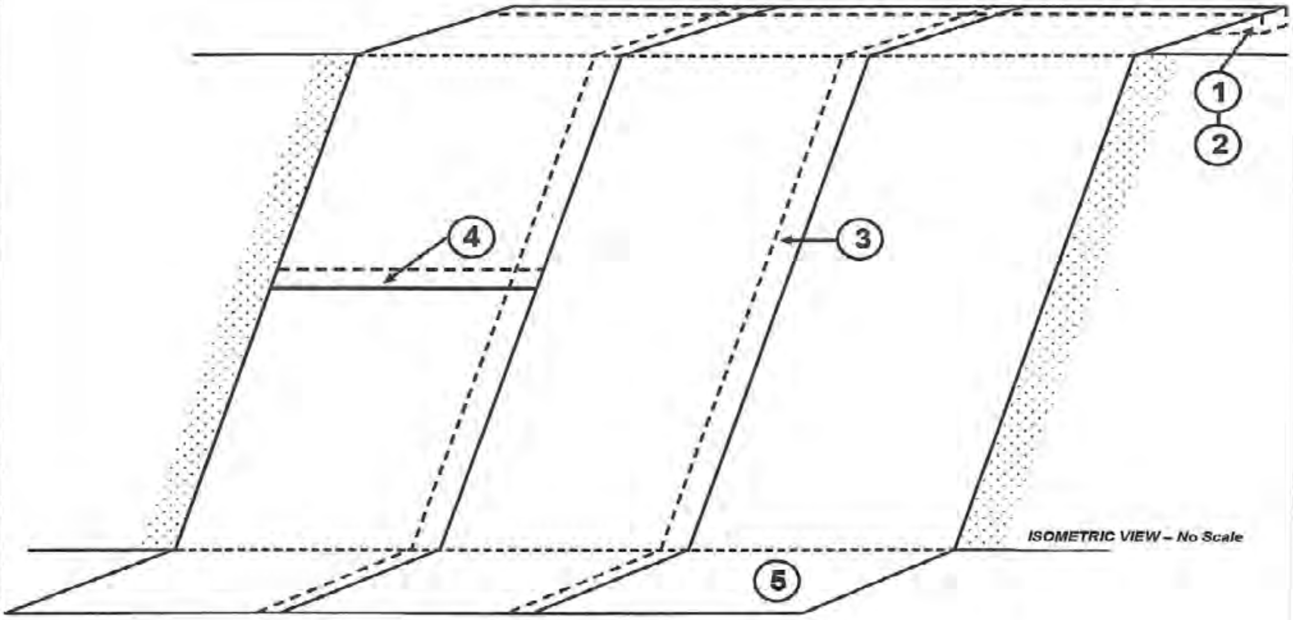
Erosion and Sediment Control Guidelines for Urban Construction, 2006. Greater Golden Horseshoe Area Conservation Authorities.

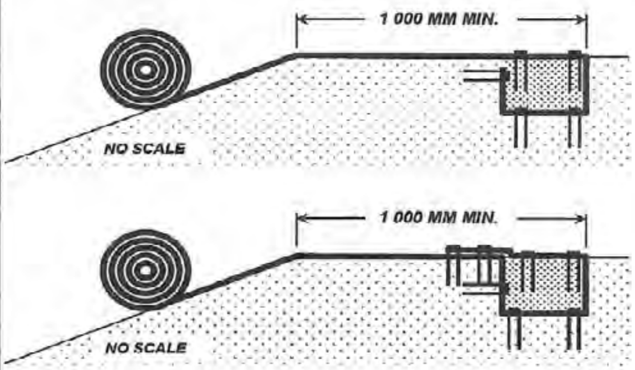
Minnesota Stormwater Manual. Erosion Prevention Practices - Tackifiers and Soil stabilizers. Available at: https://stormwater.pca.state.mn.us/index.php?title=Erosion_prevention_practices_-_tackifiers_and_soil_stabilizers

Plant and Soil Sciences eLibrary, 2017. Erosion. Available online: http://passel.unl.edu/pages/informationmodule.php?idinformationmodule=1086025423&topicorder=1&maxto=20&minto=1

VOI Training Group, 2005. Erosion and Sediment Control – Participant's Manual. Developed by Van Osch Innovations Ltd., 130 Columbia Street, Nanaimo, British Columbia, Canada.

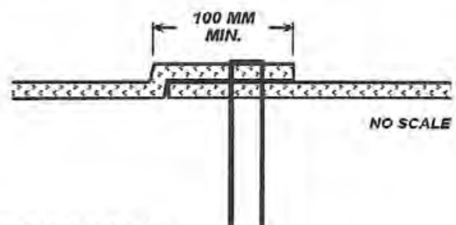
VOI Training Group, 2014. Environmental Field Procedures for Works in and About Water. Developed by Van Osch Innovations Ltd., 130 Columbia Street, Nanaimo, British Columbia, Canada.





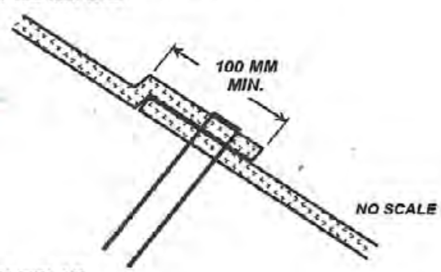
① & ② TOP SLOPE ANCHOUR TRENCH

1. EXCAVATE 300 MM X 200 MM TRENCH
2. LAY RECP THROUGH TRENCH
3. STAGGERED ANCHOURS 300 MM O.C. IN TRENCH
4. BACKFILL & LIGHTLY COMPACT FILL
5. SEED / SOIL APPLY AMENDMENTS
6. STAGGERED ANCHOURS 300 MM O.C. AT SURFACE



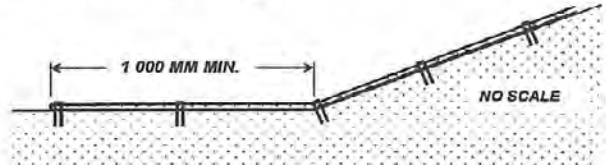
③ SIDE SEAM OVERLAP

1. ANCHOUR THROUGH BOTH RECPS
2. ANCHOURS 150 MM O.C.



④ END ROLL OVERLAP

1. ANCHOUR THROUGH BOTH RECPS
2. ANCHOURS 150 MM O.C.



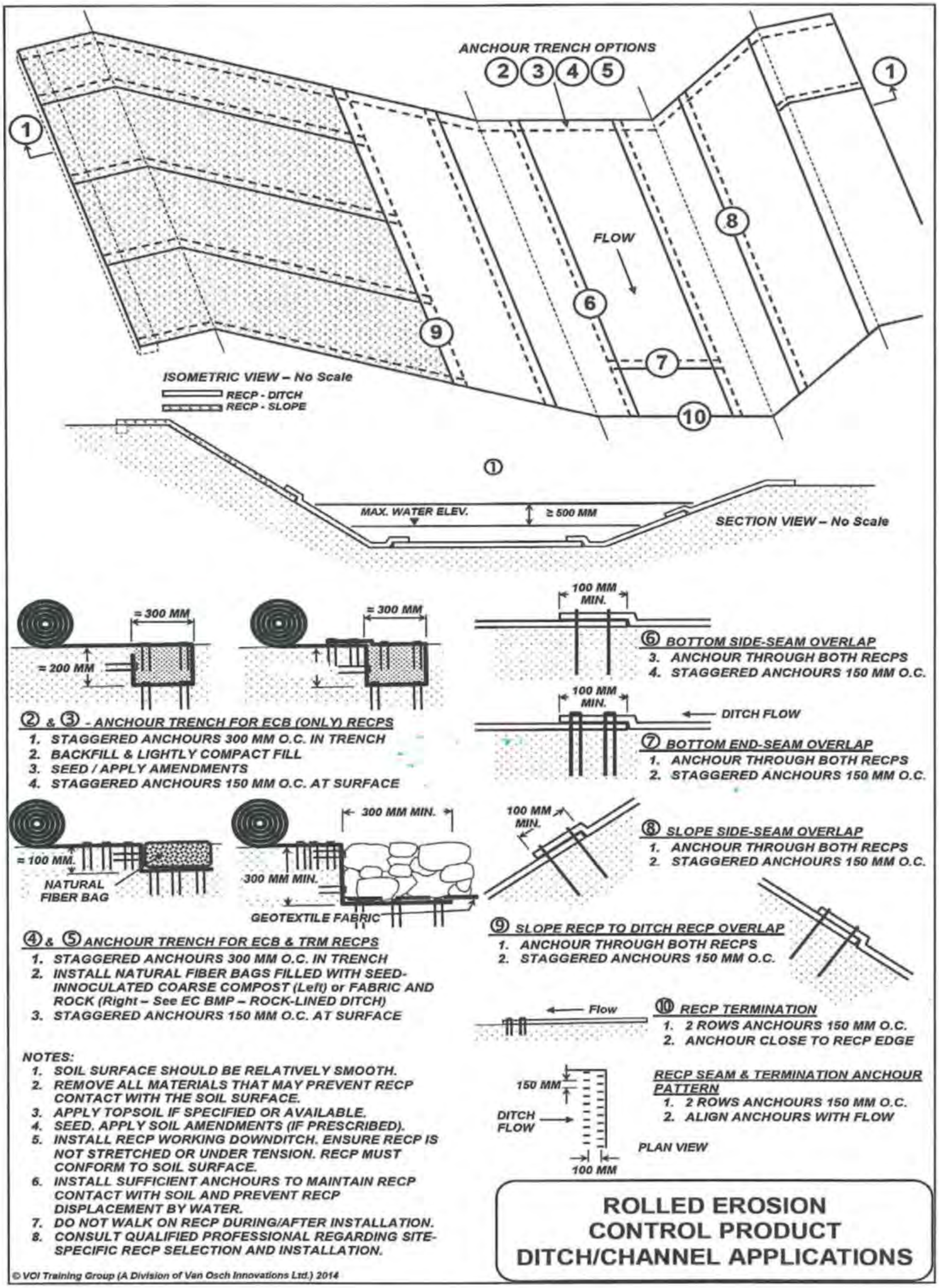
⑤ BOTTOM OF SLOPE TERMINATION

1. ANCHOURS 150 MM O.C. AT TERMINAL END OF RECP
2. ANCHOURS 150 MM O.C. AT SLOPE TRANSITION

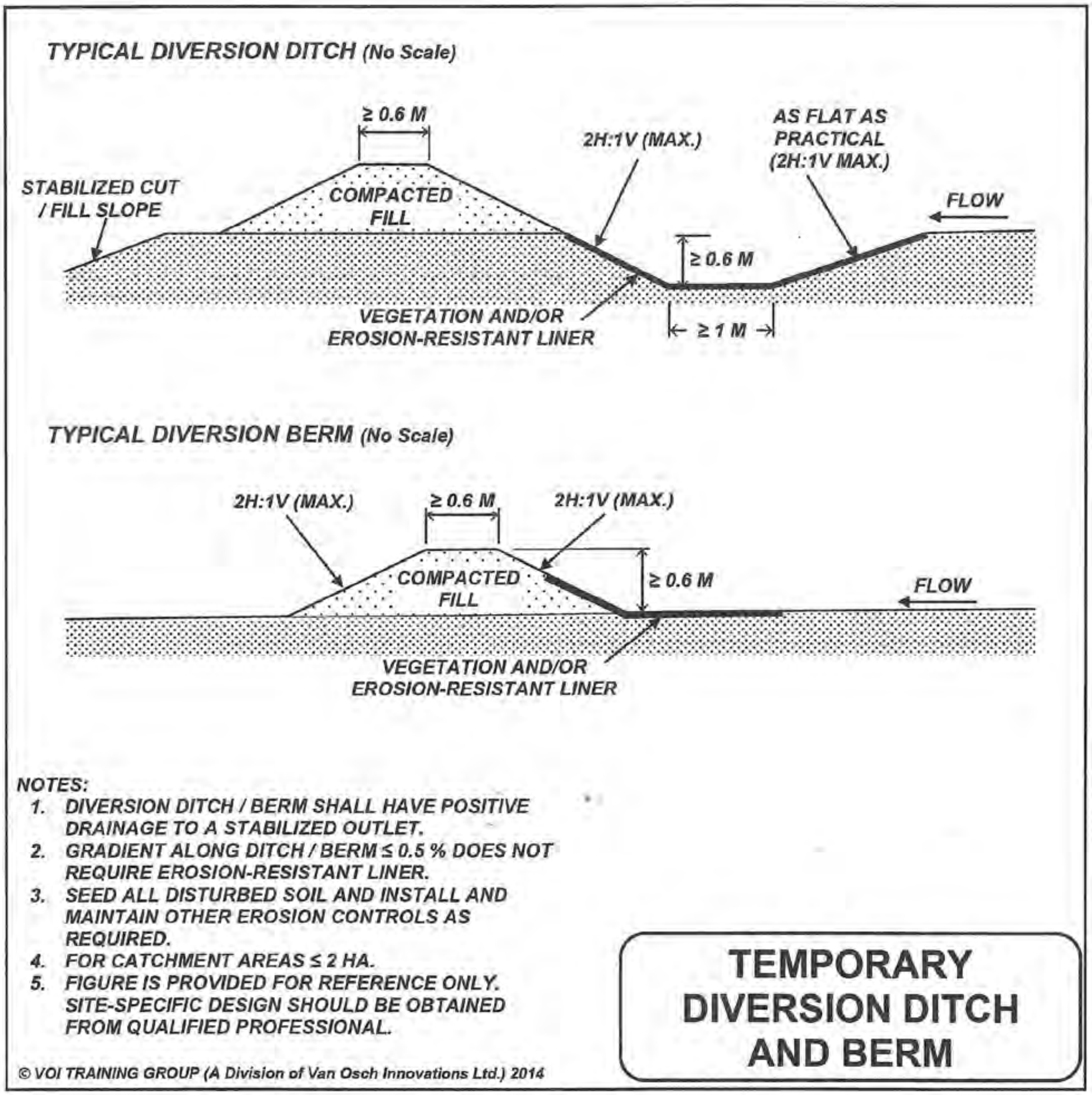
NOTES:

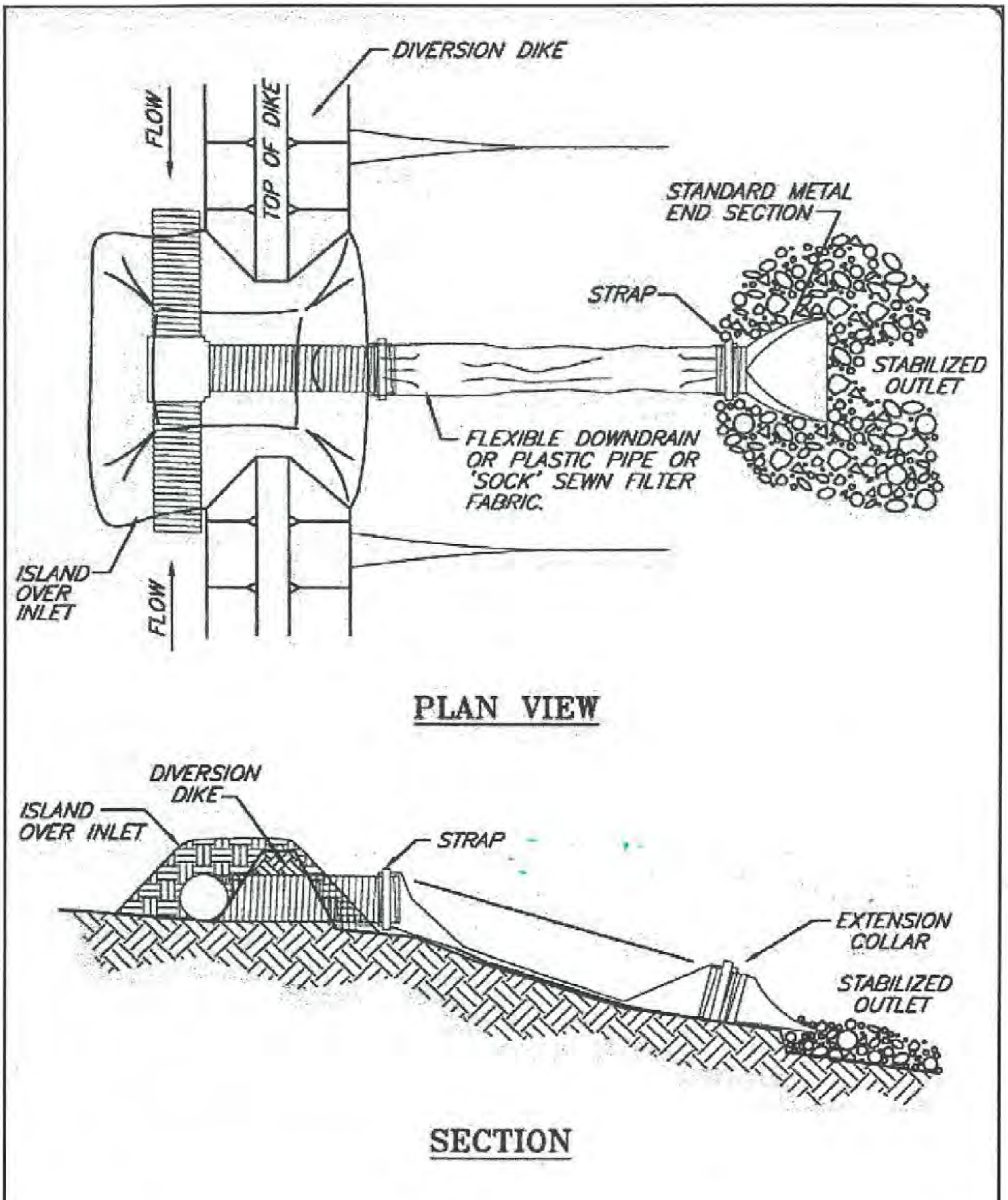
1. PREPARED SOIL SURFACE SHOULD BE RELATIVELY SMOOTH (NO SHARP DEPRESSIONS OR HUMMOCKS).
2. REMOVE ALL MATERIALS THAT MAY PREVENT RECP CONTACT WITH THE SOIL SURFACE.
3. APPLY TOPSOIL IF SPECIFIED OR AVAILABLE.
4. SEED AREA WITH SPECIFIED SEED MIXTURE AT SPECIFIED SEEDING RATE. APPLY SOIL AMENDMENTS, IF PRESCRIBED.
5. INSTALL RECP WORKING DOWNSLOPE. ENSURE RECP IS NOT STRETCHED OR UNDER TENSION. RECP MUST CONFORM TO SOIL SURFACE.
6. DO NOT WALK ON RECP DURING OR FOLLOWING INSTALLATION.
7. RECP SHOULD NOT BE INSTALLED ACROSS SLOPE.
8. INSTALL SUFFICIENT ANCHOURS TO MAINTAIN RECP CONTACT WITH SOIL AND PREVENT RECP DISPLACEMENT BY WATER / WIND.
9. ANCHOR DENSITY SHOULD BE DETERMINED BY SITE SPECIFIC CONDITIONS. CONSIDER GENERIC ANCHOR DENSITY / SPACING RECOMMENDATIONS TO BE MINIMUM ANCHOURING REQUIREMENT.
10. CONSULT QUALIFIED PROFESSIONAL REGARDING SITE-SPECIFIC RECP SELECTION AND INSTALLATION.

ROLLED EROSION CONTROL PRODUCT OPEN SLOPE APPLICATIONS

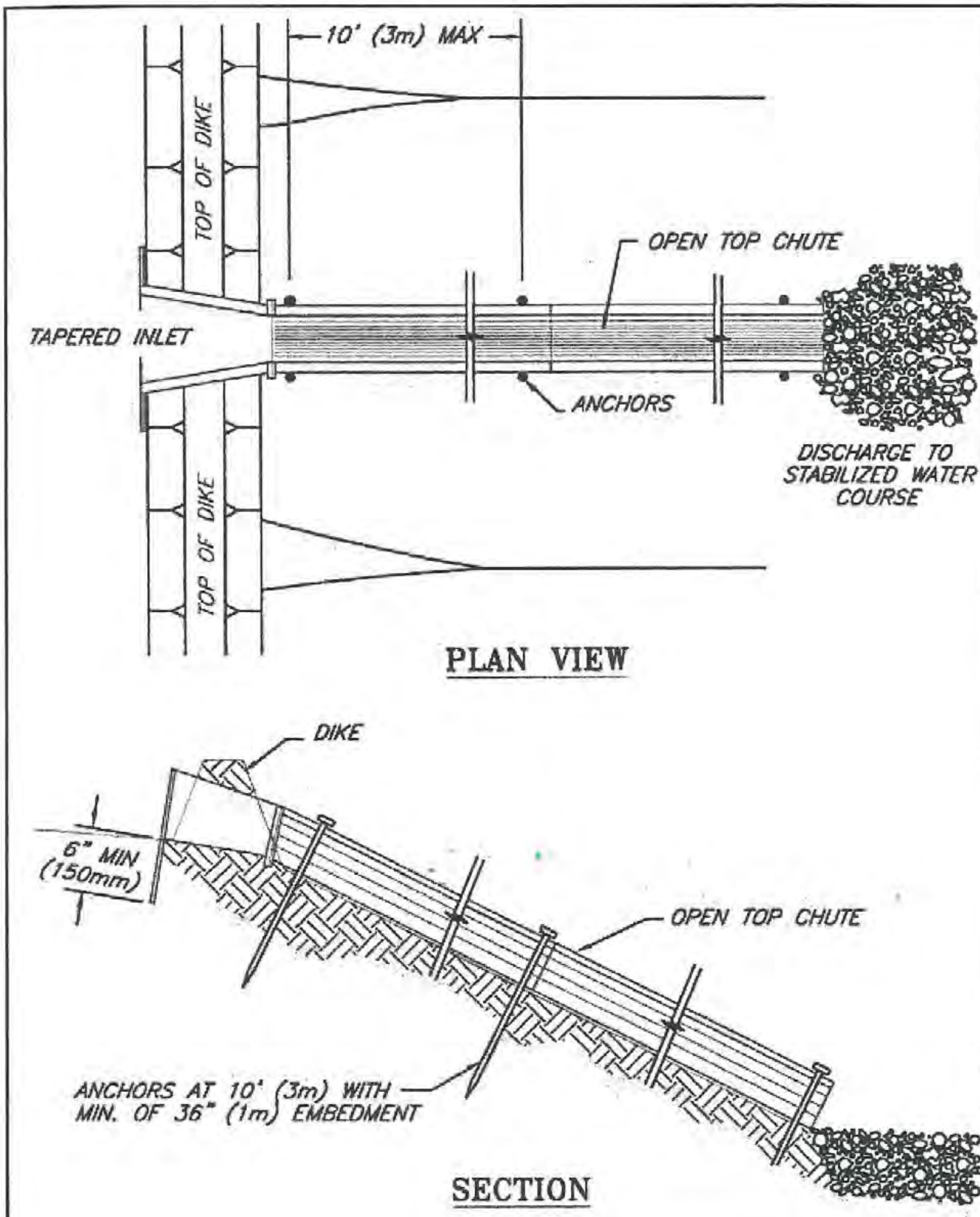


ANCHOUR TRENCH OPTIONS
2 3 4 5
1
FLOW
8
6
9
7
10
ISOMETRIC VIEW – No Scale
RECP - DITCH
RECP - SLOPE
①
MAX. WATER ELEV.
≥ 500 MM
SECTION VIEW – No Scale
≈ 300 MM
≈ 200 MM
≈ 300 MM
② & ③ - ANCHOUR TRENCH FOR ECB (ONLY) RECPS
1. STAGGERED ANCHOURS 300 MM O.C. IN TRENCH
2. BACKFILL & LIGHTLY COMPACT FILL
3. SEED / APPLY AMENDMENTS
4. STAGGERED ANCHOURS 150 MM O.C. AT SURFACE
300 MM MIN.
≈ 100 MM.
NATURAL FIBER BAG
300 MM MIN.
GEOTEXTILE FABRIC
④ & ⑤ ANCHOUR TRENCH FOR ECB & TRM RECPS
1. STAGGERED ANCHOURS 300 MM O.C. IN TRENCH
2. INSTALL NATURAL FIBER BAGS FILLED WITH SEED-INNOCULATED COARSE COMPOST (Left) or FABRIC AND ROCK (Right – See EC BMP – ROCK-LINED DITCH)
3. STAGGERED ANCHOURS 150 MM O.C. AT SURFACE
100 MM MIN.
⑥ BOTTOM SIDE-SEAM OVERLAP
3. ANCHOUR THROUGH BOTH RECPS
4. STAGGERED ANCHOURS 150 MM O.C.
100 MM MIN.
DITCH FLOW
⑦ BOTTOM END-SEAM OVERLAP
1. ANCHOUR THROUGH BOTH RECPS
2. STAGGERED ANCHOURS 150 MM O.C.
100 MM MIN.
⑧ SLOPE SIDE-SEAM OVERLAP
1. ANCHOUR THROUGH BOTH RECPS
2. STAGGERED ANCHOURS 150 MM O.C.
⑨ SLOPE RECP TO DITCH RECP OVERLAP
1. ANCHOUR THROUGH BOTH RECPS
2. STAGGERED ANCHOURS 150 MM O.C.
Flow
⑩ RECP TERMINATION
1. 2 ROWS ANCHOURS 150 MM O.C.
2. ANCHOUR CLOSE TO RECP EDGE
150 MM
DITCH FLOW
100 MM
PLAN VIEW
RECP SEAM & TERMINATION ANCHOUR PATTERN
1. 2 ROWS ANCHOURS 150 MM O.C.
2. ALIGN ANCHOURS WITH FLOW
NOTES:
1. SOIL SURFACE SHOULD BE RELATIVELY SMOOTH.
2. REMOVE ALL MATERIALS THAT MAY PREVENT RECP CONTACT WITH THE SOIL SURFACE.
3. APPLY TOPSOIL IF SPECIFIED OR AVAILABLE.
4. SEED. APPLY SOIL AMENDMENTS (IF PRESCRIBED).
5. INSTALL RECP WORKING DOWNDITCH. ENSURE RECP IS NOT STRETCHED OR UNDER TENSION. RECP MUST CONFORM TO SOIL SURFACE.
6. INSTALL SUFFICIENT ANCHOURS TO MAINTAIN RECP CONTACT WITH SOIL AND PREVENT RECP DISPLACEMENT BY WATER.
7. DO NOT WALK ON RECP DURING/AFTER INSTALLATION.
8. CONSULT QUALIFIED PROFESSIONAL REGARDING SITE-SPECIFIC RECP SELECTION AND INSTALLATION.
ROLLED EROSION CONTROL PRODUCT DITCH/CHANNEL APPLICATIONS
© VOI Training Group (A Division of Van Osch Innovations Ltd.) 2014

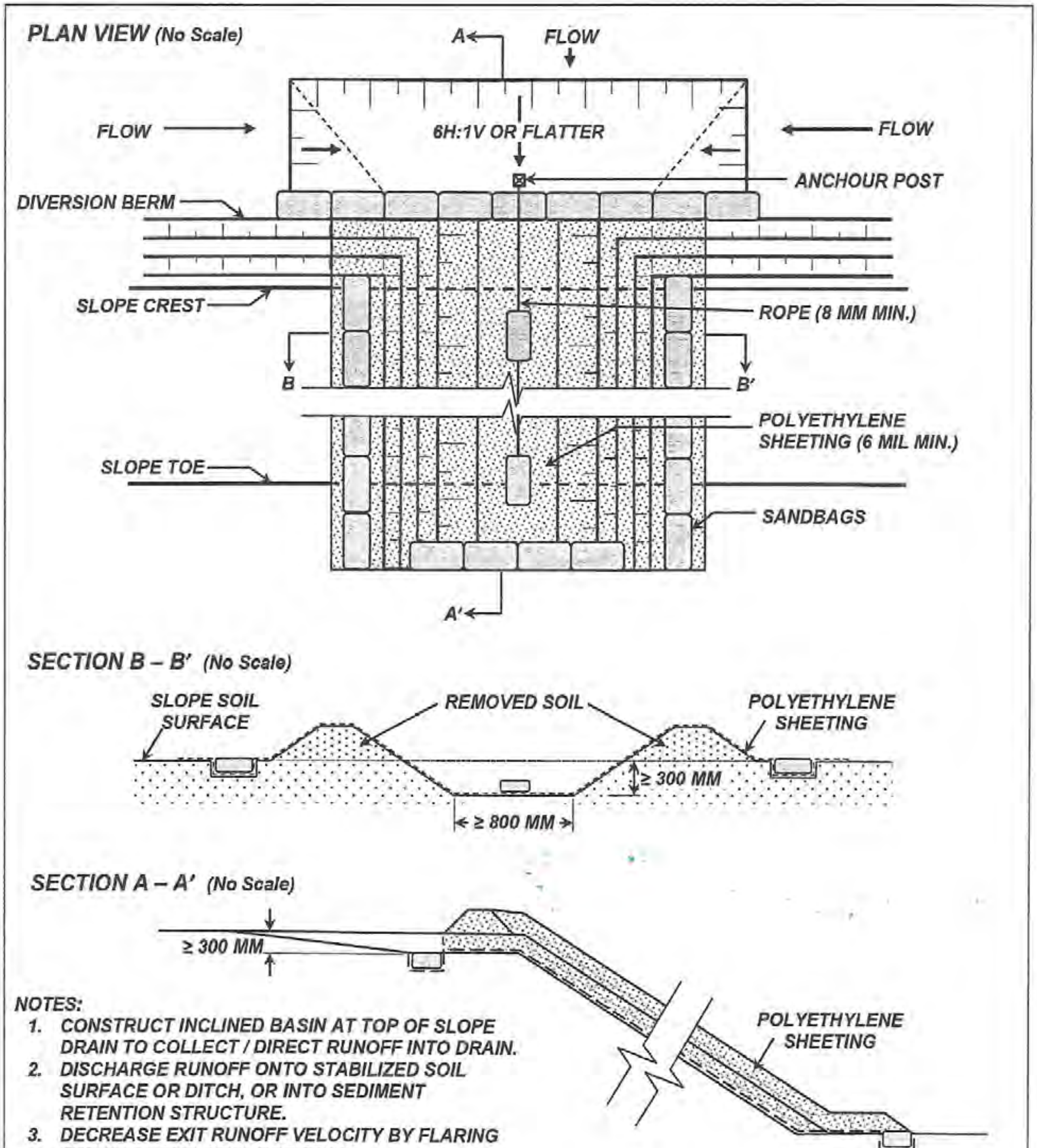

TYPICAL DIVERSION DITCH (No Scale)
≥ 0.6 M
2H:1V (MAX.)
AS FLAT AS PRACTICAL (2H:1V MAX.)
STABILIZED CUT / FILL SLOPE
COMPACTED FILL
FLOW
≥ 0.6 M
VEGETATION AND/OR EROSION-RESISTANT LINER
≥ 1 M
TYPICAL DIVERSION BERM (No Scale)
2H:1V (MAX.)
≥ 0.6 M
2H:1V (MAX.)
COMPACTED FILL
≥ 0.6 M
FLOW
VEGETATION AND/OR EROSION-RESISTANT LINER
NOTES:
1. DIVERSION DITCH / BERM SHALL HAVE POSITIVE DRAINAGE TO A STABILIZED OUTLET.
2. GRADIENT ALONG DITCH / BERM ≤ 0.5 % DOES NOT REQUIRE EROSION-RESISTANT LINER.
3. SEED ALL DISTURBED SOIL AND INSTALL AND MAINTAIN OTHER EROSION CONTROLS AS REQUIRED.
4. FOR CATCHMENT AREAS ≤ 2 HA.
5. FIGURE IS PROVIDED FOR REFERENCE ONLY. SITE-SPECIFIC DESIGN SHOULD BE OBTAINED FROM QUALIFIED PROFESSIONAL.
© VOI TRAINING GROUP (A Division of Van Osch Innovations Ltd.) 2014
TEMPORARY DIVERSION DITCH AND BERM


DIVERSION DIKE
FLOW
TOP OF DIKE
STANDARD METAL END SECTION
STRAP
STABILIZED OUTLET
FLEXIBLE DOWNDRAIN OR PLASTIC PIPE OR 'SOCK' SEWN FILTER FABRIC.
ISLAND OVER INLET
FLOW
PLAN VIEW
DIVERSION DIKE
ISLAND OVER INLET
STRAP
EXTENSION COLLAR
STABILIZED OUTLET
SECTION

SLOPE DRAIN



OVERSIDE DRAIN



NOTES:

1. CONSTRUCT INCLINED BASIN AT TOP OF SLOPE DRAIN TO COLLECT / DIRECT RUNOFF INTO DRAIN.
2. DISCHARGE RUNOFF ONTO STABILIZED SOIL SURFACE OR DITCH, OR INTO SEDIMENT RETENTION STRUCTURE.
3. DECREASE EXIT RUNOFF VELOCITY BY FLARING TERMINAL END OF SLOPE DRAIN.
4. WIDEN SLOPE DRAIN TO INCREASE CAPACITY.
5. SINGLE POLYETHYLENE SHEET MUST SPAN ENTIRE DRAIN WIDTH AND LENGTH (NO SEAMS).
6. SANDBAG SHEETING EDGES TO PREVENT DISPACMENT BY WATER / WIND.
7. PLACE NON-WOVEN GEOTEXTILE LINER UNDER SHEETING TO INCREAZE PUNCTURE RESISTANCE.
8. FIGURE IS PROVIDED FOR REFERENCE ONLY. CONSULT QUALIFIED PROFESSIONAL FOR SITE-SPECIFIC DESIGN.

TEMPORARY POLYETHYLENE SHEETING SLOPE DRAIN

Sediment Control (ESG-2-Pre)

Application to Ontario Waterways' Projects

Land based construction involving activities such as vegetation removal, topsoil stripping, excavation or soil stockpiling create the potential for soil erosion and sedimentation that can affect surface water quality or deposit fine sediment into adjacent woodlands and wetlands. Protecting exposed soil from erosion and containing run-off to prevent off-site migration and deposition of fine sediment is a critical component of construction and maintenance projects. For this reason, the use of industry accepted standard erosion and sediment control devices are extensively used on both major and small scale land based construction projects on Ontario Waterways.

Description of Activity

Sediment control involves the installation of barriers on disturbed lands to minimize sediment laden runoff from leaving the work area. This is accomplished by introducing a barrier along a flow path to reduce velocities and dissipate energy together with providing opportunity for sediments to settle. These controls offer the second line of defence after erosion control against the offsite migration of sediment. The use of sediment controls involves properly installing the appropriate device or measure and regularly inspecting and maintaining them.

Environmental Standards and Guidelines

Temporary Barriers and Perimeter Controls

Temporary barriers and perimeter controls are used to protect adjacent undisturbed areas and waterbodies down gradient from the work area. They should not be considered as sediment control measure unless it meets the applicable standards and guidelines for installation. They may be used in some circumstances to divert sediment laden or clean water away from unprotected slopes and encroaching onto adjacent sensitive features such as waterbodies, wetlands and forest. In general:

- Uncontrolled sediment entering a waterbody will be considered a spill and must be reported to PCA and the Ontario Ministry of Environment and Climate Change Spills Action Centre (SAC).
- The use of stormwater drain sediment barriers is prohibited.
- The use of straw bale check dams is prohibited. Straw bales are only appropriate for structural support (e.g., sediment pond structural walls) or as straw mulch for erosion control.
- Perimeter earthen berms shall be considered for longer periods of perimeter control consider construction of earthen berms. See Erosion Control (ESG-1-Pre) for standards and guidelines.

Sediment fences (frequently referred to as silt fences) are temporary sediment barriers consisting of synthetic filter fabric entrenched into the soil with attached wooden or metal posts. A sediment fence does not filter run-off. It is intended create upstream ponding of sediment laden water, allowing the suspended sediment to fall out of suspension. A sediment fence is intended to address moderate sheet flow and is not suitable to treat concentrated flows. Best practices and limitations (VOI, 2005) include:

- The location(s) and type(s) of sediment fence shall be identified in the EMP and accepted by PCA.
- The locations and types of sediment fences shall be determined by a Qualified Professional(s).
- Sediment fences shall not be placed into drainage ditches or into a natural watercourse.
- Sediment fences constructed from woven geotextile fabric are preferred over non-woven fabrics.

- Maximum slope length above a sediment fence should be less than or equal to 30 m.
- Maximum gradient upslope of sediment fence should be less than or equal to 1.5H:1V.
- Maximum length of a single sediment fence from corner to corner should be less than or equal to 40 m.
- Sediment fences shall be installed as per design but generally as illustrated in the Figures below (VOI, 2014).

Stabilized Site Entrances

Vehicular Tracking Control and Mud Mats are devices placed at construction site access / exit points to stabilize site entrances by removing sediment (mud and debris) from construction vehicles leaving the site and entering adjacent established public roadways. Temporary tracking pads are constructed of clear stone underlain with geotextile material. Mud mats typically consist of high-strength fabric with high tensile reinforcing ribs confined within a sleeve which allows for easy deployment. Mats connect together to form custom sizes. Best practices and limitations (VOI, 2005) include:

- All construction site entrances from public roads shall be stabilized using temporary tracking pads or mud mats. Entrances with steep grades (>8%) shall be avoided.
- The location(s) and type(s) of vehicle tracking controls and mud mats shall be identified in the EMP and accepted by PCA.
- The design of stabilized site entrances, including vehicle tracking controls and mud mats, shall be determined by a Qualified Professional(s).
- Temporary gravel pads shall be constructed from 75 mm or coarser, clean open graded aggregate, with a pad thickness not less than 15 cm placed on non-woven geotextile fabric.
- The pad or mud mats should be designed for the full width of the entrance or a minimum pad/mat width of 3.6 m wide and the minimum pad/mat length of 5 m. Shorter lengths may be required at constrained entrances.
- The stabilized site entrance should be designed in combination with other erosion and sediment control measures and in combination with vehicle wash facilities (as required).

Sediment Retention Ponds

Sediment retention ponds are constructed depressions that allow runoff to pond and promote settling of sediment. They typically serve as an “end- of pipe” control, receiving run-off from areas using other primary sediment and erosion control methods. Sediment ponds are generally used to contain runoff or divert flow during heavy precipitation events and improve the detaining of sediment through the active regulation of filling and draining. Passive draining can also be achieved using granular filled perforated risers and pipes. Sediment ponds occupy relatively large areas and are usually only considered on sites with disturbed drainage exceeding 2 ha in size. They are generally effective for 50 to 80% for the design rainfall / runoff event.

Sediment traps are similar to sediment ponds but generally smaller in area. Sediment traps require large surface areas, and as such, are not recommended for drainage areas of more than 2 hectares in size. Used in combination with sediment bags, they are generally placed near areas where sediment laden runoff may enter a waterbody. Traps are generally constructed by excavation within a low area of drainage. Best practices and limitations (VOI, 2005) include:

- The location(s) and sizes of sediment retention ponds and/or traps shall be identified in the EMP and accepted by PCA.
- The location(s) and design of sediment retention ponds and/or traps shall be determined by a Qualified Professional(s).

- Ponds shall be designed to maximize flow path length with a length to width ratio greater than 6:1.
- Embankment materials shall be clean soil placed 2H:1V in lifts not exceeding 140 mm. Soils shall be well compacted. Ponds shall be equipped with a stabilized outlet and an armoured emergency spillway.
- Sediment retention ponds shall be installed as per design but generally as illustrated in the Figures below (VOI, 2014).
- Sediment retention ponds and traps shall be cleaned when approximately 33% of their capacity has been filled with sediment.
- Proactive pumping of sediment retention ponds and traps into filtration bags shall be undertaken to improve the feature's capacity (freeboard). Access to sediment retention ponds shall be maintained in the event that sediment-laden water needs to be removed and filtered.

Filtration Controls

- Sediment Bags
- Siltsoxx™ and Filter Rings™

Sediment bags are fabricated from non-woven geotextile materials that filter sediment-laden water from dewatering operations. Sediment laden water is pumped into the non-woven geotextile fabric bag that allows filtered water to pass through. Sediment bags are preferred for use on relatively small sites as an effective method of removing sediment rather than larger sediment retention ponds. Sediment bags require frequent routine monitoring to ensure hoses and clamps remain connected and sediment accumulation does not exceed the manufacturer's specifications. Using flocculants will improve flow rates, discharge clarity and percentage of solids retained. Best practices and limitations include:

- The location(s), types and sizes of sediment bags shall be identified in the EMP and accepted by PCA prior to installation.
- The use of flocculants shall be identified in the EMP and accepted by PCA prior to use.
- The location(s), types and sizes of sediment bags shall be determined by a Qualified Professional(s).
- The required size structural integrity and flow rate of the sediment bag is dependent upon soil type in the dewatering area, pumping rates.
    - Sediment bags should be sized to accommodate a minimum of two times the peak flow rate generated from the dewatering pump to account for a 50% clogging factor.
    - Maximum pumping rate is typically 18,170 liters / hour.
- Sediment bag locations shall relatively flat. Sediment bags can be placed directly on the ground surface, but can also be placed on a thin gravel pad, jute or straw mats. Sediment bags can be co-located with sediment retention ponds in the event that sediment laden water needs to be removed and filtered in the bag.
- Remove and replace sediment bags when half full of sediment or when discharge rate is not being achieved.

Siltsoxx™ and Filter Rings™ are temporary filtration devices that incorporate filter media inside a prefabricated semipermeable material to filter water passing through the device. Siltsoxx also promote ponding to create settling of fine sediment behind the device and can therefore also be used as a settling control. Siltsoxx™ is typically used to prevent or reduce sheet flow on areas up to and exceeding a 2:1 slope. Both Siltsoxx™ and Filter Rings™ also have the ability to bind various contaminants contained in run-off. Siltsoxx and similar devices can be provided in biodegradable forms, allowing the addition of seeds to promote the establishment of vegetation directly in the Soxx, thus avoiding the need to remove the devise and disturb the soil.

Turbidity Curtains

Turbidity curtains consist of geotextile material vertically suspended in water to enclose an in-water work area and contain sediment transport to a limited area within the disturbed water body. They are used around construction activities undertaken in-water. The turbidity curtains act as a filter baffle and isolate/protect an important or sensitive in-water feature. Turbidity curtains should not be used as a primary or secondary settling area for dewatering activities. Best practices and limitations include:

- The location(s), types and sizes of turbidity curtains shall be identified in the EMP and accepted by PCA prior to installation.
- The location(s) and type of turbidity curtains shall be determined by a Qualified Professional(s).
- Turbidity curtains must be used when constructing or removing coffer dams. They should be placed according to OPSD 219.260 and 219.261 for the Turbidity Curtain specifications and as close to the coffer dam as possible to minimize area of potential impact of sedimentation.
- Curtain should be positioned at least five (5) metres outside of the perimeter of the area of disturbance.
- Floatation devices should provide greater than 50 mm of freeboard.
- Curtains should be overlapped by at least 75 mm at the ends and should be sewn or threaded to form a continuous barrier.

Inspection and Maintenance of Sediment Controls

- An inspection program (e.g., performance monitoring) that evaluates the integrity, functionality and effectiveness of sediment control methods shall be described in the EMP and accepted by PCA.
- Inspection of sediment controls within the construction area shall be undertaken a twice weekly, in advance of and following each rainfall or snowmelt event, and repaired as required. The inspections are intended to:
    - confirm sediment control methods and devices have been installed according to the contract plans and correctly according to installation standards;
    - confirm sediment control methods and devices are maintained and functioning as intended; and,
    - identify deficiencies of selected measures based on observations of terrain, soils, or construction progress.

Related Environmental Standards and Guidelines

- General Environmental Protection Procedures
- Erosion Control (ESG-1-Pre)
- Soil Stripping, Grubbing and Stockpiling (ESG-3-Pre)
- Vegetation Clearing and Protection (ESG-5-Pre)
- Treatment of Discharge Waters (ESG-14-C)

Related EMP Component Plans

- Dust and Air Quality Management
- Blasting

- Demolition
- Site Dewatering and Wastewater Management
- Surface Water Management, Erosion and Sediment Control
- Dredging and Sediment Removal
- Vegetation Protection
- Wildlife Protection and Management
- Aquatic Resources Management
- Spills Prevention and Emergency Response
- Dam and/or Bypass Channel Commissioning
- Site Restoration

Other Design and Environmental Considerations

All sediment controls shall be designed to control a specified area, slope and sediment type.

- All sediment controls shall be designed to control a specified area, slope and sediment type.
- Timing of works should avoid seasonally high rainfall and snowmelt periods.
- Timing windows for in-water works shall be respected.

Further Guidance

OPSD 219.260 for Turbidity Curtains, November 2015. Available at:
http://www.raqsb.mto.gov.on.ca/techpubs/ops.nsf/0/86fe295ab74b61158525808200628e17/$FILE/OPSD%20219.260%20Rev%232%20Nov2015.pdf

OPSD 219.261 for the Turbidity Curtains Seam Details, November 2016. Available at:
http://www.raqsb.mto.gov.on.ca/techpubs/opsa.nsf/0/2ea4866bb726ba7e85257fae006851ee/$FILE/OPSD219.261%20Rev%231%20Nov2006.pdf

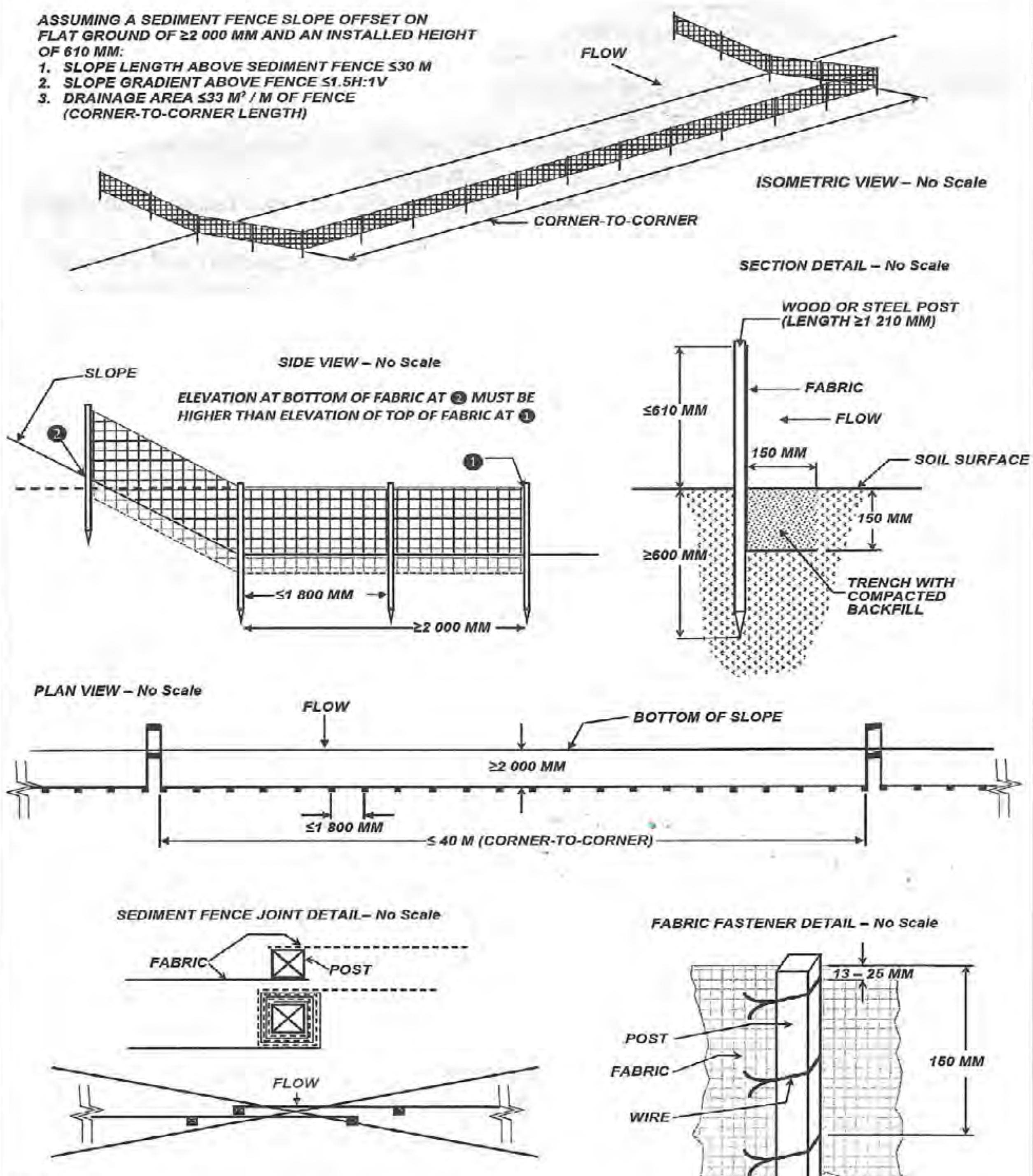
References

CISEC, 2014. Certified Inspector and Sediment and Erosion Control Training Manual. Revised Edition V6. 9520 Pine valley Drive, Woodbridge Ontario, Canada.

Erosion and Sediment Control Guidelines for Urban Construction, 2006. Greater Golden Horseshoe Area Conservation Authorities.

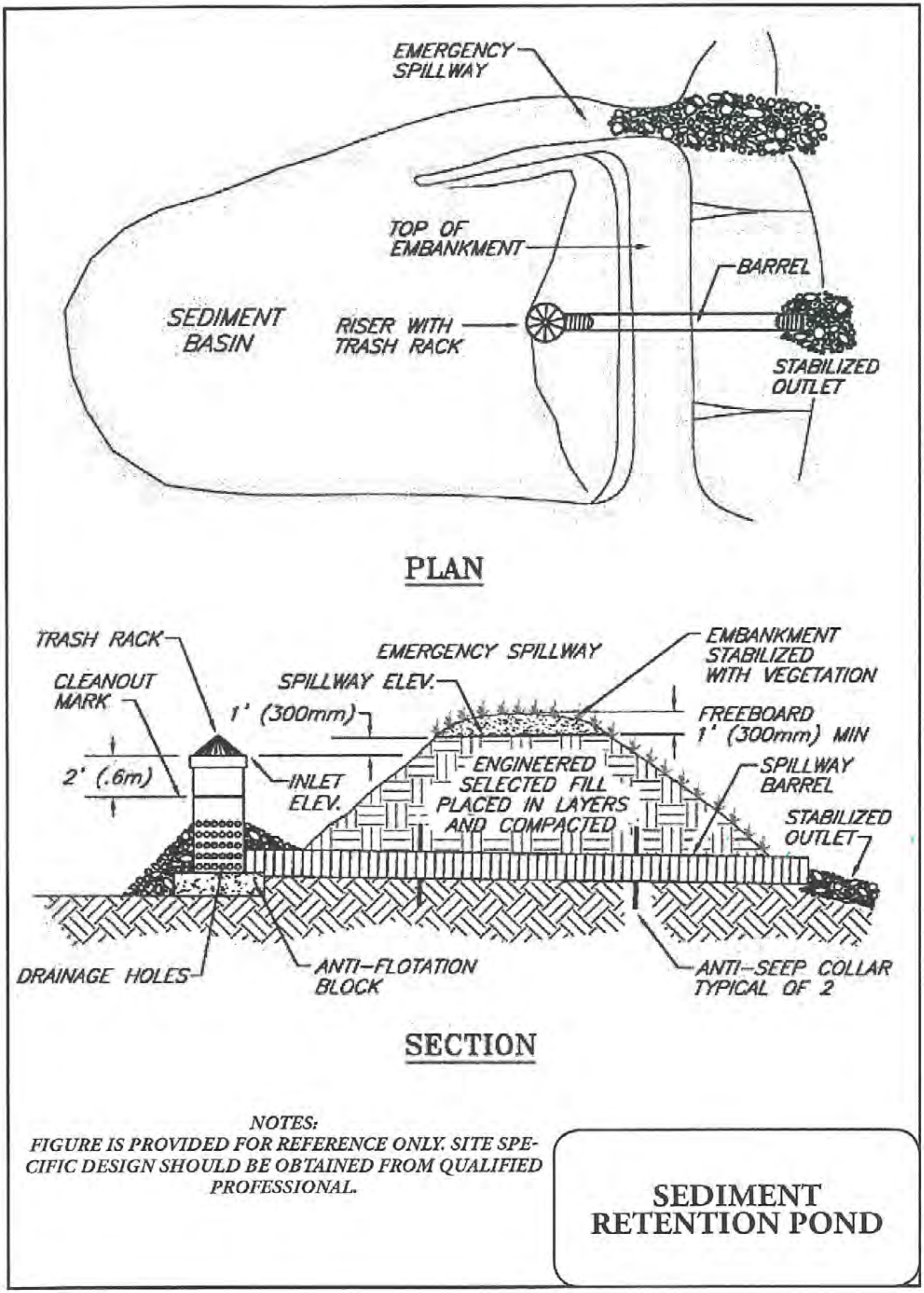
VOI Training Group, 2005. Erosion and Sediment Control – Participant's Manual. Developed by Van Osch Innovations Ltd., 130 Columbia Street, Nanaimo, British Columbia, Canada.

VOI Training Group, 2014. Environmental Field Procedures for Works in and About Water. Developed by Van Osch Innovations Ltd., 130 Columbia Street, Nanaimo, British Columbia, Canada.



NOTES:
1. SEDIMENT FENCE MUST BE CORRECTLY CONFIGURED, INSTALLED AND MAINTAINED FOR EFFECTIVE SEDIMENT CONTROL FUNCTION.
2. SEDIMENT FENCE FUNCTIONS BY POOLING RUNOFF TO PROMOTE SEDIMENTATION.
3. RUNOFF THROUGH, UNDER OR AROUND FENCE IS NOT DESIREABLE.
4. DO NOT INSTALL ACROSS WATERCOURSES OR DRAINAGEWAYS.
5. ENHANCE INTEGRITY OF SEDIMENT FENCE BY INSTALLING ADDITIONAL POSTS.
6. SEDIMENT FENCING, IF INSTALLED CORRECTLY, DOES NOT REQUIRE WIRE BACKING.
7. FUNCTIONAL LIFE OF SEDIMENT FENCE IS 1 YEAR.
8. FIGURE IS PROVIDED FOR REFERENCE ONLY. CONSULT QUALIFIED PROFESSIONAL FOR SITE-SPECIFIC DESIGN.

SEDIMENT FENCE


EMERGENCY SPILLWAY
TOP OF EMBANKMENT
BARREL
SEDIMENT BASIN
RISER WITH TRASH RACK
STABILIZED OUTLET
PLAN
TRASH RACK
CLEANOUT MARK
EMERGENCY SPILLWAY
SPILLWAY ELEV.
EMBANKMENT STABILIZED WITH VEGETATION
1' (300mm)
FREEBOARD 1' (300mm) MIN
2' (.6m)
INLET ELEV.
ENGINEERED SELECTED FILL PLACED IN LAYERS AND COMPACTED
SPILLWAY BARREL
STABILIZED OUTLET
DRAINAGE HOLES
ANTI-FLOTATION BLOCK
ANTI-SEEP COLLAR TYPICAL OF 2
SECTION
NOTES:
FIGURE IS PROVIDED FOR REFERENCE ONLY. SITE SPECIFIC DESIGN SHOULD BE OBTAINED FROM QUALIFIED PROFESSIONAL.
SEDIMENT RETENTION POND

Soil Stripping, Grubbing & Stockpiling (ESG-3-Pre)

Application to Ontario Waterways' Projects

Land based construction typically involves the disturbance and removal (stripping) of topsoil prior to excavation or contouring earthworks. The storage of stripped topsoil or other excavated surficial material creates stockpiles of erodible material that require management due to the potential for soil erosion and sediment transport into adjacent waterbodies, wetlands or forests. Proper removal and separation of topsoil from underlying soil layers preserves naturally occurring seed banks and provides a growing media that can be used during the site restoration phase. During construction and maintenance projects it is also important to protect exposed soil from erosion and to contain run-off to prevent off-site migration and deposition of fine sediment. For these reasons, the use of industry accepted standards for Soil stripping and stockpiling are used on all land based construction projects on Ontario Waterways. Soil stripping, grubbing and stockpiling activities also have invasive species management requirements.

Description of Activity

Soil stripping involves the intentional removal of the active soil layer in which rainwater, small animals and micro-organisms interact with soil particles to create conditions suitable for the growth and maintenance of vegetation. The term 'topsoil' generally refers to the A soil horizon which is usually darker than the underlying soil because of the accumulation of organic matter. Stripping is typically performed using graders or earth scrappers to remove the active growing soil layer. Storage of removed material is often accomplished by creating storage piles (stockpiles) in designated areas for later retrieval of the material.

Environmental Standards and Guidelines

General guidelines for soil management have the following objectives:

- Do not admix (i.e., mixing topsoil with other material). This helps to preserve topsoil value.
- If subsoil becomes compacted soil de-compaction measures shall be implemented (See Revegetation (ESG-1-Post)).
- All topsoil must be retained for re-use during the post-construction period.
- No vegetation shall be removed or soil shall be disturbed in riparian areas (i.e., next to wetlands and watercourses), unless identified in the site-specific EMP and accepted by PCA.

Soil Stripping

- All soil stripping locations and volumes must be identified in the site-specific EMP and accepted by PCA.
- Restrict topsoil stripping to areas that will be disturbed by the construction activities. Project staging must be described in the Construction Plan of the site-specific EMP.
- Sediment control measures must be in place prior to commencement of soil stripping activities. Erosion control measures shall be implemented for all areas following stripping;
- Vegetated buffer strips;
- Ensure full salvage of topsoil and upper root zone while avoiding admixing soil layers;

- During frozen soil conditions, topsoil/root zone salvage work is to be conducted using specialized equipment (e.g., frozen topsoil cutter) with fine excavation depth control to remove soil horizon of variable depths.

Grubbing

- All areas to be grubbed and their timing must be identified in the site-specific EMP and accepted by PCA.
- Grubbing should not be conducted unless a Site Restoration plan as part of the site-specific EMP has been accepted by PCA.
- The National Master Specification (NMS) Section 31 11 00 – Clearing and Grubbing, and OPSS 201 Guideline for “Clearing, Close Cut Clearing, Grubbing, Removal of Boulders and Mechanical Stump Cutting”, shall be adhered to during clearing and grubbing operations unless specified otherwise in the Historic Canals Regulations permit.
- Grubbing should not proceed too far ahead of construction. This will limit the time that the mineral soil is exposed to erosion.
- All stumps and visible surface roots shall be removed except where removal might endanger the health or stability of a nearby tree or other preserved element that has been identified for retention.
- Cleared and grubbed material shall be stockpiled in separate locations from growing medium stockpiles. Where noxious or undesirable weeds are found on site, grubbed materials shall not be used as a constituent of, or as a growing medium.
- Grubbing material should not be piled where it will block drainage courses.
  - If windrows are used, they should be kept behind roadside ditches and breaks should be provided so animals can move across the right-of-way (approximately 5 metres every 65 metres.
  - If push-outs are used, they should be pre-cut to a large enough size to avoid knockdown of standing trees.
- Remove material and debris, and dispose of at an authorized disposal site.
- Trees and shrubs removed from work areas during vegetation clearing activities shall be shredded and used as mulch on newly exposed surfaces. Mulch will be weed-free to prevent the introduction of invasive species.

Stockpile Management

- All stockpile locations, areas, heights and storage volumes must be identified in the site-specific EMP and accepted by PCA.
- Special attention shall be given to the placement and management of the salvaged topsoil and soils from other horizons.
  - Avoid stockpiling in low-lying wet areas that will result in saturated soils or in areas receiving site drainage flow.
  - Do not place geotextile material under topsoil stockpiles as such materials are subject to tearing mixing upon removal.

- When stockpiling topsoil, mound soil no higher than 1.3 m high for less than 1 year and preferably less than 6 months. Where space limitations necessitate higher mounds, topsoil stockpiles should not exceed 3 m.
  - Short-term stockpiles (< 6 months) should be covered with tarps or woven geotextile materials to prevent erosion and contamination by weeds during storage.
  - Longer term stockpiles (>6 months) should be stabilized by temporarily establishing ground cover vegetation using native Ontario species, either by application of seeded compost or seeded biodegradable mats.
- Ensure all stockpiles are protected with perimeter sediment controls (see Sediment Control (ESG-2-Pre)) and apply appropriate erosion control methods (see Erosion Control (ESG-1-Pre)).
- Clearly separate windrows/stockpiles of soils from different horizons, ensuring to stockpile topsoil/root zone and underlying mineral material separately and excavate in depth sequence.
- Where topsoil is stockpiled greater than 1.3 m or longer than 6 months, the soil shall be amended with compost to re-establish health soil structure and restore soil organism populations.

* Soil stockpiles shall be inspected monthly and every 6 months during construction for growth of noxious or invasive species.

Related Environmental Standards and Guidelines

* General Environmental Protection Procedures
* Erosion Control (ESG-1-Pre)
* Sediment Control (ESG-2-Pre)
* Soil Stripping, Grubbing and Stockpiling (ESG-3-Pre)
* Vegetation Clearing and Protection (ESG-5-Pre)
* Revegetation (ESG-1-Post)

Related EMP Component Plans

* Dust and Air Quality Management
* Transportation Management
* Surface Water Management, Erosion and Sediment Control
* Vegetation Protection
* Species at Risk Protection
* Invasive Species Management
* Waste Management
* Site Restoration

Other Design and Environmental Considerations

* Timing of works should avoid seasonally high rainfall and snowmelt periods.
* Timing windows for in-water works shall be respected.

Further Guidance

National Research Council of Canada, 2015. National Master Specification (NMS) Section 31 11 00 – Clearing and Grubbing. Revised August, 2015.

Government of Ontario, 2011. Ontario Provincial Standard Specification OPSS 201. Construction Specification for Clearing, Close Cut Clearing and Removal of Surface and Piled Boulders, Grubbing. November 2011.

References

CISEC, 2014. Certified Inspector and Sediment and Erosion Control Training Manual. Revised Edition V6. 9520 Pine valley Drive, Woodbridge Ontario, Canada.

Greater Golden Horseshoe Area Conservation Authorities, 2006. Erosion and Sediment Control Guidelines for Urban Construction.

Toronto and Region Conservation Authority, 2012. Preserving and Restoring Healthy Soil: Best Practices for Urban Construction. Version 1.0., June, 2012.

VOI Training Group, 2014. Environmental Field Procedures for Works in and About Water. Developed by Van Osch Innovations Ltd., 130 Columbia Street, Nanaimo, British Columbia, Canada.

Tree Protection and Hording (ESG-4-Pre)

Application to Ontario Waterways' Projects

Construction projects on Ontario Waterways are undertaken on lands that are often well vegetated with natural vegetation or grounds that have been landscaped. Individual or specimen trees may occur throughout a site and may require isolation and protection prior to site preparation works and activities (e.g., clearing, grubbing, installation of erosion and sediment controls) to prepare laydown areas, storage areas, camps, access roads/trails etc. In some cases the relocation or transplanting of trees may be warranted.

Description of Activity

Tree protection and hording involves the identification and delineation of areas and individual specimen trees to be avoided and protected from potentially damaging works and activities.

Environmental Standards and Guidelines

Trees to be Protected

All individual or specimen trees to be retained and requiring protection must be identified in the site-specific EMP and accepted by PCA. To the extent possible, retain trees >10 cm DBH intact and instead, remove lower limbs (<2.5 m high).

- All individual or specimen trees to be retained and requiring protection must be identified in the site-specific EMP and accepted by PCA. To the extent possible, retain trees >10 cm DBH intact and instead, remove lower limbs (<2.5 m high).
- Relocation or transplanting of any trees is prohibited unless accepted by PCA in the site-specific EMP. All relocations or transplanting of trees shall be planned and supervised by a Certified Arborist.
- All project personnel are to be informed of the exact location of individual or specimen trees to be retained and their protection requirements. Any special treatments or protection requirements shall be established identified in the site-specific EMP and accepted by PCA.
- Damaged trees designated for protection require assessment by a Certified Arborist.
- Delineate individual or specimen trees to be protected with flagging tape, temporary protective fence, hording or other suitable protection measures.
- The area to be protected for any individual or specimen tree shall be at a minimum radius, the area within the tree's "drip-line" plus a 1.5 m distance. This is applicable to both deciduous trees and conifers.
- The following activities are not permitted within the protected area:
    - Changes, alteration, or disturbance to grade by filling, excavating, or scraping, except as indicated in the contract documents.
    - Storage of construction materials and equipment.
    - Stockpiling of construction materials and excavated materials.
    - Disposal of liquids, including concrete sleuth, gas, oil, and paint.
    - Vehicular traffic, equipment, or pedestrian traffic.
    - Attachment of wires, ropes, lights, or other such attachments other than those of a protective nature to trees to be preserved.
    - Cleaning of equipment or material under canopy of tree or group of trees to be preserved.

Protective Fencing

Individual or specimen trees to be protected shall be fenced off by either:

- Individual or specimen trees to be protected shall be fenced off by either:
  - Chain link fence of at least 1.2 m height mounted on steel or sturdy wooden posts. Fence posts should be placed no farther than 2.4 m apart.
  - Solid plywood hoarding mounted securely on durable wooden posts. Fence posts should be placed no farther than 2.4 m apart.
  - Board fencing (i.e., hording) consisting of 100 mm square posts set securely in the ground and extending at least 1 m above the ground shall be placed as in Table 3-1, with a minimum of two horizontal boards fastened securely between posts. Fence posts should be placed no farther than 2.4 m apart.
  - Plastic fencing, “international orange” plastic (polyethylene) web fencing securely mounted on a sturdy wooden framework that includes top and bottom rail. Fence posts should be placed no farther than 2.4 m apart, or
  - Plastic fencing, “international orange” plastic (polyethylene) web fencing secured to conventional metal “T” or “U” posts driven to a minimum depth of 450 mm on 2 m minimum centers shall be installed at the limits of clearing. Plastic snow fencing should not be tied to metal stakes or rebar.

Root Protection Measures

- In the event that the installation of protective fencing for an individual or specimen tree is not possible and/or ideal, alternative measures (e.g., blasting mats, mud mats) must be implemented with prior acceptance by PCA. Such measures must provide a sufficient amount of soil compaction prevention with regards to the highest level of activity to occur within the immediate area of protection.
  - For areas of light-to-medium levels of traffic activity, a geotextile cloth shall be placed over the area of protection and covered with a 20 cm (at minimum) thick layer of mulch material. Pins or staples must be used to anchor the geotextile material to the ground.
  - For areas of medium-to-high levels of traffic activity, a geotextile cloth shall be placed over the area of protection and covered with a 20 cm (at minimum) thick layer of mulch material. The mulch material shall then be covered with 2 cm (3/4 inch) sheets of laminated plywood. Large sheets are preferred.
- Mulch material should not be permitted to pile against the trunk(s) or root flare(s) of the tree(s), as this may lead to unwanted bark rot and oxygen deprivation, subsequently leading to the death of the tree(s).

Inspections and Maintenance

- Fencing and root protection measures shall be inspected monthly.
- Plywood sheets and mulch must be replaced and replenished as necessary to maintain the 20 cm root protection layers thickness at all times.
- Any damaged fencing, hording or other approved protection measures shall be replaced immediately.
- Fencing and armoring devices shall only be removed after the completion of the project, following the final cleanup.

Related Environmental Standards and Guidelines

- General Environmental Protection Procedures
- Erosion Control (ESG-1-Pre)
- Sediment Control (ESG-2-Pre)
- Soil Stripping, Grubbing and Stockpiling (ESG-3-Pre)
- Vegetation Clearing and Protection (ESG-5-Pre)
- Invasive Species Management (ESG-11-C)
- Revegetation (ESG-1-Post)

Related EMP Component Plans

- Vegetation Protection
- Species at Risk Protection

Other Design and Environmental Considerations

- Timing windows for migratory birds and in-water works shall be respected.

References

Government of Ontario, 2011. Ontario Provincial Standard Specification OPSS 201. Construction Specification for Clearing, Close Cut Clearing and Removal of Surface and Piled Boulders, Grubbing. November 2011.

Landscape Ontario Horticultural Trades Association, 2004. Landscape Guidelines. Available at: http://landscapeontario.com/attach/1246977850.Landscape_Guidelines.pdf.

Ontario Ministry of Natural Resources, 2009. Environmental Guidelines For Access Roads and Water Crossings.

Vegetation Clearing and Protection (ESG-5-Pre)

Application to Ontario Waterways' Projects

Site preparation for a construction project on PCA property may require the removal of natural vegetation to prepare for construction. Areas of a construction site that typically require large areas to be cleared are laydown areas, storage areas, locations of camps, new access roads or trails etc. Practically all projects completed by Parks Canada on Ontario Waterways occur in close proximity to fish bearing waterbodies. The protection of fish habitat and water quality during near water and in water construction projects is of critical importance to Park Canada. Protecting existing vegetation, especially in close proximity to waterbodies, reduces the potential for soil erosion and sedimentation (off-site migration and deposition of fine sediment) at construction sites. For these reasons, the protection of riparian vegetation is applicable to most major and small scale construction projects on Ontario Waterways. This ESG applies to the removal and protection of common, natural (non-SAR) vegetation.

Description of Activity

The primary objective of vegetation protection is to identify and retain as much vegetated areas as possible. On land this is accomplished by delineating protection or "no go" zones. Near water this is accomplished maintaining or creating a buffer strip along the riparian zone to maintain of a healthy aquatic environment. Overall, protection is accomplished by limiting the removal of vegetation, avoiding unnecessary intrusion, and delaying removals until just before the area is about to be worked. Vegetative buffers protect adjacent waterbodies or wetlands from the effects of sedimentation and stabilize the shoreline against erosion and bank failure. Nevertheless, some vegetation clearing will likely be necessary for most projects. Vegetation clearing involves felling, trimming, and cutting of trees and shrubs, the removal (e.g., downed timber, snags, brush,), and grass cutting occurring within areas to be cleared in preparation for construction (i.e., not a maintenance activity).

Environmental Standards and Guidelines

- All vegetation clearing activities are subject to compliance with the *Migratory Birds Convention Act*. Vegetation clearing work shall not be undertaken during the active bird breeding season (April 1st to August 31st),
- All vegetated areas to be cleared must be identified in the site-specific EMP and accepted by PCA. An inventory of species to be removed shall be undertaken.
- All vegetated areas to be protected must be identified in the site-specific EMP and accepted by PCA. No vegetation shall be removed until all protection or "no go" zones are established and accepted by PCA.

Vegetated Areas to be Protected

- Clearing of vegetation, including the clearing of vegetation in riparian areas, shall be minimized.
- All vegetated areas (e.g., forested areas, riparian areas, other vegetated buffers) to be retained and requiring protection must be identified in the site-specific EMP and accepted by PCA.
- All project personnel are to be informed of the exact location of the areas to be retained and their protection requirements. Any special treatments or protection requirements shall be established identified in the site-specific EMP and accepted by PCA.

- Vegetated areas to be protected shall be delineated with flagging tape, temporary protective fence, hording or other suitable protection measures.
- The forested area to be protected shall be a minimum distance from the largest “drip-line” plus a 1.5 m distance. This is applicable to both deciduous trees and conifers within a forested area.
- The following activities are not permitted within the protected area:
  - Changes, alteration, or disturbance to grade by filling, excavating, or scraping, except as indicated in the contract documents.
  - Storage of construction materials and equipment.
  - Stockpiling of construction materials and excavated materials.
  - Disposal of liquids, including concrete sleuth, gas, oil, and paint.
  - Vehicular traffic, equipment, or pedestrian traffic.
  - Attachment of wires, ropes, lights, or other such attachments other than those of a protective nature to trees to be preserved.
  - Cleaning of equipment or material under canopy of tree or group of trees to be preserved.

Protective Fencing

- Vegetated areas, including riparian area buffers, to be protected shall be fenced off by either:
  - Chain link fence of at least 1.2 m height mounted on steel or sturdy wooden posts. Fence posts should be placed no farther than 2.4 m apart.
  - Solid plywood hoarding mounted securely on durable wooden posts. Fence posts should be placed no farther than 2.4 m apart.
  - Board fencing (i.e., hording) consisting of 100 mm square posts set securely in the ground and extending at least 1 m above the ground shall be placed as in Table 3-1, with a minimum of two horizontal boards fastened securely between posts. Fence posts should be placed no farther than 2.4 m apart.
  - Plastic fencing, “international orange” plastic (polyethylene) web fencing securely mounted on a sturdy wooden framework that includes top and bottom rail. Fence posts should be placed no farther than 2.4 m apart, or
  - Plastic fencing, “international orange” plastic (polyethylene) web fencing secured to conventional metal “T” or “U” posts driven to a minimum depth of 450 mm on 2 m minimum centers shall be installed at the limits of clearing. Plastic snow fencing should not be tied to metal stakes or rebar.

Clearing and Debris Handling Methods

- Vegetation clearing shall be undertaken in accordance with National Master Specification (NMS) Section 31 11 00 – Clearing and Grubbing (2015).
- Staging and sequencing of vegetation clearing shall be planned to coincide with construction activities and the installation of erosion and sediment controls.
  - Where advanced vegetation clearing is necessary, leave the vegetative ground mat and root structure intact to the extent practicable.
  - If riparian vegetation is to be removed, erosion and sediment control measures shall be in place prior to the commencement of clearing activities.
- Trees shall only be cut using tools designed for tree cutting activities (e.g., chainsaws, brush saws). Tree removal or pruning shall be a clean cut. Work on mature trees near power lines, overhead facilities or adjacent to public roads should be undertaken under the supervision of a Certified Arborist. The *Ontario Occupational Health and Safety Act* requires that people and equipment keep a minimum distance of 3 m from high voltage power lines (750 volts and above).

- Trees shall only be cut using tools designed for tree cutting activities (e.g., chainsaws, brush saws). Tree removal or pruning shall be a clean cut. Work on mature trees near power lines, overhead facilities or adjacent to public roads should be undertaken under the supervision of a Certified Arborist. The *Ontario Occupational Health and Safety Act* requires that people and equipment keep a minimum distance of 3 metres from high voltage power lines (750 volts and above).
- Vegetation clearing from unstable or erodible banks or riparian areas shall be minimized or undertaken by hand. Use of heavy machinery will not be acceptable.
- Use equipment with wide track or "high float" rubber tired vehicles and having a greater reach to reduce the overall area of disturbed vegetation and soil compaction.
- Woody material less than 10 cm DBH of non-invasive species will be chipped or mulched. The material will be stored on-site to supplement erosion and sediment controls when required. Surplus material should either be stored or disposed off-site.
- Logs of 10 cm DBH or greater may be left on-site with approval of PCA.
- Burning of vegetation or other debris is prohibited.

Related Environmental Standards and Guidelines

- General Environmental Protection Procedures
- Erosion Control (ESG-1-Pre)
- Sediment Control (ESG-2-Pre)
- Soil Stripping, Grubbing and Stockpiling (ESG-3-Pre)
- Tree Protection and Hording (ESG-4-Pre)
- Vegetation Clearing and Protection (ESG-5-Pre)
- Invasive Species Management (ESG-11-C)
- Use and Maintenance of Heavy Equipment (ESG-15-C)
- Wildlife and Species at Risk Protection During Construction (ESG-17-C)
- Revegetation (ESG-1-Post)

Related EMP Component Plans

- Dust and Air Quality Management
- Transportation Management
- Surface Water Management, Erosion and Sediment Control
- Vegetation Protection
- Species at Risk Protection
- Invasive Species Management
- Waste Management
- Site Restoration

Other Design and Environmental Considerations

- Timing of works should avoid seasonally high rainfall and snowmelt periods.
- Timing windows for in-water works shall be respected.

Further Guidance

Government of Ontario, 2011. Ontario Provincial Standard Specification OPSS 201. Construction Specification for Clearing, Close Cut Clearing and Removal of Surface and Piled Boulders, Grubbing. November 2011.

National Research Council of Canada, 2015. National Master Specification (NMS) Section 31 11 00 – Clearing and Grubbing. Revised August, 2015.

References

Coker, G.A., Ming, D.L., and Mandrak, N.E. 2010. Mitigation Guide For The Protection Of Fishes and Fish Habitat To Accompany The Species at Risk Recovery Potential Assessments Conducted by Fisheries and Oceans Canada (DFO) in Central and Arctic Region. Version 1.0. Can. Manuscr. Rep. Fish. Aquat. Sci. 2904: vi + 40 p.

Environment Yukon, 2011. Best Management Practices for Works Affecting Water in Yukon. Water Resources Branch, Government of Yukon.

Erosion and Sediment Control Guidelines for Urban Construction, 2006. Greater Golden Horseshoe Area Conservation Authorities.

Landscape Ontario Horticultural Trades Association, 2004. Landscape Guidelines. Available at: http://landscapeontario.com/attach/1246977850.Landscape_Guidelines.pdf.

Ontario Ministry of Natural Resources, 2009. Environmental Guidelines For Access Roads and Water Crossings.

VOI Training Group, 2014. Environmental Field Procedures for Works in and About Water. Developed by Van Osch Innovations Ltd., 130 Columbia Street, Nanaimo, British Columbia, Canada.

Abrasive Blasting (ESG-1-C)

Application to Ontario Waterways' Projects

Repairs and upgrades to locks, walls, dams and bridges may require abrasive blasting to remove rust, scale, paint, etc., from surfaces in preparation for finishing.

Description of Activity

The process of abrasive blasting uses compressed air to propel the abrasive material at high speeds to remove the old surface finish. Significant amounts of dust are generated during the process. A variety of abrasive materials can be used and include: silica sand, glass beads, metal slag (e.g., Kleen Blast), steel grit, metal shot, and aluminum oxide. In the case of wet blasting, water is used as the abrasive media along with compressed air to achieve the desired surface finish. Wet abrasive blast cleaning is also known as wet blasting or vapor abrasive blast cleaning. Abrasive blasting will result in the generation of solid and/or liquid wastes. The primary types of solid wastes are spent abrasives and removed coating materials, rust and scale. Other solid wastes may include off-specification coatings, contaminated soils, protective clothing and materials damaged during blasting operations. Liquid wastes are typically waters contaminated by coatings, rust and scale.

Environmental Standards and Guidelines

- The proposed use of abrasive blasting and the types of wastes that may be produced must be identified in the site-specific EMP and accepted by PCA.
- All abrasive blasting must be carried out in an approved abrasive blasting enclosure. Options include:
  - *Partial or Full Enclosure:* A partial or full enclosure is to be used when the abrasive blasting procedure is carried out in proximity to any residential area or watercourse. The abrasive blasting area is partially enclosed with a tarp on the floor to collect spent debris and partial side enclosures to prevent particles from being blown around. The sides of the enclosure shall be as high as the area which is being worked on. A full enclosure involves an abrasive blasting area that is enclosed on all sides including the top of the area.
  - *Full enclosure with negative pressure:* A full enclosure with negative pressure is to be used when escape of all or any materials or debris from the operations must be prevented. The abrasive blasting area is an area which is sealed tight on all joints and entryways to prevent any leakage of dust. It utilizes negative pressure from forced airflow along with dust collectors.
- The spent abrasive material must be cleaned out of the working area at least once a day. If heavy abrasive blasting with high accumulations of dust occurs, the area may need to be cleaned on a more regular basis (e.g., at end of shift or when sectional tasks are completed).
- Where wet abrasive blasting is carried out, care must be taken due to the accumulation of water on the floor area. Waters used in wet abrasive blasting must be separated and isolated in the work areas. If wet abrasive blasting is carried out, only a partial enclosure is required.

Spent Abrasives and Wastewater Management

- Spent abrasives along with waste generated, must be contained in covered containers with appropriate visible labels until tested.
- Spent abrasives, wastewater and other wastes generated during abrasive blasting operations cannot be removed from the project site until it is tested. This wet or dry waste material must be defined as a non-hazardous waste or hazardous waste.
- Wastewater (contaminated or otherwise) that is generated by wet abrasive blasting is to be considered as a Liquid Industrial Waste (LIW) under R.R.O 1990, Regulation 347 (O. Reg. 347) of the *Environmental Protection Act*. All wastewater must be contained in sealed containers and temporarily stored on the project site until it is collected for disposal by a licensed waste hauler.
- All off-site shipments of spent abrasives and wastewater must be accompanied by a MOECC waste manifest and the generator of the materials must be registered as a generator of hazardous waste with the MOECC. A Hazardous Waste Information Network (HWIN) number will be issued for the waste generator upon their registration with the MOECC, and this HWIN number must be used on all waste manifests.
- All other non-hazardous waste generated by abrasive blasting operations shall be disposed according to Ontario Regulation 558/00. R.R.0. 1990 (General – Waste Management).
- Environmental permits shall be obtained by the Contractor for any off-site disposal.

Related Environmental Standards and Guidelines

- General Environmental Protection Procedures
- Fugitive Dust Control During Construction (ESG-8-C)

Related EMP Component Plans

- Dust and Air Quality Management
- Noise, Vibration and Ambient Light Management
- Blasting
- Surface Water Management Erosion and Sediment Control
- Aquatic Resources Management
- Hazardous Materials Management

Other Design and Environmental Considerations

- Timing of works should avoid seasonally high rainfall and snowmelt periods.

References

Government of Newfoundland and Labrador, 1996. Environmental Code of Practice for Abrasive Blasting. Prepared by the Department of Environment and Labour, Industrial Environmental Engineering Division. March 1995. Revised June 1996. Available at: http://www.ecc.gov.nl.ca/env_protection/abrasive_blasting.pdf

Nova Scotia Power, 2014. Contractor Environmental Requirements. Available at: https://www.nspower.ca/site/media/Parent/Contractor%20Environmental%20Requirements.pdf

Blasting (ESG-2-C)

Application to Ontario Waterways' Projects

Blasting on land is occasional required during some construction projects when the removal of large quantities of rock is required. Blasting on land has the potential to result in adverse noise and vibration to local receptors including nearby residents and communities as well as wildlife. When conducted in proximity to Ontario Waterways, blasting also has the potential to harm or kill fish and adversely affect water quality. The use of explosives to remove quantities of rock is more likely to be associated with large scale PCA construction projects.

Blasting in or near waterbodies has the potential to disrupt or cause serious harm to fish. Uncontrolled or unmitigated blasting will adversely affect water quality. The proximity of PCA's assets to fish bearing waterbodies elevates the need to address these potential effects and adhere to strict standards and guidelines.

Description of Activity

Blasting is the controlled use of explosives to clear or excavate large quantities of intact rock. Blasting produces noise and vibration shock waves that can adversely affect nearby wildlife and temporarily affect nearby residents and communities. Blasting in / or near water produces shock waves that can damage fish swim bladders and rupture their internal organs. Blasting vibrations may also kill or damage fish eggs or larvae. Chemicals harmful to aquatic life, including ammonia, can be released from the explosive into the water during blasting.

Environmental Standards and Guidelines

- A construction and operation of a factory or a fixed site for the manufacture of blasting explosives shall be avoided. Explosives should be transported to the site and stored temporarily for use on-site.
- Blasting on land and in-water should be avoided. No blasting should occur within 300 m of known bat habitat features.
- Should blasting be required, a Blasting plan must be included in the site-specific EMP and accepted by PCA.
- The Blasting plan shall be developed by a Qualified Professional(s), in accordance with:
  - OPSS 120 General Specification for the Use of Explosives, including 120.04 Submission and Design Requirements.
  - "Guidelines for the use of Explosives In or Near Canadian Fisheries Waters" (DFO 1998) to reduce particle velocities and pressure changes created by underwater explosives that can result in fish injuries and mortality. This also includes the methods of small scare blasts and stacking of charges.
  - Canadian Standards Association Z107.54-M85 (R 1999) regarding procedure for measurement of sound and vibration due to blasting operations.
  - OPSS 120 General Specification for the Use of Explosives, including OPSS 120.07.04 Monitoring and address the following:
    - Ground vibration and the peak sound pressure level shall be monitored 100 m from the blast site or at the closest residence, utilities, structure, or facility within this radius during each blast.

- Water overpressure in affected fish habitats shall be monitored adjacent to the shore closest to the blast site.

- All blasting operations shall be undertaken under the supervision of a Qualified Professional.
- PCA shall be notified within 48 hours prior to the commencement of any blasting activities.

Related Environmental Standards and Guidelines

- General Environmental Protection Procedures
- Erosion Control (ESG-1-Pre)
- Sediment Control (ESG-2-Pre)
- Borehole and Rock Drilling (ESG-3-C)
- Fish Exclusion, Salvage and Relocation (ESG-7-C)

Related EMP Component Plans

- Dust and Air Quality Management
- Noise, Vibration and Ambient Light Management
- Blasting
- Demolition
- Surface Water Management Erosion and Sediment Control
- Vegetation Protection
- Wildlife Protection and Management
- Aquatic Resources Management
- Species at Risk Protection
- Hazardous Materials Management
- Fuel Management

Other Design and Environmental Considerations

- Timing windows for migratory birds and in-water works shall be respected.

Further Guidance

Ontario Provincial Standard Specification (OPSS) 120 - General Specification for the Use of Explosives Department of Fisheries and Oceans, 1998. Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters.

Canadian Standards Association Z107.54-M85 (R 1999) Procedure for Measurement of Sound and Vibration Due to Blasting Operations.

References

British Columbia Ministry of Forests, Lands and Natural Resource Operations, 2014. A Compendium of Wildlife Guidelines for Industrial Development Projects in the North Area, British Columbia Interim Guidance, November 19 2014.

Gosse, M.M., A.S. Power, D.E. Hyslop, and S.L. Pierce. 1998. Guidelines for Protection of Freshwater Fish Habitat in Newfoundland and Labrador. Fisheries and Oceans, St. John's, NF. x + 105 pp., 2 appendices.

Borehole and Rock Drilling (ESG-3-C)

Application to Ontario Waterways' Projects

Borehole and rock drilling are occasional required during some construction projects when there is a need to undertake geotechnical investigations to determine the physical properties of soil and rock in order to assist with the design earthworks and/or foundations for locks, dams and bridges. Borehole and rock drilling may also be required for the construction of anchors, coffer dam steel beams, the installation of ground water monitoring or dewatering wells. Borehole and rock drilling has the potential to result in adverse noise and vibration to local receptors including nearby residents and communities as well as wildlife. When conducted in water or in proximity to a waterway, borehole and rock drilling also has the potential to disturb or harm fish and adversely affect water quality.

Description of Activity

There are several types of borehole and drilling methods. Diamond drilling produces cylindrical pieces of rock called core; reverse circulation or rotary drilling produces chips of rock; overburden drilling is conducted to sample overburden, and augur drilling is used most often to sample surficial soils for geotechnical purposes. Borehole and rock drilling can be conducted with small truck mounted or track mounted drill rigs or with larger fixed drill rigs. Drill rigs may also be employed on barges.

For most drilling activities, small areas of land must be cleared to make a drill pad or for access. It must be large enough for safe operation of the drill and other equipment. Some types of drilling, including diamond drilling, pump water to the drill and down the hole. The water pumps may be placed on the shores of lakes, rivers and streams. The water is pumped through heavy hoses to the drill rig.

Environmental Standards and Guidelines

- Borehole and rock drilling shall conform to Parks Canada Agency's "BMP: Geotechnical Investigations (Bore-hole Drilling)" (2016).
- All borehole and rock drilling activities, including construction, operation and decommissioning shall be undertaken under the supervision of a Qualified Professional.
- The PCA Environmental Authority shall be contacted and advised at least fourteen (14) days in advance of the start of the proposed borehole or rock drill operations. All drilling locations will be identified on a map with GPS coordinates in the EMP. If borehole locations are moved greater than 3 m or are within 5 m of identified/know archaeological resources, PCA's Environmental Authority must review and accept changes.

Drill Cuttings and Fluid Management

- Drill cuttings and fluids shall not be released into a wetland, watercourse or waterbody under any circumstances.
- If drilling fluids are required, only fresh water shall be used for fluid preparation. No toxic or hazardous substances are to be added to the drilling fluid at any time.
- All lubricants used on drill bits, casings or down-hole applications shall be free of any toxic or hazardous substances
- Recirculation pits or in-ground sumps shall be constructed (as surface conditions allow) to contain drilling mud, cuttings, treatment chemicals and discharged water from the drilling process. Drill cuttings recirculation tanks that capture cuttings will be required where sumps cannot be constructed, such as in bedrock.
- At the conclusion of drilling, sumps will be backfilled with clean soil materials, leveled and graded.

Purged Groundwater and Drilling Wastes

- Groundwater (contaminated or otherwise) that has been purged/removed from groundwater monitoring wells is defined as a Liquid Industrial Waste (LIW) under R.R.O 1990, Regulation 347 (O. Reg. 347) of the *Environmental Protection Act*. All groundwater purged from monitoring wells must be contained in sealed containers and temporarily stored on the project site until it is collected for disposal by a licensed waste hauler.
- All off-site shipments of purged groundwater must be accompanied by a MOECC waste manifest and the generator of the purged groundwater must be registered as a generator of hazardous waste with the MOECC. A Hazardous Waste Information Network (HWIN) number will be issued for the waste generator upon their registration with the MOECC, and this HWIN number must be used on all waste manifests.
- All waste generated by drilling shall be disposed according to Ontario Regulation 558/00. R.R.0. 1990 (General – Waste Management)
- Environmental permits shall be obtained by the Contractor for any off-site disposal.

Artesian or Flowing Wells

- Artesian or flowing wells must be controlled and constructed in accordance with Ontario Regulation 903 (Wells) as amended, made under the *Ontario Water Resources Act* which provides minimum construction requirements for the construction of a flowing well.

Borehole or Well Decommissioning

- A borehole or well shall be abandoned if it is not being used or maintained for future use and decommissioned in accordance with Ontario Regulation 903 (Wells) as amended, made under the *Ontario Water Resources Act*.

Related Environmental Standards and Guidelines

- General Environmental Protection Procedures
- Erosion Control (ESG-1-Pre)
- Sediment Control (ESG-2-Pre)
- Vegetation Clearing and Protection (ESG-5-Pre)
- Fugitive Dust Control During Construction (ESG-8-C)
- Refueling and Spill Management (ESG-13-C)
- Treatment of Discharge Waters (ESG-14-C)
- Use and Maintenance of Heavy Equipment (ESG-15-C)

Related EMP Component Plans

- Dust and Air Quality Management
- Noise, Vibration and Ambient Light Management
- Site Dewatering and Wastewater Plan
- Surface Water Management, Erosion and Sediment Control
- Species at Risk Protection
- Fuel Management
- Spills Prevention and Emergency Response

Other Design and Environmental Considerations

- Works are preferably undertaken during periods of dry weather (e.g., summer) as this allows easier control of sediment.
- Timing windows for in-water works shall be respected.

Further Guidance

Parks Canada Agency, 2016. BMP: Geotechnical Investigations (Bore-hole Drilling), September, 2016.

Ontario Water Resources Act, R.R.O. 1990, Regulation 903. Wells.

Ontario Protection Act, R.R.O. 1990, Regulation 558/00. General – Waste Management.

Chipping and Cutting (ESG-4-C)

Application to Ontario Waterways' Projects

Projects involving repairs and upgrades to assets such as locks, bridges, retaining / approach walls and concrete dams often require the removal of concrete by chipping and cutting. Construction operations that involve chipping and cutting require special consideration because concrete is alkaline and highly toxic to fish and aquatic life. Concrete and concrete wastewater that contains suspended cement particles may increase the pH of water to a pH of 10 – 12. Concrete chipping and cutting also produces fine dust and sediment that is extremely difficult to remove once in suspension with water. Measures must be taken to prevent any incidence of concrete or concrete wastewater or leachate from entering a watercourse, either directly or indirectly.

Description of Activity

Chipping typically involves breaking off small pieces of concrete from surfaces by chiseling and/or routing out cracks in concrete with a saw or angle grinder before filling with a repair material. Cutting involves scoring the concrete surface and/or slicing the concrete into pieces using a sharp, straight-edged tool (e.g., concrete saw). While chipping is primarily a dry operation undertaken on land, concrete cutting can be undertaken on land using water to wet the concrete surface and cutting tool and underwater. Both chipping and cutting of concrete results in rubble of various dimensions, from fine dust to large concrete slabs. Concrete cutting may also result in leachates and slurries or concrete pastes. Concrete pieces may contain internal or exposed materials (e.g., rebar, wood, rock)

Environmental Standards and Guidelines

General

- Chipping and cutting operations undertaken in the "dry" are preferred to operations using water or those conducted underwater.
- The work site involving chipping and cutting of concrete shall be isolated from the environment. The isolated work site should be sufficiently large to contain water run-off, residues and any waste material. Prior to commencement of the work, water, erosion and sediment control measures shall be installed to ensure that concrete debris, concrete fines, wash or contact water is not deposited directly or indirectly into any watercourse, stormwater drain, ditch or street gutter. Measures (e.g., sediment bags with or without the use of flocculants) must be tailored to capture very small fines. See Sediment Control (ESG-2-Pre).

Dry Chipping and Cutting – Fugitive Dust Control

- Fugitive dust emissions from dry chipping and cutting operations shall be strictly controlled. See Abrasive Blasting (ESG-1-C).

Wet Cutting – Water Management

- Use as little water as possible when wet cutting.
- Runoff water shall be collected by a wet industrial vacuum or suction pump and filtered into covered containers.
- Water from wet cutting operations shall be strictly controlled. The discharge of concrete leachate or slurries into a watercourse is prohibited. See Concrete Pour Operations and Grouting (ESG-5-C).

Clean-up and Waste Management

- Concrete debris shall be placed into an enclosed container daily, or more frequently if required, in order to ensure that no debris escape or remain at the site.
- Washing of cutting or chipping tools and equipment in any body of water is prohibited. All cutting and chipping equipment must be washed in a wash down area. Any wash-down area location shall be identified and approved in the EMP. (See Concrete Pour Operations and Grouting (ESG-5-C)).
- All concrete debris shall be completely removed and area restored to original state upon completion of work.
- Concrete cutting leachates or slurries generated during chipping or cutting operations cannot be removed from the project site until tested. This waste material must be defined as a non-hazardous waste or hazardous waste.
- Leachates or slurries (contaminated or otherwise) that are generated by wet cutting with a pH ≥ 12.5 are considered corrosive and a hazardous waste under Ontario Regulation 347 of the *Environmental Protection Act.* All leachates and slurries must be contained in sealed containers and temporarily stored on the project site until they are collected for disposal by a licensed waste hauler.
- All off-site shipments of concrete cutting leachates or slurries must be accompanied by a MOECC waste manifest and the generator of the materials must be registered as a generator of hazardous waste with the MOECC. A Hazardous Waste Information Network (HWIN) number will be issued for the waste generator upon their registration with the MOECC, and this HWIN number must be used on all waste manifests.
- All other non-hazardous waste generated chipping or cutting operations shall be disposed according to Ontario Regulation 558/00. R.R.0. 1990 (General – Waste Management). Concrete debris that is considered to be inert should be diverted from landfill.
- Environmental permits shall be obtained by the Contractor for any off-site disposal.

Environmental Performance and Monitoring

- Concrete leachate and slurries shall be routinely tested to confirm compliance with performance standards.
- Monitor pH frequently in the intake of discharge pump, holding tank, outflow of the isolated worksite until the works are completed. Corrective measures should be implemented if downstream water pH has changed more than 1.0 pH unit, measured to an accuracy of +/- 0.2 pH units from the background level, or is below 6.5 or above 9.0 pH units.

Related Environmental Standards and Guidelines

- General Environmental Protection Procedures
- Erosion Control (ESG-1-Pre)
- Sediment Control (ESG-2-Pre)
- Concrete Pour Operations and Grouting (ESG-5-C)
- Treatment of Discharge Waters (ESG-14-C)

Related EMP Component Plans

- Dust and Air Quality Management
- Noise, Vibration and Ambient Light Management
- Demolition
- Surface Water Management, Erosion and Sediment Removal

Other Design and Environmental Considerations

- Works are preferably undertaken during periods of dry weather (e.g., summer) as this allows easier control of sediment.

References

NSW Environmental Protection Authority, 2002. Environmental Management Best Practice Guideline for Concrete Contractors. ISBN o-7347-7535-0, October 2002. Available at: www.epa.nsw.gov.au.

VOI Training Group, 2014. Environmental Field Procedures for Works in and About Water. Developed by Van Osch Innovations Ltd., 130 Columbia Street, Nanaimo, British Columbia, Canada.

Concrete Pour Operations and Grouting (ESG-5-C)

Application to Ontario Waterways' Projects

Concrete dam replacement projects, and projects involving repairs and upgrades to assets such as locks, bridges, retaining / approach walls and concrete dams may require the pouring of concrete for foundations and/or for the main structure. Concrete pours underwater are undertaken by a special technique referred to as a "Tremie Pour". Grouting and sealing operations are also undertaken to seal a dam to its foundations, stabilize rock anchors. Sealants may also be used to seal concrete surfaces or infill cracks and joints in the concrete once poured.

Construction operations that involve concrete pours and grouting require special consideration because concrete and grouts are alkaline and highly toxic to fish and aquatic life. Concrete and concrete wastewater contains suspended cement particles which may increase to a pH of 10 – 12. Measures must be taken to prevent any incidence of concrete, wastewater or concrete leachate from entering a watercourse, either directly or indirectly.

Description of Activity

Concrete pouring operations involve producing the desired concrete material either on-site or off-site, ensuring the concrete is properly mixed, placed into forms, shaped, and cured / set within time constraints. Cement pouring operations are strictly controlled to achieve its desired properties such as mechanical strength, low moisture permeability, and chemical and volumetric stability.

Tremie concrete is a special mix that allows the concrete to be placed underwater or into deep foundations. Tremie concrete has the ability to achieve full compaction by self-weight when placed by Tremie in a deep foundation, under submerged conditions. Underwater concreting using the Tremie method is convenient for pouring large amount of high flowable concrete. The concrete is moved to the hopper by either pumping, belt conveyer or skips. Tremie pipe, which upper end connected to a hopper and lower end continuously submerged in fresh concrete, is used to place concrete at the exact location from a hopper at the surface.

Any interruption in pouring of the concrete can cause the initially placed material to begin to set before the next batch is added on top. A wide variety of equipment is used for concrete pour operations, from hand tools to heavy industrial machinery (e.g., mixers, pumpers). Concrete washout areas are typically used to contain concrete slurry and liquids when the chutes of concrete mixers and hoppers of concrete pumps are rinsed out after delivery to a site. The washout facilities are used to consolidate solids for easier disposal or reuse and to prevent runoff of contaminated liquids.

Grouting and sealing is carried out to fill cracks and voids in concrete and to fill voids partly occupied by several different types of materials (e.g., concrete, metal, rock, etc.). Cementitious grouts are most commonly applied in sealing of concrete, brick or rock structures. Chemical grouts (e.g., epoxy mixes, polyurethane) are used in smaller quantities for more specialized purposes. Equipment used in the application of cementitious grouting includes grout mixers, holding tanks with agitators, pumps and various grout applicators.

Environmental Standards and Guidelines

General

- All concrete pour operations must be described in the Construction Plan of the site-specific EMP and accepted by PCA.
- Use pre-cast concrete structures where feasible to minimize concrete pour operations.
- Works are preferably undertaken during periods of dry weather (e.g., summer) as this allows easier control of sediment.
- Concrete delivery routes and pump truck and/or concrete delivery system location(s) must be described in the site-specific EMP and accepted by PCA.
- Washing of concrete pouring, grouting and sealing tools and equipment in any body of water is prohibited. All concrete pouring, grouting and sealing equipment must be washed in a wash-down area.
- All wash-down area and containment facility locations must be identified in the site-specific EMP and accepted by PCA.
- All concrete products, grouts and sealants shall be stored under cover, away from watercourse, stormwater drains, ditches or street gutters
- Prior to commencement of the work, ensure water, and sediment control measures are designed to ensure that concrete is not deposited directly or indirectly into any watercourse, stormwater drain, ditch or street gutter.
- No excess concrete shall be deposited on-site.

Normal Concrete Pour Operations

- PCA shall be notified within 48 hours prior to the commencement of any significant concrete pour operations (e.g., foundations) and for all Tremie pour operations.
- Maintain complete isolation of cast-in-place concrete for a minimum of 48 hours if the ambient air temperature is above 0°C (for the entire period) and for a minimum of 72 hours if ambient air temperature is below 0°C;
- All water that contacts uncured or partly cured concrete, all leachates or wastewater with high pH (greater than 9) shall be captured in a wastewater containment area.
- The waste water containment area shall be designed by a Qualified Professional(s) and sized to hold twice the volume of anticipated water run-off, leachate or wastewater.
- Carbon dioxide (CO_2) or neutralizing acids shall be used to neutralize waters with high pH (greater than 9).
- Sufficiently sized carbon dioxide (CO_2) tanks with regulators, hoses and gas diffuser, shall be readily available during normal concrete pour operations. The tank shall be used to release carbon dioxide gas into an affected area to neutralize pH levels should a concrete spill occur. Workers shall be trained in the use of the tank.
- Neutralizing acids must be contained in a professionally established system operated by a Qualified Professional.
- Any use of carbon dioxide (CO_2) or neutralizing acids to modify pH levels shall be reported to PCA as soon as reasonably possible

Tremie Pour Operations

- Tremie pour operations must be described in the Construction Plan of the site-specific EMP and accepted by PCA.
- Tremie pour operations may be undertaken where site conditions do not allow work in the "dry" and in still water or near zero flow conditions exist (i.e., <0.5 m/sec). Justification of the need for the Tremie pour operations must be included in the site-specific EMP.
- All Tremie our equipment shall be operated from the shore.
- All forms shall be examined prior to concrete pours to ensure they are tight.
- The work area for a Tremie pour shall be isolated with a turbidity curtain (See Sediment Control ESG-2-Pre) and/or impermeable material (e.g., sheet piling, sandbags plus impermeable material to line sandbags).
- Carbon dioxide (CO_2) shall be used to neutralize waters with high pH (greater than 9).
- Sufficiently sized carbon dioxide (CO_2) tanks with regulators, hoses and gas diffuser, shall be readily available during normal concrete pour operations. The tank shall be used to release carbon dioxide gas into an affected area to neutralize pH levels should a concrete spill or seepage from the concrete form occur. Workers shall be trained in the use of the tank.
- Any use of carbon dioxide (CO_2) to modify pH levels shall be reported to PCA as soon as reasonably possible
- The use of neutralizing acids to neutralize waters with high pH is prohibited at Tremie pour operations.

Grouting and Sealing

- The type(s) of grouts and sealants proposed for use shall be identified in the site-specific EMP and accepted by PCA.
- Avoid mixing or ordering more grout and sealant material than is required to complete the work.
- Isolate the work site involving grouting to the extent possible. The isolated work site should be sufficiently large to contain water run-off, residues and any waste material.
- Store grout and sealant products under cover, away from watercourse, stormwater drains, ditches or street gutters.
- All grout and sealant products and excess materials shall be removed in a way that will ensure material does not enter the waterway, stormwater drain, ditch or street gutter. Collect excess grout in the "dry".

Wash-down Areas

- Provide appropriately sized containment facilities for the wash-down water from concrete delivery trucks, concrete pumping equipment.
- Containment structure area should be emptied/changed once 50% full.
- The wash-down area should be located away from a watercourse, stormwater drain, ditch or street gutter on flat even terrain.
- The wash-down area should be conveniently located for washing out equipment and clearly sign-posted.
- All wash-down water is to be contained.
- Concrete wash-down areas are generally not designed for the collection of excess concrete. Excess concrete waste should be returned to the local batching plant for treatment and re-use, or placed in a site receptacle designated for concrete and masonry, and allowed to set.
- To minimize the amount of wash-down water generated, excess concrete should be scraped off the equipment before it is washed and placed in a site receptacle designated for concrete.
- A high pressure, low volume water spray nozzle should be used to reduce water use.

Spill Response Involving Wet Concrete

In situations where wet (fresh) concrete or partially mixed cementitious materials, or waste water are released from concrete pouring equipment (e.g., the mixer drum, pumper truck) or forms in an uncontrolled situation the following release response procedures should be followed:

- Concrete is considered a deleterious substance and must be reported to PCA and the Ontario Ministry of Environment and Climate Change Spills Action Centre (SAC).
- Maintain an on-site concrete spill response kit that includes:
  - Sand bags (number to match the scale of the project) and to isolate a contaminated area
  - Impermeable material to line sandbags
  - Impermeable turbidity curtains
  - CO_2 Bubblers
- Secure concrete spill area and establish access control.
- Safely contain the released material. Build berms using available on-site surface materials to contain the wet concrete or slurry. Berms constructed from low permeability material (e.g., clays) are preferred. Ensure the flow of wet concrete or slurry is prevented from entering any storm sewer opening, drainage ditch or water body.
- Depending on site conditions and area activities, let the wet concrete set, (usually within 75 to 120 minutes). Once set up, spilled concrete can be broken up using available equipment (e.g., loader, dozer or backhoe), loaded and trucked away for recycling or disposal. If the release occurs on bare ground, some surface soil may have to be removed.
- For slurry, collect into drums or plastic garbage cans if spill volume is less than one cubic meter. A vacuum truck is recommended for collecting any larger volumes of slurry.
- If the concrete spill occurs into a drainage ditch, use berms of low permeability materials and sandbags to contain the spilled concrete.
- If concrete is spilled in a watercourse or waterbody – deploy impermeable turbidity curtains to contain area. Once site is contained, install CO_2 bubbler and removed as much solid material as possible.
- Let the wet concrete set. When set, concrete can be recovered using available equipment (e.g., loader, dozer or backhoe), broken up and trucked away for recycling or disposal. All efforts must be made in recovery to avoid further disturbance of the bed, slopes or banks of the water body or watercourse. Isolation berms cannot be removed until pH has returned to background levels.
- Monitoring of water pH downstream of a worksite or discharge point shall be undertaken at 100 m, 200, and 400 m or as directed by PCA.

Water Quality Monitoring

- All concrete pours in or near water must have a Qualified Professional(s) on-site to monitor downstream surface water turbidity and pH and assist in mitigating the effects of a concrete release.
- Water pH shall be monitored frequently in the intake of discharge pump, holding tank, outflow, and/or downstream of the isolated work site or discharge point until the works are completed. Monitoring of water downstream of a worksite or discharge point shall be undertaken at 100 m, 200, and 400 m or as directed by PCA. In addition, waters within the isolated work area for a Tremie pour operation shall be sampled.
- Water pH monitoring must be conducted by a Qualified Professional(s) using a digital pH meter with an accuracy of +/- 0.2 pH units.
- Corrective measures shall be implemented if downstream pH has changed more than 1.0 pH unit from background, measured to an accuracy of +/- 0.2 pH units, or is below 6.5 or above 9.0 pH units.

Waste and Wastewater Management

- The discharge of concrete wastewater, leachate or slurries into a watercourse is prohibited.
- Should the amount of water in the Tremie pour work site exceed the amount that the Tremie pour is able to handle, the excess water and any leachate will be pumped and contained in covered containers with appropriate visible labels and tested. Waters and leachates (contaminated or otherwise) that are generated by a concrete pour operation with a pH ≥ 12.5 are considered corrosive and a hazardous waste under Ontario Regulation 347 of the *Environmental Protection Act.* All wastewater, leachates and slurries must be contained in sealed containers and temporarily stored on the project site until they are collected for disposal by a licensed waste hauler.
- All off-site shipments must be accompanied by a MOECC waste manifest and the generator of the materials must be registered as a generator of hazardous waste with the MOECC. A Hazardous Waste Information Network (HWIN) number will be issued for the waste generator upon their registration with the MOECC, and this HWIN number must be used on all waste manifests.
- All other non-hazardous waste generated by a concrete pour operation shall be disposed according to Ontario Regulation 558/00. R.R.0. 1990 (General – Waste Management).
- Environmental permits shall be obtained by the Contractor for any off-site disposal.

Related Environmental Standards and Guidelines

- General Environmental Protection Procedures
- Erosion Control (ESG-1-Pre)
- Sediment Control (ESG-2-Pre)
- Treatment of Discharge Waters (ESG-14-C)

Related EMP Component Plans

- Transportation Management
- Site Dewatering and Wastewater Plan
- Surface Water Management, Erosion and Sediment Control
- Dredging and Sediment Removal
- Hazardous Materials Management
- Spill Prevention and Emergency Response

Other Design and Environmental Considerations

- Confirm need /exemption for a PTTW based on volume and duration of removals and the requirement of a Historic Canals Regulations permit. Planning must allow sufficient time to obtain a permit from the MOECC/PCA.
- Grouting operations to be undertaken when ambient temperature falls below 4.4°C require special design considerations regarding the selection of masonry materials for cold weather performance need to protect and/or heat materials, water requirements, etc.)

References

Canadian Ready Mixed Concrete Association, CRMCA, 20014. Recommended Guideline for Environmental Management Practices for the Canadian Ready Mixed Concrete Industry. May, 2004. Available at https://3qcake159kca33qhh23so84g-wpengine.netdna-ssl.com/wp-content/uploads/2014/09/CRMCA-EMP-MAY-04.pdf

Ontario Waterpower Association, 2012. Best Management Practices Guide for the Mitigation of Impacts of Waterpower Facility Construction. Version 1, June 2012.

NSW Environmental Protection Authority, 2002. Environmental Management Best Practice Guideline for Concrete Contractors. ISBN o-7347-7535-0, October 2002. www.epa.nsw.gov.au.

NSW Government, 2015. Concrete Washout Guideline. Document 3TP-SD-112/2.0. Available at:http://www.transport.nsw.gov.au/sites/default/files/b2b/projects/Concrete%20Washout%20Guideline%20-%203TP-SD-112.pdf

Portland Cement Association, 2008. Cold Weather Masonry Construction. Available at: http://www.cement.org/docs/default-source/fc_mat-app_pdfs/masonry/is248-cold-weather-masonry-construction.pdf?sfvrsn=4

VOI Training Group, 2014. Environmental Field Procedures for Works in and About Water. Developed by Van Osch Innovations Ltd., 130 Columbia Street, Nanaimo, British Columbia, Canada.

Dredging and Sediment Removal (ESG-6-C)

Application to Ontario Waterways' Projects

Dredging and sediment removal is occasionally undertaken in waterways to facilitate construction, for facility maintenance and/or navigation purposes. Pre-dredging to remove soil or soft sediments may be undertaken in conjunction with cofferdam installation, and dredging is often used to remove sediment from behind a cofferdam or for site restoration. Dredging and sediment removal have the potential to harm or kill benthic organisms and fish. Water quality can be adversely affected through the resuspension of sediment.

Description of Activity

Dredging and sediment removal refers to the removal of sediment from areas where sediment has accumulated over time (e.g., channel beds, water intakes, beneath boat slips / dock areas, locks and dams). Dredging and sediment removal can be undertaken using a variety of equipment, including mechanical dredges (e.g., buckets, clamshells, dippers); hydraulic or suction dredges (e.g., cutter head, auger head); and/or using speciality equipment and methods (e.g., water injection, or "jetsed", pneuma pumps and precision dredging tools).

Environmental Standards and Guidelines

<u>General</u>

- All sediment removal should be considered in the "dry" as the primary option. Where sediment removal in the "dry" is not feasible then dredging can be undertaken.
- All dredging activities shall be undertaken under the supervision of a Qualified Professional(s).
- Timing windows for in-water works shall be respected for dredging and sediment removal activities.
- The area(s) and volumes to be dredged, the dewatering method, equipment and operational controls to be used shall be outlined in a Dredging and Sediment Removal Plan to be reviewed and accepted by PCA prior to commencement of these activities.
- The PCA Environmental Authority shall be contacted and advised at least 48 hours in advance of the start of the proposed dredging or sediment removal operations if the activity has been previously assessed in the EIA.

<u>Dredging Operations</u>

- Hydraulic or suction dredging will be the preferred method for sediment removal. Where contaminated sediments exist there is a potential for contaminated sediments, hydraulic or suction dredging is the only acceptable method for sediment removal. Refer to the Canadian Sediment Quality Guidelines for the Protection of Aquatic Life (CCME, 2001).
- Dredging operations shall be conducted from the shore or from an existing structure (e.g., berm, dam) where possible.
- If necessary, dredging and sediment removal may be conducted from a floating structure (i.e., a barge). In addition:
    - o sufficient water must be present to prevent the barge from grounding;
    - o minimize the use of barge stabilizing spuds and their disturbance of bottom substrates;
    - o fully restore any areas disturbed by barge stabilizing spuds;
    - o prop scour must not occur from tending vessel(s). This may require maneuvering of barges in shallow water with ropes tied to shore and/or pilings;

- exclude fish and other wildlife from the work area prior to the commencement of any pile driving operations;
  - All boats and equipment used in pile driving operations will be cleaned off-site before coming onto the project site and before leaving the project site; and
  - Boats shall be free of ballast water.

- Turbidity curtains shall be deployed around the dredge area for water depths greater that 0.5 m above the sediment bed. Turbidity curtains are ineffective at depths greater than 6 m and at current velocities greater than 0.5 m/sec (approx. 1 knot). Where turbidity curtains cannot be deployed then suction dredging or alternatives that minimize re-suspension of sediments will be used.
- Dredging operations shall be monitored using a Global Positioning System (GPS) tracking device to maintain dredging within the designated area(s).

Dewatering

- The pumping of turbid water directly back into the waterbody is not permitted. Downstream waters shall be routinely tested and compared to background to confirm compliance with performance standards. The field measurement for turbidity will be in NTU.
  - At the discharge points of pumping into any waterbody, a maximum increase of 8 NTU from background levels within 100 m of the dredge area for a short-term exposure (i.e., less than 24 hours). Maximum average increase of 2 NTU from background levels for a longer term exposure (e.g., more than 30 days). Should there be exceedances the PCA Environmental Authority may analyze Suspended Solids (SS) concentration with laboratory samples. When this occurs, TSS samples should be taken upstream of the work area (background), within the work area, and 100 m downstream of the dredge area. Additional downstream samples may be required by PCA.
  - At the discharge points of pumping into any waterbody, a maximum increase of suspended sediment concentration shall not be more than 25 mg/L over background levels within 100 m of the dredge area during any short term exposure period (i.e., less than 24 hours). For longer term operations (i.e., more than 30 days), average suspended sediment concentrations shall not be increased by more than 5 mg/L over background levels. TSS (mg/L) is only acceptable from laboratory results and will only be used if there is exceedances and for potential enforcement action.

Dredged Material Management

- No dredged materials shall be stored or stockpiled on top of ice during winter operations or where turbidity can run off-site and contaminate surrounding waterbodies.
- Any dredged material must have a suitable holding area designed to contain the volume of anticipated removal in a containment area or trucked off-site immediately.
- Dredged materials shall not be disposed of in a waterbody. Dredged materials shall be disposed in an approved Confined Disposal Facility (CDF) or licensed landfill.
- Storage of dredged material shall be managed and contained in accordance with PCA Sediment and Erosion and Sediment Control standards and guidelines.

Restoration

- Prior to re-watering, site must meet navigation depth requirements (these are site specific). All materials shall be removed and the dredge site restored.

Related Environmental Standards and Guidelines

- General Environmental Protection Procedures
- Erosion Control (ESG-1-Pre)
- Sediment Control (ESG-2-Pre)
- Fish Exclusion, Salvage and Relocation (ESG-7-C)
- Installation and Removal of Coffer Dams and Isolation Structures (ESG-10-C)
- Invasive Species Management (ESG-11-C)
- Refueling and Spill Management (ESG-13-C)
- Treatment of Discharge Waters (ESG-14-C)
- Use and Maintenance of Heavy Equipment (ESG-15-C)
- Vehicle and Equipment Washing and Cleaning (ESG-16-C)
- Wildlife and Species at Risk Protection During Construction (ESG-17-C)

Related EMP Component Plans

- Dust and Air Quality Management
- Noise, Vibration and Ambient Light Management
- Transportation Management
- Demolition
- Site Dewatering and Wastewater Plan
- Surface Water Management, Erosion and Sediment Control
- Dredging and Sediment Removal
- Vegetation Protection
- Aquatic Resources Management
- Species at Risk Protection
- Fuel Management
- Spills Prevention and Emergency Response
- Dam and/or Bypass Channel Commissioning

Other Design and Environmental Considerations

- Design and locate new structures to avoid the need for future maintenance dredging.

Further Guidance

Parks Canada Agency, 2013. Parks Canada EIA - Best Management Practice for Routine Maintenance Dredging: Trent-Severn Waterway and Rideau Canal National Historic Sites. August, 2013.

Canadian Council of Ministers of the Environment (CCME), 2001. Canadian Environmental Quality Guidelines - Canadian Sediment Quality Guidelines for the Protection of Aquatic Life. Available at: http://ceqg-rcqe.ccme.ca

References

British Columbia Ministry of Environment, General BMPs and Standard Project Considerations - Standards and Best Practices for Instream Works. Available at: http://www.env.gov.bc.ca/wld/instreamworks/downloads/GeneralBMPs.pdf

Fish Exclusion, Salvage and Relocation (ESG-7-C)

Application to Ontario Waterways' Projects

In-water works often require partial isolation of work areas to perform construction and maintenance activities in the "dry". The installation of the isolation structures like (coffer dams, turbidity curtains), coupled with dewatering operations, may result in stranded fish in the work areas to be dewatered and will require that measures are taken for fish exclusion, salvage and relocation.

Description of Activity

Fish exclusion measures are those that prevent fish from entering or re-entering the working area. Fish exclusion involves deploying netting and "sweeping" the areas to drive fish out of the work area or into the netted area for capture. Fish salvage means the physical, non-lethal, capture of fish using other gear such as netting and electrofishing. Fish relocation involves moving the salvaged fish from the work area to either storage in buckets and tanks or directly to another location for release.

Environmental Standards and Guidelines

General

- Fish exclusion, salvage and relocation procedures and equipment shall be outlined in the site-specific EMP and accepted by PCA.
- All fish exclusion, salvage and relocation operations must be completed by a Qualified Professional(s) typically supported by a trained team.

Work Site Isolation

- In low flow settings (<0.5 m/sec), deploy turbidity curtains around the perimeter of the work site unless work area is isolated using impermeable materials (coffer dam, sheet pile, etc.). See Sediment Control (ESG-2-Pre) for guidance regarding turbidity curtain installation. If using a net instead of a turbidity curtain, the mesh size must be sized according to the smallest fish expected.
- In high flow conditions, where turbidity curtains will be ineffective, low turbidity isolation structures (e.g., low berms constructed from lined sandbags) shall be used as an exclusion structure.

Fish Salvage

- Perform an initial sweep of the work area to drive fish out prior to completely closing off the turbidity curtains surrounding the work area.
- Collect fish using gear suitable for the project site, habitat complexity, fish species likely to be encountered (particularly Species at Risk), and fish activity as determined by the Qualified Professional(s). Typical gear includes seine nets, dip nets, enmeshing nets and fish traps, and/ or electrofishing. Other equipment includes buckets, holding tanks, fish transportation tanks. A combination of methods will usually be required. Electrofishing as a fish salvage method will be employed only if other salvage methods prove unsuccessful.
- Salvage should occur at water depths <0.5 m or depths that are most effective for the method chosen (e.g., boat efishing vs. seine netting).

- Initial fish salvage must continue until a rate of decline in the catch from subsequent efforts is observed and only a few individuals are caught.
  - A minimum of three (3) passes is recommended. Larger work areas and salvage undertaken at greater depths will require more passes.
  - Fish traps (bated or unbaited) must be deployed for a minimum of 24 hours. More traps (typically more than two) are required for larger work areas.
- Following initial salvage operations, the presence of residual fish should be anticipated. Additional efforts to safely remove stranded individuals should continue until dewatering activities are complete.
- An Inventory of captured fish numbers, species caught and mortality in accordance with permit conditions shall be prepared and submitted to PCA within one week of the completion of salvage operations.
- Any substantial mortality event (greater than 2%) shall be reported immediately to PCA.
- Release live fish into the same waterbody at the location of the salvaging of the work area (i.e., upstream fish go upstream and downstream go downstream)
- If invasive species are caught, fish will be euthanized and disposed of according to Canadian Council on Animal Care's "Guidelines on The Care and Use of Fish in Research, Teaching and Testing".
- Any fish exclusion method including turbidity curtains must be monitored for the duration of in water works. If fish are observed within the exclusion area, barriers must be reinstalled and fish salvage must reoccur.

Fish Handling Guidelines

- Fish must be handled as little as possible while collecting and transferring them into buckets, holding tanks or safety pools.
- Fish shall be transferred immediately to either a safe upstream or downstream area (15 min max holding time).
- Live tanks fitted with aeration bubblers must be used for larger capture operations where numerous (i.e., thousands) fish or sensitive coldwater species are anticipated. Fish should not be crowded in the holding containers. Fish will be less stressed in larger containers (300 gallons or larger preferred), in colder water, and with supplemental oxygen or aeration.
- Fish should be carefully released into the watercourse. Buckets will be submersed and fish allowed to swim out under their own power.
- The water temperature in the holding tanks will not be substantially (within1-2 C^{o}) different from the river water.

Related Environmental Standards and Guidelines

- General Environmental Protection Procedures
- Erosion Control (ESG-1-Pre)
- Sediment Control (ESG-2-Pre)
- Installation and Removal of Coffer Dams and Isolation Structures (ESG-10-C)
- Treatment of Discharge Waters (ESG-14-C)
- Wildlife and Species at Risk Protection During Construction (ESG-17-C)

Related EMP Component Plans

- Blasting
- Site Dewatering and Wastewater Management
- Surface Water Management, Erosion and Sediment Control
- Dredging and Sediment Removal
- Aquatic Resources Management
- Species at Risk Protection
- Invasive Species Management
- Spills Prevention and Emergency Response
- Dam and/or Bypass Channel Commissioning
- Site Restoration

Other Design and Environmental Considerations

- None

Further Guidance

Canadian Council on Animal Care, 2005. Guidelines on The Care and Use of Fish in Research, Teaching and Testing. ISBN: 0–919087–43–4. Available at: http://www.ccac.ca.

References

British Columbia Ministry of Agriculture, Food and Fisheries, 2005. Drainage Management Guide – No. 17 in series order No. 527.110.1 – Fish Salvage. April, 2005.

Washington State Department of Transportation (WSDOT), undated. WSDOT Fish Exclusion Protocols and Standards. Available at: https://www.wsdot.wa.gov/NR/rdonlyres/70E7E285-ECC6-41BA-A2DF-87FD0D68128D/0/BA_FishHandling.pdf

Fugitive Dust Control during Construction (ESG-8-C)

Application to Ontario Waterways' Projects

Site preparation, construction and site restoration activities undertaken for projects on Ontario Waterways such as earthworks, excavation, soil stripping, clearing and grubbing, earthmoving and revegetation, can result in significant dust emissions, especially during dry weather periods and particularly if followed by high winds.

Description of Activity

Water or chemical dust suppressants can be applied to mitigate fugitive dust from site preparation and construction activities. The application of water is typically the most common and preferred by PCA dust control method that is employed by construction companies across Canada. A variety of chemical dust suppressants are available to suppress fugitive dust emissions from construction sites.

Environmental Standards and Guidelines

General

- All fugitive dust control measures must be described in the site-specific EMP and accepted by PCA, including all proposed chemical applications for dust control.
- Use of salts or petroleum products for dust control is prohibited.
- Fugitive dust levels, measured as total suspended particulate (TSP) at the property boundary shall not exceed the Ontario Ambient Air Quality Criteria (AAQC) of 120 micrograms per cubic metre ($\mu g/m^3$) over 24 hours or 60 $\mu g/m^3$ averaged over a year. For measuring methods, refer to the Canada-wide Standards for Particulate Matter and Ozone Ambient Air Monitoring Protocol.

The following best practices for the management of construction sites shall be considered in developing a Dust and Air Quality Management Plan as part of the site specific EMP.

Site Preparation

The first principle in minimizing fugitive dust is to follow erosion control best practices (See Erosion Control (ESG-1-Pre)).

- Clear and grade the construction site in stages
- Maintain vegetative buffers as wind screens and utilize wind fencing
- Stabilize surfaces of completed earthworks
- Prohibit open burning
- Where possible, reduce earthworks during windy conditions.

Storage Piles

- Locate storage piles in sheltered areas
- Utilize enclosures/coverings for storage piles where feasible
- Utilize wind fences/screens for storage piles in addition to sediment fencing.

- Stabilize short term and long term stockpiles (See Soil Stripping, Grubbing and Stockpiling, ESG-3-Pre)

Material Handling and Transfer Systems

- Establish stabilized work site entrances (See Sediment Control ESG-2-Pre)
- Secure loads on haul trucks. Total enclosures are preferred to partial enclosures
- Minimize material handling
- Where possible, reduce certain material handling activities during windy conditions

Using Water and Chemical Dust Suppressants at Construction Sites

- The use of water as a dust suppressant is preferred to then use of chemical agents.
- Water should be applied, at a minimum, once a daily basis, to all inactive disturbed areas, unpaved roads used for vehicular traffic and active storage or stockpiles. The frequency of application should be increased beyond once per day to prevent visible emissions of fugitive dust. Consideration should be given to spraying water onto materials with the potential to generate dust 15 minutes prior to handling and/or at points of transfer.
- Water will not be applied in volumes capable of creating erosion or uncontrolled run-off.
- Only approved chemical agents, accepted by PCA, can be applied as dust suppressants. The categories of products for dust suppression include:
    - Lignin derivatives (e.g., Tembec's Tembind or TDS)
    - Vegetable oils (canola, soybean, linseed, etc.)
    - Synthetic polymer emulsions
- Products that have not been accepted by PCA must undergo an assessment before being accepted for use as a dust suppressant.
- Application of chemical agents must follow manufacturer's specifications.

Related Environmental Standards and Guidelines

- General Environmental Protection Procedures
- Erosion Control (ESG-1-Pre)
- Sediment Control (ESG-2-Pre)
- Soil Stripping, Grubbing and Stockpiling (ESG-3-Pre)

Related EMP Component Plans

- Dust and Air Quality Management
- Noise, Vibration and Ambient Light Management
- Blasting
- Vegetation Protection
- Wildlife Protection and Management
- Aquatic Resources Management
- Species at Risk Protection

Other Design and Environmental Considerations

- A variety of chemical dust suppressants are available to suppress fugitive dust emissions from construction sites. While being more expensive than water, they are also more effective in suppressing dust and have to be applied much less frequently.
- MSDS sheets or equivalent data for chemical dust suppressants should be available on-site.

Further Guidance

Canadian Council of Ministers of the Environment (CCME). (2011). Ambient Air Monitoring Protocol for $PM_{2.5}$ and Ozone – Canada –wide Standards for Particulate Matter and Ozone. PN 1456. Available at: http://www.ccme.ca/files/Resources/air/pm_ozone/pm_oz_cws_monitoring_protocol_pn1456_e.pdf

References

Centre for Excellence in Mining Innovation (CEMI), 2010. Literature Review of Current Fugitive Dust Control Practices within the Mining Industry. Prepared by Golder Associates, August 11, 2010.

Cheminfo, 2005. Best Practices for the Reduction of Air Emissions from Construction and Demolition Activities. Report prepared for Environment Canada, March 2005.

Federation of Canadian Municipalities and National Research Council, 2005. Dust Control for Unpaved Roads. Version 1.0. October, 2005. ISBN 1–897094–93–0. Available at: https://www.fcm.ca/Documents/reports/Infraguide/Dust_Control_for_Unpaved_Roads_EN.pdf

Ontario Ministry of Environment, 2012. Ontario's Ambient Air Quality Criteria. Standards Development Branch, Ontario Ministry of the Environment, April 2012. PIBS#6570e01.

Provincial / Territorial Committee (PTOC) on Local Government, 2016. Dust Suppression Alternatives – 2016 Update. June 2016.

Grinding and Welding (ESG-9-C)

Application to Ontario Waterways' Projects

Grinding and welding operations are anticipated for projects on Ontario Waterways involving placement of steel and structural steel for locks, gates, building super-structure,;, the fabrication, installation, dismantling of mechanical equipment (HVAC equipment) and ancillary equipment such as handrails, guardrails, specialties, and ornamental metal.

Description of Activity

Grinding and welding are processes used to cut or join metal using heat. Operations such as welding and grinding, or similar, are capable of igniting combustible materials or flammable atmospheres or providing a source of ignition for a fire. They involve the use of portable compressed gas cylinders, arc welding equipment, open flame or spark-producing equipment. Compressed gas cylinders have inherent dangers. The handling and storage of compressed gas cylinders must be undertaken with great care. Grinding and welding operations on land are undertaken with shielding such as non-combustible welding drapes, used in hot work areas.

Grinding and welding can also be undertaken underwater by trained divers. Underwater grinding and welding operations involve several hazards, including lethal electrical currents and the use of oxygen and hydrogen rich gases which can explode.

Environmental Standards and Guidelines

- Land-based or grinding and welding activities conducted in the "dry" are preferred to underwater grinding and welding.

Land-based Grinding and Welding

- All land based grinding and welding activities must be conducted in a manner as to prevent release of weld rods, metal chips, or any other debris into a stormwater drain, waterbody or watercourse.
- Undertake grinding and welding activities indoors or off-site where possible and comply with health & safety, technical and waste management specifications. Ensure designated substance report is followed (if applicable).
- Fit grinders and other power tools with dust extraction and collection systems.
- Establish an isolated, well-ventilated area for using oxy-acetylene torches and welders, away from combustible materials such as fuels, oils, grease and rubber.
- Conduct all grinding operations on a sealed surface inside a screened area to minimize the dispersion of metal fragments
- Schedule outdoor grinding and welding activities for dry weather. Do not conduct outdoor grinding and welding activities during a rain event.
- Daily records must be maintained of all weld rods consumed.
- Metal scraps, filings and waste/unusable weld rods shall be stored in a container identified for scrap metal recycling.

Underwater Grinding and Welding

- All underwater grinding or welding activities must be described in the site-specific EMP and accepted by PCA, including:
    - o all chemicals and gases to be used underwater;
    - o Procedures for the containment or otherwise collection / retrieval of metal scraps, filings and waste/unusable weld rods from the underwater work area.
- Underwater grinding and welding operations shall only be undertaken in still or extremely low flow conditions.
- Underwater grinding and welding operations shall be undertaken by a Qualified Professional(s).
- Daily records must be maintained of all weld rods consumed.
- Metal scraps, filings and waste/unusable weld rods shall be stored in a container identified for scrap metal recycling.

Waste Management

- Wastes that are generated by grinding and welding operations that are considered to be hazardous wastes under Ontario Regulation 347 of the *Environmental Protection Act* must be contained in sealed containers and temporarily stored on the project site until they are collected for disposal by a licensed waste hauler.
- All other non-hazardous waste generated by a concrete pour operation shall be disposed according to Ontario Regulation 558/00. R.R.0. 1990 (General – Waste Management).
- Environmental permits shall be obtained by the Contractor for any off-site disposal.

Related Environmental Standards and Guidelines

- General Environmental Protection Procedures
- Fugitive Dust Control During Construction (ESG-8-C)
- Refueling and Spill Management (ESG-13-C)

Related EMP Component Plans

- Dust and Air Quality Management
- Noise, Vibration and Ambient Light Management
- Demolition
- Fuel Management
- Hazardous Materials Management
- Spills Prevention and Emergency Response
- Dam and/or Bypass Channel Commissioning

Other Design and Environmental Considerations

- None

References

Centre for Environmental Excellence, 2017. Construction Practices for Environmental Stewardship. http://environment.transportation.org/environmental_issues/construct_maint_prac/compendium/manual/detailed_toc.aspx

Installation and Removal of Coffer Dams and Isolation Structures (ESG-10-C)

Application to Ontario Waterways' Projects

In-water works often require partial isolation of work areas to perform construction and maintenance activities in the "dry". In some instances, this may require the maintenance of downstream flow and fish passage using a coffer dam. Coffer dams may be used for larger scale projects (e.g., dam replacements) and smaller scale projects such as maintenance, minor upgrades and repairs.

Description of Activity

The use of a coffer dam involves isolating a portion of a water body to create a dry work area. In channels this involves isolating the work area from the active flow and dewatering the created isolated work area. Coffer dams are also used in static waterbodies such as lakes to isolate piers or retaining walls. This isolation technique is general considered a "passive" method, only requiring periodic removal of water from the work area using a small pump and hose following precipitation events or minor seep inflow. Due to the passive nature of this technique, its use should be encouraged during all operations having an anticipated duration of more than one week on appropriate sized waterbodies.

Environmental Standards and Guidelines

- To the extent possible, all in-water work shall be conducted in the "dry" by using an isolation coffer dam.
- All coffer dam designs, installation and removal procedures, including timing, shall be described in the site-specific EMP and accepted by PCA.
- Cofferdams shall be designed by a Qualified Professional(s), taking into consideration the following best practices:

Sizing	It is essential to use an adequately sized coffer dam in order to prevent overtopping during high flow events. A coffer dam shall be sized to isolate a specified portion of a channel during discharge events up to bankfull or the 1 in 20 year return flow, per year of construction. Frequent over-topping or persistent leaks requiring repeated dewatering of the work area shall not be permitted.
Materials	• It is essential that the most appropriate type of material be selected to construct a coffer dam. The preferred method is to use sheet steel, prefabricated inflatable rubber dam, meter bags filled with washed stone with a waterproof liner, or a form dam. See Pile Driving (ESG-12-C) for guidance regarding installation of sheet piling. • For larger coffer dams, cellular structures containing aggregate shall be used. • The placement of loose aggregate into a waterbody shall not be permitted.

Dewatering	• A "clean water zone" on the inside of the coffer dam shall be established to keep water from leaking into the work area. • Dewatering of the work area requires the use of a pump. Clean water may be pumped directly into the active portion of the water body if no scour potential exists. The pumping of turbid water directly back into the waterbody is not permitted. Pumping operations shall ensure that the pump inlet(s) is protected using an appropriately designed and sized fixed screen or other device to prevent debris blockage and fish entrainment. • Screens may need to be designed and fabricated to be "fit for purpose". See Treatment of Discharge Waters (ESG-14-C). • Periodic removal of water from behind the coffer dam may be required following precipitation events or minor seep inflow to keep the work area dry.
Fish Salvage and Relocation	• Fish from within the isolated work area shall be salvaged and relocated. See Fish Exclusion, Salvage and Relocation (ESG-7-C). • In the event that the coffer dam is overtopped and inundated with water from the surrounding waterbody, fish shall be removed from the work area prior to de-watering.
Dam Removal	• Following completion of works, the coffer dam shall be carefully removed from the waterbody so as to avoid disturbance of the bed and banks. Removal shall begin at the downstream end of a coffer dam in flowing water.

Related Environmental Standards and Guidelines

- General Environmental Protection Procedures
- Erosion Control (ESG-1-Pre)
- Sediment Control (ESG-2-Pre)
- Fish Exclusion, Salvage and Relocation (ESG-7-C)
- Treatment of Discharge Waters (ESG-14-C)

Related EMP Component Plans

- Dust and Air Quality Management
- Noise, Vibration and Ambient Light Management
- Blasting
- Demolition
- Site Dewatering and Wastewater Plan
- Surface Water Management, Erosion and Sediment Control
- Dredging and Sediment Removal
- Vegetation Protection
- Wildlife Protection and Management
- Aquatic Resources Management
- Species at Risk Protection
- Invasive Species Management
- Fuel Management
- Spills Prevention and Emergency Response
- Dam and/or Bypass Channel Commissioning

Other Design and Environmental Considerations

- Confirm need /exemption for a PTTW based on volume and duration of removals and the requirement of a Historic Canals Regulations permit. Planning must allow sufficient time to obtain a permit from the MOECC/PCA.
- Timing of works should avoid seasonally high rainfall and snowmelt periods.
- Timing windows for in-water works shall be respected.

Further Guidance

Department of Fisheries and Oceans (DFO), 1995. Freshwater Intake End-of-Pipe Fish Screen Guideline. ISBN 0-662-23168-6. Catalogue No. Fs 23-270 / 1995E.

Invasive Species Management (ESG-11-C)

Application to Ontario Waterways' Projects

There are a number of invasive species at properties along Ontario waterways sites that are currently being managed by PCA. Invasive species can be both plants, animals, fungi and/or viruses (e.g., dog strangling vine, water flea, butternut canker, snake fungal disease).

Construction activity requires numerous types of vehicles, boats and equipment, such as: passenger cars and trucks, motorbikes, all terrain Vehicles (ATV's), snowmobiles, boats and heavy equipment (e.g., trucks, tractors, backhoes, graders, dozers, excavators, skidders, loaders, cement pumpers, water tankers and trucks). The transport and operation of these vehicles, boats and equipment has the potential to introduce invasive species into areas of native vegetation and non-infested waters. Similarly, the disturbance of soils, stockpiling, moving impacted soils, water, wood, mulch and compost can result in the spread of invasive species across a site.

Description of Activity

Activities associated with the clearing, construction, and restoration could introduce and accelerate the spread of invasive plants. Avoiding and/or reducing the introduction and spread of invasive species during construction activity is desirable for the protection of native vegetation and wildlife habitat. The term invasive plant species includes plants listed as weeds and/or noxious listed by the Ontario Ministry of Agriculture, Food and Rural Affairs. The most current list is available at: http://www.omafra.gov.on.ca/english/crops/facts/noxious_weeds.htm

Environmental Standards and Guidelines

General

- Management or control plans to address invasive species infestations identified on-site and those highlighted in the EIA will be included in the site-specific EMP to be accepted by PCA.
- Any new invasive species identified will be reported to PCA and a management plan shall be developed and accepted by PCA.
- Management or control plans for invasive species infestations will be developed by a Qualified Professional(s).

Preventive Measures at Construction Sites

- The following preventative measures shall be implemented for all construction sites:

Movement of Construction Vehicles, Vessels and Equipment	• All construction vehicles, vessels (i.e., boats, barges, etc.) and equipment will be cleaned off-site before coming onto the project site and before leaving an area of infestation. • Boats shall be free of ballast water.
Cleaning of Construction Vehicles, Vessels and Equipment	• Vehicles, vessels and equipment should be cleaned at least weekly and in accordance with the Ontario Invasive Plant Council's "Clean Equipment Protocol" for cleaning of vehicles and equipment. See Vehicle and Equipment Washing and Cleaning (ESG-16-C) for additional guidance. • Pressure wash (non-frozen conditions) or use compressed air (frozen conditions) to clean vehicles, vessels and equipment when leaving infested areas.
Construction Crews	• Work attire, boots, and other personal protection equipment will be cleaned in accordance with the Ontario Invasive Plant Council's "Clean Equipment Protocol".
Construction Materials	• Contractors shall certify that all construction material sources used for supplies of sand, gravel, rock and mulch are weed-free prior to obtaining or transporting any material from them. Obtain and use only certified weed-free straw or use fiber roll logs for sediment containment. Hay shall not be used as it contains seed heads and seeds from agricultural fields (often weedy/invasive species).
Construction Works and Activities	• Soils where invasive species are present will not be reused or left on-site but disposed off-site at a licensed facility. • No intact, untreated wood will be removed off-site or brought to the site, to prevent the spread of invasive insects, unless removed by a Qualified Professional(s) following approved treatment or disposal methods. • Invasive fish species shall not be relocated during fish salvage operations. If invasive species are caught, fish will be euthanized and disposed of according to Canadian Council on Animal Care's "Guidelines on The Care and Use of Fish in Research, Teaching and Testing".
Inspections	• Vehicle, vessel and equipment inspection shall be done before: o Moving vehicles out of a local area of operation. o Moving machinery between properties or sites within the same property where invasive species may be present in one area, and not in another. o Using machinery along roadsides, in ditches, and along watercourses. o Vehicles using unformed dirt roads, trails or off road conditions. o Using machinery to transport soil and quarry materials. o Visiting remote areas where access by vehicles is limited.

Post-Construction Works and Activities	• Revegetate or otherwise prevent the establishment of invasive species in all areas of the job site through a program of monitoring and post-construction weed treatment for the life of the project. • Revegetate using soil components and mulches obtained from non-weed infested sources. • Utilize seed and other plant material that has been checked and certified as noxious weed-free and that has a weed content of 0.05% or less. • Revegetate using native plant materials that have a high likelihood of survival. • Maintain all planted material and native vegetation located on the project site for the life of the project. • Monitor all seeded sites for weed infestation. Treat all weeds adjacent to newly seeded areas prior to planting and treat planted areas for weeds in the first growing season.

.

Control Measures in Areas Infested with Invasive Species

- Control measures shall be undertaken for infestations of invasive plant species prior to and after construction under the supervision of a Qualified Professional(s). The control method should be informed by the biological characteristics of the species, the size of the infestation, and the potential to transport on-site and off-site. Acceptable methods of invasive species control include:
  - **Mechanical Control** – Mechanical control methods involve doing manual labour to remove the vegetation from the ground. Some techniques include cutting, pulling, mowing, smothering, removing the outer layer from the stem, or prescribed burning.
  - **Chemical Control** – Chemical control methods involve using herbicides to target the invasive plant species. Pesticides should only be used if other more desirable methods did not work and if there is a net benefit to the environment that is positive. Any proposed chemical control must be included in the site-specific EMP and accepted by PCA.

Related Environmental Standards and Guidelines

- General Environmental Protection Procedures
- Vegetation Clearing and Protection (ESG-5-Pre)
- Fish Exclusion, Salvage and Relocation (ESG-7-C)
- Revegetation (ESG-1-Post)

Related EMP Component Plans

- Transportation Management
- Wildlife Protection and Management
- Aquatic Resources Management
- Species at Risk Protection
- Invasive Species Management

Further Guidance

Canadian Council on Animal Care, 2005. Guidelines on The Care and Use of Fish in Research, Teaching and Testing. ISBN: 0–919087–43–4. Available at: http://www.ccac.ca.

Ontario Invasive Plant Council, 2013. Clean Equipment Protocol for Industry - Inspecting and cleaning equipment for the purposes of invasive species prevention. Available at: http://www.ontarioinvasiveplants.ca/wp-content/uploads/2016/07/Clean-Equipment-Protocol_June2016_D3_WEB-1.pdf

References

Ontario Ministry of Agriculture, Food and Rural Affairs, 2015. Noxious Weeds in Ontario. Available at: http://www.omafra.gov.on.ca/english/crops/facts/noxious_weeds.htm

Ontario Invasive Species Strategic Plan 2012. Government of Ontario. Available at: http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@biodiversity/documents/document/stdprod_097634.pdf

Invasive Species Management for Infrastructure Managers and the Construction Industry 2008.

Wade, M. Booy, O. and White, V. Available at:
http://www.ciria.org/service/Web_Site/AM/ContentManagerNet/ContentDisplay.aspx?Section=Web_Site&ContentID=9001

Pile Driving (ESG-12-C)

Application to Ontario Waterways' Projects

Pile driving is often used to establish or support the foundations of buildings and structures, control settlement or used as part of a coffer dam installation (e.g., sheet pile coffer dam). Pile driving has the potential to result in adverse noise and vibration to local receptors including nearby residents and communities as well as wildlife. When conducted in water or in proximity to a waterway, pile driving also has the potential to disturb or harm fish and adversely affect water quality.

Description of Activity

Pile driving can be undertaken using a variety of construction methods, equipment and materials. Hammers; including drop, diesel, air, vibratory and hydraulic, vibroflot, and rotary, air and churn drills are the primary instruments in a pile driving operation. These hammers and drills are supported by a wide variety of heavy equipment, including a range of conventional cranes (truck mounted, crawler and pedestal mounted), scows and barges. The piling types may include: lumber, concrete and steel piles (pipes, beams and sheets).

Environmental Standards and Guidelines

- All pile driving activities shall be undertaken under the supervision of a Qualified Professional.
- The PCA Environmental Authority shall be contacted and advised at least 48 hours in advance of the start-up of the proposed pile driving operations.
- Use inert (concrete, steel) or untreated materials that are to be submerged in water. Treated lumber must not be used as it may contain compounds that can be released into the water and become toxic to the aquatic environment. Any proposed use of treated wood must be approved by PCA and undertaken in accordance with PCA's "Guidelines for the Use, Handling and Disposal of Treated Wood" (Parks Canada, 2009).
- Timing windows for in-water works shall be respected for pile driving activities in water.
- The energy required to drive the pile to the final point of installation shall not result in sound pressure in excess of 30 kPa (BC Marine and Pile Driving Contractors Association and Fisheries and Oceans Canada, 2003).
- Visual and hydrophone monitoring of the impact on fish by the sound waves emitted will be required when driving concrete piles with a diameter greater than 60 cm (approximately 24 inches) (BC Marine and Pile Driving Contractors Association and Fisheries and Oceans Canada, 2003).
- Pile driving should be done within an isolated work area where fish have been excluded, salvaged and relocated.
- Pile driving shall be conducted from the shore or from an existing structure (e.g., berm, dam) where possible.
- If necessary, pile driving in water shall be conducted from a floating structure (i.e., a barge) so that disturbance to the waterbody bottom is prevented. In addition:
    - sufficient water must be present to prevent the barge from grounding;
    - minimize the use of barge stabilizing spuds and their disturbance of bottom substrates;
    - fully restore any areas disturbed by barge stabilizing spuds;
    - prop scour must not occur from tending vessel(s). This may require maneuvering of barges in shallow water with ropes tied to shore and/or pilings;

- o exclude fish and other wildlife from the work area prior to the commencement of any pile driving operations;
- o All boats and equipment used in pile driving operations will be cleaned off-site before coming onto the project site and before leaving the project site; and
- o Boats shall be free of ballast water.

- If conducting pile driving work during the winter, inspect shoreline conditions and foreshore substrates to determine whether frozen conditions exist and if machine pads are required to minimize disturbance.

Related Environmental Standards and Guidelines

- General Environmental Protection Procedures
- Fish Exclusion, Salvage and Relocation (ESG-7-C)
- Invasive Species Management (ESG-11-C)
- Refueling and Spill Management (ESG-13-C)
- Treatment of Discharge Waters (ESG-14-C)
- Use and Maintenance of Heavy Equipment (ESG-15-C)
- Vehicle and Equipment Washing and Cleaning (ESG-16-C)
- Wildlife and Species at Risk Protection During Construction (ESG-17-C)

Related EMP Component Plans

- Dust and Air Quality Management
- Noise, Vibration and Ambient Light Management
- Blasting
- Site Dewatering and Wastewater Plan
- Surface water Management, Erosion and Sediment Control
- Dredging and Sediment Removal
- Fuel Management
- Spills Prevention and Emergency Response
- Dam and/or Bypass Channel Commissioning

Further Guidance

Parks Canada, 2009. Guidelines for the Use, Handling and Disposal of Treated Wood.

BC Marine and Pile Driving Contractors Association and Fisheries and Oceans Canada, 2003.

Best Management Practices for Pile Driving and Related Operations. March 2003. Available at: https://projects.eao.gov.bc.ca/api/document/5887e34fad20ac134d916367/fetch

References

British Columbia Ministry of Environment, General BMPs and Standard Project Considerations - Standards and Best Practices for Instream Works. Available at: http://www.env.gov.bc.ca/wld/instreamworks/downloads/GeneralBMPs.pdf

Refueling and Spill Management (ESG-13-C)

Application to Ontario Waterways' Projects

The use of heavy equipment and other machinery near water is generally required on many PCA construction and maintenance projects on Ontario Waterways. Refueling and routine maintenance of this machinery occur at the work site on a daily basis. Although most machinery is mobile, some equipment such as pumps and cranes cannot practically be relocated for fueling and maintenance. Fuel, grease and other mechanical fluids are pollutants and considered a deleterious substance under the *Fisheries Act*. The proximity of PCA's assets to natural areas and fish bearing waterbodies elevates the need to address refueling and routine maintenance through the application of these standards and guidelines. Most Ontario Waterways sites do not have space to allow for refueling in areas greater than 30 m from the water.

Description of Activity

Refueling and maintenance refer to the regular activity of providing fuel, upkeep and light duty repair to heavy equipment and other construction machinery throughout the construction period. The most common form of potential fuel contamination on work sites occurs from drips and spills released from fueling nozzles and gas can spouts as they are moved between the fuel tank and the equipment. Being a daily activity, the potential for drips and minor spills is a common and frequently occurring potential environmental hazard.

Environmental Standards and Guidelines

General

- A Fuel Management plan, including refueling procedures, shall be developed as part of the site-specific EMP and accepted by PCA.
- A Spill and Emergency Management Plan will be developed as part of the site-specific EMP and accepted by PCA. The Spill and Emergency Management plan shall use a risk based approach. It shall be tailored to seasonal conditions at the site.

Fuel Storage

- Fuel storage facilities and containers shall comply with the CCME Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products. Double-walled storage containers must be used and located within a berm or impermeable containment boom.
- All fuel storage and containment must be intact, monitored and replaced as required through all phases of the project.

Refueling

- Vehicle, heavy equipment and machinery re-fuelling shall be conducted in a designated, flat and low sensitive area. Commonly, this area is the same location that fuel and other chemicals are stored.
- Designated refueling areas shall be constructed with impermeable containment such as berms, booms and liners. They shall contain an adequately sized drip tray or other impermeable layer to capture and contain drips form the nozzle and minor spills. Snow and water must be managed

from the drip trays to prevent contamination of the water. Drip trays must be on level ground. Any contaminated soil or aggregate must be disposed of properly.

- Spill containment for refueling shall be sized adequately to accommodate the volume of the fuel source container.
- The use of small volume fuel cubes is preferred for refueling immobile equipment and equipment operating in or near water.
- Fuel trucks and hoses cannot be used on coffer dam or within dewatered areas.

Spill Management and Reporting

- All construction staff should be trained and familiar with the Spills and Emergency Management plan, including roles and responsibilities, locations and contents of spill kits, and use of equipment. A check list approach should be developed for staff to sign-off and confirm training.
- Upon identification of a spill, immediate containment is required. All areas affected by the spill shall be remediated.
- Spill response equipment shall be located and maintained on-site and utilized in accordance with applicable the spill containment procedures. Multiple spills kits (number to match the scale of the project and to isolate a contaminated area) shall be placed in covered, accessible structures around the construction site.
    - Typical spill response equipment (spill kit) shall include as a minimum: absorbent spill pads, berms, cover drains and personal protective equipment (materials for both in-water and on land spill) to be used to contain the spill as appropriate. Replace or repair material after use.
    - Concrete spill response equipment (spill kit) will include as a minimum: sand bags (number to match the scale of the project and to isolate a contaminated area); impermeable material to line sandbags; Impermeable turbidity curtains; and CO_2 Bubblers. Replace or repair material after use.
- Wastes that are generated from remedial operations that are considered to be hazardous wastes under Ontario Regulation 347 of the *Environmental Protection Act* must be contained in sealed containers and temporarily stored on the project site until they are collected for disposal by a licensed waste hauler.
- All other non-hazardous waste generated by a concrete pour operation shall be disposed according to Ontario Regulation 558/00. R.R.0. 1990 (General – Waste Management).
- Environmental permits shall be obtained by the Contractor for any off-site disposal
- Any spill into water, onto ice or in a dewatered area must be reported immediately to PCA's Environmental Authority, the Departmental Representative and the Ontario Ministry of Environment and Climate Change's Spills Action Centre (SAC).
- Any spill on land must be reported immediately to PCA's Environmental Authority and the Departmental Representative. Any spill on land meeting the criteria set out in Ontario's *Environmental Protection Act*, O. Reg. 675/98 must be reported immediately to the Ontario Ministry of Environment and Climate Change's Spills Action Centre (SAC).

Related Environmental Standards and Guidelines

- General Environmental Protection Procedures
- Use and Maintenance of Heavy Equipment (ESG-15-C)

Related EMP Component Plans

- Dust and Air Quality Management
- Noise, Vibration and Ambient Light Management
- Transportation Management
- Site Dewatering and Wastewater Plan
- Surface Water Management, Erosion and Sediment Control
- Dredging and Sediment Removal
- Vegetation Protection
- Aquatic Resources Management
- Species at Risk Protection
- Hazardous Materials Management
- Fuel Management
- Spills Prevention and Emergency Response

Other Design and Environmental Considerations

- Spill prevention and response measures shall consider spills on land, in water and on ice.

References

Environment Yukon, 2011. Best Management Practices for Works Affecting Water in Yukon. Water Resources Branch, Government of Yukon.

VOI Training Group, 2014. Environmental Field Procedures for Works in and About Water. Developed by Van Osch Innovations Ltd., 130 Columbia Street, Nanaimo, British Columbia, Canada.

Treatment of Discharge Waters (ESG-14-C)

Application to Ontario Waterways' Projects

In-water works often require isolation of work areas to perform construction and maintenance activities in the "dry". This will require pumping of water from the isolated worksite (e.g., from behind a coffer dam, aqua-dams, or other temporary dams constructed with rock, pea gravel bags, concrete blocks, steel or wood walls) or from inside a lock and discharging the water into a receiving watercourse or elsewhere. Most construction sites on Ontario Waterways will have limited area that can be used for sediment retention pond construction, which limits pond size and consequently decreases settling efficiency. Therefore, novel methods will need to be considered to ensure that the water discharged meets specified performance criteria in the receiving waters. Design coffer dams to have a clean water collection area that can be directly discharged back to the river – this will limit the need to remove turbid water from the worksite.

High velocity flows from discharge structures (e.g., pipes) or outfalls can cause extensive erosion and scour at an outfall and/or receiving waterway. Every attempt should be made to decrease this energy where erosion concerns warrant. If discharged directly to a watercourse there may be no requirement.

Description of Activity

Treatment of discharge waters is intended to control sediment concentrations in water pumped from a work area and discharged downstream. Treatment options include:

- Isolate clean water from the worksite to minimize the amount of turbid water requiring treatment
- Sediment retention and waste water storage ponds;
- Water tanks and tanker trucks;
- Dedicated wastewater and filtration equipment;
- Sediment retention "bags".
- The use of a flocculation treatment

Suitable techniques for energy dissipation must be tailored to the amount of flow expected compared to the erodibility of the soil at the outflow location. These techniques are also used to slow the flow out of lined open channels such as spillways, ditches and other hydraulic structures.

Environmental Standards and Guidelines

- The pumping of turbid water directly back into the waterbody is not permitted. Water which is in exceedance of the following performance criteria must be treated/managed appropriately:
    - At the discharge points of pumping into any waterbody, a maximum increase of suspended sediment concentration shall not be more than 25 mg/L over background levels during any short term exposure period (i.e., less than 24 hours). For longer term operations (i.e., more than 30 days), average suspended sediment concentrations shall not be increased by more than 5 mg/L over background levels. Note: the field measurement for turbidity will be in NTU. TSS (mg/L) is only acceptable from lab results and will only be used if there is exceedances and potential enforcement action.
    - At the discharge points of pumping into any waterbody, a maximum increase of 8 NTU from background levels for a short-term exposure (i.e., 24 hours). Maximum average increase of 2 NTU from background levels for a longer term exposure (e.g., more than 30 days). Should

there be exceedances then PCA/Contractor may analyze Suspended Solids (SS) concentration with lab samples. Measurements should be taken µ/s(background) within the work area and downstream directly in the receiving water.

- o Receiving waters at the point of discharge shall be routinely tested and compared to background to confirm compliance with performance standards (e.g., pH readings should be taken if there is any concrete work being completed).

Sediment Retention and Waste Water Storage Ponds

- Avoid steep and or unstable slopes, surface water and wetlands, areas with soils susceptible to erosion and existing drainage channels (VOI).
- Ponds are to be used when the anticipated volume of water is very large. A site specific design (e.g., location, size, configuration) for the sediment pond shall be prepared by a Qualified Professional in accordance with standards provided in Sediment Control (ESG-2-Pre).
- A Qualified Professional(s) should design embankment dykes and other water retaining structures to avoid failure.
- The optimal design parameters is a 5:1 to 10:1 length to width ratio is preferred (VOI Training Group, 2014).
- Areas to be used for a pond shall be identified in the site-specific EMP and accepted by PCA.
- Ponds shall be constructed prior to any construction activity with the exception of vegetation clearing and grubbing for the pond itself.
- Ponds are largely dependent on the sediment type as a result there needs to be sufficient retention time for the various sediment types to settle.
- Embankment dykes should be stripped of vegetation, and fill materials should be clean soil, properly compacted.
- The main outlet structure should be installed at the farthest possible point from the inlet to encourage settling. An emergency spillway should be constructed to convey flows not carried by the main outlet to prevent embankment failure during high volume and flow periods.
- Prevent erosion of outlets by reinforcing/armoring them with rip rap or other appropriate measures If utilizing reinforcement/armoring measures consider the following:
  - o place large, durable, clean (free of fine particulate matter), suitably graded and sized angular rocks (rip rap) into the eroding area at the outlets only;
  - o carefully unload and key into place (if placing rocks along the embankment) above the high water mark (HWM);
  - o implement appropriate erosion and sediment control measures and maintain their functionality;
  - o do not obtain rocks from below the high water mark (HWM) of any water body;
  - o install rip rap at a similar slope as the stream bank to maintain a uniform stream bank slope and natural stream alignment;
  - o use acid-free rocks; and
  - o ensure rip rap does not constrict the channel width or flow.
- Sediment retention ponds should be inspected regularly and during high volume and flow periods.
- Sediment accumulation in the ponds must be measured regularly as required. Bathymetric surveys indicate the amount of sediment that has accumulated within the pond and consequently, estimates the remaining stormwater pond life, and dreading volumes. The pond will require cleaning when sediment accumulation reaches 50% of the design capacity.
- Waste water storage ponds are used to store waste waters with no provision to discharge the water into a well vegetated area or a receiving watercourse.

Water Tanks and Trucks

- Water tanks and trucks can be used to temporarily store small volumes of water prior to discharge, typically at an off-site location.
- An incremental or iterative approach should be used, whereby additional capacity is added
- Any off-site or on-site discharge location shall be identified and approved in the EMP. Environmental permits shall be obtained by the Contractor for any off-site discharges.
- If transport and disposal is interrupted, in-water works that require pumping should be stopped.
- If clean, Water stored in tanks and trucks can be used for fugitive dust control

Sediment Retention Bags

- Sediment retention bags are best used when appropriately sized sediment retention or waste water ponds cannot be located on-site. See Sediment Control (ESG-2-Pre) for further guidance.
- For fine sediment soils treating discharge water prior to the filter bag with a flocculant will improve results.
- Bags are manufactured in various sizes with various opening sizes. The numbers, type and size of filter bag should be determined by a Qualified Professional(s) based on expected discharge rates and predicted particle sizes to be treated.
- Not to be used for concrete waste water as it will not filter pH.
- High quality woven monofilament geotextile of 100% polypropylene stable fibers are preferred to non-woven geotextile materials.
- Areas to be used for sediment retention bags shall be identified in the site-specific EMP and accepted by PCA. A minimum setback of 10 m from a watercourse is recommended.
- The sediment retention bag must be secured to the ground surface, surrounded by silt fencing and straw bales with a designed outlet.
- If a flocculant is used it must be designed for the soil type and for optimum mixing and retention time prior to release at the outlet. Use a treated Jute with flocculant to clarify the discharge water.
- Any off-site disposal location shall be identified in the site-specific EMP and accepted by PCA. Environmental permits shall be obtained by the Contractor for any off-site disposal of bags and sediment.

Dedicated Wastewater and Filtration Equipment

- Must be designed by engineer for expected flows and soil types
- Dedicated filtration equipment should be used when appropriately sized sediment retention or waste water ponds or sediment retention bags cannot be located on-site. Suitable options include:
    - Sediment treatment tank with internal weirs (over and under weirs), to remove waste, solids (gravel, sand, and silt), visible oil grease and hydrocarbons, and some metals (removed with sediment);
    - Sand Media Filters, Clay & Carbon Media Filters; and
    - Canister Filters.
- Flocculent addition can be done to waters contained Enviro-Tanks and canister filters so that mixing can be done in a controlled mode.
- Any off-site disposal location shall be identified and approved in the EMP. Environmental permits shall be obtained by the Contractor for any off-site disposal of sediment.

Energy Dissipation

- All water discharge structures or outfalls will be designed with energy dissipation devices where erosion is likely to occur.
- The design of an energy dissipation device is unique to the site. The Qualified Professional designing the system should consider that the device may not match these specifications. However, as long as it can be proven to both dissipate energy and protect against erosion and scour, it can be considered acceptable.
- The energy dissipater (width, length substrate) will be designed according to the expected outflow velocities and soil types and will be detailed in the dewatering plan.
- Outfalls shall not be located in areas of steep slopes or banks or where the bank is susceptible to slumping.
- Any erosion protection applied must be free of fines (overburden, spoil, silt, clay, and or organic material).
- Energy dissipation devices will be inspected before periods of flow to ensure they are functioning as expected. The devices should also be inspected periodically to check for scour and if there are any repairs required. Typical maintenance practices include:
  - Restore dissipater to its original specifications if it is found to diverge from design criteria.
  - Replace rock or other components that have been dislodged by heavy flows.
  - If rock continues to wash away, consider using larger material.
  - Repair and damage to underlying fabric.
  - Where erosion/scour is occurring outside dissipater area, increase dissipater size in the eroded area.
  - Frequently remove sediment and other debris accumulations from inlets, flow pipes/ditches, and the dissipater area.

Related Environmental Standards and Guidelines

- General Environmental Protection Procedures
- Erosion Control (ESG-1-Pre)
- Sediment Control (ESG-2-Pre)

Related EMP Component Plans

- Blasting
- Demolition
- Site Dewatering and Wastewater Plan
- Surface Water Management, Erosion and Sediment Control
- Dredging and Sediment Removal
- Vegetation Protection
- Aquatic Resources Management
- Invasive Species Management
- Waste Management
- Spill Prevention and Emergency Response

Other Design and Environmental Considerations

- Sediment retention bags have seasonal limitations as they can freeze in the winter, reducing capacity and effectiveness.
- Large retention ponds may be required to retain fine sediments, while smaller ponds may only be effective to retain larger sediment sizes (e.g., sands).
- If suspended sediment concentrations are very high in the discharge water and/or receiving watercourse, discharges could be shut down until issues are identified and rectified.
- The design of an energy dissipation device is unique to the site. The engineer designing the system should consider that the device may not match these specifications. However, as long as it can be proven to both dissipate energy and protect against erosion and scour, it can be considered acceptable.
- For appropriate design for drainage system outfalls, OMAFRA Factsheet, Subsurface Drainage System Outfalls.

Further Guidance

Ontario Ministry of Agriculture, Food and Rural Affairs, 2015. Subsurface Drainage System Outfalls Factsheet. October 2015. Available at: http://www.omafra.gov.on.ca/english/engineer/facts/13-035.htm

Ontario Ministry of Environment and Energy (MOEE), 2003. Stormwater Management Planning and Design Manual, March, 2003.

References

Department of Fisheries and Oceans (DFO), 1995. Freshwater Intake End-of-Pipe Fish Screen Guideline. ISBN 0-662-23168-6. Catalogue No. Fs 23-270 / 1995E.

Nova Scotia Ministry of Environment, 2015. Nova Scotia Watercourse Alterations Standard.

Ontario Ministry of Transportation, 2011. OPSS511 – Construction Specification for Rip-Rap, Rock Protection and Granular Sheeting. April 2001.

Oregon Department of Transportation. Hydraulics Manual. Chapter 11 – Energy Dissipaters. Available at:https://www.oregon.gov/ODOT/HWY/GEOENVIRONMENTAL/docs/Hydraulics/Hydraulics%20Manual/CHAPTER_11.pdf

VOI Training Group, 2014. Environmental Field Procedures for Works in and About Water. Developed by Van Osch Innovations Ltd., 130 Columbia Street, Nanaimo, British Columbia, Canada.

Use and Maintenance of Heavy Equipment (ESG-15-C)

Application to Ontario Waterways' Projects

The use of heavy equipment near water is generally required on many PCA construction and maintenance projects on Ontario Waterways. Heavy equipment moving through the construction area has the potential to render soils susceptible to erosion. Used in proximity to waterbodies, heavy equipment can destabilize banks and affect water quality through the release of fuel, grease and other fluids. In-water use of heavy machinery can also affect fish habitat through the resuspension of fine sediments and creation of elevated turbidity. The proximity of PCA's assets to fish bearing waterbodies elevates the need to address these potential impacts and adhere to best practices and guidelines for the protection of fish and water quality during near water and in water construction projects on Ontario Waterways.

Description of Activity

Heavy equipment includes all specialized construction tracked or tired vehicles or machinery used during PCA maintenance, upgrade or construction projects. Such equipment is often used to transport or lift into place construction materials or move, excavate or compact soil.

Environmental Standards and Guidelines

- All heavy equipment to be used on-site, their anticipated designated work areas and site entrances shall be described in the site-specific EMP and accepted by PCA.

- An equipment maintenance program shall be described in the site-specific EMP and accepted by PCA.

Heavy Equipment Condition

- All heavy machinery brought to the work site shall be in good repair, free of leaks and be externally cleaned / degreased. All equipment using hydraulic fluids shall use vegetative (non-petroleum based) based fluids.
- All heavy equipment should comply with the latest equipment specifications in the *Off-Road Compression-Ignition Engine Emission Regulations (*SOR/2005-32) that contain emission standards for diesel engines used in off-road applications such as those typically found in construction. The Regulations, under Section 160 of the *Canadian Environmental Protection Act*, 1999 (CEPA 1999), are applied to engines of the 2006 and later model year.
- All heavy machinery brought to the work site shall arrive free of soil, seeds and vegetation fragments to avoid the import and spread of invasive species.
- Equipment shall be inspected prior to arrival on site. An inspection checklist shall be included in the site-specific EMP and accepted by PCA.

Stabilized Site Entrances and Heavy Traffic Areas

- All site entrances shall be stabilized as per standards set in Sediment Control (ESG-2-Pre).
- Equipment storage areas, laydown areas and other high traffic areas shall be stabilized with geotextile overlain with a minimum 15 cm of clean gravel surface layer or other suitable cover material.

Heavy Equipment Use

- Heavy equipment shall be operated exclusively by trained equipment operators or other Qualified Professionals.
- Heavy machinery shall operate from above the top of the streambank, on-shore above the normal water level, or within a dewatered site. Heaving equipment shall not enter water. Only working part of equipment (bucket or drill end or equivalent) entering the water shall be free of fluid leaks and externally cleaned/degreased to mitigate any deleterious substance from entering the water.
- Heavy machinery shall not be parked overnight or for long periods of shutdown in dewatered areas or on coffer dams. Where site conditions do not allow for removal of equipment, other measures to address potential flooding must be implemented (e.g., ground protection mats or rig mats)
- For guidance on refueling, see Refueling and Spill Management (ESG-13-C).

Related Environmental Standards and Guidelines

- General Environmental Protection Procedures
- Erosion Control (ESG-1-Pre)
- Sediment Control (ESG-2-Pre)
- Vegetation Clearing and Protection (ESG-5-Pre)
- Installation and Removal of Coffer Dams and Isolation Structures (ESG-10-C)
- Refueling and Spill Management (ESG-13-C)
- Vehicle and Equipment Washing and Cleaning (ESG-16-C)

Related EMP Component Plans

- Dust and Air Quality Management
- Noise, Vibration and Ambient Light Management
- Transportation Management
- Blasting
- Demolition
- Site Dewatering and Wastewater Management
- Surface Water Management, Erosion and Sediment Control
- Dredging and Sediment Removal
- Vegetation Protection
- Wildlife Protection and Management
- Aquatic Resources Management
- Invasive Species Management
- Fuel Management
- Spills Prevention and Emergency Response

Other Design and Environmental Considerations

- The Regulations Amending the Off-Road Compression-Ignition Engine Emission Regulations (the Amendments) impose stricter standards and new requirements starting with engines of the 2012 and later model years.

References

CISEC, 2014. Certified Inspector and Sediment and Erosion Control Training Manual. Revised Edition V6. 9520 Pine valley Drive, Woodbridge Ontario, Canada.

Coker, G.A., Ming, D.L., and Mandrak, N.E. 2010. Mitigation Guide For The Protection Of Fishes and Fish Habitat To Accompany The Species at Risk Recovery Potential Assessments Conducted by Fisheries and Oceans Canada (DFO) in Central and Arctic Region. Version 1.0. Can. Manuscript Rep. Fish. Aquatic. Sci. 2904: vi + 40 p.

Erosion and Sediment Control Guidelines for Urban Construction, 2006. Greater Golden Horseshoe Area Conservation Authorities.

VOI Training Group, 2014. Environmental Field Procedures for Works in and About Water. Developed by Van Osch Innovations Ltd., 130 Columbia Street, Nanaimo, British Columbia, Canada.

Vehicle and Equipment Washing and Cleaning (ESG-16-C)

Application to Ontario Waterways' Projects

Construction activity requires numerous types of vehicles, boats and equipment, such as: passenger cars and trucks, all terrain vehicles (ATV's), snowmobiles, boats and heavy equipment (e.g., trucks, tractors, backhoes, graders, dozers, excavators, skidders, loaders, cement pumpers, water tankers and trucks). Construction vehicles, boats and equipment will become soiled over time and require washing and cleaning, particularly if they are to be used or transported off the construction site. Washing and cleaning reduces fugitive dust emissions and is integral to invasive (non-native) species management.

Description of Activity

Washing and cleaning is a process of inspection, sweeping, vacuuming or using a compressed air or a high pressure hose to wash and clean vehicles, boats and equipment from visible direct and plant material. This ESG does not address solvent cleaning, abrasive cleaning, and other types of cleaning such as ultrasonic cleaning, chemical polishing and electro-polishing.

Environmental Standards and Guidelines

- Inspection, washing and cleaning of all vehicles, boats and equipment should be performed in accordance with the procedures, checklists and diagrams provided in the "Clean Equipment Protocol for Industry - Inspecting and Cleaning Equipment for the Purposes of Invasive Species Prevention", as summarized below:
  - When vehicle/equipment washing/cleaning must occur on-site, and the operation cannot be located within a structure or building equipped with appropriate water management facilities, the outside cleaning area should be:
    - accepted by PCA prior to use;
    - mud free, gravel covered or a hard surface (i.e., stabilized construction entrance if designated to handle runoff). If this option is not available, choose a well maintained (i.e., regularly mowed) grassy area;
    - gently sloping to assist in draining water and material away from the vehicle or equipment;
    - at least 30 m away from any watercourse, water body and natural vegetation; and
    - large enough to allow for adequate movement of larger vehicles and equipment.
  - Washing and cleaning is required when inspection identifies visible dirt, plant material or snow and when moving vehicles, boats or equipment from one area to another or off-site.
  - Used of compressed air is preferred to pressure washing. Compressed air may also be used under frozen conditions.
  - Clean the interior of the vehicle by sweeping, vacuuming or using a compressed air device. Particular attention should be paid to the floor, foot wells, pedals, seats, and under the seats.
  - Clean the interior of the vehicle by sweeping, vacuuming or using a compressed air device. Particular attention should be paid to the floor, foot wells, pedals, seats, and under the seats.

- Clean exteriors of vehicles, boats and equipment with either compressed air or a high pressure hose in combination with a stiff brush and/or pry bar to further assist the removal of dirt.
- Equipment such as boats that may be exposed to aquatic invasive species should also be disinfected with bleach solution before conducting work in a new area or left to dry for 5-7 days in warm, dry weather.

- The use of diesel for vehicle and equipment cleaning is prohibited. Cleaning of vehicles and equipment with soap, solvents or steam should not occur on the project site.
- Resulting wastewater must be fully contained and treated in accordance with Treatment of Discharge Waters (ESG-14-C) and Sediment Controls (ESG-2-Pre).
- If the area has been identified as having invasive species, waste water will be disposed of off-site.

Related Environmental Standards and Guidelines

- General Environmental Protection Procedures
- Sediment Control (ESG-2-Pre)
- Vegetation Clearing and Protection (ESG-5-Pre)
- Invasive Species Management (ESG-11-C)
- Revegetation (ESG-1-Post)

Related EMP Component Plans

- Dust and Air Quality
- Transportation Management
- Surface Water Management, Erosion and Sediment Control
- Vegetation Protection
- Aquatic Resources Management
- Invasive Species Management
- Fuel Management

Further Guidance

Ontario Invasive Plant Council, 2013. Clean Equipment Protocol for Industry - Inspecting and cleaning equipment for the purposes of invasive species prevention. Available at: http://www.ontarioinvasiveplants.ca/wp-content/uploads/2016/07/Clean-Equipment-Protocol_June2016_D3_WEB-1.pdf

Wildlife and Species Protection During Construction (ESG-17-C)

Application to Ontario Waterways' Projects

Construction projects on Ontario Waterways are undertaken on lands that are often well vegetated with natural vegetation (e.g., forests, wetlands, grasslands, etc.) or grounds that have been landscaped. Similarly, projects on Ontario Waterways are undertaken in or near water. These areas and watercourses can provide suitable habitat for a variety of wildlife species including Species at Risk (SAR).

All projects on Ontario Waterways must be in compliance with the *Species at Risk Act* (*SARA*) and have regard for listed species identified by the Province in the *Ontario Endangered Species Act* that are not listed under the federal *SARA*.

Ontario Waterways evaluates the impact on species listed under the *SARA* whenever it grants a formal permit, or undertakes work that has the potential to affects species or habitats. Ontario Waterways may require follow-up and monitoring to be undertaken that is consistent with relevant species' recovery strategies and action plans, and the objectives, scope, timelines and responsibilities for monitoring activities outlined in the EIA report.

Description of Activity

Wildlife protection during construction involves the diligent implementation of wildlife and related habitat mitigation measures identified in the EIA along with relevant best practices, specifications and performance criteria, particularly timing windows. In addition, wildlife protection during construction will require recording and reporting of incidental encounters with wildlife (non-SAR).

SAR protection involves the diligent implementation of SAR mitigation measures identified in the EIA along with relevant best practices, specifications and performance criteria, particularly timing windows. In addition, SAR protection will require contractor staff training and awareness that support the implementation of procedures and work modifications to be undertaken in the event of encounters with SAR. Prompt recording and reporting of SAR encounters is also required.

Environmental Standards and Guidelines

General

- All wildlife and habitat related mitigation measures identified in the EIA and any other measures proposed must be included in the site-specific EMP and accepted by PCA. All measures must implemented, with special emphasis on:
    - the construction timing windows identified in the Project's EIA;
    - tailoring protection measures to wildlife seasonal patterns; and
    - the implementation of any protection measures aimed at excluding wildlife species from the work area, minimizing disturbance/harm and any "no go" areas aimed at excluding project works activities from species habitats.
- The work site should be inspected by a Qualified Professional(s) prior to vegetation clearing, to identify potential wildlife issues (e.g., hibernating animals or nursing mothers and their young, etc.) and to inform or adjust mitigation planning as needed. The timing and scope of this

inspection will vary depending on the type and extent of habitat to be affected and the anticipated timing for site clearing. If recommended by a Qualified Professional and accepted by PCA, exclusion zones or “no go” areas will be established to protect critical habitat or areas with known residences (e.g., hibernacula, dens, nests).

- If recommended by a Qualified Professional and accepted by PCA, conduct “Pre-stressing” activities within a few days prior to the onset of site preparation to encourage wildlife to move away from a site. The need for, type and frequency of pre-stressing activities will consider:
  - The amount and quality of information available about wildlife;
  - The size of the area to be affected;
  - The proposed timing of project works and activities (i.e., within or outside of prescribed timing windows);
  - The need for multiple pre-stressing events.

- On a daily basis, an inspection or “sweep” of the work area shall be performed prior to commencement of project works and activities to ensure wildlife is not present in the work area. A site inspection checklist shall be included in the site-specific EMP and accepted by PCA.
- Animals should be provided a safe corridor to escape and/or move around the construction site. Corridors designed to facilitate species movement should be a minimum of 50 m to 100 m in width.
- Any proposed material changes to the EIA or EMP must be reviewed and accepted by PCA.

Wildlife Protection Best Practices

- All vehicles and equipment used by project personnel will follow construction zone speed limits to reduce the risk of hitting wildlife, as enforced by the site supervisor.
- Camps and associated infrastructure will be designed to exclude wildlife. Options include security fencing, regular snow removal, covering vents with wire mesh to exclude small mammals and birds, and metal mesh skirting around elevated trailers, walkways, and stairs to prevent wildlife access. Fencing should be tailored to the wildlife expected on-site. Fencing will be used to prevent wildlife from entering waste storage areas. See Tree Protection and Hording (ESG-4-Pre) for guidelines regarding exclusion fencing.
- Work areas will be kept clean and free of potential hazards to wildlife such as wire, cable, tubing, plastic, antifreeze or other materials that wildlife may eat or become entangled in.
- Waste will be stored, handled, and transported in accordance with the Waste Management Plan included in the site-specific EMP, including external storage of all solid waste in sealed, bear-proof containers. Proper food storage/cleanup of all wildlife attractants. Avoid littering, keeping all trash secured in wildlife-proof containers and promptly remove waste from site especially in warm weather.
- Feeding of wildlife is prohibited.
- Hunting or trapping by project personnel is prohibited.

Encounters with Wildlife (SAR and/ non-SAR)

The following procedures shall be followed for incidental encounters with all species, including SAR

- For a SAR, immediately cease activity within the work area of the encounter;
  - Immediately notify site supervisors and PCA and prepare a report to PCA;
  - Do not approach or handle the species (i.e., do not harm or harass the species);
  - Identify the individual species and determine species status.

- For mobile species:
    - Provide 24 hours and a safe corridor for species to leave the area before continuing the activity. If the species does not leave the site within 24 hours and work must proceed in the area of the encounter, take measures to relocate the species to a nearby suitable location.
    - Only a Qualified Professional should handle or relocate species.

- For injured species:
    - Take measures to ensure the species is protected from further harm (e.g. provide operator/worker awareness to avoid the location of the encounter).
    - Contact a Qualified Professional to determine and implement required actions (e.g., if feasible, the capture and relocation of an injured species to an appropriate care facility by the Qualified Professional).
    - Do not perform any work in the immediate location of the encounter until the species is removed from further harm.
    - Species handling and relocation measures will be based on the Ontario Species at Risk Handling Manual and will be implemented by, or under the guidance of the Qualified Professional.

- For a nest or breeding site of a species:
    - Stop work within 100 m and consult with a Qualified Professional.
    - Contact a Qualified Professional to determine whether the nest is active or inactive.
    - Notify PCA immediately of the nest status.
    - If active, mark an area at the location of the encounter around the nest and implement protective measures. Ensure that the nest is not more identifiable to predators.
    - Monitor the species to ensure it is not stressed or disturbed, including not disturbing its habitat. If the species appears stressed or disturbed cease operations immediately and contact a Qualified Professional for direction.
    - If a protected underground nest has been exposed, ensure it is covered with the same material and to the same depth if appropriate.
    - If it is necessary to remove a nest to proceed with work, contact the Qualified Professional to determine options for removal in accordance with the legislation and regulation (including the *Migratory Birds Convention Act*) and to determine consultation requirements with regulatory agencies.
    - Understand the nesting periods of various species.

- For species giving live birth, with eggs, or young:
    - Mark an area at the location of the encounter in a way that will protect the species from harm and will not identify the species to predators.
    - Contact the Qualified Professional to determine and implement required actions.
    - Monitor the species to ensure it is not stressed or disturbed, including not disturbing its habitat. If the species appears stressed or disturbed cease operations immediately and contact a Qualified Professional for direction.
    - Species handling and relocation measures will be based on the Ontario Species at Risk Handling Manual and will be implemented by, or under the guidance of the qualified biologist.

- For hibernating species:
    - Contact a Qualified Professional to determine how work may proceed. If the species must be relocated, obtain a SAR permit to proceed.

- Species handling and relocation measures will be based on the Ontario Species at Risk Handling Manual and will be implemented by, or under the guidance of the qualified biologist.

- For mosses, lichens, or vascular plant species:
  - Mark and protect the area at the location of the encounter in a way that will protect the species from harm and will not identify the species to predators.

- For reptile and amphibian species:
  - Contact a Qualified Professional to determine how to proceed.
  - Turtles can often be gently moved to a safe location nearby. Wear gloves or use a broom to steer the turtle in the direction of safety.
  - Exclusion fencing shall be used to eliminate access to specific area where activities could harm animals are occurring.
  - Exclusion fence design should consider the target species as well as those that might be unintentionally impacted. Fencing material should not pose a risk of entanglement or permit individuals to pass under or between openings.
  - For short-term activities (<6 months), a light-duty geotextile fence is appropriate and for longer term or permanent fencing projects, a more durable material such as heavy-duty geotextile, wood, concrete, woven-wire etc. would be appropriate.
  - Geotextile fencing with nylon mesh lining should be avoided due to the risk of entanglement by snakes.
  - To deter digging, bury the fence at least 10 cm down with an additional 10 cm horizontal lip. For snakes and toads, the fence should have an overhanging lip on the species side.
  - Exclusion fences should be installed prior to emergence from hibernation. Once the fence is installed, a survey should be done to ensure that no individuals have been trapped inside.
  - Fences should be inspected at regular intervals throughout the active season, especially following heavy rain events.

- For any other wildlife species:
  - No shut down is required unless young are present or animals do not calmly move away.
  - Provide the animal with a safe corridor to escape.
  - If young are present, stop construction actives within 100 m of sighting until animal moves away.
  - If a bear is detected within 1 kilometer away from the work area, issue an alert to all workers.

SAR Protection Measures

- The site-specific EMP must reflect the project as designed for implementation and the most current Species at Risk (SAR) records.
- Prior to any physical works or activities to be conducted on the project site, the Historic Canals Regulations permit for the project, and the site-specific EMP accepted by PCA should be reviewed to confirm if any SAR and/or habitat may be present and potentially affected by project works and activities.
- If SAR and/or habitat are present and are likely to be affected by the project, the SAR mitigation measures identified in the EIA and accepted site-specific EMP must be implemented, with special emphasis on:
  - the construction timing windows identified in the Project's EIA;
  - tailoring protection measures to wildlife seasonal patterns; and

- the implementation of any protection measures aimed at excluding wildlife species from the work area, minimizing disturbance/harm and any “no go” areas aimed at excluding project works activities from species habitats.

SAR Training and Awareness

All personnel conducting work on the site should be provided with SAR information and/or awareness training so they are familiar with the SAR procedures for the work, including reporting requirements. A record of all persons provided information and awareness training should be kept. The information and training should include:

- Obligations under the SARA;
- Information about the specific species that may be present in the work area;
- How to identify the species;
- Habitat characteristics for the species/where species are likely to be found;
- Potential threats and impacts to the species; and
- EMP commitments regarding SAR protection, including the SAR encounters procedure.

Recording and Reporting

- For all wildlife encounters, the following information should be recorded in the field:
    - Locations, dates and time of day where species at risk were encountered;
    - the names of species encountered;
    - photographs of the species, if taken.
    - Condition of the animal.
- PCA shall be notified immediately if injured/dead wildlife are encountered. PCA may require retrieval and storage on ice of carcass for laboratory testing.
- Field information regarding incidental encounters with wildlife (non-SAR wildlife) shall be compiled and reported on a monthly daily basis.
- To document that the SAR encounter procedure has been followed for the purpose of demonstrating compliance, record and make available the following information:
    - A description of the work or activity being undertaken;
    - The locations, dates and times of day the activity was undertaken;
    - A list of SAR potentially affected and its condition / status during the encounter;
    - All measures implemented to avoid or minimize harm; including specific locations the best practices process was implemented;
    - The Qualified Professional assisting in implementation;
    - The duration of the work stoppage; and
    - The restart and completion dates of the activity at each location.

Related Environmental Standards and Guidelines

- General Environmental Protection Procedures
- Erosion Control (ESG-1-Pre)
- Sediment Control (ESG-2-Pre)
- Vegetation Clearing and Protection (ESG-5-Pre)
- Invasive Species Management (ESG-11-C)
- Revegetation (ESG-1-Post)

Related EMP Component Plans

- Dust and Air Quality Management
- Noise, Vibration and Ambient Light Management
- Site Dewatering and Wastewater Plan
- Vegetation Protection
- Wildlife Protection and Management
- Aquatic Resources Management
- Species at Risk Protection
- Invasive Species Management
- Spills Prevention and Emergency Response
- Site Restoration

Other Design and Environmental Considerations

- For sites located within or adjacent to existing developed areas, nearby residents should be informed about the onset of pre-stressing activities and the potential for increased encounters with wildlife dispersing from the site. Local noise by-laws shall be respected.
- Scratches and bites from animals, whether domestic or wild, can result in serious infections and/or transmit diseases. Immediate medical treatment should be sought for any person injured by an animal.

Further Guidance

Environment and Climate Change Canada, 2017. General Nesting Periods of Migratory Birds in Canada. Available at: http://www.ec.gc.ca/paom-itmb/default.asp?lang=En&n=4F39A78F-1#cn-tphp

Ontario Ministry of Natural Resources and Forestry, 2016. Best Management Practices for Mitigating the Effects of Roads on Amphibian and Reptile Species at Risk in Ontario.

Ontario Ministry of Natural Resources and Forestry, 2013. Species at Risk Branch Best Practices Technical Note: Reptile and Amphibian Exclusion Fencing. Version 1.1. Available at: http://files.ontario.ca/environment-and-energy/species-at-risk/mnr_sar_tx_rptl_amp_fnc_en.pdf

Ontario Ministry of Transportation, 2016. MTO Best Management Practices for Species at Risk Protection during Maintenance Activities. Draft for Comment, November 18, 2016.

Ontario Ministry of Natural Resources and Forestry. Ontario Species at Risk Handling Manual: For *Endangered Species Act* Authorization Holders. Available at: http://files.ontario.ca/environment-and-energy/species-at-risk/mnr_sar_tx_sar_hnd_mnl_en.pdf

References

City of Ottawa, 2015. Ottawa Region Best Management Practices for Wildlife During Construction. Available at http://ottawa.ca/en/wildlife-strategy-city-ottawa/wildlife-construction-protocol

Environment and Climate Change Canada, 2013. How Much Habitat is Enough? Third Edition. Environment Canada, Toronto, Ontario. Available at: https://www.ec.gc.ca/nature/default.asp?lang=En&n=E33B007C-1

Winter Weather Stabilization and Operations (ESG-18-C)

Application to Ontario Waterways' Projects

Winter weather stabilization activities are critical to projects that carry over more than one construction season or require construction during the winter. Heavy accumulation of snow in disturbed areas or poor snow management practices can create blowing snow that reduces visibility or lead to severe erosion and sediment transport during temporary thaws or during the spring melt. Heavy truck and equipment traffic over unprotected and recently thawed or wet ground can create deep ruts that could divert or hold meltwater. Water accumulation can freeze creating a slippery ice hazard.

Description of Activity

Winter weather stabilization or winterization activities involve preparing disturbed areas and erosion and sediment control features for effective operation during winter, temporary thaws and during the spring melt. Winter operations involve snow and meltwater management through plowing, dozing and/or storing snow on the site and measures to prevent excessive snow accumulation and uncontrolled meltwater.

Environmental Standards and Guidelines

- All construction sites must be winterized no later than November 15 of each year.
- No fish salvage operations shall be undertaken after freeze-up or November 15 of each year.
- Areas of a construction site that will remain ***inactive*** over winter (i.e., where construction activity will not occur), must meet the following winterization requirements:
    - Install and maintain effective temporary erosion and sediment control devices prior to ground freezing.
    - Stabilize all disturbed and bare soil areas with native vegetation, mulch, hydro-mulch with a tackifier or erosion control blankets. See Erosion Control (ESG-1-Pre) and Sediment Control (ESG-2-Pre).
    - All mulch applied during winter shall be anchored. Installing erosion control blankets is not recommended on frozen ground or if more than one inch of snow is present.
    - Cover soil stockpiles to be used next season with mulch or plastic sheeting and contain within sediment fencing. Sediment fences shall not be installed when frozen conditions prevent proper embedment.

- All drainage ditches, swales, berms and channels should be constructed and stabilized prior to ground freeze. Temporary stabilization shall be undertaken using stone or erosion control blankets appropriate for the design flow conditions, as determined by a Qualified Professional.
- All spills on snow, ice or frozen ground shall be cleaned-up immediately and reported.
- Ice shall not be used as a catchment area for construction debris (concrete rubble/dust, gravel, etc.)
- Frozen materials that are removed during winter construction, should be stockpiled separately from previously excavated materials in a designated location.
- Prior to the onset of a forecasted thaw and following each rainfall, or thaw period, the site Contractor shall conduct an inspection of all installed erosion and sediment control devices and

perform repairs as needed to ensure they function as required. If supplementary ditching or berming needs to be constructed this shall be done before melt starts to prevent flooding.

- For any area stabilized by temporary or permanent seeding prior to the onset of the winter season, the Contractor should conduct an inspection in the spring to ascertain the condition of vegetation cover, and repair any damaged areas or bare spots and reseed as required to achieve an established vegetative cover (at least 85% of area vegetated with healthy, vigorous growth).

Snow and Meltwater Management

- The storage and application of road salt for de-icing purposes is prohibited. Only environmentally friendly sand and de-icing products approved by PCA shall be used at a construction site. Grit and deicers should be ordered and on-site prior to first snow fall, usually in September. Follow manufacture's specifications for application of de-icing products.
- Accumulated snow shall be removed from active construction work areas prior to significant earth-moving activities when accumulations reach up to 30 cm.
- Utilize snow blowers, snowploughs or other equipment to remove snow into windrows or to move snow to designated storage areas. Do not pile snow on erosion sensitive areas. These areas should be identified in the EMP. For snow windrows, gaps would be left at natural drainage swales to allow for cross drainage.
- Designated snow disposal areas within the site shall be identified in the EMP. They should be clearly delineated in a way that is easily identifiable under adverse winter conditions, to ensure that the snow is placed in the proper location on the site.
- Snow storage areas should be designated in locations where soil rutting will not be an issue otherwise storage areas shall be constructed with a solid base as designed by a Qualified Professional (e.g., Geotechnical engineer).
- All excavations occurring through the winter season should be marked with high visibility markers, blinking lights or bermed / barricaded. Snow cover can hide leading edges of excavations causing deep holes to look like shallow depressions.
- Remove equipment and supplies from flood prone areas prior to snow melt or spring thaw.
- To avoid flooding during spring melt, snow disposal areas should not be placed on high ground. Site meltwater should be directed away from the snow piles and dumping area to reduce ponding/rutting.
- Remove snow accumulations from around flow conveyance structures such as culverts and ditches following major snowfalls to minimize ice jamming or structure failure during freeze-thaw cycles.
- Install snow fences in areas where snow drifts of more than 1.5 m in depth can occur. Snow fences should be between 1.5 to 2.0 m in height, placed at a distance of 15 to 20 times the fence height from the area to be protected.
- Prior to spring melt, review the site's surface water management plan and ensure that planned water run-off areas are still appropriate. If supplementary ditching or berming needs to be constructed, this should be done before melt starts to prevent flooding.

Related Environmental Standards and Guidelines

- General Environmental Protection Procedures
- Erosion Control (ESG-1-Pre)
- Sediment Control (ESG-2-Pre)
- Fish Exclusion, Salvage and Relocation (ESG-7-C)
- Refueling and Spill Management (ESG-13-C)
- Revegetation (ESG-1-Post)

Related EMP Component Plans

- Transportation Management
- Demolition
- Site Dewatering and Wastewater Management
- Surface Dewatering and Wastewater Plan
- Aquatic Resources Management
- Waste Management
- Hazardous Materials Management
- Fuel Management
- Spills Prevention and Emergency Response

References

Transportation Association of Canada, 2013. Syntheses of Best Practices Road Salt Management - Snow Storage and Disposal. April 2013. Available at: http://www.tac-atc.ca/en/bookstore-and-resources/free-resources-and-tools/syntheses-practice

Hawryluk, T., 2014. Winter Works Best Practice. Available at: https://www.coaa.ab.ca/COAA-Library/SAF-WTW-PBP-01-2014-v1%20Winter%20Works%20with%20Appendices.pdf

Revegetation (ESG-1-Post)

Application to Ontario Waterways' Projects

Site preparation for a construction project on PCA property will require vegetation removal (i.e., clearing and grubbing) to prepare laydown areas, storage areas, camps, access roads/trails etc. Riparian and aquatic vegetation removal may also necessary for in-water works (e.g., bridge and dam sites, water crossings). Revegetation is required as part of site restoration. Revegetation covers many different habitat types, boreal, St. Lawrence lowlands, Carolinian, manicured, open/savannah, riparian, etc.

Description of Activity

Revegetation is a key component of site restoration. Revegetation stabilizes soil, reduces erosion and sediment runoff, and inhibits growth of invasive species. Revegetation involves providing a suitable growing medium for vegetation. Revegetation can include reseeding and replanting of shrubs and trees. There are two approaches to seeding: 1) temporary seeding for short-term exposed soils and 2) long-term seeding associated with site restoration. Replanting of shrubs and trees is undertaken for long-term site restoration following the completion of construction works and activities.

Environmental Standards and Guidelines

General

- All proposed revegetation measures shall be described in the site-specific EMP and accepted by PCA.
- Develop revegetation objectives in terms of short-term and long-term goals (revegetation plan in EMP provided to PCA):
    - Short Term: stabilize the ground surface at all disturbed areas.
    - Long Term: restore the site and work areas to a specific future state or for a specific end use (e.g., public use, recreation, wildlife habitat), including any remediation, if required.
- Native species to Ontario will be used when revegetating sites, with the exception of sod. Species will be appropriate for site conditions and habitat. Invasive species will not be used.
- Necessary erosion and sedimentation control practices should be established prior to seeding.
- Optimal timing for seeding is early spring (before spring runoff) or fall; however, seeding can occur throughout summer with irrigation.

Soil De-compaction

- De-compact soil which has been compacted from the movement of construction equipment and project staging.
    - The most effective way to manage soil compaction on construction sites is to avoid compacting the soil in the first place. This can be accomplished by dedicating access and haul routes and restricting access to areas of the site that are more susceptible to compaction such as clay soils and wet soils. All site entrances will be identified in the site-specific EMP and accepted by PCA.

- Topsoil stripping and stockpiling should be employed at all construction sites where heavy machinery, continuous lightweight traffic, equipment storage or stockpiling of materials is anticipated. See Soil Stripping, Grubbing and Stockpiling, ESG-3-C.
- Areas that have been compacted or had the topsoil layer removed must be decompacted and amended by reapplying topsoil, the addition of compost or through other techniques that are capable of mitigating lost moisture holding capacity.
- Prior to de-compaction activities, the location of all buried utilities must be determined. Avoid de-compaction of soils in areas that have buried utilities, wires, pipes, culverts, or diversion channels.
- Soil de-compaction is most effective when the ground is dry. This is especially important for clay soils.
- Perform ripping operations during late summer or fall to take advantage of the relatively dry seasonal conditions while allowing soil settling for early spring tree planting.
- When ripping is performed on nearly level ground, the direction of ripping is not critical. However, when ripping is performed on slopes, it is advisable to rip along the contour to minimize erosion. Once soil has been decompacted follow up immediately with topsoil placement and seeding/erosion control or sod as per the specifications.
- It is recommended to following ground contours whenever possible when performing de-compaction to increase water capture, protect run-off quality, and reduce soil erosion.
- Decompaction becomes increasing important in relation to the root depth of the vegetation being planted as part site restoration. Deeper rooted plants such as shrubs and trees require deeper de-compaction to facilitate healthy root penetration and vigorous growth. Ensure that de-compaction depth is consistent with the revegetation plan.

- Placement of topsoil over disturbed lands shall be undertaken to provide a suitable growing medium for revegetation plant species and site conditions. Most of the soil to be used for this purpose should come from on-site topsoil stockpiles (See Invasive Species Management ESG-11-C). Typically, topsoil is not applied to slopes greater than 2:1.
- Suitable sub-soils must also be used for revegetated areas if the native fill has been removed. Revegetation will follow the poorly drained soil requirements in the table below.
- The following minimum depths of growing medium should be achieved to the extent possible (given soil availability and site conditions).

Application	Over Prepared Sub-grade, retaining the "A" horizon	Over rapidly draining soil	Over poorly draining soil
Lawns	100 mm	150 mm	225 mm
Ground Cover Areas	150 mm	300 mm	225 mm
Small Shrubs	300 mm	450 mm	225 mm
Large Shrubs	450 mm	600 mm	450 mm
Trees	600 mm	600 mm	600-900 mm

- Mulch will be applied to areas where invasive plants have been removed. Areas where mulch has been displaced by a rainfall event or high winds should be repaired when conditions allow.
- Any seeding requires some form of erosion protection product (e.g., compost, mulch, erosion control blanket) in order to minimize disturbance and provide immediate stabilization while establishment occurs. See Erosion Control (ESG-1-Pre).

- Where a seedbed cannot be prepared properly, hydromulching, compost shall be used on slopes up to 1.5:1 or for anything steeper, an anchored rolled erosion protection measures (see Erosion Control ESG-1-Pre) shall be used. Hydromulching may also be used where seedbeds may retain large clods of soil or rocks, and on sites where other soil stabilising, seeding, and mulching practices would not be effective due to unacceptable levels of surface soil disturbance. See Erosion Control (ESG-1-Pre) and Sediment Control (ESG-2-Pre) for further guidance on hydromulching and required thickness for slopes.
- Revegetation of all exposed soils shall be undertaken using Ontario native seed mixes, as soon as practicable and accepted by PCA, to reduce the risk of soil erosion and sedimentation.
- Sod can be used at lock stations where areas are expected to be mowed. Any areas where plants will be left to go to seed, then Ontario native species must be used.
- Seeding shall be undertaken on slopes of 3:1 or less. For greater slopes, hydraulic seeding is recommended.
- Native Ontario seed mixes should be applied at a rate that produces a seedling density such that each seedling develops into a viable reproducing plant. Some species require only small quantities of seed. According to the Ontario Construction Specification for Seeding and Mulching, Temporary Cover, and Erosion Control Blanket, the minimum rate of seed application for standard roadside, salt tolerant, lowland or acidic soil mix should be 100 kg/ha and for crown vetch or birdsfoot trefoil mix the rate is 75 kg/ha.
- Bags of commercial seed are frequently sources of non-native invasive species. Only certified, weed-free seed will be used.
- Areas that fail to establish adequate cover, or have been invaded by weedy species shall be reseeded. Spot seeding can be done on small areas to fill in bare spots where seed did not germinate. Successful re-vegetation is considered once seeded/planted species have reached a ground cover of 80%.
- Where shrubs and/or deciduous trees were present along a watercourse or wetland prior to construction, willow stakes, red-osier dogwood, aspen, and other riparian trees and shrubs will be implanted in moist soils along the edge up to 20 m of the width of the clearance area and for the full area of work areas to stabilize disturbances and reduce sedimentation.
- All tree and shrubs planted should be covered by mulch (the size of planted root ball) with a well around the trunk to allow for water infiltration.
- The use of fertilizers is prohibited. Compost will be considered the first option where fertilizers would otherwise be utilized. Compost must be weed-free or from a facility where temperatures have rendered seeds non-viable.
- Ensure Qualified Professional(s) complete post-construction vegetation monitoring to ensure success of revegetation.
- During the establishment period of the new plants, the plants will need to be watered (weather dependant) at minimally every 7 to 10 days or preferably every 2-3 days between May and August 30, and minimally every 14 to 21 days between September 1 and November 15.
    - Watering should be enough to penetrate the full depth of the growing medium.
    - Soil moisture should be monitored throughout the growing season and the frequency of watering should be increased when plant materials are reaching the permanent wilting point. Scheduled applications of water should be skipped when rainfall has penetrated the soil fully.

Related Environmental Standards and Guidelines

- General Environmental Protection Procedures
- Erosion Control (ESG-1-Pre)
- Sediment Control (ESG-2-Pre)
- Soil Stripping, Grubbing and Stockpiling (ESG-3-Pre)
- Vegetation Clearing and Protection (ESG-4-Pre)
- Invasive Species Management (ESG-11-C)

Related EMP Component Plans

- Vegetation Protection
- Wildlife Protection and Management
- Species at Risk Protection
- Invasive Species Management
- Site Restoration

Other Design and Environmental Considerations

- Necessary erosion and sedimentation control practices should be established prior to seeding.
- Optimal timing for seeding is early spring (before spring runoff) or fall; however, seeding can occur throughout summer with irrigation.
- Timing of works should avoid seasonally high rainfall and snowmelt periods.

Further Guidance

Landscape Ontario Horticultural Trades Association, 2004. Landscape Guidelines. Available at: http://landscapeontario.com/attach/1246977850.Landscape_Guidelines.pdf.

TRCA. 2010. Preserving and Restoring Healthy Soil: Best Practices for Urban Construction. Version 1.0. June 2012. Available online: www.conservationhalton.ca/.../preserving_and_restoring_healthy_soil_trca_2012.pdf

References

Kees, 2008. Using Subsoiling To Reduce Soil Compaction; USDA Forest Service Technology and Development Program Missoula, MT 5E52F74 Soil Tilth Restorer

Government of Yukon, 2011. Best Management Practices for Works Affecting Water in Yukon. Water Resources Branch, Environment Yukon. May 2011. ISBN 978-1-55362-525-4.

Government of Ontario. 1990. Contract Design, Estimating and Documentation – Special Provisions Volumes, Seeding and Cover. August 1990. Index 572S01. Available online: http://www.raqsa.mto.gov.on.ca/techpubs/cdedspa.nsf/83b14ef9766e4ae385257081006823bb/ecb4894b75949c39852568070076d35e?OpenDocument

Minnesota Stormwater Manual, 2016. Alleviating Compaction from Construction Activities; URL: https://stormwater.pca.state.mn.us/index.php?title=About_the_Minnesota_Stormwater_Manual&oldid=21614

Virginia Department of Conservation and Recreation (VA-DCR), 2011. Virginia DCR Stormwater Design Specification No. 4: Soil Restoration, http://vwrrc.vt.edu/swc/.

APPENDIX A
Glossary and Acronyms

Word/Acronym	Acronym	Definition
Adaptive Management		A planned and systematic process for continuously improving environmental management practices by learning about their outcomes.
Angular gravel		Typically 14 to 20 mm in size and most suitable for driveways as the pieces lock together when driven on so are less likely to rut. Also referred to as Flint or Golden Spa gravel.
ATV	ATV	All-Terrain Vehicle
By-pass Channel		An alternate passage created to carry excess water from river or channel while work is being completed on a portion of the river or channel.
Capital Plan		A plan for four to ten years identifying projects that will help maintain or improve City assets, providing a planning schedule and identifies option for financing the plan.
CEAA	*CEAA*	*Canadian Environmental Assessment Act*
CEPA	*CEPA*	*Canadian Environmental Protection Act*
CO2	CO2	Carbon Dioxide
Coffer dam		A watertight enclosure pumped dry to permit construction work below the water line.
Compaction (soil)		Soil compaction is the process in which a stress applied to a soil causes densification as air is displaced from the pores between the soil grains.
Component plans		As part of a broader Environmental Management Plan, a highly specific plan aimed at providing guidance regarding how a specific project work, activity would be undertaken or how an objective would be achieved.
Compost blankets		A layer of loosely applied composted material placed on the soil in disturbed areas to reduce storm water runoff and erosion.
Cut slope roughening		Creating a rough soil surface to reduce the speed of runoff, increase infiltration and trap sediment. This helps establish vegetative cover by reducing runoff velocity and thus reducing erosion.
Cutoff walls		An area of reclamation separated by an impervious material.
DBH	DBH	Unit of measure applied to mature trees - diameter at breast height.

Word/Acronym	Acronym	Definition
Deleterious substances		A substance which when introduced to fish bearing waters is one that will harm fish or fish habitat.
Drip-line		The area defined by the outermost circumference of a tree canopy where water drips from and onto the ground.
Dust suppressants		Water or chemical compounds that are finely sprayed on a surface to eliminate or minimize dust generation.
EA	EA	Environmental Assessment
Earthworks		Activities that include grading, excavation, backfilling in connection to a construction project.
ECCC	ECCC	Environment and Climate Change Canada
EIA	EIA	Environmental Impact Assessment
Environmental Management Plan	EMP	An EMP is a project-specific and site-specific document, based on the site-specific EIA, that contains a set of over-arching EMP requirements plus a set of highly specific component plans that, when implemented collectively as a management system, are intended to avoid, eliminate or reduce the severity of adverse environmental effects.
Energy dissipation		Equipment or structures used where concentrated flows are discharged into a natural or manmade drainage feature such as a stream, wetland, lake, or ditch, typically applied at the outlets of ponds, pipes, drains, culverts, ditches, or other conveyances.
EPA	EPA	Effective Project Approval
Erosion		The gradual process of degrading soil as a result of wind, water or other natural agents.
Erosion control blanket	ECB	A degradable rolled erosion control product composed of processed natural or polymer fibers mechanically, structurally or chemically bound together to form a continuous matrix to provide erosion control and facilitate vegetation establishment.
ESG	ESG	Environmental Standards and Guidelines
ESSB	ESSB	Explosives Safety and Security Branch

Word/Acronym	Acronym	Definition
Fiber roll		A temporary erosion control and sediment control device used on construction sites to protect water quality in nearby streams, rivers and lakes from sediment erosion. It is made of straw, coconut fiber or similar material formed in a tubular roll.
Fish salvage		The physical removal of fish from an isolated in-water work area, aimed at removing fish, using non-lethal methods, from construction areas and releasing them downstream or elsewhere with minimal handling.
Flumes		An artificial narrow channel conveying water through it.
Fugitive dust		Visible emissions of particulate matter released from sources other than stacks, typically dust blown from storage piles, roads, and areas of disturbed soil.
Grubbing		The activity of digging out or mulching in-situ stumps and roots below the ground surface. The removal of visible rocks and boulders is often undertaken while grubbing.
HASP	HASP	Health and Safety Plan
High water mark	HWM	The water level reached by a lake or river at its highest stand.
Hoarding		A temporary wooden or metal structure placed around a building or structure under construction or repair or around trees or other areas to be protected from encroachment by construction personnel or equipment.
HVAC	HVAC	Heating, ventilation and air conditioning
HVLP	HVLP	High volume low pressure
Hydromulching		A one-step process where seed, fertilizer and mulch and a binder are combined together in water. The resulting slurry is sprayed onto the soil surface providing a wood fiber interlocking mat that retains moisture for seed germination.
Industrial Health and Safety Plan		A plan listing how worker safety, health and welfare will be maintain during a project.
Invasive species		Non-native species to an ecosystem whose introduction causes or is likely to cause environmental harm.

Word/Acronym	Acronym	Definition
In-water works		Construction work which occurs in a watercourse or waterbody (e.g., canal).
Isolated piers		Piers are vertical structures made from brick, concrete, block, stone, timber or steel which supports floor structures. An engaged pier is a pier that is bonded to a wall while an isolated pier is separate from a wall.
Land-Based Activities		Construction work which occurs primarily on land.
MSDS	MSDS	Material Safety Data Sheet
Mud Mats		Used for construction site access and other soft or sensitive ground condition areas where vehicle access is required. They can be unrolled on any muddy or swampy ground and driven over without rutting, getting stuck or tracking mud off-site.
Noise abatement		A set of strategies to reduce noise pollution or to reduce the impact of that noise.
Notional approval		The approval of a concept or idea.
Noxious weeds		A plant species that has been designated by an agricultural authority as one that is injurious to agricultural or horticultural crops, natural habitats or ecosystems or humans or livestock.
NRCan	NRCan	Natural Resources Canada
NTU	NTU	Nephelometric Turbidity Unit, measure of turbidity
Off-road compression-ignition engine emission regulations (SOR/2005-32)		The Off-Road Compression-Ignition Engine Emission Regulations (the Regulations) introduced emission standards for diesel engines used in off-road applications such as those typically found in construction, mining, farming and forestry machines.
OMRF	OMRF	Ontario Ministry of Natural Resources and Forestry
Ontario Ambient Air Quality Criteria	AAQC	A desirable concentration of contaminant in air, based on protection against adverse effects on health or the environment. The term ambient is used to reflect general air quality independent of location or source of a contaminant.
Ontario Regulation 347		An Ontario regulation on waste management.

Word/Acronym	Acronym	Definition
Ontario Waterways		Lands and waters in the Rideau Canal and Trent-Severn Waterway owned and administered by Parks Canada Agency
OPSD	OPSD	Ontario Provincial Standards
OPSS 120.04		Ontario Provincial Standard Specification for general specification for the use of explosives.
OPSS 201 Guideline for clearing, close cut clearing, grubbing, removal of boulders and mechanical stump cutting		Ontario Provincial Standard Specification for the construction specification for clearing, close cut clearing, grubbing and removal of surface boulders.
OWA	OWA	Ontario Waterpower Association
Oxy-acetylene torch		A cutting and welding process that uses fuel gases and oxygen to weld and cute metals.
PCA	PCA	Parks Canada Agency
Peak particle velocity		The maximum speed of a particular particle as it oscillates about a point of equilibrium that is moved by a passing wave.
Performance Criteria		Standards by which performance is evaluated.
pH	pH	Unit of measure - potential of hydrogen, which is measure of the degree of acidity or alkalinity
Physiographic regions		A definition of the earth's landforms into distinct regions based upon the tree-tiered approach that further defines landforms.
PPA	PPA	Preliminary Project Approval
Pre-stressing activities		In the context of environmental protection, the activity of temporarily disturbing wildlife to encourage them to vacate an area
PTTW	PTTW	Permit to take Water
Qualified Professional	QP	Typically an engineer, applied scientist or technologist who is registered and in good standing with an appropriate professional organization or who, through demonstrated experience and knowledge relevant to the particular matter, may be reasonably relied on to provide advice within their area of expertise. Such a professional could be an ecologist / biologist, forester, geoscientist, engineer, or technologist.
Riparian		The banks of a river

Word/Acronym	Acronym	Definition
Rock check dam		A small rock dam constructed across a drainage way, swale or road ditch to counteract erosion by reducing water flow velocity.
Rolled erosion control products	RECP	Rolled erosion control products consist of prefabricated blankets or netting which are formed from both natural and synthetic materials to provide erosion control.
RPA	RPA	Requests for Project Approval
SAR	SAR	Species at Risk
SARA	*SARA*	*Species at Risk Act*
SEC	SEC	Sediment and Erosion Control
Sediment bags		A filter for silt laden water from construction sites. As water from the construction site is pumped into the bag, sediment is collected by the fabric allowing filtered water to pass through.
Sediment fence		A temporary sediment barrier, typically comprised of a permeable geotextile fabric designed to intercept and slow the flow of sediment-laden s runoff from areas of disturbed soil.
Sediment ponds		A temporary pond built on a construction site to capture eroded or disturbed soil that is washed off during rain storms, and protect the water quality of nearby stream, rive or lake. The sediment-laden soil settles in the pond before the runoff is discharged.
Sediment traps		Instruments used to measure the quantity of sinking particulate material in an aquatic system.
Sedimentation		The tendency for particles in suspension to settle out of the fluid in which they are entrained and deposit or accumulate against a barrier.
Seine nets		A fishing net that hangs vertically in the water with its bottom edge held down by weights and its top edge buoyed by floats.
Shock-tubes		An instrument used to replicate and direct blast waves at a sensor or a model in order to simulate actual explosions and their effects on a smaller scale.

Word/Acronym	Acronym	Definition
Siltsoxx		A tubular mesh sediment-trapping device which uses filter media materials applied with a pneumatic blower device or equivalent.
Soil horizon		A layer generally parallel to the soil crust, whose physical characteristics differ from the layers above and beneath. Each soil type usually has three of four horizons. Horizons are defined in most cases by obvious physical features, chiefly colour and texture.
SPEC	SPEC	Specifications
Stripping		The disturbance and removal of topsoil.
Surveillance monitoring		Compliance monitoring or site inspection
Tackifiers		A chemical compound used in formulating adhesives to increase the tack, the stickiness of the surface of the adhesive.
TDG	*TDG*	*Transportation of Dangerous Goods Act*
Timing windows		A time interval in which construction can occur.
Total suspended particulate	TSP	A measure of mass concentration of particulate matter in air
Tremie concrete pours		A method which uses a pipe, through which concrete is placed below water level. The lower end of the pipe is kept immersed in fresh concrete so that the rising concrete from the bottom displaces the water without washing out the cement content.
UNESCO World Heritage Site		A place that is listed by the United Nations Education, Scientific and Cultural Organization as of special cultural or physical significance.
Vehicular tracking control	VTC	Provides stabilized construction site access where vehicles exit the site onto paved public roads. It helps remove sediment from vehicles, reducing tracking onto the paved surface.
Wash-down Area		An area of a construction site, typically located at an access points, constructed and equipped to remove debris and sediment from tires and undercarriages of vehicles or other equipment to prevent sediment from entering a watercourse or waterbody or from being transported onto public roadways.

APPENDIX B
Policy and Legislative Context for Projects on Ontario Waterways

APPENDIX B: POLICY AND LEGISLATIVE CONTEXT FOR PROJECTS ON ONTARIO WATERWAYS

B.1. PCA Policies

PCA has developed a comprehensive set of Guiding Principles and Operational Policies which give direction to current and future programs, initiatives and projects on Ontario Waterways. These guiding principles and policies are centered on the goals and values of Parks Canada articulated in their mission statement:

> *"Building our future together - strengthening a shared sense of Canadian identity which respects the diversity of the land and the people"* (Parks Canada, 2013).

PCA's vision is to protect heritage areas through stewardship, citizen awareness and the protection of their ecological and commemorative integrity. PCA's activities entail direct responsibility for the management of federal lands and their associated assets and natural resources. This is the case for national parks, aspects of marine conservation areas and a number of national historic sites, including historic canals such as the Rideau Canal and the Trent-Severn Waterway (Parks Canada, 2013).

PCA, its Contractors or their agents must have regard for PCA's policies. The following sections summarize key PCA's policies that may apply to projects on Ontario Waterways.

Historic Canals Policy

As a result in the change of use of canals in Canada from commercial transportation to heritage appreciation, the Government of Canada transferred the responsibility for a number of operating canals in the 1970's from the Minister of Transport to the Minister responsible for Parks Canada. The objective of the Historic Canals Policy is to:

> *"foster appreciation, enjoyment and understanding of Canada's historic canals by providing for navigation; by managing cultural and natural resources for purposes of protection and presentation; and by encouraging appropriate uses"* (Parks Canada, 2009).

Any project on Ontario Waterways will require careful consideration of navigation. The following considerations will guide the provision of navigation: availability of adequate water levels, maintenance of public safety, preservation of heritage character, physical condition of the works, time of year, demand, and available human and financial resources. It is PCA's objectives to maintain adequate canal water depths, structures and navigation aids in order to provide for navigation.

Policies for In-Water and Shoreline Works Related Activities

PCA's Ontario Waterways Unit has developed policies for In-Water and Shoreline Works Related Activities[4] that provide guidance for a variety of construction activities which may be proposed along the canals. This policy applies to the following:

[4] For a detail description on each of these policies, refer to Parks Canada website: http://www.pc.gc.ca/eng/docs/r/poli/page01.aspx

- Docks and Boatlifts
- Boathouses and Boat Ports
- Dredging including the removal or relocation of logs, stumps or rock
- Shoreline Stabilization
- Beach Creation
- Inland Boatslips and Mooring Basins
- Launch Ramps
- Marine Railways
- Heat Pump Loops
- Waterlines
- Mooring Buoys, Swimming Buoys, Rafts and Water Ski Courses and Ramps
- In-Water and Shoreline Works in Narrow Channels
- In-Water and Shoreline Works in Wetlands.

These policies for In-Water Works and Shoreline Works can also be considered as Best Practices.

Cultural Resource Management Policy

PCA has developed a Cultural Resource Management Policy to assist in the management of cultural resources, including historic canals, in accordance with the principles of value, public benefit, understanding, respect and integrity. In the design and construction of projects on Ontario Waterways, reasonable precautions will need to be taken by Contractors and their agents to ensure that PCA continues to:

- provide for navigation;
- manage cultural and natural resources for purposes of protection and presentation; and
- encourage appropriate uses of federal lands and resources.

Green Energy Development

PCA is working with Ontario Waterpower Association (OWA) to optimize water power production and expanding Green Energy development opportunities[5]. PCA has also made available select sites that are suitable for hydro development applications. The process to permit, licence, and generate electricity through water power is extensive and ensures that the needs of many partners are met, including the PCA, the Province of Ontario, the environment, the water power industry and, ultimately, the Canadian public.

PCA's historic canals are important to the waterpower industry, and a major employer. The historic canals and local economies benefit directly from the revenue derived from waterpower generation, which is reinvested back into the canals to support their long-term sustainability.

B.2. Federal Legislation

PCA, its Contractors or their agents must have regard for, and remain in compliance with all applicable federal legislative requirements throughout the duration of any project, from its initial design through construction, project completion / close-out. Specifically, a Contractor's Environmental Management Plan (EMP) will need to demonstrate their understanding of the

[5] Parks Canada (2016). Trent-Severn Waterway National Historic Site: Green Energy Development on Parks Canada's Historic Canals in Ontario. Available online: http://www.pc.gc.ca/eng/lhn-nhs/on/trentsevern/plan/energie-verte-green-energy.aspx

legislative context and how their proposed works and activities will be undertaken to ensure compliance.

Parks Canada Agency Act

The *Parks Canada Agency Act*[6] (1998) is administered by Environment and Climate Change Canada (ECCC). The *Act* established the Parks Canada Agency for the purpose of ensuring that Canada's national parks, national historic sites and related heritage areas are protected and presented for this and future generations. All work completed in water and on land within historic canals are under the authority of PCA.

Canada National Parks Act

The *Canada Parks Act*[7] (2000) is administered by the PCA. The *Act* states that national parks are for the benefit, education and enjoyment of the Canadian people and the parks shall be maintained and made use of as to leave them unimpaired for future enjoyment. While the *Canada National Parks Act* does not specifically apply to Historic Canals, the *Act* and its regulations are often used by PCA as guidance regarding various standards, design, materials, construction and maintenance activities that may be undertaken on Historic Canals.

Historic Canals Regulations

The Historic Canals Regulations[8] under the *Department of Transport Act* is administered by the PCA. The Regulations are intended to assist in the maintenance, management and protection of historic canals. Authorization for work to be completed in water and on land within historic canals is under the authority of PCA. Contractors and their agents will require a permit from PCA prior to the commencement of any physical works or activities on the Rideau Canada and/or the Trent-Severn Waterway. The permit will be based on the EIA and the accepted EMP. The regulation gives PCA's the authority to issue a stop work order if the work fails to comply with the terms and conditions specified in the permit.

Navigation Protection Act

The *Navigation Protect Act* is administered by Transport Canada. The *Act* was established to protect transportation along Canada's navigable waterways listed in Schedule of the *Act*. Many of the waterways listed in the schedule to the *Act* are within the Rideau Canal and Trent-Severn Waterways. Authorization for work completed in water and on land within the listed canals is not required if a permit under the Historic Canals Regulations has been issued.

---

[6] *Parks Canada Agency Act* (S.C. 1998, c. 31). Available from the Department of Justice Canada website: http://laws-lois.justice.gc.ca/eng/acts/P-0.4/index.html

[7] *Canada National Parks Act* (S.C. 2000, c. 32). Available from the Department of Justice Canada website: http://laws-lois.justice.gc.ca/eng/acts/N-14.01/

[8] Historic Canals Regulations (SOR/93-220) (last amended June 5, 2015). Available from the Department of Justice Canada website: http://laws-lois.justice.gc.ca/eng/regulations/SOR-93-220/index.html

CEAA 2012

The *Canadian Environmental Assessment Act*, 2012 [9] is administered by the Canadian Environmental Assessment Agency. The *Act* was established to protect the environment from significant adverse environmental effects caused by a designated project and to ensure that designated projects are considered in a careful and precautionary manner to avoid significant adverse environmental effects. Currently, none of the projects subject to this ESG Document are "designated projects", although future projects may be added to the Designated Project list. Under Section 67 of the CEAA 2012, all projects on federal lands must not result in significant adverse environmental effects, or if there are significant adverse effects those effects must be justified in the circumstances. PCA will ensure that an Environmental Impact Analysis (EIA) is undertaken for projects on the Rideau Canal and Trent-Severn Waterway in accordance with PCA's EIA procedures and that a determination is made regarding if the project can proceed. Additional details are available in PCA's "Guide to the Parks Canada Environmental Impact Analysis Process" [10] (June 2015). No construction can begin until an EIA is approved by PCA.

Contractors and their agents will need to ensure that all mitigation measures identified in the approved EIA are implemented and effective as they are the requirements under which the assessment has concluded that there will likely be no significant adverse effects.

Fisheries Act

The *Fisheries Act* [11] is administered by the Fisheries and Oceans Canada (DFO). The *Act* was established to protect fish and fish habitat by prohibiting work or the deposition of a deleterious substance that results in serious harm to fish that are part of a commercial, recreational or Aboriginal fishery, or to fish that support such fishery unless the work is completed in accordance with prescribed conditions within a DFO authorization.

Should PCA determine that serious harm to fish is likely, PCA will send the Projects to DFO for project review and possible authorization. Residual serious harm to fish will need to offset in accordance with an approved offsetting plan. DFO requires all information stated in Schedule 1 of the *Fisheries Act* to begin a *Fisheries Act* review. This process may take up to 60 days. If a *Fisheries Act* authorization is required there is an additional 90 days to issue an authorization from the date all information is provided including an approved offsetting plan. An EIA cannot be approved until there is a *Fisheries Act* authorization.

Contractors and their agents will be required to comply with all provisions of any authorization issued by DFO or other measures identified by PCA intended to protect fish and fish habitat. These measures will need to be included in an EMP.

---

[9] *Canadian Environmental Assessment Act*, 2012 (S.C. 2012, c. 19, s. 52). Available from the Department of Justice Canada website: http://laws-lois.justice.gc.ca/eng/acts/c-15.21/FullText.html

[10] "Guide to the Parks Canada Environmental Impact Analysis Process" June 2015. Available from Parks Canada Agency's website: http://www.pc.gc.ca/progs/eie-eia/itm1/itm1b/itm1b-2.aspx.

[11] *Fisheries Act*, 2012 (R.S.C., 1985, c. F-14). Available from the Department of Justice Canada website: http://laws-lois.justice.gc.ca/eng/acts/F-14/

Species at Risk Act

The *Species at Risk Act*[12] (*SARA*) is administered by Environment and Climate Change Canada, but Parks Canada is the competent minister for all PCA lands and waters. The *Act* was established to prevent wildlife species from being extirpated or becoming extinct, to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity and to manage species of special concern to prevent them from becoming endangered or threatened.

SARA imposes obligations on federal land management agencies. As such, PCA has the responsibility for implementing *SARA* for those species at risk that occur on federal lands it administers, including species of fish (as defined by *SARA*) and of migratory birds.

PCA evaluates the impact on species listed under the *Act* whenever it grants a formal permit, or undertakes work that has the potential to affects species or habitats. Similarly, an authorization under *SARA* is required before any authorization such as a lease, license, or permit can be issued if the activity being authorized may affect an individual of a species listed in Schedule 1 of the *Act* or the critical habitat of the species. PCA may require follow-up and monitoring to be undertaken that is consistent with relevant species' recovery strategies and action plans, and the objectives, scope, timelines and responsibilities for monitoring activities outlined in the EIA report[13].

Contractors and their agents will be required to comply with all provisions of any permits issued by PCA and include measures to protect species at risk within an EMP.

Migratory Birds Convention Act

The *Migratory Birds Convention Act*[14] is administered by Environment and Climate Change Canada. The *Act* was established to implement the Convention by protecting and conserving migratory birds as populations and as individual birds and their nests. In general, projects affecting migratory birds, their nests, egg or egg shelter are protected under the *Act*. The discovery of a migratory bird's nest could result in a temporary shutdown of construction until a process for mitigation can be agreed to with Parks Canada and Environment and Climate Change Canada. During construction, no substances shall be deposited that may be harmful to migratory birds.

Contractors and their agents will be required to comply with all provisions of any permits issued under the *Act* and include measures to protect migratory birds within an EMP.

---

[12] *Species at Risk Act* (S.C. 2002, c. 29). Available from the Department of Justice Canada website: http://laws-lois.justice.gc.ca/eng/acts/s-15.3/

[13] For further information, please consult "Addressing *Species at Risk Act* Considerations Under the *Canadian Environmental Assessment Act* for Species Under the Responsibility of the Minister Responsible for Environment Canada and Parks Canada" and "*Species at Risk Act* Guidelines - Guidelines for Permitting Under Section 73 of the *Species at Risk Act*"

[14] *Migratory Birds Convention Act* (S.C. 1994, c. 22). Available from the Department of Justice Canada website: http://laws-lois.justice.gc.ca/eng/acts/M-7.01/FullText.html

Canadian Environmental Protection Act

The *Canadian Environmental Protection Act*[15] (CEPA), 1999, is administered by Environment and Climate Change Canada. The *Act* was established to contribute to sustainable development through pollution prevention and to protect the environment, human life and health from the risks associated with toxic substances.

Contractors and their agents must be in compliance with the *Act* by ensuring that any relevant policies, guidelines, codes of practice, government notices and orders which may affect the construction work are considered in project planning and design, or referenced within an EMP.

Transportation of Dangerous Goods Act

The *Transportation of Dangerous Goods Act*[16], (TDG) 1992, is administered by Transport Canada. The *Act* was established to promote public safety in the transportation of dangerous goods (e.g., explosives, gases, flammable liquids and solids). Under the Historic Canals Regulations (see above) no person in charge of a vessel shall allow the vessel to transport any dangerous goods as defined in the *TDG Act* in a historic canal, except in accordance with a permit issued by PCA.

Contractors and their agents will be required to comply with all provisions of any permit issued by PCA or other measures identified by PCA intended to protect public safety in the transportation of dangerous goods. These measures will need to be included in an EMP.

Explosives Act

The *Explosives Act*[17] is administered by the Explosives Safety and Security Branch (ESSB) of Natural Resources Canada (NRCan). The *Act* was established to respecting the manufacture, testing, acquisition, possession, sale, storage, transportation, importation and exportation of explosives and the use of fireworks. Any work on land or in the water in the canals which may require explosives for construction (i.e., blasting) will require a permit or licence.

Contractors and their agents may be required to submit permit applications and will be required to comply with all provisions of any permit issued by NRCan or other measures identified by PCA intended to protect public safety and the environment from blasting activities. These measures will need to be included in an EMP.

B.3. Provincial Legislation

In general, Provincial legislation is not applicable to projects undertaken on federal lands. Nevertheless, PCA, its Contractors or their agents should be aware and have regard for Provincial legislative requirements throughout the duration of any project, from its initial design through construction, project completion / close-out. There may also be circumstances where certain project works or activities are undertaken on non-federal lands (e.g., private or municipal

---

15 *Canadian Environmental Protection Act* (S.C. 1999, c. 33). Retrieved from the Department of Justice Canada website: http://laws-lois.justice.gc.ca/eng/acts/c-15.31/FullText.html

16 *Transportation of Dangerous Goods Act*, 1992 (S.C. 1992, c. 34). Retrieved from the Department of Justice Canada website: http://laws-lois.justice.gc.ca/eng/acts/T-19.01/

17 *Explosives Act* (R.S.C., 1985, c. E-17). Retrieved from the Department of Justice Canada website: http://laws-lois.justice.gc.ca/eng/acts/E-17/FullText.html

leased properties, Provincial Crown lands). In such instances, Provincial legislative requirements would apply. Key Provincial legislation that may require consideration during and EIA and throughout project delivery include:

Ontario Environmental Assessment Act

The *Ontario Environmental Assessment Act* is administered by the Ontario Ministry of the Environment and Climate Change. The *Act* is not applicable to PCA projects conducted on federal lands. However, some projects on Ontario Waterways may involve or otherwise interact with other proposed projects subject to the *Ontario Environmental Assessment Act*. These other projects may be proceeding as either Individual Environmental Assessments, an EA process defined by an approved Class Environmental Assessment (Class EA) or other form of Provincial EA (e.g., Class Environmental Assessment for Resource Stewardship and Facility Development Projects; Class Environmental Assessment for Waterpower Projects).

Ontario Endangered Species Act

The *Ontario Endangered Species Act*[18] is administered by the Ontario Minister of the Natural Resources and Forestry (OMRF). The *Act* identifies species at risk, protects species that are at risk and their habitats and promotes the recovery of species that at risk. The *Act* is not applicable to PCA projects conducted on federal lands, however PCA is to have regard for endangered species identified by the Province that are not listed under the federal *SARA*.

Ontario Invasive Species Act

The *Ontario Invasive Species Act*[19], 2015, is administered by the Ontario Minister of the Natural Resources and Forestry (OMNRF). The *Act* provides rules to prevent and control the spread of invasive species in the natural environment. Specific provisions apply to the release of invasive species into Provincial Park or conservation reserve. The *Act* is not applicable to PCA projects conducted on federal lands; however PCA is to have regard for the *Act* and associated guidance materials.

Lakes and Rivers Improvement Act

The *Lakes and Rivers Improvement Act*[20] is administered by the Ontario Minister of the Natural Resources and Forestry. The *Act* provides rules for the management, protection, preservation and use of the waters of the lakes and rivers of Ontario and the land under them and the use of the fish, wildlife and other natural resources dependent on the lakes and rivers. The *Act* does not apply to PCA projects conducted on federal lands.

[18] *Endangered Species Act* (S.O. 2007, CHAPTER 6). Retrieved from the Ontario e-Laws website: https://www.ontario.ca/laws/statute/07e06#top

[19] *Invasive Species Act* (S.O. 2015, c. 22). Retrieved from the Ontario e-Laws website: https://www.ontario.ca/laws/statute/15i22

[20] *Lakes and Rivers Improvement Act* (R.S.O. 1990, c. L.3). Retrieved from the Ontario e-Laws website: https://www.ontario.ca/laws/statute/90l03

Ontario Water Resources Act

The *Ontario Water Resources Act* [21] is administered by the Ontario Minister of Environment and Climate Change. The purpose of the *Act* is to provide for the conservation, protection and management of Ontario's waters and for their efficient and sustainable use, in order to promote Ontario's long-term environmental, social and economic well-being. The *Act* prohibits discharges (or permitting the discharge) of any material of any kind into or in any waters or on any shore or bank or into any place that may impair the quality of the water of any waters. The *Act* also requires a permit to take water (PPTW) for takings of more than 50,000 L of water on any day by any means expect in accordance with a permit issued.

The following water takings related to construction site dewatering and road construction may be eligible for registration in the Environmental Activity and Sector Registry (EASR):

- Surface water takings related to specific road construction purposes; and
- Ground water and/or storm water takings of more than 50,000 L/day but less than 400,000 L/day for the purposes of construction site dewatering.

For an activity to be exempted as a water taking and not require a PTTW, all conditions for the exemption must be met. Further information can be found in The Water Taking User Guide for Environmental Activity and Sector Registry[22] and Ontario Regulation 387/04[23].

Ontario Environmental Protection Act

The *Environmental Protection Act*[24] is the principal pollution control statute in Ontario. It is used interchangeably with the *Ontario Water Resources Act* to address sources of water pollution. The *Act* contains a number of general provisions that can be used to protect surface water and groundwater against contamination. Primarily, the *Environmental Protection Act*: prohibits discharges of contaminants into the natural environment in an amount, concentration or level in excess of prescribed regulatory standards. The Act is also where regulations establishing the Environmental Activity and Sector Registry (EASR) have been enacted.

Ontario Conservation Authorities Act

The *Ontario Conservation Authorities*[25] *Act* is administered by the Ontario Minister of Natural Resources and Forestry. The *Act* established and governs all Conservation Authorities in Ontario. The *Act* gives Conservation Authorities jurisdiction over one or more watersheds and the ability to enforce regulations in order to ensure a complete and rational approach to issues

---

[21] *Ontario Water Resources Act* (R.S.O. 1990, c. O.40). Retrieved from the Ontario e-Laws website: https://www.ontario.ca/laws/statute/90o40#BK0

[22] The Water Taking User Guide for Environmental Activity and Sector Registry. Available at: https://www.ontario.ca/page/water-taking-user-guide-environmental-activity-and-sector-registry

[23] *Ontario Regulation 387/04*. Retrieved from the Ontario Laws website: https://www.ontario.ca/laws/regulation/040387

[24] *Ontario Environmental Protection Act* (R.S.O. 1990), c. E.19. Retrieved from the Ontario Laws website: https://www.ontario.ca/laws/statute/90e19

[25] *Ontario Conservation Authorities Act* (R.S.O. 1990, Chapter C.27). Last amendment: 2011, c. 9, Sched. 27, s. 22. Retrieved from the Ontario Laws website: https://www.ontario.ca/laws/statute/90c27#BK0

such as flood protection and erosion control. This *Act* becomes relevant for all non-federal land that may be leased by Contractors.

B.4. Municipal Requirements

The *Ontario Municipal Act* is the main statute governing the creation, administration, governance of municipalities in Ontario, and Ontario's *Planning Act* affords municipalities a major role in local planning decisions. The Ministry of Municipal Affairs promotes infrastructure planning, environmental protection, economic development and safe communities, but it is the municipality's responsibility to execute this through municipal planning decisions identified in the Official Plans and through municipal by-laws. Common by-laws include by-laws for zoning, tree cutting, noise, water and sewage, waste disposal.

While municipal requirements are not applicable on federal lands, there may be instances where a project requires municipal or private lands off federal property, where the project relies on municipal services (e.g., waste management, water and sewage, storm sewers, electric utilities, fire and emergency services, roads/transportation) or where project effects (e.g., noise, dust, traffic) extend off-site.

APPENDIX C
Parks Canada Agency's Environmental Impact Assessment Process

APPENDIX C:
PARKS CANADA AGENCY'S ENVIRONMENTAL IMPACT ASSESSMENT (EIA) PROCESS

Under Section 67 of *CEAA 2012* PCA has a legal responsibility to ensure that projects and activities undertaken on the lands it manages do not result in significant adverse environmental effects. These include the project and activities undertaken at the National Historic Sites of the Rideau Canal and the Trent-Severn Waterway.

C.1. Environmental Impact Assessment Process

Project proponents, contractors or their agents may be requested to assist PCA in making their determination regarding the most appropriate EIA pathway through the preparation of an initial project description and/or design documents that describe the physical works and activities to be undertaken and any project features aimed at avoiding or minimizing adverse environmental effects.

The objective of Parks Canada's Environmental Impact Assessment (EIA) process is to ensure project review is conducted efficiently and that effort is focused on projects with the greatest potential to significantly affect the integrity of natural or cultural resources or characteristics of the environment that are important to key visitor experience objectives.

A project will not occur until an EIA has been completed, approved and the results taken into account in decision-making. It is the responsibility of the project proponent (i.e., either PCA itself or an external organization) to follow the PCA EIA process and gain the necessary approvals for the project to proceed.

No EIA is required if an initial analysis completed by PCA determines that the proposed project is not likely to cause adverse effects to natural or cultural resources, or characteristics of the environment that are important to key visitor experience objectives, and the potential for effects does not require further investigation. An EIA is also not required if the proposed project is being prepared in response to a clear and immediate emergency (e.g., dam failure) where there is insufficient time to undertake an EIA. No EIA is required if the proposed project was part of another project that was previously assessed in sufficient detail.

If the initial analysis determines that a proposed project is likely to cause adverse effects on natural or cultural resources, or on characteristics of the environment important to key visitor experience objectives, it will be assigned to one of the four (4) EIA pathways deemed by Parks Canada to be the most appropriate for addressing the potential environmental effects. These are described below. Parks Canada has developed an EIA Decision Framework and associated criteria to guide their decision-making on specific projects and taking into consideration site-specific circumstances.

1. Alternative Process

PCA's EIA requirements may be fulfilled through the application of an alternative process that has been approved as fulfilling EIA requirements by PCA. Currently, no such process exists for typical projects on Ontario Waterways, however in some cases, Provincial EAs (i.e., Individual or Class EAs) may be considered as meeting PCA's EIA requirements.

In any case, PCA determines, in accordance with its legal obligation, whether the project may cause significant adverse environmental effects. Taking into account the information available to PCA and other considerations as appropriate to the proposed project, a project would only proceed if it is determined not to cause significant adverse effects. Prior to approving a project, Parks Canada must ensure the EIA adequately meets *SARA* and *Fisheries Act* requirements.

2. Best Management Practices

In addition to the Environmental Standards and Guidelines presented in this ESG Document, PCA has developed a number of other Best Management Practices (BMPs) as pre-determined environmental management and mitigation measures for a defined class of routine, repetitive projects with well understood and predictable effects.

Parks Canada may determine that the measures presented in this ESG Document and/or other BMPs shall be applied in whole, or in part, as mitigation for a proposed project. In circumstances where potential environmental effects can be fully addressed through the application of these measures, no additional EIA may be required.

Parks Canada will inform a proponent if a proposed project is subject to BMPs and will provide BMPs along with any project-specific clarifications or additions as appropriate.

In some circumstances accepted Environmental Standards and Guidelines and BMPs may only address a portion of the potential effects associated with a project. In these cases, Parks Canada will advise proponents regarding the potential application of these measures in association with the requirements for these other EIA paths as appropriate.

3. Basic Impact Analysis (BIA)

A Basic Impact Analysis (BIA) is typically undertaken where:

- The adverse effects are predictable and well understood;
- The adverse effects will be confined to the project site or immediate surroundings;
- Mitigation measures and impact management techniques are familiar;
- There is minimal potential for contributing to cumulative adverse effects to the integrity of ecological and cultural resources, or to environmental components critical to visitor experience;
- These is little or no need for follow up monitoring; and
- There is normally no need to consult the public.

BIAs are typically conducted using a standard template or form. The template documents how a proposed project may interact with valued environmental components, identifies any applicable Standards or Guidelines and BMPs, and identifies other site and project-specific mitigation or other measures (e.g., follow-up and monitoring) as needed to ensure that the project does not result in significant adverse environmental effects.

Although a BIA does not typically require public or stakeholder consultation, PCA may conduct engage the public and stakeholder in the preparation and/or review of the BIA, at its discretion.

Following completion of the draft BIA, Parks Canada will determine, in accordance with its legal obligation, whether the project may cause significant adverse environmental effects. Taking into account the BIA and other considerations as appropriate to the proposed project, a project would only proceed if it is determined not to cause significant adverse effects. Prior to approving a BIA, Parks Canada must ensure the BIA adequately meets *SARA* and *Fisheries Act* requirements.

4. Detailed Impact Analysis (DIA)

A Detailed Impact Analysis (DIA) is typically undertaken where the proposed project may potentially result in significant adverse effects, and/or public concern with respect to ecological integrity, the integrity of cultural resources or characteristics of the environment that are important to key visitor experience objectives.

PCA has developed criteria that are used to guide the decision-making as to whether a proposed project should be required to undergo a DIA. Examples relevant to projects on Ontario Waterways include:

- Projects likely to result in the substantive alteration of water level, flow or management regime in a water body, or result in other important changes to surface or groundwater resources;
- Projects involving new or expanded roads, including operational service or access roads or crossing structures;
- Projects likely to change the nature and experience of unique, iconic or otherwise valued environmental components characteristic of wilderness, the natural environment, or the historical and cultural significance of a protected heritage place; and
- Projects likely to adversely affect the integrity of level 1 cultural resources.

DIAs are typically conducted on the basis of a project description (as necessary, such as when more detailed project design information becomes available) and a Terms of Reference (ToR) prepared by Parks Canada.

A DIA would specifically address all items identified in the ToR, but would typically include the following:

- A description and comparison of feasible alternatives to be assessed, as specified in ToR;
- A description of existing or baseline environmental conditions, supported by additional research or field work, as identified in the TOR;
- A description of potential environmental effects of the project including the integrated consideration of cumulative effects;
- The development of mitigation measures including improvements or modifications to designs, plans or implementation procedures;
- A prediction of residual impact based on desired conditions or outcomes including integrated consideration of cumulative effects;
- An assessment of the significance of the predicted residual adverse effects; and
- The identification of any follow-up or monitoring required.

PCA may conduct engage the public and stakeholder in the preparation and/or review of the DIA, as outlined in the ToR.

Following completion of the draft DIA, Parks Canada will determine, in accordance with its legal obligation, whether the project may cause significant adverse environmental effects. Taking into account the DIA and other considerations as appropriate to the proposed project, a project would only proceed if it is determined not to cause significant adverse effects. Prior to approving a DIA, Parks Canada must ensure the DIA adequately meets *SARA* and *Fisheries Act* requirements.

The need for the public and/or stakeholders to be informed of and otherwise engaged in a project EIA will be considered at the outset of the EIA process. Parks Canada must engage in additional and separate consultations with Aboriginal groups if there is a possibility of a project, adversely affecting established or potential Aboriginal or Treaty rights. The requirement for consultation with Aboriginal peoples is determined as early as possible during an EIA. PCA will consult and collaborate with relevant departments and jurisdictions as appropriate when a project may have adverse effects outside of the lands and waters it administers.

APPENDIX D
Typical Project Works and Activities on Ontario Waterways

APPENDIX D:
TYPICAL PROJECT WORKS AND ACTIVITIES ON ONTARIO WATERWAYS

PCA undertakes a wide variety of projects on Ontario Waterways in order to maintain and operate their marine and land-based assets. Many of PCA assets on Ontario Waterways were constructed between the 1950's and 1970's with some of the most historic and culturally valuable assets were constructed the early 1800's through to the early 1900's. As such, they require substantial work to maintain their physical integrity, function and commemorative value. The potential environmental effects of such projects are vast and varied and inevitably very site-specific (i.e., dependent on the nature of the local environmental and socio-economic setting) and project-specific (i.e., dependent on the nature, scale, timing and design of the project).

In most cases, PCA projects on Ontario Waterways tend to involve a set of common works and activities during the ***site preparation*** phase:

- **Vegetation Removal** (e.g., clearing, grubbing) at a construction site is often undertaken to prepare laydown areas, storage areas, camps, access roads/trails. Vegetation removal involves stripping of the ground cover; felling, trimming, and cutting of trees and shrubs; and, other the removal (e.g., downed timber, snags, brush, and rubbish) occurring within areas to be cleared. Grubbing involves digging out or mulching in-situ stumps and roots below ground surface. This would include removal of visible rocks and boulders. Riparian and aquatic vegetation removal may also necessary for in-water works (e.g., bridge and dam sites, water crossings). In some cases, this would involve removal of natural vegetation, while in others this may require removal of lawns (e.g., at lock stations).
- **Earthworks** (e.g., excavation, grading) are undertaken to prepare laydown areas, storage areas, camps, access roads/trails allow construction equipment and personnel access to structures (e.g., lock or approach walls, bridge abutments, dam foundations, etc.) to be repaired or upgraded. Top soil is stripped and excavated materials may be stockpiled for future backfilling or site restoration. Earthworks are also required for major construction activities that require the removal of overburden to allow for construction of foundations or supports on bedrock. In some instances existing shoreline protection measures such as 'rip-rap' or armour stone may need to be removed.
- **Installation and Removal of Sediment and Erosion Control and Water Quality Protection Measures** are undertaken. This involves installing measures that prevent sediment laden waters from ground disturbance or other project activities from entering the aquatic environment. Measures may range from physical devices such as sediment controlling fencing and mats to re-vegetation, hydro seeding and tackifiers. Water treatment measures may involve the installation and/or use of filter bags, settling ponds, silt curtains, fractionation tanks etc.
- **Dewatering** may need to be undertaken for repairs and upgrades of canal locks by draining or pumping water out of the lock or from below a coffer dam. Similarly, dewatering may involve dam and flume operations to divert water away from work areas near locks, dams and bridges. In some instances, dewatering may be required to remove groundwater to permit excavation and construction below grade.
- **Installation and Removal of Cutoff Walls, Coffer Dams or By-Pass Channels** may be required to provide a dewatered area upstream and/or downstream of the lock, dam

or other structure or surrounding a bridge abutment or support, if work is occurring in these areas. By-pass or water diversion channels may need to be installed to accommodate minimum flow requirements during the construction period.

- **Fish Passage, Salvage and Relocation** measures are typically undertake in conjunctions with coffer dam installations and dewatering operations.

Locks are typically concrete, brick and/or stone chambers with gates and sluiceways that allow the chamber to be drained and filled with water. Along many sections of the Rideau Canal or Trent-Severn Waterways, there are many locks at a given lockstation. They may be pedestrian or vehicular bridges (fixed or swing bridges; headrace and weir bridges) constructed from concrete, metal and/or wood. The physical works and activities undertaken during the ***construction phase*** for lock, bridge or concrete dam repair or upgrade projects on Ontario Waterways typically involve:

- **Demolition and/or Dismantling** of major structural features at locks, dams and bridges such as concrete foundations and other structures such as gates, spillways, sluices etc. Demolition materials may be temporarily stored on-site, salvaged or transported off-site for recycling or disposal.
- **Concrete Removal** from lock chamber walls, dam structures, bridge abutments and supports. Additional removal of concrete from areas where concrete removal and repair is required may include monoliths, approach and retaining walls, stairs, and floors. This may involve removal of chipped concrete, parging and other small eroded areas of the concrete surfaces by chipping, cutting and/or sandblasting.
- **Concrete Application and Minor Re-construction** may involve repairing concrete by applying new coping concrete, pouring concrete formwork and curing, deck pours, pouring concrete formwork underwater, concrete placement by pump, underwater pour by tremie, concrete/masonry repair, replacing grout, pointing stone, cutting back the surface of concrete structures. Major concrete works involve forming and repouring of foundations and structures at their original location or total replacement of entire sections of concrete or concrete structures.
- **Repair, Salvage and/or Reinstallation of Ancillary Equipment** is often undertaken for lock and dam gates and arms; various swing bridge mechanical components; lock and dam scramble ladders, handrails/railings, wooden/metal decking, roller assemblies, mooring cleats/cables; anchor bolts, lock and dam signage. Repairs may involve metal work (e.g., grinding and welding), cleaning and/or painting of the equipment.

Earth dams may require repairs and/or upgrades to increase their heights/widths and to strengthen them by addressing washouts and/or removing vegetation. Some vegetation may loosen the soil in the dam creating seepage paths that can lead to internal erosion and vulnerabilities in the embankment. In some instances, earth dam repairs may also involve works and activities similar to concrete dam repairs (see above). Gravel roads that service PCA assets such as locks, bridges and dams may also require repairs and upgrades involving similar works and activities. The physical works and activities undertaken during the ***construction phase*** for earth dam and gravel road repair or upgrade projects on Ontario Waterways typically involve:

- **Transport and Stockpiling of Earth, Aggregate and/or Clean Fill** will often be required to increase the heights/widths of earthen dams. Stockpiling could be undertaken on-shore or on the existing dam structure itself.
- **Designated Vegetation Removal** (e.g., stripping clearing, grubbing) on an earthen dam site is often undertaken by stripping of the ground cover in designated areas; felling, cutting of designated trees and shrubs; and, digging out stumps and roots below ground surface.
- **Earth, Aggregate and/or Clean fill Placement** involves transfer, placement and compaction of materials at specific locations along the dam that are subject to repair or upgrade. This may be on the dam surface or along its embankments. Holes created by removal of trees or shrubs would be filled.

Concrete dam replacement projects involve either reconstruction in-situ or reconstruction downstream. Reconstruction in-situ typically involves the removal of the existing dam and construction of a new dam at the same location, and isolation of the work area from the Waterway with cofferdams or by-pass channels. Reconstruction Downstream involves construction of a new dam immediately downstream of the existing dam and isolation of the work area from the Waterway with cofferdams or by-pass channels. The existing dam could either be partially or fully removed. The physical works and activities undertaken during the ***construction phase*** for concrete dam replacement projects (e.g., in-situ or downstream replacements) on Ontario Waterways typically involve:

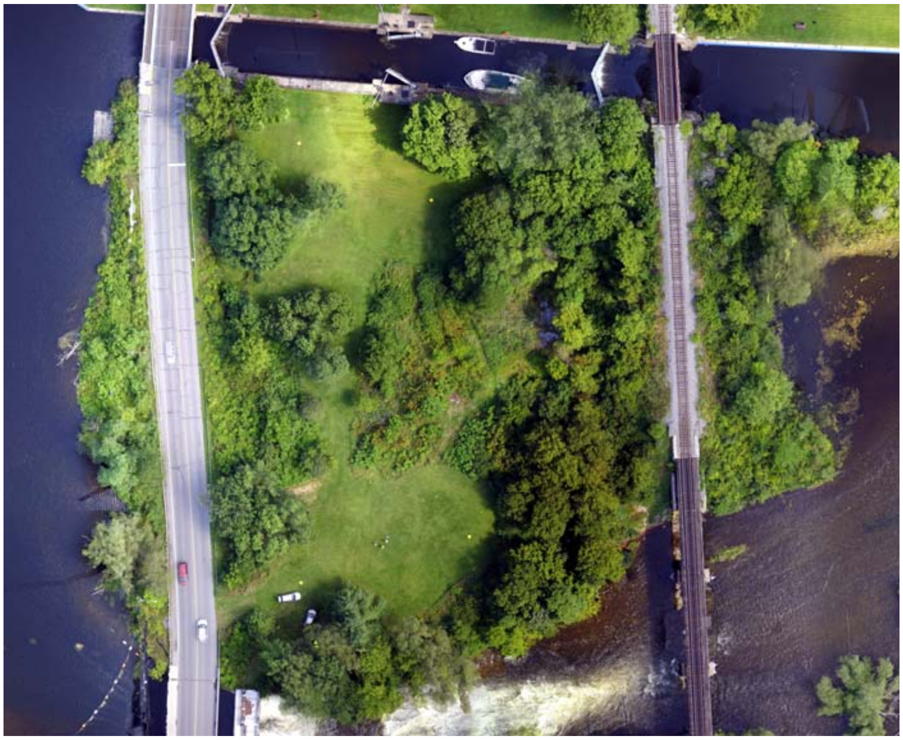
- **Demolition and/or Dismantling** of major structural features at the existing dam such as concrete foundations, gates, spillways, sluices etc. Demolition materials may be temporarily stored on-site, salvaged or transported off-site for recycling or disposal.
- **Blasting or Drilling** may be required during the demolition of existing dam structures and/or to prepare foundations and footings for the new dam structure.
- **Concrete Pouring and Dam Reconstruction** involves preparing reconstruction forms, re-enforcing steel placement, and concrete pouring for approach walls, piers, dam foundations and primary structures.
- **Installation of Ancillary Equipment** involves gates and arms; various swing bridge mechanical components; lock and dam scramble ladders, handrails/railings, wooden/metal decking, roller assemblies, mooring cleats/cables; anchor bolts, lock and dam signage. Repairs may involve metal work (e.g., grinding and welding), cleaning and/or painting of the equipment.

In most cases, PCA projects on Ontario Waterways tend to involve a set of common works and activities during the ***site restoration*** phase:

- **Backfilling** of excavated areas and other earthworks are undertaken to restore the ground surface to its original or to establish desired slopes and surface drainage patterns. In some cases, restoration would re-establish erosion protection measures (e.g., river stone, riprap) along exposed banks and shorelines susceptible to erosion.
- **Site restoration** activities typically involve removal of temporary vegetation protection measures (e.g., hoarding), reseeding, placement of sod, replanting of ground cover, trees and shrubs.

Risk Assessment and Environmental Monitoring
Old Slys Lockstation, Smiths Falls, Ontario
PIN: 052740116 and 052740097
FSCI # 09412002

Prepared For:
Parks Canada Agency
Attn: Viviane Paquin
30 Victoria Street
Gatineau, Quebec J8X 0B3



Source: AEL Site visit, 2017

Prepared by:
AEL environment (a division of Aeon Egmond Ltd.)
1705 Argentia Road, Unit 3,
Mississauga, ON, L5N 3A9
Telephone and Facsimile: (416) 657-2367

June 15, 2018
AEL Project: 10888

I. Executive Summary

i. Location

Located at 9 Old Slys Road, Smiths Falls, Ontario, the Site is situated on the southeast side of Old Slys Road, south of Old Slys Lockstation. The Site consisted of two (2) adjacent properties, the north property and south property, referred to as 9 Old Slys Road (collectively referred to as "the Site"). For this project, project north was oriented towards Old Slys Lockstation. See Figure 1 for the area defined as the Site.

ii. Objective and Approach

AEL Environment (AEL) was retained by Parks Canada to conduct an Environmental Site Assessment (ESA) as a follow-up to work completed by other consultants and undertake a Detailed Quantitative Human Health and Ecological Risk Assessment (DQ HHERA) for the Site. The work completed as part of this project will address elements of step 8 of the Federal Contaminated Sites Action Plan (FCSAP) 10 step process and will include a human health DQHHERA to improve quantification of site specific risks associated with contaminants of concern (COCs) identified at the Site in soil, groundwater, sediment, and surface water, including the risks associated with select planned Site construction activities. The Site Closure Tool (SCT) will be completed to determine if remediation or risk management actions are required for site closure.

The Site historically operated as a landfill in the mid-1960's, and potential environmental concerns at the Site were identified by previous consultants due to the presence of buried landfill materials. ESAs conducted by previous consultants have concluded that COCs include metals and polycyclic aromatic hydrocarbons (PAHs) in soil, metals and polychlorinated biphenyls (PCBs) in groundwater, and metals in sediment and surface water.

AEL completed an ESA in 2017, which included collection of soil, groundwater, sediment and surface water samples, and analyses for petroleum hydrocarbons (PHCs)/benzene, toluene, ethylbenzene, and xylenes (BTEX), volatile organic compounds (VOCs), metals and inorganics, PAHs and PCBs.

From August 28th to September 1st, 2017, eight (8) boreholes were advanced at the Site, in which five (5) monitoring wells were installed. Based on field observations, AEL selected soil samples from all eight (8) boreholes and groundwater samples from the five (5) newly installed monitoring wells, along with groundwater samples from four (4) existing monitoring wells, for analysis by a laboratory certified by the Canadian Association of Laboratory Accreditation (CALA). Soil samples were collected at different depths, from ground surface to about 4.57 meters (m) below the ground surface (bgs) and all monitoring wells were purged prior to sampling. During this time, AEL also collected seven (7) surface water samples and six (6) sediment samples, from locations on-Site, as well as up- and down-stream of the Site. A groundwater seepage sample was collected from both the upper and lower lock walls. Samples were submitted for analyses of PHCs, VOCs, metals and inorganics, PAHs and PCBs. The results of the laboratory analyses were compared with the applicable federal, or provincial guidelines.

The following parameters were identified as COCs:

- Surface soil: PHCs, metals, VOCs and PAHs.
- Subsurface soil: PHCs, metals and VOCs.
- Groundwater: PHCs, metals and inorganics, VOCs and PAHs.
- Sediment: Metals and PAHs.
- Surface Water: Inorganics.

Based on the results of sediment monitoring, Parks Canada requested that a benthic invertebrate study be conducted, to assess the health of benthic invertebrate communities on-site, in comparison to up- and down-stream communities. This investigation was undertaken in November 2017.

iii. Results and Recommendations

Analytical Results: Analytical results were compared against the applicable federal guidelines. Where no federal guidelines existed, or where federal guidelines were not considered sufficiently protective within 10 m of surface water, provincial standards were used for comparison.

Soil: Laboratory results showed that two (2) locations exhibited surface soil exceedances for one or more of Ethylbenzene, PHCs F3 and F4 Gravimetric; one (1) location exhibited surface soil exceedances for Copper; and two locations exhibited surface soil exceedances for one or more of Methylnaphthalene, 2-(1-), Naphthalene and Phenanthrene by generally 1 to 6 times guideline levels (less than 1 order of magnitude), with the exception of Naphthalene which exhibited an exceedance by approximately 285 times guideline level (greater than 2 orders of magnitude).

Laboratory results showed that five (5) locations exhibited subsurface soil exceedances for one or more of Ethylbenzene, Toluene and Total Xylenes, and PHCs F2, F3, F4 and F4 Gravimetric; and three (3) locations exhibited subsurface soil exceedances for one or more of Antimony, Arsenic, Cadmium, Copper, Lead, Nickel, Tin and Zinc by generally 1 to 6 times guideline levels (less than 1 order of magnitude.)

Previous investigations, completed in 1994, identified two (2) locations which exhibited subsurface soil exceedances for Lead and Zinc; one (1) location which exhibited subsurface soil exceedances for Anthracene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene and Phenanthrene; and two (2) locations which exhibited subsurface soil exceedances for total DDD and Methoxychlor.

Exceedances in surface and subsurface soil were found across the Site and are likely related to the placement of impacted fill.

Groundwater: Laboratory results showed that four (4) locations exhibited groundwater exceedances for one or more of PHCs F3, F4 and F4 Gravimetric; eight (8) on-site locations and one (1) off-site trans-gradient location exhibited groundwater exceedances for one or more of Arsenic, Barium, Cadmium, Iron, Chloride and Cyanide; and three (3) locations exhibited groundwater exceedances for one or more of Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Fluoranthene, Naphthalene, Phenanthrene and Pyrene by generally 1 to 60 times guideline levels (1 to 2 orders of magnitude.) with the exception of Iron and Cyanide exceedances approximately 115 to 2300 times the FCSAP guideline (2 to 3 orders of magnitude).

Previous investigations, conducted from 1994 to 2011, also identified exceedances of Cobalt and Zinc at two (2) of these on-site locations, total PCBs at one of these on-Site locations and exceedances of one or more of Arsenic, Cadmium, Iron, Mercury and Zinc at three (3) additional on-Site locations.

In general, the variable distribution of impacts suggest impacts are associated with the nature of fill materials used for infilling, and this source is reflected in the horizontal distribution of groundwater impacts which are largely limited to those areas of the Site where infilling occurred.

Sediment: Laboratory results showed that three (3) on-site locations, one (1) off-site up-stream location and one (1) off-site down-stream location, exhibited exceedances for one or more of Arsenic, Cobalt, Lead, Mercury, Nickel and Cyanide; and three (3) locations on-Site and one (1) off-Site up-stream location exhibited exceedances for one or more of Acenaphthene, Acenaphthylene, Benzo(a)anthracene, Benzo(a)pyrene, Chrysene, Dibenz(a,h)anthracene, Fluoranthene, Phenanthrene and Pyrene by generally 1 to 13 times guideline levels (1 to 2 orders of magnitude).

Previous investigations, conducted from 1994 to 2011, also identified exceedances of Cadmium, Chromium and Zinc at one (1) of the on-site and the off-site up-stream location, and exceedances of one or more of Lead, Mercury and Zinc at additional locations, one (1) located on-site and one (1) located off-site up-stream.

Surface Water: Laboratory results showed that one (1) on-Site location, one off-Site up-stream location and one (1) off-Site down-stream location exhibited exceedances for one or more of Cyanide and Total Un-ionized ammonia. by generally 1 to 2 times guideline levels (less than 1 order of magnitude).

Previous investigations, conducted from 1994 to 2011, also identified exceedances of Iron and Mercury at one (1) additional on-Site location. In general, the variable distribution of metals and inorganics impacts suggest impacts are associated with the Site, and specifically from surface runoff of contaminated surface soil, groundwater seepage of contaminated groundwater and/or leaching from buried infill materials.

Risk Assessment Results: The human receptors potentially exposed to the COCs at the Site are members of the public of all ages using the park or the Lockstation; long-term and short-term workers operating the Lockstation or completing routine maintenance of the Site; and construction/remediation workers completing proposed construction activities. The exposure pathways for the human receptors are incidental ingestion of soil, dermal contact with soil, inhalation of particulate matter, incidental ingestion of groundwater, and dermal contact with groundwater.

Typical terrestrial ecological receptors include soil invertebrates, vegetation, birds, and small mammals; for example, earthworms, trees, grasses and shrubs; American Robin, Song Sparrow Meadow Vole, and Red Fox. Aquatic ecological receptors include invertebrates, plants, and fish. The primary exposure pathways for terrestrial ecological receptors are contact with soil, root uptake, and ingestion of soil and food. Aquatic receptors may be exposed to the COCs via direct contact with surface water and ingestion of water and food.

Recommendation: The results of the HHRA indicate that risk management measures are not required for the protection of site visitors or Long-term workers due to exposure to the identified COCs in soil, groundwater, surface water, or sediment. For Construction workers, typical Health and Safety measures (i.e., the wearing of pants, long sleeves, and gloves) are recommended to limit dermal contact with groundwater containing PHCs; no risk management measures are required for the other COCs/exposure pathways.

The results of the ERA suggest the possibility of some adverse effects on plants and soil invertebrates in the vicinity of MW10/17, due to the presence of naphthalene in surface soil. The results of the ERA do not indicate that risk management measures are required for the protection of terrestrial VECs due to exposure to the remaining identified COCs in soil. It is recommended that the surface soils in the vicinity of MW10/17 be excavated as part of the construction activities on-site, and closure samples from the sidewalls and floor of the excavation taken to confirm the concentration of naphthalene in surface soil meets the CCME Soil Quality Guidelines applicable to the Site.

The results of the benthic invertebrate survey indicated that it is unlikely that the historical landfill has impacted the benthic invertebrate community in the area of the Old Sly Locks, and as such risk management measures are not required for the protection of aquatic VECs due to exposure to identified COCs in surface water and sediment. There is some indication that the area of SED7 is experiencing anthropogenic impacts which are likely unrelated to the presence of the historic landfill (see Section 4.0 of Appendix 4). While the benthic community at station SED7 had Hilsenhoff values that indicated poor water quality this could be due to other anthropogenic influences that may influence the area (municipal waste and/or runoff, upstream agriculture, residential fertilizer application). The change in community function is due to filter feeders which is an indication of increased nutrient load (see Figure 3-3 in appendix 4). In particular, the trichopteran family Hydroposychidae is only present at SED7 (see Appendix Table A-6 in appendix 4) and is used as an indicator of nutrient loading (Merritt et al., 2008).

Personal Protective Equipment (PPE), above the ministry of labour mandated construction site PPE, should be worn to be protective of workers in surface water or working with groundwater given conservative working average times as provided by Parks Canada as follows on site:

- Construction workers who come into contact with subsurface groundwater should wear gloves, long pants, and sleeves to minimize dermal contact with groundwater in areas containing PHCs,
- Construction workers acting as divers contacting sediment during repairs should wear a wet suit while submerged in the lock water body to minimize dermal contact with sediment.

iv. Limitations

The report was completed for the sole use of the client and AEL only in accordance with the terms of reference and the limitations, during the 2017/2018 site evaluation stage. Others with an interest in the Site must decide on the Site conditions and conduct their own investigation to determine how or if the Site affects them.

v. Conflict of Interest

Neither AEL nor its officers know of any conflicts of interest AEL has respecting the Site or the owner of the Site.

I. Table of Contents

II. Tables

1705 Argentia Road, Unit 3 | Mississauga, Ontario, L5N 3A9
Tel/Fax: 416-657-2367 Toll free: 1-800-267-4797
info@aelenv.com | www.aelenv.com

III. Figures

IV. Appendices

1. Introduction

1.1 Site Description

1.1.1 Site Location

Located at 9 Old Slys Road, Smiths Falls, Ontario, the Site is situated on the southeast side of Old Slys Road, south of Old Slys Lockstation. The Site consisted of the island bounded by Old Slys Lockstation to the north, Old Slys Road to the west, CP rail tracks to the east and the Old Slys Weir to the south. For this project, project north was oriented towards Old Slys Lockstation. See Figure 1 for the area defined as the Site.

The Site has a total area of about 11,700 m^2 (1.17 Ha), according to measurements obtained from aerial survey completed as part of the environmental site assessment (ESA) work. The Site is located in an area of parkland use, as determined from the Site walkover and from records reviewed.

1.1.2 Legal Description

The Site consisted of two (2) adjacent properties, the north property and south property, referred to as 9 Old Slys Road (collectively referred to as "the Site" or "Old Sly Island"). For this investigation, only a portion of the north property was investigated, at the direction of Parks Canada, and included only those lands that formed the northern portion of the above described island. The remainder of the property to the north, south and west were not part of the "Site" investigated at this time. A surveyor or lawyer shall be retained to obtain the exact title and encumbrances if needed.

1.1.2.1 Northern Parcel

Based on a titles review the Site legal description for the northern property is: Bed of Rideau River Montague lying south of the rdal between Con 3 and Con 4 Montague and east of the rdal between Twp of South Elmsley and Twp of Montague; Pt Lt 30 Con 3 Montague Pt 11 27R2419, Pt 2 & 3 27R9018, Pt 4 & 5 27R9486 except Part 7 on 27R7052 Town of Smiths Falls. The property identification number (PIN) is 05274-0116.

1.1.2.2 Southern Parcel

Based on a titles review the Site legal description for the southern property is: Lt 4 Government Res Pl 13884 Lanark S Wolford; Smiths Falls. The property identification number (PIN) is 05274-0097.

1.1.3 Geographic Centre

The Site is centered on approximately 18T 420,684 m east, 4,971,500 m north based on data derived from Google Earth. The Site is at a surface elevation of about 110 meters above sea level (m asl) according to contour map estimates from Land Information Ontario (LIO).

1.2 Property Ownership

1.2.1 Owner

The owner of record for both land parcels was:

Her Majesty The Queen In Right of Canada

1.2.2 Client

The client of record was:

Parks Canada Agency
Attn: Viviane Paquin
30 Victoria Street
Gatineau, Quebec J8X 0B3

1.3 Current and Proposed Future Uses

At the time of the field work the Site was parkland, consisting of a mix of natural and maintained parkland. Access to the park can be gained from the north, via Old Slys Lockstation, and gated vehicle access can be gained from the southwest.

At the time of this report, the future use of the property was to remain parkland, and was completed as part of a follow-up to work completed by other consultants, in preparation for select construction activities to be undertaken on the lock in 2018.

1.4 Applicable Criteria

AEL used the information as follows in determining the applicable criteria for use at the Site.

1.4.1 Land Use

The current classification of the Site is parkland. The surrounding area was a mix of parkland and residential land use.

1.4.2 Non-Potable Groundwater Criteria and Well Head Protection

Well records searched on the Ministry of Environment and Climate Change (MOECC) online database found one well record for wells located on the Site. This record was reviewed, and indicated use was water supply for domestic livestock, installed in 1958. This well is no longer in use, and the exact location is unknown. There were no well records for wells located on surrounding lands within 250 m of the Site.

AEL noted the presence of five (5) monitoring wells on-Site, and previous reports reviewed indicated the presence of an additional two (2) monitoring wells on-Site, which could not be located by AEL.

Groundwater flow in the area is expected to be to the east, towards the Rideau River.

The Town of Smiths Falls was contacted in relation to non-potable groundwater criteria at the Site. Based on the absence of potable water wells on or around the Site and the absence of source water protection or wellhead protection zones on or around the Site, AEL consider the Site to be in an area of non-potable water use.

1.4.3 Criteria Used to Evaluate the Results

As stated in the scope of work, results were compared to appropriate federal standards. Where federal standards did not exist for a particular parameter, provincial standards were applied.

In addition, it was determined that the Canadian Council of Ministers of the Environment (CCME) guidelines for soil and groundwater may not be sufficiently protective for sampling locations which fall within 10 m of a surface water body. As the Site is adjacent to the Rideau River, AEL used more conservative provincial standards for those sampling locations which fall within 10 m of a surface water body.

AEL considered soil pH for the Site based on samples taken from the site and analysed by a CALA certified laboratory. AEL sent sixteen (16) soil samples to confirm soil pH. Thirteen (13) of the samples ranged from 6.80 – 7.83, within the acceptable range of greater than 6 and less than 8 (See Table 3 and Appendix 3). Two samples (A0228 – BH11/17: 1.52 – 3.05 m; and A0232 – BH13/17: 3.05 – 4.57 m), had a pH of 11.6 and 8.9, respectively, indicating a tendency towards basic; One sample (A0258 – Pond: 0.00 – 0.20 m), and its duplicate sample, had a pH of 5.78 and 5.99, indicating a tendency towards acidic. As the majority of the Site samples measured were within the acceptable range for application of the CCME guidelines of above 6 and less than 8, the CCME guidelines are considered applicable at the Site.

The following guidelines were deemed applicable to the Site:

Soil

- For sampling locations more than 10 m from a surface water body: CCME, Soil Quality Guidelines for the Protection of Environmental and Human Health, 1991 – 2015, Residential/Parkland property use, coarse textured soil.
- For sampling locations less than 10 m from a surface water body: the lower of MOECC, Ontario Regulation (O. Reg.) 153/04 (as amended), “Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act” dated April 15, 2011, Table 9 Standards, generic site condition standards for use within 30 m of a water body in a non-potable groundwater condition and coarse textured soil,, All Types of Property Use and the CCME Soil Quality Guidelines.

- For parameters for which no federal guidelines exist, and a sampling location falls more than 30 m from a surface water body: MOECC, O. Reg. 153/04, "Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act" dated April 15, 2011, Table 3 Standards, full depth generic site condition standards in a non-potable groundwater condition, Residential/Parkland/Institutional Property Use, coarse textured soil.

Groundwater

- Federal Contaminated Sites Action Plan (FCSAP) Guidance Document on Federal Interim Groundwater Quality Guidelines (IGQG) for Federal Contaminated Sites, May 2010 (updated November 2012), Tier 1 Guidelines for Residential/Parkland Land Use with coarse textured soil (herein referred to as the FCSAP IGQGs).
- For sampling locations less than 10 m from a surface water body, where the FCSAP IGQGs may not be sufficiently protective: MOECC, O. Reg. 153/04, "Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act" dated April 15, 2011, Table 9 Standards, generic site condition standards for use within 30 m of a water body in a non-potable groundwater condition, All Types of Property Use, coarse textured soil.
- For parameters for which no federal guidelines exist, and a sampling location falls more than 30 m from a surface water body: MOECC, O. Reg. 153/04, "Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act" dated April 15, 2011, Table 3 Standards, full depth generic site condition standards in a non-potable groundwater condition, Residential/Parkland/Institutional Property Use, coarse textured soil.

Sediment

- CCME Sediment Quality Guidelines for the Protection of Aquatic Life, 1997 – 2015, Freshwater. Concentrations were compared to both the interim sediment quality guidelines (ISQG) and the probable effect level (PEL). The ISQG defines the concentration below which adverse biological effects are expected to occur rarely. The PEL defines the level above which adverse effects are expected to occur frequently (more than 50% adverse effects occur above the PEL).
- For parameters for which no federal guidelines exist: MOECC, O. Reg. 153/04, "Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act" dated April 15, 2011, Table 9 Standards, generic site condition standards for use

within 30 m of a water body in a non-potable groundwater condition, All Types of Property Use.

Surface Water

- CCME Water Quality Guidelines for the Protection of Aquatic Life, 1997 – 2015, Freshwater.
- For parameters for which no federal guidelines exist: Ministry of the Environment and Energy (MOEE) Provincial Water Quality Objectives (PWQOs), 1994 (updated 1999).

The report was prepared on the understanding and assumption that any work recommended or required and any materials found will be completed and dealt with in accordance with any applicable law.

2. Background Information

2.1 Physical Setting

2.1.1 Site Topography

According to LIO, the Site sits at an elevation of approximately 110 m asl. The local site topography is sloped to the east. The closest visible body of water is the Rideau River, which is present at the north and south sides of the Site. Groundwater was anticipated to flow east, towards the Rideau River.

2.1.2 Site Geology

2.1.2.1 Surficial Soils

The regional physiography is dominated by the Smiths Falls limestone plain. This is a nearly continuous tract of shallow soil over limestone that covers 3600 square kilometres centred on Smiths Falls.

Upon review of the Ministry of Northern Development and Mine's "Surficial Geology of Southern Ontario" layer from OGSEarth, the surficial soils consist of bedrock-drift complex in Paleozoic terrain, which are characterized by till components. These materials may resist the infiltration of fluids, with higher surface runoff.

2.1.2.2 Bedrock

Upon review of the Ministry of Northern Development and Mine's "Bedrock Geology" layer from OGSEarth, the bedrock consists of the Beekmantown Group (dolostone and sandstone) of the Phanerozoic, Paleozoic, Ordovician, Lower Ordovician eras. Based on previous sampling undertaken at the Site, the depth to bedrock is anticipated to be between 1.68 to 5.27 m bgs.

2.1.3 Site Hydrogeology

Based on local soil and surface conditions, the flow of groundwater in soils in the vicinity of the Site is anticipated to the east, towards the Rideau River. Previous investigations undertaken at the Site studied the site hydrogeology. Old Slys Island is graded down towards the east, creating up to a four meter head of water from the west side of the Island to the east. As the CP rail line is present at the east side of the Island, this creates a dam-like structure, forcing groundwater to flow to the north and south, around the rail line. Analysis of shallow versus deep intakes of the groundwater wells indicated that groundwater is consistently sitting lower in the deep groundwater wells, indicating a lower hydraulic head at depth and thus a downward component of flow. Hydraulic conductivity was calculated to be between 0.11 and 0.73 m/day, consistent with fine sands and silts, which was consistent with the types of materials encountered during drilling. It was concluded that the fill material was not impermeable, and is able to transmit groundwater. The values in general, were lower at those wells with deeper intakes (MW-1 and

MW-3D), indicating the landfill materials may be less permeable at depth, with greater compaction.

Groundwater flow at the north side of the Site is likely influenced by the operation of the lock system at the north side of the Site. Operational from May to October, the locks are opened and closed, reportedly causing groundwater fluctuations on the island of between 1.5 m near the lock, and 0.4 m away from the lock. This operation effectively "flushes" water into the landfill when the locks are filled, and allows groundwater to seep out when the locks are emptied.

During the 2017 investigation, a leak was visible from the upper lock, onto the Island, when the upper lock was full. Once the lock was emptied, the flow of water ceased. The flow of water was traced to a lower lying area, just west of the rail tracks, to an area of ponded water. This general area had approximately 0.15 to 0.20 m of ponded water, with high amounts of orange precipitate present. The well-established presence of high moisture plants, such as cattails, indicated that this ponded area has been present for some time.

2.2 Past Investigations

AEL was provided with the following reports for review:

- "Environmental Site Assessment at Old Sly's Landfill Site Along the Rideau Canal", prepared by Green Plan Environmental Corp. (GPEC), dated 3 February 1994 (herein referred to as the GPEC February 1994 Environmental Site Assessment Report).
- "Environmental Site Assessment Old Sly's Lockstation/Lower Reach Park, Smiths Falls, Ontario", prepared by Jacques Whitford Environment Ltd. (JEWL), dated 21 February 1996 (herein referred to as the JEWL February 1996 Environmental Site Assessment Report).
- "Screening Level Ecological Risk Assessment at Lower Reach Park, smiths Falls, Ontario", prepared by Bonnell Environmental Consulting (BEC), dated 18 October 1996 (herein referred to as the BEC October 1996 Screening Level Ecological Risk Assessment Report).
- "Chemical Monitoring Study at Old Slys and Lower Reach Park, Summer 1999", prepared by Bonnell Environmental Consulting (BEC), dated 15 October 1999 (herein referred to as the BEC October 1999 Summer Sampling Report).
- "Chemical Monitoring Study at Old Slys and Lower Reach Park, Summer and Fall 2000", prepared by Bonnell Environmental Consulting (BEC), dated 31 December 2000 (herein referred to as the BEC December 2000 Summer and Fall Sampling Report).
- "Groundwater, Surface Water and Sediment Sampling at Lower Reach and Old Slys at the Rideau Canal National Historic Site of Canada, Smiths Falls,

Ontario", prepared by Aqua Terre Solutions Inc. (Aqua Terre), dated 7 December 2006 (herein referred to as the Aqua Terre December 2006 Sampling Report).

- "Groundwater, Surface Water and Sediment Sampling at Lower Reach Park and Old Slys Lockstation at the Rideau Canal National Historic Site of Canada Smiths Falls, Ontario", prepared by Golder Associates Ltd. (Golder), dated September 2011 (herein referred to as the Golder September 2011 Sampling Report).

Based on AEL's review of the reports, the following information was noted.

2.2.1 GPEC February 1994 Environmental Site Assessment Report

- Landfilling activities were restricted at the Site to between 1965 and 1966.
- Between 1959 and 1976, three separate sites were used as landfill sites for the Town of Smiths Falls. The largest Site was located at Lower Reach Park, located just southwest of Old Sly Island. A second, smaller, landfill site was located to the south of Old Sly Island, and the third occupied a portion of Old Sly Island (the Site). In addition, records indicated that fill of an unknown quality was placed on lands to the south of Old Sly Island, south of the Old Sly Weir, to the north of Old Sly Island, near the lockstation, and to the east of the rail line.
- The landfill area is a largely flat-bottomed basin of approximately 100 m from north to south, and 80 m from east to west. Fill material extends up to Old Slys Road to the west, to the lock walls to the north, to the CP rail line to the east, and to within approximately 30 m of the southern shoreline of the island.
- Stratigraphy generally consisted of between 0.61 to 0.91 m of topsoil, overlying fill. Fill was comprised of liquid black silt and "garbage" (clothing, plastic, wire). Stratigraphy encountered off-site to the south and southwest consisted of sand and gravel fill.
- The depth of fill ranged from a maximum of 5 m in the centre of the landfill area, to 3 m near the rail line. Assuming an average depth of 4 m, the calculated volume of fill was 32,000 m^3.
- A sampling program was employed, and included sampling soil, surface water, groundwater and sediment. Six (6) monitoring wells were installed. Groundwater samples were also obtained from gas vent pipes, previously installed in 1984, as well as from the newly installed monitoring wells.
- The sampling program identified both inorganic and organic contaminants above CCME Interim Remediation Generic Criteria or the Ontario Ministry of Environment and Energy (MOEE) in the landfill, and demonstrated potential for these contaminants to leach from the landfill to Rideau River. Parameters above criteria included Boron and Tin in surface soil; Boron, Tin, Zinc and PAHs in subsurface

soil; Aluminium, Cobalt, Copper, Iron, Manganese, Bis(2-ethylhexyl)phthalate (DEHP), PCBs, 1,3-Dichlorobenzene and Ethyl Benzene in groundwater; Iron and Mercury in surface water; and lead in sediment.

- There is continual recharge to the landfill by leakage through the stone-key arch dam and by infiltration of precipitation (largely due to the absence of a clay cap or liner over the landfill).
- When the canal locks are full, the locks provide a significant source of recharge to the landfill by leakage through the lock walls, enhancing the production of leachate which then discharges into the Rideau River. It was surmised that a significant portion of the flow from the upper lock is held in bank storage and diverted down the outside of the lock walls without fully penetrating the landfill; the landfill was not able to dissipate the rapidly imposed head of the filled lock quickly enough and various pressure relief mechanisms, such as discharge and pooling on the landfill, were witnessed.
- Groundwater discharge from the landfill is around the ends of the CP Rail line.
- Calculated hydraulic conductivity within the fill was calculated to range from 0.11 m/day to 0.73 m/day.
- Lead levels in sediment at one location (at the southeast corner of the Site, just east of the rail line) were found to be in excess of the Severe Effect Level of the MOEE Aquatic Sediment Quality Guidelines, indicating that the material is considered to be highly contaminated, and a management decision is required at the site.
- Based on analytical testing, and on exposure scenarios modelled in a Site Specific Risk Assessment (SSRA), there is no appreciable risk to human health associated with Old Slys Island or lock station operations.
- Accumulation of metals in the river sediments, particularly lead, represents a potential environmental concern, with potential toxicity to bottom dwelling benthic organisms, but does not pose a risk to human health.
- An orange coating was present on the river bottom at leachate discharge points at the southeast side of the island, on the eastern side of the rail line. This is a result of the precipitation of ferric hydroxide gels and floc particles, which may adversely affect the sediment dwelling benthic community, but does not represent a human health risk.
- PCB testing was undertaken, however results from two separate sampling events returned contradictory results, and were thus considered inconclusive. However, modelling undertaken on the highest levels obtained demonstrated that the levels were below the human health risk.

- The proposed management strategy for the site is based on mitigating the recharge to the landfill by grouting the lock walls, and continuing to monitor contaminant emissions
- Sediment bioassays were recommended at and downstream of the discharge areas, to assess whether the sediment is acutely toxic.

2.2.2 JEWL February 1996 Environmental Site Assessment Report

- The report outlined a sampling and analysis program undertaken at the Site, as well as at Lower Reach Park, which is located southwest of the Site, and was also historically a landfill site in the 1960's. The review focussed on activities undertaken at, and results as they pertain to the Old Sly Site only.
- It was noted that between 1994, when the previous site assessment activities were undertaken, and 1996, when the JEWL site assessment activities took place, the lock walls had been repaired with grout to limit the amount of leakage from the lock to the landfill, and vice versa. Hydrogeological testing undertaken by JWEL at Old Slys Island indicates that discharge rates through the landfill were significantly reduced as a result of the repair of the south facing lock chamber wall.
- Surface water samples were collected up and down stream of Old Slys Island, and one monitoring well was sampled (MW-2, at the northeast corner of the Island, adjacent to the lower lock).
- Results were compared to 1994 Ontario PWQOs. As groundwater at the Site is discharged to the Rideau River, it was determined that the PWQO values were applicable to groundwater as well as surface water.
- Parameters above criteria included Iron, Ammonia, Total Phenols, Turbidity and Hydrogen sulphide in groundwater; and Iron, Turbidity, Chromium, Copper, Lead and Zinc in surface water.
- It was noted that the exceedances of Chromium, Copper, Lead and Zinc were only present in the upstream background surface water sample, but were not present downstream.
- The Iron exceedance in surface water was obtained from beneath the rail bridge, in an area of orange Iron hydroxide precipitate on the shoreline. Although this was an exceedance of PWQO criteria, it was determined that the exceedance was due to the Iron precipitate, and was not indicative of the overall Site.
- Exceedances in groundwater were not present downstream, and as such it was concluded that, although there is some impairment of the

groundwater within the landfill, it is not adversely impacting downstream water.

- It was concluded that the Old Sly landfill leachate was not producing negative environmental impacts downstream.
- It was recommended that surface water and groundwater sampling continue three times per year (during the spring thaw, summer and at the close of the navigation season).

2.2.3 BEC October 1996 Screening Level Ecological Risk Assessment Report

- The objective of the Screening Level Ecological Risk Assessment (SLERA) was to assess the potential risks to non-human receptors of heavy metals contamination in soil and groundwater at Lower Reach Park. The study focussed only on Lower Reach Park, located southwest of the Old Sly landfill. It was concluded that aquatic receptors are not at risk from the, then, current levels of metals in waters in the nearshore area of Lower Reach Park.
- It was noted in the report that elevated concentrations of Lead and Aluminium were noted in some surface water samples, including the background surface water sampling location, above CCME guidelines, and it was surmised that the levels may be elevated due to natural or anthropogenic sources into the Rideau River.

2.2.4 BEC October 1999 Summer Sampling Report

- The report outlined a sampling and analysis program undertaken at the Site, as well as at Lower Reach Park. The review focussed on activities undertaken at, and results as they pertain to the Old Sly Site only.
- Testing for inorganics, VOCs and PCBs in groundwater, and inorganics in sediments/precipitate was undertaken at the Site in August 1999. Parameters were selected based on previous testing undertaken by GPEC in 1994 and JEWL in 1996, where levels of analytes were measured above non-detect.
- Groundwater sampling was undertaken at six (6) previously installed monitoring wells. Sediment sampling was undertaken in locations where orange precipitate was observed (below the lower lock and below the train bridge in the weir channel), and where groundwater precipitate was observed to be leaking from areas of degraded grout along the retaining wall below the lower lock.
- Results were compared to 1994 Ontario PWQOs. As groundwater at the Site is discharged to the Rideau River, it was determined that the PWQO values were applicable to groundwater as well as surface water.

- Parameters above criteria included Chlorobenzene, Aluminium, Arsenic, Chromium, Cobalt, Copper, Iron, Lead and Zinc in groundwater; and Iron and Lead in sediment. Detectable levels of PCBs were noted in three (3) monitoring wells, however these levels were not above criteria.
- Results indicated that there was a general increase of metals concentrations in the groundwater at the Site, but only Aluminium and Iron were present in concentrations above the applicable criteria in the leachate being released through degrading grout in the retaining wall below the lower lock.
- Although previous assessments had determined that the toxicity of sediment/precipitate samples at the Site had no adverse effect on benthic organisms, the levels of metals were comparable to those of previous samples taken from Lower Reach Park, which did conclude that the levels were toxic to benthic organisms. It was concluded that, as concentrations of metals in sediment were observed to be increasing, it should be assumed that the sediment zones below the rail bridges at the northeast and southeast corners of the Island (SED1 and SED3) are toxic to benthic organisms. It was recommended that the size of the precipitate plumes be monitored to determine if the plume is increasing in size, and thus having a greater impact on the river.
- As PCBs were detected in groundwater at the Site, it was recommended that sediment/precipitate sampling be undertaken at groundwater high and low flow periods from discharge areas, to monitor the relative load to the river at these times, and determine if PCBs are reaching the river.

2.2.5 BEC December 2000 Summer and Fall Sampling Report

- The report outlined a sampling and analysis program undertaken at the Site, as well as at Lower Reach Park. The review focussed on activities undertaken at, and results as they pertain to the Old Sly Site only.
- Testing for inorganics, VOCs and PCBs in groundwater, and inorganics and PCBs in sediments/precipitate was undertaken at the Site in June and September 2000. Parameters were selected based on previous testing undertaken by GPEC and JEWL, as well as previous sampling undertaken by BEC in 1999 (see section 2.2.4).
- Visual observations indicated the level of orange precipitate was to a much lower degree as was observed in 1999, possibly due to higher water levels.

- Groundwater sampling was undertaken at six (6) previously installed monitoring wells. Sediment sampling was undertaken in locations where orange precipitate was observed (below the lower lock and below the train bridge in the weir channel), and where groundwater precipitate was observed to be leaking from areas of degraded grout along the retaining wall below the lower lock.
- Results were compared to 1994 Ontario PWQOs. As groundwater at the Site is discharged to the Rideau River, it was determined that the PWQO values were applicable to groundwater as well as surface water.
- Parameters above criteria included Aluminium, Arsenic, Chromium, Cobalt, Copper, Iron, Silver, Selenium and Zinc in groundwater; and Iron, Lead, Arsenic and Cadmium in sediment.
- Detectable levels of PCBs were noted in three (3) monitoring wells, however these levels were not above criteria. Compared to previous sampling, PCB levels are variable, suggesting PCBs are fluctuating with water levels, due to high rainfall rates and infiltration into the landfill. Sediment/precipitate results suggests the PCBs were not entering the river.
- In general, results indicated that the levels of metals in groundwater and leachate are higher in fall than in summer, suggesting a dilution effect from higher rainfall rate.
- Results indicated that Aluminium, Chromium, Selenium and Silver were present in concentrations above the applicable criteria in the leachate being released through degrading grout in the retaining wall below the lower lock.
- It was recommended that monitoring of inorganics, VOCs and PCBs continue in groundwater, groundwater leachate and sediment/precipitate, in early summer and fall, to high and low rainfall events.

2.2.6 Aqua Terre December 2006 Sampling Report

- The report outlined a sampling and analysis program undertaken at the Site, as well as at Lower Reach Park. The review focussed on activities undertaken at, and results as they pertain to the Old Sly Site only.
- Sampling was undertaken in July and August 2006. A Seepage sample was obtained from one (1) location on-site where groundwater precipitate was observed to be leaking from areas of degraded grout along the retaining wall below the lower lock, collection of two (2) sediment samples in locations where orange

precipitate was observed (below the lower lock and below the train bridge in the weir channel) and collection of six (6) groundwater samples from previously installed monitoring wells.

- Results were compared to federal (CCME 1999) and provincial (MOE 2004 Table 3 and Ontario PWQO) standards.
- Parameters above criteria included Iron (federal) and Iron and Toluene (provincial) in surface water seepage; and Iron and Mercury (federal) and Zinc, PCBs, Mercury, Cobalt and Xylenes (provincial) in groundwater. No exceedances in sediment were noted.
- It was noted that although there is variability in groundwater concentrations, there was no significant temporal increasing or decreasing trends.
- As there was the potential for impacts to surface water from the Site, it was recommended that immediate measures be taken to evaluate and implement a management approach. It was recommended that, due to a lack of consistent temporal data, a gap analysis be conducted, and supplemental investigations be undertaken for any gaps identified. Site management options could then be developed and implemented at the Site.

2.2.7 Golder September 2011 Sampling Report

- The report outlined a sampling and analysis program undertaken at the Site, as well as at Lower Reach Park. The review focussed on activities undertaken at, and results as they pertain to the Old Sly Site only.
- Sampling was undertaken between April and August 2011.
- Results were compared to federal (CCME 2001 and Guidance Document on Federal Interim Groundwater Quality Guidelines (IGQG) for Federal Contaminated Sites 2010) and provincial (MOECC 2011 Table 9 and Ontario PWQO) standards.
- Surface water samples were collected up- and downstream of the locks, as well as within the locks. Five monitoring wells were sampled; it was noted that one well (MW5, located at the east side of the Island) was dry at the time of sampling, and one well (MW3B and MW3C, located at the west side of the Island) were blocked at the time of sampling. One seepage sample was collected where groundwater precipitate was observed to be leaking from areas of degraded grout along the retaining wall below the lower lock.
- The report noted that Parks Canada staff had noted the presence of a viscous black substance along the lock wall, but this substance was not observed during the field visits.

- Parameters above criteria included Iron (federal and provincial) in surface water seepage; Lead, Mercury, Cadmium, Copper and Zinc (federal and provincial) and Chromium and Silver (provincial) in sediment; and Iron, Cadmium, Arsenic and Zinc (federal) and Cobalt, PCBs (provincial) in groundwater. No exceedances in surface water were noted.
- It was noted that iron concentrations at the seepage sampling location have been increasing since the summer of 2002.
- Iron concentrations in groundwater were noted to be within the same range as those concentrations historically reported, since 1994.
- It was recommended that monitoring well deficiencies (such as missing well caps and blockages in wells) be addressed, and an elevation survey be completed for all monitoring wells, in order to calculate groundwater elevations and gradients.

2.2.8 Areas of Potential Environmental Concern (APEC)

Based on the reviewed information, APECs at the Site include the entire Site over which fill/buried waste was placed.

Table 2-1 outlines the APECs and how they were investigated at the Site. Figure 1 outlines the Phase II Site and APEC, as outlined below.

Table 2-1 Investigation of Areas of Potential Concern

Area of Potential Environmental Concern	Potentially Contaminating Activity	Reason	How The Concern Was Investigated
1. Across the Site	Importation of fill and buried wastes of an unknown quality	Historical records indicate the Old Sly Lock was built in the mid-1800's. Construction activities caused the formation of an Island south of the Lock. Infill of the Island likely took place from the creation of the Island onwards, but the Site also acted as a landfill for the town between 1965 and 1966.	Soil samples collected and analyzed for PHCs, VOCs, metals and inorganics, PAHs and PCBs. Groundwater samples collected and analyzed for PHCs, VOCs, metals and inorganics, PAHs and PCBs. Sediment samples collected and analyzed for PHCs, VOCs, metals and inorganics, PAHs and PCBs. Surface water samples collected and analyzed for VOCs and metals and inorganics.

2.2.9 Potential Contaminants of Concern (COCs)

Based on the reviewed information, five (5) main groups of potential COCs were identified at the Site:

- PHCs F1 to F4 where fill and buried wastes may have been placed;
- VOCs (including BTEX) where fill and buried wastes may have been placed;
- Metals and inorganics where fill and buried wastes may have been placed;
- PAHs where fill and buried wastes may have been placed; and
- PCBs where fill and buried wastes may have been placed.

3. Scope of Investigation

3.1 Overview of Site Investigation

According to the scope of work provided by the client the objectives of the investigation were to review existing information with regards to previous work completed at the Site, assess groundwater, soil, surface water and sediment quality at the Site in regards to applicable federal guidelines and criteria, conduct a Detailed Quantitative Human Health and Ecological Risk Assessment (DQ HHERA) to determine human health and ecological risks at the site, specifically taking into account upcoming select construction activities to be undertaken on the lock, and produce a report documenting the data, methods, results and recommendations of the risk assessment and environmental monitoring program.

The following scope of work was undertaken to address the above objectives:

- Review of previous environmental investigations;
- Advance boreholes to a maximum depth of up to 4.57 m (15′) to characterize soil lithology and to collect soil samples;
- Advance five (5) monitoring wells to a maximum depth of 4.57 m (15′) to characterize groundwater flow direction and quality and to collect groundwater samples;
- Purge and sample up to six (6) existing monitoring wells.
- Collect surface water samples from up to twelve (12) locations.
- Collect sediment samples from up to ten (10) locations.
- Submit selected samples to a certified CALA laboratory for testing.
- Compare the analytical testing results of the samples tested the applicable guidelines and criteria, as set out in section 1.4.
- Prepare a Phase II ESA report to outline the findings and provide engineering opinions based on the information available to the date received in AEL offices.
- Prepare a DQ HHERA report based on available data and provide engineering opinions based on the information available to the date received in AEL offices.

All matters not listed in the terms of reference or general conditions were specifically excluded from AEL responsibilities and reporting

3.2 Media Investigated

3.2.1 Soil

Soil testing was conducted on the Site soils for the presence of metals and inorganics, PHCs F1/BTEX – F4, PAHs, PCBs and VOCs, due to history of the Site as a landfill. Previous testing by other consultants included testing for pesticides, however as Parks Canada does not currently use pesticides, it was assumed that a current measurement was not warranted as the current levels of pesticides on Site would be lower than previously measured.

3.2.2 Groundwater

Eight (8) monitoring wells were investigated on-Site, and one (1) monitoring well was investigated off-Site to the southwest. Groundwater testing was conducted for the presence of metals and inorganics, PHCs F1/BTEX – F4, PAHs, PCBs and VOCs, due to history of the Site as a landfill. Groundwater level measurements were recorded to aid in the determination of groundwater flow direction.

3.2.3 Sediment

Sediment testing was conducted on-Site and nearby off-Site up- and down-stream locations for the presence of metals and inorganics, PHCs F1/BTEX – F4, PAHs, PCBs and VOCs, due to history of the Site as a landfill.

3.2.4 Surface Water

Surface water testing was conducted on Site and nearby off-Site up- and down-stream locations for the presence of metals and inorganics and VOCs, due to history of the Site as a landfill.

3.3 Deviations from Sampling and Analysis Plan

The original generic Sampling and Analysis Plan called for the drilling of eight (8) boreholes, five (5) of which were to be developed into monitoring wells for groundwater sampling. Ten (10) sediment samples, eleven (11) surface water samples and one (1) seepage sample from the lock wall were also to be collected.

During the Phase II investigation, water was viewed by field staff as flowing through the upper lock onto Old Sly island; a sample of the seep was collected. An additional soil sample was obtained from an area where the seepage water from the upper lock was collecting and ponding, at the east side of the Site. Several sediment and surface water sampling locations were moved or not accessed, due to unsafe conditions at the time of sampling. Groundwater samples were obtained from existing groundwater wells MW-1, MW-3S, MW-3D and MW-6; groundwater was not present in MW-5, and could not be sampled. Existing monitoring wells MW-2 and MW-4 could not be located, and thus were not sampled. See Appendix 1 for the sampling and analysis plan.

3.4 Impediments

Due to a high water level at the time of the Phase II investigation, some sediment and surface water sampling locations were unsafe, and samples could not be obtained (further discussions regarding this are found in sections 3.3, 5.9 and 5.9.1).

4. Investigation Methodology

4.1 General

The field investigation was undertaken between August 28th and September 1st, 2017. These methods included drilling using a Geoprobe 7822DT Direct Push Drill for soil sampling and monitoring well installation, field screening methods, surface water and sediment collection and monitoring well development and sampling.

4.1.1 Drilling and Excavating

AEL used a Geoprobe 7822DT Direct Push Drill, supplied by Strata Drilling Group, for sampling eight (8) borehole locations.

4.1.2 Soil: Sampling

AEL conducted sampling in areas of potential concern based on information obtained prior to the Phase II work. Sample locations were recorded in relation to a common benchmark. Locations were input into AEL's data management software. The borehole locations are shown in the borehole location plan (Figure 2).

Overburden was comprised of a layer of topsoil overlying sandy fill materials to the maximum depth investigated in all areas identified as the former landfill. Native materials at one location, MW9/17, consisted of a layer of topsoil overlying sand and gravel to the depth investigated, approximately 4.11 m bgs.

Drill refusal was encountered at five (5) locations across the Site, likely due to the presence of bedrock, at depths of between 3.66 and 4.27 m bgs.

Soil sampling down to a maximum depth of 4.57 m at each location was performed using a Geoprobe 7822DT Direct Push Drill. The 7822 machine provides a 0.61 m long, 2.54 cm diameter soil core in a single use plastic (PVC) liner. The samples were then field tested, and transferred into lab prepared sample jars. Soil sampling was continuous and samples were collected across the entire interval and examined using visual, olfactory and field screening methods.

The following sampling protocol was applied to reduce the risk of cross contamination:

- Only new, clean, 0.61 m long PVC liners are used for direct push drill cores;
- Only new clean jars for were used for each sample sent to laboratory;
- Only new clean latex sample gloves are used when handling all samples or sample containers. In cases where the liners are used, the

gloves may be redundant, so that gloves may not be needed. The AEL protocol is to always require new gloves for each sample;

- Each sample is marked and labelled with a unique barcode identification label.

Sample or project information reliability and security are one of the most important features of a Phase II ESA sampling program. Out of sequence or erroneous logging of samples can significantly affect the cost of site cleanups or the understanding of a site.

Sample identification information is supplied in multiples to be applied to borehole logs, sample containers, and chain of custody information. This minimizes the potential for sample mislabelling and facilitates tracking as each sample is provided with a unique identifier, regardless of related location or project information.

4.1.3 Field Screening Measurements

4.1.3.1 RKI Eagle 2 Gas Detector

On-Site field screening involved screening soil cores with a pre-cleaned and calibrated RKI Eagle 2 gas detector to measure VOCs and Hydrocarbons (HCs). The Eagle 2 is capable of 0-2000 ppm VOC detection and 0 – 50,000 ppm HC detection with an accuracy of ± 25 ppm or ± 5%. It was calibrated prior to use by Pine Environmental.

After the soil sample was removed from the ground, a sample of soil was placed in a Ziploc bag and sealed. After a period of five minutes, the gas detector was inserted into the bag, and a headspace reading was taken to determine if any VOCs and/or HCs were present. The summarized results from the field screening can be found in Table 25.

4.1.3.1 X-Ray Fluorescence

On-Site field screening also involved screening soil cores with a high-resolution X-Ray Fluorescence (XRF) analyzer in the detection and quantification of metals in soil, manufactured by Innovx. After 105 seconds, these elements can be detected from 0.1 ppm (depending on the element) in sand, with longer readings giving lower detection limits and more precise results.

The instrument is calibrated with an internal reference before any testing is done. The Calibration of the instrument was checked once daily with the NIST reference standard Blank, #2711a (low) and #2710a (high) before and at regular intervals after samples are tested. If at any time these checks fall outside the acceptable limits of the instrument, all samples tested after the last accepted check were either retested or marked as inaccurate, and the instrument recalibrated.

XRF testing in soil followed protocols established by EPA Method 6200 - Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment. All sampling results are stored electronically. Field data sets were downloaded electronically into AEL's data management system. XRF testing in soil was completed on soil samples from all boreholes, and assisted in determining which samples were submitted for further laboratory analysis. The summarized results from the field screening can be found in Table 26.

4.2 Ground Water: Monitoring Well Installation

AEL used a Geoprobe 7822DT Direct Push Drill, supplied by Strata Drilling Group, of Carleton Place, Ontario, for installation of monitoring wells using a 203.2 mm diameter hollow stem auger. Monitoring wells were constructed of 50 mm inside diameter PVC riser pipe fitted with 50 mm inside diameter threaded PVC well screen (No. 10 slot). The annular space of the borehole around the screen was backfilled with clean silica sand to approximately 30.48 cm above the top of the screen. The annular space above the sand pack was grouted with a bentonite seal to ground surface. The entire top was outfitted with a flushmount or monument lockable metal protective casing.

All wells were equipped with sealed caps to prevent surface water infiltration.

AEL developed the wells over 24 hours after installation by purging no less than three well volumes or until the measurements of groundwater temperature, pH, turbidity and conductivity were stable as measured on a Horiba Water Quality Instrument. In cases where the wells went dry, they were purged once and allowed to recover fully. Please see Table 8 for identification of remaining on site wells.

4.3 Ground Water: Sampling

AEL developed monitoring wells by purging at least three well volumes or until the measurements of groundwater temperature, turbidity, pH and conductivity were stable as measured on the Horiba Water Quality Instrument. Purge water was collected on-site and removed for disposal in accordance with appropriate regulations. Groundwater samples were collected after purging. Water levels were measured prior to purging and the collection of samples. The wells were sampled using an inertial or peristaltic pump directly into the bottles provided by the CALA laboratory, with filtering where necessary. Each sample was labelled with a unique identifying label and placed immediately into a cooler packed with ice.

4.4 Surface Water/Seepage: Sampling

All surface water samples were collected close to shoreline, obtained by hand or using a swing sampler, where necessary, directly into the bottles provided by the CALA laboratory, with filtering where necessary. AEL took field measurements of pH and temperature prior to collection of samples. Each sample was labelled with a unique identifying label and placed immediately into a cooler packed with ice.

Two (2) seepage samples were collected from active seeps along the lock wall, at the north side of the site. One (1) sample was collected from the upper lock, flowing from a crack in the lock wall onto the island, when the lock was full; and one (1) sample was collected from the lower lock, flowing from a crack in the lock wall from the island to the lock, when the lock was empty. Samples were obtained by hand or using a swing sampler, where necessary, directly into the bottles provided by the CALA laboratory, with filtering where necessary. AEL took field measurements of pH and temperature prior to collection of samples. Each sample was labelled with a unique identifying label and placed immediately into a cooler packed with ice.

4.5 Sediment: Sampling

All sediment samples were collected close to shoreline. The base of the Rideau River in the area of the Site was largely rock, with some coarse sand and gravel sediment. As there was little sediment to sample, samples were obtained using a stainless-steel trowel where possible, or by hand, directly into the bottles provided by the CALA laboratory. Each sample was labelled with a unique identifying label and placed immediately into a cooler packed with ice.

4.6 Analytical Testing

Twenty-four (24) soil samples with two (2) duplicate samples, nine (9) groundwater samples plus one (1) trip blank and one (1) duplicate, six (6) sediment samples plus one (1) duplicate, and nine (9) surface water samples plus two (2) duplicates, were sent to Maxxam Analytics (32 Colonnade Rd, Unit #1000, Nepean, ON) for the analysis of selected metals and inorganics, PHC, VOCs, PAH and PCB analysis.

4.7 Residue Management Procedures

All drill cuttings, direct push samples not used for analysis, purge well water and fluids from equipment cleaning were placed in drums on site. These residues were removed daily, as per Park's Canada's instructions. Residues were removed and disposed of in accordance with appropriate regulations.

4.8 Elevation Surveying

AEL completed a topographic survey of the new wells. Elevations were acquired using a Trimble® R10 RTK GPS at an average accuracy of approximately 10 mm horizontal and 15 mm vertical. This sampling generated a sufficiently dense point cloud to create a Digital Elevation Model using topographic modelling in ArcGIS.

4.9 Quality Assurance and Quality Control Measures

AEL maintains a Quality Assurance/Quality Control (QA/QC) procedure in accordance with CSA requirements. AEL's QA/QC sampling protocol is as outlined below and includes:

- Adequate samples to provide for quality assurance and control of the sample results.
- Laboratory QA/QC procedures as required by applicable guidelines or regulations. In some instances where elevated test results are found that do not match sampling trends observed at a site, AEL may require samples be re-tested, or additional samples tested nearby. Furthermore, in some cases duplicate samples are tested.

The AEL QA/QC protocol is directed towards eliminating the potential for cross-contamination of samples and maintaining control and knowledge of the sample and sample results from the field through to reporting of the result. As a result, true field duplicates for soil samples are not generally obtained in the field during a Phase II ESA investigation owing to the variability of soils. Split field duplicates are obtained in completion of remedial work where composite samples are generally used to monitor field progress.

4.9.1 Sampling QA/QC

4.9.1.1 Background

To reduce the risk of cross-contamination of soil the following steps are implemented on AEL projects. AEL ensures and uses:

- Only new, clean, 0.61 m long PVC liners for direct push drill cores;
- Non-disposable sampling equipment is cleaned with residue free cleaners and rinsed with distilled water before and/or after each sample is taken;
- Only new clean jars for were used for each sample sent to laboratory;
- Only new clean latex sample gloves are used when handling all samples or sample containers. In cases where the liners are used, the gloves may be redundant, so that gloves may not be needed. The AEL protocol is to always require new gloves for each sample.

4.9.1.2 AEL Samples and Containers

The AEL approach produces samples in new laboratory-prepared sample containers specific to the parameter of interest, so that sample filtration and preservation are as dictated by analytical needs.

5. Results and Discussion

5.1 Geology

Overburden was comprised of a layer of topsoil overlying sandy fill materials to the maximum depth investigated in all areas identified as the former landfill. Native materials at one location, MW9/17, consisted of a layer of topsoil overlying sand and gravel to the depth investigated, approximately 4.11 m bgs.

Drill refusal was encountered at five (5) locations across the Site, likely due to the presence of bedrock, at depths of between 3.66 and 4.27 m bgs.

5.2 Ground Water: Elevations and Flow Direction

Monitoring well locations were chosen to cover the Site in a non-linear configuration. Screened intervals of monitoring wells used for interpretations of ground water flow direction were chosen to intercept the anticipated groundwater flow levels on Site.

Field measurements, taken using a water level indicator during water level measurements, have been kept for review as necessary.

No free product was present in monitoring wells.

Telephone, water, sewer and gas services are not currently provided to the Site, therefore no effect on potential contaminant migration is anticipated associated with these utilities.

At the time of water sampling groundwater was encountered between 0.96 m and 3.43 m bgs at the Site. The elevations of each monitoring well can be found on the Borehole Logs in Appendix 2. Based on flow of surface water surrounding the Site, groundwater flows in an easterly direction from the Site. See Figure 3 for inferred groundwater direction.

5.3 Ground Water: Hydraulic Gradients

Based on water levels from the current investigation, the horizontal gradient was calculated to be between 0.00015 m/m and 0.062 m/m on the Site, and confirmed an easterly groundwater flow. The vertical gradient, calculated between MW-3S and MW-3D, indicated a downwards vertical hydraulic gradient of 0.28. Previous investigations calculated the hydraulic conductivity to be between 1.3×10^{-4} cm/sec to 8.4×10^{-4} cm/sec, which is consistent with the soil/fill encountered at the Site, and indicates moderate permeability which would allow transmission of groundwater contaminants.

5.4 Coarse Grained Soil Texture

Based on visual evidence collected during soil sampling, coarse grained soil was determined to be the soil classification for comparison and as such this texture will be used in determining the applicable standards.

5.5 Soil: Field Screening

Soil samples were screened for VOCs, hydrocarbons and metals in the field using an RKI Eagle 2 Gas Detector and an XRF. All field screened samples returned low or non-detect levels of VOCs and hydrocarbons. Results from the field screening can be seen in Table 25.

Select soil samples were also screened for metals in the field using an InnovX XRF analyser. Several samples returned levels of metals above the values established by AEL as the screening levels for meeting MOECC Table 9 criteria. Results from the field screening can be seen in Table 26.

5.6 Site Characterization: Background Conditions

AEL collected background samples for soil, groundwater, surface water and sediment.

5.6.1 Soil and Groundwater Background Conditions

Previous investigations used MW-6 as a background sampling location for soil and groundwater. Although this location is up-gradient of the Site, it is down-gradient of Lower Reach Park, which was historically a landfill site at the same time as the Site, in the mid-1960's. Historic sampling completed at MW-6 indicate this well is likely being impacted to some degree by the Lower Reach Park historic landfill, and may not be appropriate as a background monitoring location, or as a monitoring location for the Site. As such, AEL installed a new monitoring well, which was off the landfill portion of Old Sly Island, and most likely to be unaffected by the landfill. This location was identified as MW9/17. AEL obtained soil and groundwater samples from this location, for laboratory analysis of PHCs, VOCs, PAHs and PCBs. All results were below the applicable guideline values, with the exception of Cadmium and Chloride, which exceeded the CCME residential/parkland property use guidelines for groundwater. There is the potential for the exceedances of Cadmium and Chloride to be related to the landfill, however, as the landfill is trans-gradient to MW9/17, and no landfill materials were present during soil sampling, it is more likely related to an off-site source. Overall, it appears that the background sampling location may be measuring off-site sources, but is generally useful in determining if off-site sources may be contributing to impacts on-site.

5.6.2 Surface Water Background Conditions

AEL obtained two (2) samples up-stream (SW1 and RR2) and one sample down-stream (SW8), plus one (1) duplicate sample, of the Site, in order to obtain background concentrations of metals and VOCs.

The sample from up-stream of the lock (SW1), did not meet the CCME Water Quality Guidelines for the Protection of Aquatic Life in Freshwater or the MOECC PWQOs for Cyanide. As Cyanide has not been sampled for historically, there is no historical data available for comparison. Concentrations of Cyanide at all other sampled locations, including up-stream, on-site and down-stream, were below the detection limit for Cyanide, indicating this may be a localized impact, and not related to the landfill.

Surface water down-stream of the Site, at SW8, showed elevated levels of total un-ionized ammonia above the MOECC PWQOs. As total un-ionized ammonia has not been sampled for historically in surface water, there is no historical data available. When compared to the surrounding sampling locations, concentrations of total un-ionized ammonia were also above the guideline at the seepage sample (SW3), taken from the lock wall just up-stream of RR3, but had decreased to below the guideline further down-stream, at SW7, the closest up-stream sampling location to SW8. This indicates that seepage may be having an impact immediately downstream of the lock, but impacts do not extend past SW7, and thus levels of total un-ionized ammonia at SW8 are not likely related to the Site, and there are likely other contributing sources.

Exceedances of the CCME Water Quality Guidelines for the Protection of Aquatic Life in Freshwater were noted for Acrolein, Mercury, Cadmium and Selenium. The results for Acrolein, Mercury, Cadmium and Selenium in all samples were inconclusive as the reported detection limit (RDL) was above the applicable guideline value. As VOCs have not been sampled for historically, there is no historical data available for comparison. Acrolein is most commonly used as a biocide in the control of floating weeds and algae in irrigation canals. Current laboratory methods are not capable of detection limits as low as the current guideline value, therefore AEL cannot confirm if there are exceedances of Acrolein in the background samples.

Overall, it appears that background sampling locations are measuring off-site sources, but are generally useful in determining if off-site sources may be contributing to impacts on-site. The down-stream background sampling location for surface water shows impacts which are not all likely related to the Site, indicating that the background sampling location may be too far down-stream to reflect impacts, if any, from the Site. Additional work is recommended to clarify the down-stream condition and potential contributors.

5.6.3 Sediment Background Conditions

AEL obtained one (1) sample up-stream (SED2) and one sample down-stream (SED10), plus one (1) duplicate sample, of the Site, in order to obtain background concentrations of PHCs, VOCs, metals and inorganics, PAHs and PCBs. Historically, an additional sample was collected up-stream of the lock (SED4), however due to the absence of sediment at this location at the time of the investigation, AEL could not collect a sample for analysis.

Sediment concentrations up-stream of the Site showed elevated levels of Mercury, Benzo(a)anthracene, Benzo(a)pyrene, Phenanthrene and Pyrene above the CCME Freshwater ISQGs, but not above the CCME PELs. Sediment concentrations downstream of the Site showed elevated levels of Arsenic above the CCME Freshwater PEL, and Cobalt, Nickel and Cyanide all above the MOECC Table 9 guidelines. Historical sediment sampling did not test for PAHs. As PAHs were identified up-stream of the Site, but not at the most down-stream location sampled (SED10), the presence of PAHs indicates that there is likely a source up-stream of the Site, possibly related to the Lower Reach Park landfill, and the Site may be acting as a contributing source to impacts down-stream. The low concentrations of PAHs seen at SED10, combined with the concentrations of metals indicates that SED10 is not related to the Site, and there are likely other contributing sources. The exceedance of Arsenic of the CCME PEL at the down-stream location (SED10) are not likely to be related to the landfill as exceedances of Arsenic were not present up-stream, and other levels of metals, specifically lead, have decreased as compared to up-stream concentrations.

Overall, it appears that background sampling locations are measuring off-site sources, but are generally useful in determining if off-site source may be contributing to impacts on-site. The down-stream background sampling location for sediment shows impacts which are not all likely related to the Site, indicating that the background sampling location may be too far down-stream to reflect impacts, if any, from the Site.

5.7 Site Characterization: Soil Quality

The results did not indicate the presence of light or dense non-aqueous phase liquids (LNAPLs or DNAPLs).

A total of eight (8) boreholes were advanced on the Site. Borehole and well locations are shown on Figure 2. Soil samples were taken from 0.0 to 4.57 m bgs. Based on visual, olfactory and other on-site examinations, soil samples were collected from all eight (8) boreholes for further laboratory investigation. Fourteen (14) samples, plus one (1) duplicate sample, were investigated for PHCs F1/BTEX – F4; fourteen (14) samples, plus one (1) duplicate sample, for metals and inorganics; fourteen (14) samples, plus one (1) duplicate samples, for VOCs; eight (8) samples for PAHs; and eight (8) samples for PCBs.

5.7.1 PHC/BTEX Analysis

A total of fourteen (14) samples, along with one (1) duplicate, were selected for laboratory analysis. Results indicated two (2) locations, MW7/17 and MW10/17, in the northeast corner of the Site which exhibited surface soil exceedances for one or more of Ethylbenzene, PHCs F3 and F4 Gravimetric. Five (5) locations, MW7/17, MW10/17, BH11/17, BH12/17 and BH13/17, at the north side of the Site, and one (1) location, MW8/17, at the west side of the

Site, exhibited subsurface soil exceedances for one or more of Ethylbenzene, Toluene and Total Xylenes, and PHCs F2, F3, F4 and F4 Gravimetric.

Historical soil sampling completed by GPEC in 1995 identified concentrations of Xylenes above the current MOECC 2011 Table 9 standard, but not above the current CCME residential/parkland property use guideline. PHCs were not analysed for at this time. Exceedances in soil, both historically and currently, were distributed across the northern portion of the Site, but were only present within the fill which was historically placed on-Site. The variable distribution of impacts suggests they are associated with the nature of fill materials used for infilling, and this source is reflected in the vertical distribution of soil impacts which are limited to the fill layer. Due to the proximity of the exceedances on the north and west sides of the Site boundary, impacts are delineated horizontally by the Site boundary at these locations.

A tabular representation of this analysis can be found in Table 1. See Figure 4a for lateral distribution of soil PHC and BTEX contaminants. See Figures 9a, b – d for vertical distribution of soil PHC and BTEX contaminants and stratigraphy of the Site.

5.7.2 VOC Analysis

A total of fourteen (14) samples, along with one (1) duplicate, were selected for laboratory analysis. Results indicated one (1) location, MW10/17, in the northeast corner of the Site which exhibited surface soil exceedances for Ethylbenzene. Three (3) locations, MW10/17, BH11/17 and BH12/17, at the north side of the Site, and one (1) location, MW8/17, at the west side of the Site, exhibited subsurface soil exceedances for one or more of Ethylbenzene, Trichloroethylene, Toluene and Total Xylenes.

Historical soil sampling completed by GPEC in 1995 identified concentrations of Chlorobenzene, Dichlorobenzene and Xylenes above the current MOECC 2011 Table 9 standards, but no exceedances of the current CCME residential/parkland property use guidelines were noted. Exceedances in soil, both historically and currently, were distributed across the Site, but were only present within the fill which was historically placed on-Site. The variable distribution of impacts suggests they are associated with the nature of fill materials used for infilling, and this source is reflected in the vertical distribution of soil impacts which are limited to the fill layer. Due to the proximity of the exceedances on the north and west sides of the Site boundary, impacts are delineated horizontally by the Site boundary at these locations.

A tabular representation of this analysis can be found in Table 2. See Figure 4b for lateral distribution of soil VOC contaminants. See Figures 9a, e – g for vertical distribution of soil VOC contaminants and stratigraphy of the Site.

5.7.3 Metals and Inorganics Analysis

A total of fourteen (14) samples, along with one (1) duplicate, were selected for laboratory analysis. Results indicated one (1) location, MW7/17, at the northeast corner of the Site, which exhibited surface soil exceedances for Copper. AEL identified one (1) location, MW7/17, at the south side of the Site, one (1) location, MW8/17, at the west side of the Site, and one (1) location, MW5/17, at the southeast portion of the Site, which exhibited subsurface soil exceedances for metals (including Antimony, Arsenic, Cadmium, Copper, Lead, Nickel, Tin and Zinc) within the fill.

Historical soil sampling completed by GPEC in 1995 identified concentrations of Lead and Zinc above the current CCME residential/parkland property use guidelines and concentrations of Lead, Zinc and Silver above the current MOECC 2011 Table 9 standards. Exceedances in soil, both historically and currently, were distributed across the Site, but were only present within the fill which was historically placed on-Site. The variable distribution of impacts suggests they are associated with the nature of fill materials used for infilling, and this source is reflected in the vertical distribution of soil impacts which are limited to the fill layer. Due to the proximity of the exceedances on the north and west sides of the Site boundary, impacts are delineated horizontally by the Site boundary at these locations.

A tabular representation of this analysis can be found in Table 3. See Figure 4c for lateral distribution of metals and inorganics contaminants. See Figures 9a, h – j for vertical distribution of soil metals and inorganics contaminants and stratigraphy of the Site.

5.7.4 PAH Analysis

A total of eight (8) samples were selected for laboratory analysis. Results indicated one (1) location, MW10/17, at the northeast corner of the Site, and one (1) location, MW8/17, at the west side of the Site, which exhibited surface soil exceedances for one or more of Methylnaphthalene, 2-(1-), Naphthalene and Phenanthrene. Previous investigations, completed in 1995, identified one (1) location, MW-5, at the southeast portion of the Site, which exhibited subsurface soil exceedances for Anthracene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene and Phenanthrene, within the fill.

Historical soil sampling completed by GPEC in 1995 identified concentrations of Anthracene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene and Phenanthrene above the current CCME residential/parkland property use guidelines and concentrations of Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Fluoranthene, Phenanthrene and Pyrene above the current MOECC 2011 Table 9 standards. Exceedances in soil, both historically and currently, were distributed across the Site, but were only present within the fill which was historically placed on-Site. The variable distribution of impacts suggests they are associated with the nature of fill materials used for infilling, and this source is reflected in the vertical distribution of soil impacts which are limited to the fill layer. Due to the proximity of the exceedances on the west and southeast sides of the Site boundary, impacts are delineated horizontally by the Site boundary at these locations.

A tabular representation of this analysis can be found in Table 4. See Figure 4d for lateral distribution of soil PAH contaminants. See Figures 9a, k – m for vertical distribution of soil PAH contaminants and stratigraphy of the Site.

5.7.5 PCB Analysis

A total of eight (8) samples were selected for laboratory analysis. All samples were below the applicable federal and provincial guidelines.

Previous investigations, completed in 1995, identified two (2) locations, MW-1 and MW-5, at the north and east sides of the Site, which exhibited subsurface soil exceedances for total DDD and Methoxychlor within the fill. The variable distribution of impacts suggests they are associated with the nature of fill materials used for infilling, and this source is reflected in the vertical distribution of soil impacts which are limited to the fill layer. Due to the proximity of the exceedances on the north and east sides of the Site boundary, impacts are delineated horizontally by the Site boundary at these locations.

A tabular representation of this analysis can be found in Table 5. See Figure 4e for lateral distribution of soil PCB contaminants.

5.8 Site Characterization: Ground Water Quality

AEL tested four (4) existing groundwater monitoring wells and five (5) newly installed groundwater monitoring wells installed across the property. One monitoring well, MW-5, did not have groundwater present, therefore a sample could not be obtained. Two monitoring wells, MW-2 and MW-4 could not be located, therefore a sample could not be obtained.

Eight (8) samples, along with one (1) duplicate and one (1) trip blank, were collected for the analyses of PHCs (F1 – F4) and VOCs (including BTEX); eight (8) samples, plus one (1) duplicate, were collected for analysis of metals and inorganics; and four (4) samples were collected for the analysis of PAHs and PCBs. The samples for metals analysis were field filtered.

5.8.1 PHC/BTEX Analysis

A total of eight (8) samples, along with one (1) duplicate, were selected for laboratory analysis. All samples returned concentrations below the FCSAP IGQGs for BTEX and PHC F1 and F2, however no guideline values exist for PHC F3 and F4. Four (4) samples (MW5/17, MW7/17, MW8/17 and MW10/17), plus the duplicate sample, did not meet the MOECC Table 9 guidelines for one or more of PHC F3, F4 and F4 gravimetric. Concentrations of PHCs F1 and F2 were also present in MW-1, MW-3S MW5/17, MW8/17 and MW10/17, although these were below the guideline.

The previous groundwater sampling event, undertaken by Golder in 2011, BTEX concentrations were non-detect in all wells, with the exception of MW-4, which returned low concentrations of Xylenes. Xylenes have been noted historically at MW-4, although have not exceeded federal guidelines. PHCs have not been sampled historically.

Exceedances in groundwater were distributed across the Site, but are likely related to the fill which was historically placed on-Site. The variable distribution of impacts suggests they are associated with the nature of fill materials used for infilling, and this source is reflected in the horizontal distribution of groundwater impacts which are limited to the wells within the fill area, and are not present in the background well (MW9/17). Due to the proximity of the exceedances on the north and west sides of the Site boundary, impacts are delineated horizontally by the Site boundary at these locations.

A tabular representation of this analysis can be found in Table 8. See Figure 5a for lateral distribution of soil PHC and BTEX contaminants. See Figures 9a, n – p for vertical distribution of groundwater PHC and BTEX contaminants and stratigraphy of the Site.

5.8.2 VOC Analysis

A total of eight (8) samples, along with one (1) duplicate, were selected for laboratory analysis. Two (2) samples (MW5/17 and MW10/17), exceeded the FCSAP IGQGs for Chlorobenzene, and one (1) sample (MW-1) exceeded the MOECC Table 9 standard for Chlorobenzene. Concentrations of Chlorobenzene were also present in MW-3D and MW7/17, although these were below the guideline. Other VOCs were present across the Site in groundwater, including Acetone, Benzene, 1,4-Dichlorobenzene, Ethylbenzene, Toluene and Xylenes, although the concentrations were not above the FCSAP IGQGs.

Historically, concentrations of Chlorobenzene have exceeded the current FCSAP IGQGs at MW-2, MW-3, MW-4 and MW-5 in 1994 and at MW-2 and MW-5 in 1999. VOCs were not sampled in 2000, 2006 or 2011. The current results are within the range of historical Chlorobenzene concentrations, since 1994.

Other VOCs present in groundwater, but below the FCSAP IGQGs, included Acetone, Benzene, 1,4-Dichlorobenzene, Ethylbenzene, Toluene and Xylenes. All of these current results are within the range of historical concentrations, since 1994.

Exceedances in groundwater were distributed across the Site, but are likely related to the fill which was historically placed on-Site. The variable distribution of impacts suggests they are associated with the nature of fill materials used for infilling, and this source is reflected in the horizontal distribution of groundwater impacts which are limited to the wells within the fill area, and are not present in the background well (MW9/17). Due to the proximity of the exceedances on the north, west and southeast sides of the Site boundary, impacts are delineated horizontally by the Site boundary at these locations.

A tabular representation of this analysis can be found in Table 9. See Figure 5b for lateral distribution of soil VOC contaminants. See Figures 9a, q – s for vertical distribution of groundwater VOC contaminants and stratigraphy of the Site.

5.8.3 Metals and Inorganics Analysis

A total of eight (8) samples, plus one (1) duplicate sample, were collected for analysis of metals and inorganics. Six (6) samples (MW-3D, MW-3S, MW5/17, MW-6, MW8/17 and MW10/17), plus the duplicate sample, exceeded the FCSAP IGQGs for one or more of Arsenic, Barium, Cadmium, Iron, Chloride and Cyanide; and two (2) samples (MW-1 and MW7/17) exceeded the MOECC Table 9 guidelines for Iron; and MW7/17 also exceeded the MOECC Table 9 standard for Cyanide.

In general, Iron concentrations across the Site have remained consistent since the previous groundwater sampling event, undertaken by Golder in 2011. Iron concentrations have historically exceeded the applicable criteria, and the current results are within the range of historical iron concentrations, since 1994.

In general, Arsenic concentrations have been variable since sampling for Arsenic began in 1999, but exceedances of the applicable standards have only been noted at one location, MW-3. The concentration of Arsenic at MW-3 has decreased since the previous groundwater sampling event, undertaken by Golder in 2011, and concentrations were non-detect at all other wells sampled.

It was noted by Golder in 2011 that the concentration of Cobalt at MW-3 was the highest to date in 2011, although the concentration did not exceed the FCSAP IGQGs. The concentration has decreased significantly, and is currently within range of historical Cobalt concentrations, since 1994.

Historically Zinc concentrations have been variable across the Site, exceeding the FCSAP IGQGs at MW-1, MW-2, MW-4 and MW-5 at various sampling events since 1994. No exceedances of Zinc were noted in the current sampling event, with all concentrations below the detection limit, which are within the range of historical Zinc concentrations, since 1994.

Chloride has not been sampled historically. The highest concentration of chloride was noted in the background well (MW9/17), and concentrations decreased with distance from this well. It is likely that there are naturally elevated levels of chloride present in the groundwater.

Cyanide has not been sampled historically. Cyanide exceeded the MOECC Table 9 standards at one location (MW7/17), and exceeded the FCSAP IGQGs at one location (MW5/17). It is likely the variability is related to the nature of the fill materials present in the landfill.

Exceedances in groundwater were distributed across the Site, but are likely related to the fill which was historically placed on-Site. The variable distribution of impacts suggests they are associated with the nature of fill materials used for infilling, and this source is reflected in the horizontal distribution of groundwater impacts which are limited to the wells within the fill area, and are not present in the background well (MW9/17), with the exception of Chloride, which is likely naturally occurring. Due to the proximity of the exceedances on the north, east and west sides of the Site boundary, impacts are delineated horizontally by the Site boundary at these locations.

A tabular representation of this analysis can be found in Table 10. See Figure 5c for lateral distribution of soil metals and inorganics contaminants. See Figures 9a, t – v for vertical distribution of groundwater metals and inorganics contaminants and stratigraphy of the Site.

5.8.4 PAH Analysis

A total of four (4) samples were selected for laboratory analysis. Three (3) samples (MW-1, MW5/17 and MW10/17), exceeded the FCSAP IGQGs for one or more of Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Fluoranthene, Naphthalene, Phenanthrene and Pyrene. Other PAHs were present across the Site in groundwater, including Acenaphthene, Acenaphthylene, Benzo(b/j)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenz(a,h)anthracene, Fluorene, Indeno(1,2,3-cd)pyrene and Methylnaphthalene, 2-(1-), although the concentrations were not above the FCSAP IGQGs or the MOECC Table 9 standards.

PAHs have not been sampled historically. Several PAHs exceeded the FCSAP IGQGs at three locations (MW-1, MW5/17 and MW10/17), and PAHs are generally present across the Site, but were below the guideline. It is likely the variability is related to the nature of the fill materials present in the landfill, and this source is reflected in the horizontal distribution of groundwater impacts which are limited to the wells within the fill area, and are not present in the background well (MW9/17). Due to the proximity of the exceedances on the north and southeast sides of the Site boundary, impacts are delineated horizontally by the Site boundary at these locations.

A tabular representation of this analysis can be found in Table 11. See Figure 5d for lateral distribution of groundwater PAH contaminants. See Figures 9a, w – y for vertical distribution of groundwater PAH contaminants and stratigraphy of the Site.

5.8.5 PCB Analysis

A total of four (4) samples were selected for laboratory analysis. PCBs were present in groundwater at MW-1, MW5/17 and MW10/17, but concentrations were below the MOECC Table 9 standard.

Previous testing by Golder in 2011 returned an exceedance of PCBs at one location, MW-3. Current results of this well are inconclusive, as the detection limit was above the MOECC 2011 Table 9 standard. Historical exceedances were also noted at MW-1, in 2000. Concentrations of total PCBs was present in the current sampling event, but did not exceed the Table 9 standard. In general, PCB concentrations are lower than the previous sampling event in 2011, and all concentrations are within the range of historical PCB concentrations, since 1994. The distribution of PCB impacts suggests impacts are likely associated with the nature of fill materials used for infilling, and this source is reflected in the horizontal distribution of groundwater impacts which are limited to a localized area of the Site where infilling occurred. Due to the proximity of the exceedances on the north sides of the Site boundary, impacts are delineated horizontally by the Site boundary at this location.

A tabular representation of this analysis can be found in Table 12. See Figure 5e for lateral distribution of groundwater PCB contaminants.

5.9 Site Characterization: Sediment Quality

AEL obtained samples from one (1) location previously sampled and three (3) new locations not previously sampled. Sampling locations were chosen to represent on-site, as well as up- and down-stream conditions. Due to high water levels, a sample could not be obtained from one previously sampled location (SED1).

Four (4) samples were investigated for PHCs F1/BTEX – F4, metals and inorganics, VOCs, PAHs, and PCBs.

5.9.1 PHC/BTEX Analysis

A total of four (4) samples were selected for laboratory analysis. No guidelines currently exist for the presence of BTEX or PHCs in sediment, therefore no exceedances could be noted. All results were below the detection limit, with the exception of PHC F3 at SED6, and Toluene at SED6 and in the duplicate sample.

At the time of the Phase II investigation, water levels were very high, and thus water flow through the Old Sly dam was higher than normal. The location of SED6 was at the northeast side of a bay-like formation between the island and peninsula to the east of the rail tracks. Due to the high water flow and the bay formation, impacts at SED6 may be the result of deposition of contaminants carried into the bay and deposited in the sediment.

Historical sediment sampling did not test for BTEX or PHCs. PHCs and Toluene were identified both up- and down-stream of the Site. The presence of PHCs and Toluene indicate that there is likely a source up-stream of the Site, possibly related to the Lower Reach Park landfill, and impacts down-stream are not likely related to the Site.

A tabular representation of this analysis can be found in Table 14.

5.9.2 VOC Analysis

A total of four (4) samples were selected for laboratory analysis. No guidelines currently exist for the presence of VOCs in sediment, therefore no exceedances could be noted. All results were below the detection limit, with the exception of Acetone at SED6 and Toluene at SED6 and in the duplicate sample.

At the time of the Phase II investigation, water levels were very high, and thus water flow through the Old Sly dam was higher than normal. The location of SED6 was at the northeast side of a bay-like formation between the island and peninsula to the east of the rail tracks. Due to the high water flow and the bay formation, impacts at SED6 may be the result of deposition of contaminants carried into the bay and deposited in the sediment.

Historical sediment sampling did not test for VOCs. VOCs were identified both up- and down-stream of the Site. The presence of Acetone and Toluene indicate that there is likely a source up-stream of the Site, possibly related to the Lower Reach Park landfill, and impacts down-stream are not likely related to the Site.

A tabular representation of this analysis can be found in Table 15.

5.9.3 Metals and Inorganics Analysis

A total of four (4) samples were selected for laboratory analysis. Two (2) samples (SED5 and SED6) did not meet the CCME Freshwater PELs or the MOECC Table 9 guidelines for Lead and SED6 also exceeded the guidelines for Cyanide. One (1) sample (SED3) did not meet the CCME Freshwater ISQGs for Lead, but this sample did not exceed the CCME PEL.

Lead concentrations have increased slightly since the last sampling event in 2011 at SED3, but remain within the lower range of historical lead concentrations, since 1994.

The Lead concentration at SED5 is higher than the up-stream concentration at SED3. The Lead concentration at SED6 is also higher than SED3, and is similar to that of SED5. Although located on opposite sides of the peninsula, it is possible that the landfill is contributing a source of lead to the sediment. The location of these samples also may indicate a contributing source from the rail line, as they are all down-stream of the rail line.

Concentrations of Cadmium, Chromium, Lead, Mercury and Zinc have all decreased significantly at SED2 since the previous sampling event undertaken in 2011. Currently only Mercury is exceeding the CCME ISQG, but not the CCME PEL. Concentrations at this location were measured in 1994, 2011 and 2017. Concentrations increased significantly between 1994 and 2011, and then dropped down from 2011 to 2017, although levels still remain above the concentrations measured in 1994.

Exceedances noted at SED1 historically, and at SED6 currently, indicate that the rail line may be a contributing source to impacted sediment down-stream, as no exceedances were noted at SED7, which is down-stream of the island, but up-stream of the rail line, and concentrations of all parameters in general are lower than those at SED1 or SED6.

The variable distribution of metals and inorganics impacts suggests impacts are associated with the Site, and specifically from surface runoff of contaminated surface soil, groundwater seepage of contaminated groundwater and/or leaching from buried infill materials. These sources are reflected in the horizontal distribution of sediment impacts, which are highest immediately around the Site, and decrease down-stream.

A tabular representation of this analysis can be found in Table 16. See Figure 6a for lateral distribution of sediment metals and inorganics contaminants.

5.9.4 PAH Analysis

A total of four (4) samples were selected for laboratory analysis. Three (6) samples, plus the duplicate sample, did not meet the CCME Freshwater ISQGs for one or more of Acenaphthene, Acenaphthylene, Benzo(a)anthracene, Benzo(a)pyrene, Chrysene, Dibenz(a,h)anthracene, Fluoranthene, Methylnaphthalene, 2-(1-), Phenanthrene and Pyrene, but these samples did not exceed the CCME PELs or the MOECC Table 9 guidelines.

Historical sediment sampling did not test for PAHs. PAHs were identified both up- and down-stream of the Site, but not at the most down-stream location sampled (SED10). The presence of PAHs indicates that there is likely a source up-stream of the Site, and the landfill may be acting as a contributing source to impacts down-stream, and specifically from surface runoff of contaminated surface soil, groundwater seepage of contaminated groundwater and/or leaching from buried infill materials.

A tabular representation of this analysis can be found in Table 17. See Figure 6b for lateral distribution of sediment PAH contaminants.

5.9.5 PCB Analysis

A total of four (4) samples were selected for laboratory analysis. One (1) sample did not meet the CCME Freshwater ISQG for Total PCBs, but this sample did not exceed the CCME PEL.

Current results of SED6 are inconclusive, as the detection limit was above the CCME Freshwater ISQG. As this location has never been sampled previously, there is no historical data available for comparison. Historical concentrations from SED1, and current concentration from SED7, both up-stream of SED6, were slightly lower than SED6, although SED6 is within the range of historical PCB concentrations measured at SED1, since 2000. The presence of PCBs indicates that the landfill may be acting as a contributing source to impacts down-stream, and specifically from surface runoff of contaminated surface soil, groundwater seepage of contaminated groundwater and/or leaching from buried infill materials.

A tabular representation of this analysis can be found in Table 18. See Figure 6c for lateral distribution of sediment PCB contaminants.

5.10 Site Characterization: Seepage Quality

AEL obtained samples from flowing seeps at two (2) locations. Two (2) seepage samples were collected from active seeps along the lock wall, at the north side of the site. One (1) sample (LOCK1) was collected from the upper lock, flowing from a crack in the lock wall onto the island, when the lock was full; and one (1) sample (SW3) was collected from the lower lock, flowing from a crack in the lock wall from the island to the lock, when the lock was empty. AEL did not note the presence of any black viscous substance, as described by Parks Canada Lock Staff, seeping from the lower lock wall, thus a sample was not collected. AEL also did not note any seepage in the area of OW-1 (formerly SED 3W), previously noted and sampled in 2011 and 2006, therefore a sample could not be obtained from this location.

Two (2) samples, plus one (1) duplicate sample, were investigated for VOCs and metals and inorganics.

5.10.1 VOC Analysis

A total of two (2) samples, along with one (1) duplicate, were selected for laboratory analysis. No exceedances of the CCME Water Quality Guidelines for the Protection of Aquatic Life in Freshwater or the MOECC PWQOs were noted, with the exception of Acrolein. The results for Acrolein in both samples were inconclusive as the RDL was above the applicable guideline value. As these locations have never been sampled previously, and VOCs have not been sampled for historically, there is no historical data available for comparison.

Acrolein is most commonly used as a biocide in the control of floating weeds and algae in irrigation canals. Current laboratory methods are not capable of detection limits as low as the current guideline value, therefore AEL cannot confirm if there are exceedances of Acrolein in the seepage samples.

Testing completed in 2006 indicated an exceedance of the CCME Water Quality Guidelines for the Protection of Aquatic Life in Freshwater for Toluene, but was below the detection limit when re-sampled in 2011. Although this seep could not be re-sampled in the current investigation, the seep sampled from the lower lock (SW3) had detectable low levels of Toluene, but did not exceeded the CCME Water Quality Guidelines for the Protection of Aquatic Life in Freshwater.

A tabular representation of this analysis can be found in Table 20. See Figure 7a for the location of these exceedances.

5.10.2 Metals and Inorganics Analysis

A total of two (2) samples, along with one (1) duplicate, were selected for laboratory analysis. One (1) sample, from SW3, did not meet the CCME Water Quality Guidelines for the Protection of Aquatic Life in Freshwater or the MOECC PWQOs for total un-ionized ammonia, dissolved Oxygen and Iron. The results for Mercury, total Cadmium and total Selenium in both samples were inconclusive as the RDLs were above the CCME Water Quality Guidelines for the Protection of Aquatic Life in Freshwater, but were below the MOECC PWQOs.

As SW3 has never been sampled previously, there is no historical data available. Historical concentrations of Iron at OW-1 (formerly SED 3W), located below the lower lock, were higher than the concentration of Iron at SW3 in 2011, but lower in 2006. In general, Iron concentrations are thus within the range of historical Iron concentrations, since 2006. Dissolved Oxygen has not historically been sampled for, although given that the sample was obtained from a seep in the lock wall, the concentration of dissolved would expected to be lower than compared to a surface water sample. This is corroborated by field measurements taken of groundwater during purging of the groundwater wells, and of surface water during sample collection, which indicated the dissolved oxygen concentration of SW3 was slightly higher than groundwater, but lower than surface water.

A tabular representation of this analysis can be found in Table 21. See Figure 7b for the location of these exceedances.

5.11 Site Characterization: Surface Water Quality

AEL obtained samples from one (1) location previously sampled and three (3) new locations not previously sampled. Sampling locations were chosen to represent on-site as well as up- and down-stream conditions. Due to high water levels, a sample could not be obtained from two previously sampled locations (RR1 and SW5/RR5).

Four (4) samples were investigated for VOCs and metals and inorganics.

5.11.1 VOC Analysis

A total of four (4) samples were selected for laboratory analysis. No exceedances of the CCME Water Quality Guidelines for the Protection of Aquatic Life in Freshwater or the MOECC PWQOs were noted, with the exception of Acrolein. The results for Acrolein in both samples were inconclusive as the RDL was above the applicable guideline value. As these locations have never been sampled previously, and VOCs have not been sampled for historically, there is no historical data available.

Acrolein is most commonly used as a biocide in the control of floating weeds and algae in irrigation canals. Current laboratory methods are not capable of detection limits as low as the current guideline value, therefore AEL cannot confirm if there are exceedances of Acrolein in the seepage samples.

A tabular representation of this analysis can be found in Table 22.

5.11.2 Metals and Inorganics Analysis

A total of four (4) samples were selected for laboratory analysis. One (1) sample, from RR3, did not meet the MOECC PWQO for total un-ionized ammonia. The results for Mercury, total Cadmium and total Selenium in all samples were inconclusive as the RDLs were above the CCME Water Quality Guidelines for the Protection of Aquatic Life in Freshwater, but were below the MOECC PWQOs.

Previous investigations, conducted from 1995 to 2011, also identified exceedances of Iron and Mercury at one (1) additional location, RR1.

As total un-ionized ammonia has not been sampled for historically in surface water, there is no historical data available for comparison. When compared to the surrounding sampling locations, concentrations of total un-ionized ammonia were also above the guideline at the seepage sample (SW3), taken from the lock wall just up-stream of RR3, but had decreased to below the guideline further down-stream, at SW7. This indicates that seepage may be having an impact immediately downstream of the lock, but impacts do not extend past SW7. The locations of exceedances would suggest that the Site may be a contributing source of un-ionized ammonia, but these impacts are localized, and an additional source is likely present downstream.

The variable distribution of metals and inorganics impacts suggests impacts are associated with the Site, and specifically from surface runoff of contaminated surface soil, groundwater seepage of contaminated groundwater and/or leaching from buried infill materials. These sources are reflected in the horizontal distribution of sediment impacts, which are highest immediately around the Site, and decrease down-stream.

A tabular representation of this analysis can be found in Table 23. See Figure 8 for lateral distribution of surface water metals and inorganics contaminants.

5.12 Quality Assurance and Quality Control Results

All certificates of analysis or analytical reports received comply with the applicable regulation and/or guideline. Certificates of analysis have been received for each sample submitted for analysis and all certificates of analysis received are included in full, in Appendix 3.

5.12.1 Soil Sample QA/QC

5.12.1.1 Soil RPD

As part of the field investigation 10% QA/QC field duplicate soil samples were collected and analyzed. Two (2) soil duplicates (A0233 and A0257, duplicates of A0230 and A0256, respectively) were submitted.

Analytical results for the QA/QC field duplicate samples in soil are presented in Appendix 3. Relative percent differences (RPDs) were calculated only where detected concentrations in both samples were greater than the five (5) times the laboratory reportable detection limit (RDL). All RPDs were within industry acceptance limits confirming that sample handling and analytical protocols were acceptable and the results were reproducible.

5.12.1.2 Analytical Laboratory QA/QC

The analytical laboratory performed matrix spikes, spiked blanks, method blanks as well as performing their own RPD calculations and percent recovery calculations, where indicated (see Appendix 3).

Sodium was not detected in samples A0215 (MW7/17), A0219 (MW10/17), A0228 (BH11/17), A0224 (BH12/17), A0225 (BH12/17), A0232 (BH13/17), A0256 (Pond), A0216 (MW7/17), A0220 (MW10/17), A0231 (BH13/17), A0241 (MW5/17), A0254 (MW9/17) and A0251 (MW9/17), as well as the duplicate sample. To report the SAR the sodium detection limit was used in the calculation. This value represents a maximum ratio. All results were below criteria.

For sample A0225 (BH12/17), it was reported that due to the sample matrix, dilution was required for PAH analysis, and detection limits were adjusted accordingly. All adjusted detection limits remained below the applicable guideline values.

For sample A0256 (Pond), it was reported that due to a high moisture content, detection limits were adjusted for PAH and PCB analysis. All adjusted detection limits remained below the applicable guideline values.

For sample A0254 (MW9/17), it was reported that due to the sample matrix, dilution was required for metals analysis, and detection limits were adjusted accordingly. All adjusted detection limits remained below the applicable guideline values.

For QC batch 5152238 it was reported that the matrix spike recovery for Chromium VI (CrVI) was below the Lab's lower control limits and was attributed to the reducing environment of the sample. Since the environment is the same as our sample, any CrVI released at these sample points on the Site would have been reduced to become less toxic, although an overall increase in total Chromium would be seen. Total Chromium did not exceed the allowable limits for the samples and thus is not of a concern.

5.12.2 Groundwater Sample QA/QC

5.12.2.1 Groundwater RPD

As part of the field investigation 10% QA/QC field duplicate groundwater samples were collected and analyzed. One (1) groundwater duplicate (A0247, duplicate of A0246) was submitted.

Analytical results for the QA/QC field duplicate samples in groundwater are presented in Appendix 3. Relative percent differences (RPDs) were calculated only where detected concentrations in both samples were greater than the five (5) times the laboratory reportable detection limit (RDL).

The RPD for MW8/17 (A0246 and A0247) for PHC F3 was calculated to be outside the acceptability limits. This confidence was then evaluated in relation to the MOECC Table 9 parkland standard that is being used for the Sample. An increase in the value of the PHC F3 was calculated by adding the difference between the duplicate sample and the parent sample. As both samples were already well above the stated Table 9 standard, the apparent confidence in the value is not a concern to the Site.

All other RPDs were within industry acceptance limits confirming that sample handling and analytical protocols were acceptable and the results were reproducible.

5.12.2.2 Analytical Laboratory QA/QC

The analytical laboratory performed matrix spikes, spiked blanks, method blanks as well as performing their own RPD calculations and percent recovery calculations, where indicated (see Appendix 3).

For all VOC, PHC, PAH, Chromium VI, Cyanide and Chloride samples for analysis, some bottles had visible sediment which was included in the analysis. This may represent a high bias in some results for these specific analytes.

For sample A0262 (MW9/17), it was reported that due to matrix interferences, dilution was required for PCB analysis, and detection limits were adjusted accordingly. All adjusted detection limits remained below the applicable guideline values.

For sample A0193 (MW-3D), a smaller portion of the sample was extracted for PCB analysis, due to the nature of the sample matrix. Detection limits were adjusted accordingly, which resulted in the RDL being greater than the applicable standard (see Table 5-1 below). Although this analyte is not necessarily considered a contaminant of concern, this is viewed as an exceedance since it exceeds the MOECC Table 9 standard.

Samples A0193 (MW-3D), A0194 (MW-3S) and A0191 (MW-6) had a RDL which exceeded FCSAP IGQGs (see Table 5-1 below). Although these analytes are not all considered contaminants of concern, they are viewed as exceedances since they exceed the Table 2 FCSAP IGQGs.

Table 5-1 Groundwater Exceedances Due to Sample Dilution and Adjusted RDL		
Location	Sample ID	Soil Exceedance
MW-3D	A0193	Cadmium, Selenium, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Fluoranthene, Pyrene, Total PCBs
MW-3S	A0194	Cadmium, Selenium
MW-6	A0191	Cadmium, Selenium

5.12.3 Sediment Sample QA/QC

5.12.3.1 Sediment RPD

As part of the field investigation 10% QA/QC field duplicate soil samples were collected and analyzed. One (1) soil duplicate (A0213, duplicate of A0197) was submitted.

Analytical results for the QA/QC field duplicate samples in soil are presented in Appendix 3. Relative percent differences (RPDs) were calculated only where detected concentrations in both samples were greater than the five (5) times the laboratory reportable detection limit (RDL).

The RPD for SED2 (A0197 and A0213) for Indeno(1,2,3-cd)pyrene was calculated to be outside the acceptability limits. This confidence was then evaluated in relation to the MOECC Table 9 parkland guideline standard that is being used for the Sample. An increase in the value of the Indeno(1,2,3-cd) pyrene was calculated by adding the difference between the duplicate sample and the parent sample. This increase did not result in an exceedance of the Table 9 standard, and thus the apparent confidence in the value is not a concern to the Site.

All other RPDs were within industry acceptance limits confirming that sample handling and analytical protocols were acceptable and the results were reproducible.

5.12.3.2 Analytical Laboratory QA/QC

The analytical laboratory performed matrix spikes, spiked blanks, method blanks as well as performing their own RPD calculations and percent recovery calculations, where indicated (see Appendix 3).

Sodium was not detected in samples A0198 (SED7), A0204 (SED5) and A0206 (SED3). To report the SAR the sodium detection limit was used in the calculation. This value represents a maximum ratio. All results were below criteria.

For samples A0197 (SED2), A0200 (SED10), A0202 (SED6) and the duplicate sample, it was reported that due to a high moisture content, detection limits were adjusted for F24FID, PAH and PCB analysis. This resulted in some RDLs being greater than the applicable guideline or standard (see Table 5-2 below). Although these analytes are not all considered contaminants of concern, they are viewed as exceedances since they exceed the CCME Freshwater PELs or the MOECC Table 9 guidelines.

Table 5-2 Sediment Exceedances Due to Sample Dilution and Adjusted RDL

Location	Sample ID	Sediment Exceedance
SED2	A0197 A0213, Duplicate of A0197	Acenaphthylene, Dibenz(a,h)anthracene
SED10	A0200	Dibenz(a,h)anthracene
SED6	A0202	Acenaphthylene, Dibenz(a,h)anthracene, Total PCBs

For samples A0200 (SED10) and A0202 (SED6), it was reported that due to a high moisture content, detection limits were adjusted for VOC and PHC F1 analysis. All adjusted detection limits remained below the applicable guideline values.

For QC batch 5146206 it was reported that the matrix spike recovery for Chromium VI (CrVI) was below the Lab's lower control limits and was attributed to the reducing environment of the sample. Since the environment is the same as our sample, any CrVI released at these sample points on the Site would have been reduced to become less toxic, although an overall increase in total Chromium would be seen. Total Chromium did not exceed the allowable limits for the samples and thus is not of a concern.

For QC batch 5168391 it was reported that the recovery Matrix Spike for Antimony was outside control limits, but the overall quality control for this analysis met acceptability criteria.

5.12.4 Surface Water/Seepage Sample QA/QC

5.12.4.1 Surface Water/Seepage RPD

As part of the field investigation 10% QA/QC field duplicate soil samples were collected and analyzed. Two (2) surface water/seepage duplicates (A0210 and A0249, duplicates of A0196 and A0239, respectively) were submitted.

Analytical results for the QA/QC field duplicate samples in soil are presented in Appendix 3. Relative percent differences (RPDs) were calculated only where detected concentrations in both samples were greater than the five (5) times the laboratory reportable detection limit (RDL). All RPDs were within industry acceptance limits confirming that sample handling and analytical protocols were acceptable and the results were reproducible.

5.12.4.2 Analytical Laboratory QA/QC

The analytical laboratory performed matrix spikes, spiked blanks, method blanks as well as performing their own RPD calculations and percent recovery calculations, where indicated (see Appendix 3).

5.13 Benthic Invertebrate Assessment

Based on the results of sediment monitoring, a study of benthic communities was undertaken in an effort to assess impacts from sediment quality on certain ecological receptors. This study was carried out by EcoMetrix Inc., under the direction of AEL, in November 2017. The study followed the Canadian Aquatic Biomonitoring Network (CABIN) protocol, and examined communities on-site, in comparison to communities up- and down-stream.

Sampling locations were selected based on sediment sampling undertaken during the Phase II ESA, to target communities in the area of sediment exceedances, as outlined in Section 5.9. Five (5) sampling locations were selected, representing three (3) different area types:

- SED4 – upstream control, lentic ecosystem;
- SED3 and SED5 – on-site, exposed canal;
- SED6 and SED7 – on-site, exposed lotic ecosystem.

SED4, SED3 and SED5 were all located in similar habitats (lentic ecosystems), while SED6 and SED7 were located in similar habitats (lotic ecosystems). The location of SED10 was originally chosen to be sampled, as a downstream control; however, this location was found to be frozen over at the time of sampling, so SED7 was selected for sampling instead, as flow was typical of that sampled in CABIN reference datasets.

Benthic communities were evaluated through calculated summary metrics of mean invertebrate abundance, mean taxon richness, Simpson's Diversity, and Evenness. Hilsenhoff's biotic index (BI) was also calculated at the genus level, and used to infer potential community impairments. The BI calculated indicates the overall tolerance of a benthic community, based on genus specific tolerance values for organic pollutants.

It was noted that field measurements of temperature and conductivity were found to be higher at SED3 and SED5, as compared to SED4. This was attributed to groundwater/solute inputs at SED3 and SED5, which may be related to the leaks noted in the lock wall.

Evaluation of biotic endpoints indicated that the up-stream and canal locations have benthic invertebrate communities which are representative of good to fair water quality conditions (see appendix 4 Figure 3-3 page 3.5 for bar graph). The community structure of lentic environments is comprised of fewer EPT taxa relative to that of lotic systems (Merritt et al., 2008). Therefore, it is not surprising that %EPT is lower at the upstream location as this station occurs at the lake shoreline (see Appendix 4, Figure 1-1, page 1-1). It was noted that in general, the upstream and canal locations are similar in community richness, abundance, diversity measures and Functional Feeding Groups, however a slight difference was noted in community structure, attributed to the fact that the canal locations experience flow only during the summer months when the canal is active, whereas the upstream location is representative of a true lentic ecosystem. The very low numbers of EPT taxa in upstream location is due to the community structure difference between lentic and lotic environments (see Appendix 4, Tables 2-1 and 3-2 , appendix pages 2.3 and 3.6, respectively).

Evaluation of biotic endpoints at one location, SED7, indicated that the benthic invertebrate community may experience anthropogenic impacts, having fairly poor water quality. When compared to SED6, this location showed no appreciable anthropogenic impacts, having good water quality.

It was concluded that it is unlikely that the historical landfill has impacted the benthic invertebrate community in the Old Sly Lock area, and impacts at SED7 may not be due to the historic landfill as many anthropogenic disturbances likely affect this area.

6. Human Health Risk Assessment

6.1 Introduction

6.1.1 Background and Objectives

The Site is an island, located within the Rideau River, and is used as parkland. The Site historically operated as a landfill in the mid-1960's, and potential environmental concerns at the Site were identified due to the presence of buried landfill materials. COCs identified in soil and/or groundwater at the Site include PHCs, VOCs, PAHs, and inorganic parameters. PAHs and inorganic parameters have been identified as COCs in sediment and inorganic parameters have been identified as COCs in surface water.

The objective of the human health risk assessment (HHRA) is to evaluate human exposure to users of the Site, including members of the public and workers, to the COCs in soil, groundwater, sediment, and surface water and to identify the need for any risk management measures. In addition, construction activities are planned for the Site and the HHRA is to evaluate the risks associated with those activities.

6.1.2 Site Description

The Site consists of an island, approximately 11,700 m^2 (1.17 Ha) in size, located within the Rideau River and is used as parkland. The Rideau River is present to the east and west of the Site, and the Old Slys Lockstation and associated weir are present to the north and south of the Site. Surrounding land uses include parkland and residential to the northeast.

There are no buildings or structures on-Site. The entire Site is covered with grasses and trees/shrubs. A gated vehicle access point is located at the southwest corner of the Site. The Site is publicly accessible and access is not restricted. No change in land use is proposed. The Site is not serviced by utilities; however, the surrounding properties are serviced by the municipality for water and sewage.

In the 1960's, the Site was used as a landfill by the Town of Smiths Falls. There is no liner for the landfill and it is not capped. There is a thin layer of topsoil overlying fill or sand/gravel and the Site is vegetated with grass and trees. Groundwater at the Site is very shallow (0.64 m bgs). Old Slys Island is graded down towards the east, creating up to a 4 m head of water from the west side of the Island to the east. As the CP rail line is present at the east side of the Island, this creates a dam-like structure, forcing groundwater to flow to the north and south, around the rail line. Groundwater flow at the north side of the Site is likely influenced by the operation of the lock system at the north side of the Site. Operational from May to October, the locks are opened and closed, reportedly causing vertical groundwater fluctuations on the island of between 1.5 m near the lock, and 0.4 m away from the lock. This operation effectively "flushes" water into the landfill when the locks are filled, and allows groundwater to seep out when the locks are emptied.

As discussed in Section 2.2, several ESAs have been completed at the Site, from 1994 to 2017. The ESAs have included collection and laboratory analysis of samples of soil, groundwater, sediment, and surface water for a broad range of parameters. Consistent with the source of the COCs being a landfill, the COCs are heterogeneously distributed, both laterally and vertically. These ESAs have identified the following parameters as COCs:

Soil: Ethylbenzene, toluene, xylenes, PHCs (F2 to F4 fractions); trichloroethylene; anthracene, benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, methylnaphthalene, naphthalene, phenanthrene; methoxychlor, DDD; antimony, arsenic, cadmium, copper, lead, nickel, tin, and zinc were measured in excess of soil guidelines.

Groundwater: PHCs (F3 and F4 fractions); chlorobenzene; anthracene, benzo[a]anthracene, benzo[a]pyrene, fluoranthene, naphthalene, phenanthrene, pyrene; arsenic, chloride, cyanide (free), and iron were measured in excess of guidelines. Cadmium and selenium were not detected; however, the detection limits of 0.10 and 2.0 ug/L, respectively, exceeded groundwater guidelines.

Sediment: Arsenic and lead were measured in excess of CCME Probable Effect Levels (PELs). Acenaphthene, acenaphthylene, benzo[a]anthracene, benzo[a]pyrene, chrysene, dibenzo[a,h]anthracene, fluoranthene, methylnaphthalene, phenanthrene, pyrene, and mercury were measured in excess of ISQGs. Cobalt, cyanide (free), nickel, and silver were measured in excess of MOECC standards (no CCME guidelines are available). Acetone, toluene, benzo[b/j]fluoranthene, antimony, barium, beryllium, boron, molybdenum, selenium, thallium, uranium, vanadium were detected; however no sediment guidelines are available. PCBs were not detected; however, the detection limit exceeded the ISQG, but was below the PEL.

Surface water: Cyanide (free) and un-ionized ammonia were measured in excess of surface water guidelines. Acrolein, cadmium, mercury, and selenium were not detected; however, the detection limits exceeded guidelines, but were below PWQO. Detection limits (DL) for Acrolein were three orders of magnitude greater than PWQO , however, acrolein parameter was only included in the general list of analytes by the lab, but there is no background supporting information or reason to believe that it is a contaminant of potential concern, therefore, it was not carried forward in the RA.

6.1.3 Scope of Human Health Risk Assessment

The HHRA uses a combination of qualitative and quantitative approaches. The COCs in soil, groundwater, sediment, and surface water are identified, as described above, based on comparison with applicable guidelines. The components considered in derivation of the guidelines are then examined for their relevance to human health and to the exposure pathways present at the Site (e.g. soil guideline components for protection of inhalation of vapours indoors are not applicable to the Site). This process qualitatively eliminates many of the COCs as a concern for human exposure at the Site. Exposures to the COCs remaining following this screening process are then quantified. Tables 27 to 30 present comparative criteria for the COCs for soil, groundwater, sediment, and surface water, respectively, used to screen the COCs for exposure pathways relevant to the Site. The results of this comparison are discussed in Section 6.2.

6.2 Problem Formulation

Problem formulation is the first step in the human health risk assessment process. It comprises the identification of COCs at the Site and the receptors that may be exposed to those contaminants. The conceptual site model is developed during the problem formulation stage. The conceptual site model and risk assessment included the site specific construction activities proposed for the Site: construction of upstream and downstream cofferdams; de-watering of work areas; removal of algae, debris and zebra mussels; saw-cutting and raking mortar joints; removal of deteriorated stones/materials; potential for excavation behind lock/approach walls; masonry/grouting; and, landscaping, site reinstatement to previous condition.

6.2.1 Site Characterization

The results of ESAs completed at the Site have identified PHCs, VOCs, PAHs, and inorganic parameters as COCs in soil and/or groundwater. PAHs and inorganic parameters have been identified as COCs in sediment and inorganic parameters have been identified as COCs in surface water. Tables 6, 7, 13, 19, and 24 summarize the maximum measured concentrations of all parameters analyzed in samples of surface soil, subsurface soil, groundwater, sediment, and surface water, respectively, and identifies those parameters that exceed guidelines. The locations of the exceedances are presented on Figures 4 to 8. Figures 9a to 9y present the exceedances in soil and groundwater as cross-sections.

6.2.2 Hazard Identification

The maximum measured concentrations of the COCs are presented in Tables 27 to 30 for soil, groundwater, sediment, and surface water, respectively, along with comparative criteria used to screen the COCs for exposure pathways relevant to the Site. Note that for soil and groundwater, the maximum concentrations are presented separately for locations within 10 m of surface water and more than 10 m from surface water as the CCME guidelines are not applicable within 10 m of surface water. As discussed in Section 1.4, MOECC standards developed for sites adjacent to water bodies are applied within 10 m of surface water. Note, also, that for this initial screening, the soil evaluation does not distinguish between COCs identified in surface soil and subsurface soil; all soil COCs are considered accessible. The results of the screening are as follows:

Soil: The CCME soil quality guidelines are based on consideration of multiple human health components, as shown in Table 27. There are no buildings on the Site and groundwater is not used for drinking water and, therefore, those components do not need to be considered (i.e., the components identified as indoor air, drinking water check, and produce, meat, dairy check in Table 27 are not relevant to the Site). For the current and future use of the Site, the relevant components are those protective of soil ingestion, dermal contact with soil, and inhalation of particulate matter, and the COCs measured in excess of applicable guidelines for one or more of these components are: anthracene, benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, methylnaphthalene, naphthalene, phenanthrene; methoxychlor; antimony, arsenic, lead, nickel, tin, and zinc. These are the COCs carried forward for further evaluation of human exposure.

Groundwater: As for soil, the groundwater guidelines are based on consideration of multiple human components, as shown in Table 28. There are no buildings on the Site and groundwater is not used for drinking water; however, because groundwater is so shallow, there is a potential for direct contact and incidental ingestion of groundwater by human receptors. Therefore, the maximum measured concentrations are conservatively compared with the Guidelines for Canadian Drinking Water Quality (GCDWQ) or, in the absence of a GCDWQ, the drinking water component of the MOECC Site Condition Standards. As shown in Table 28, the following COCs are identified as requiring further evaluation of human exposure through dermal contact and incidental groundwater ingestion: PHCs (F3 and F4 fractions), benzo[a]pyrene, fluoranthene, and arsenic.

Sediment: VOCs, PAHs, PCBs, and inorganic parameters have been identified as COCs in sediment based on comparison with guidelines protective of ecological receptors. Sediment guidelines based on human exposure are not available. For the Site, members of the public use the surface water for swimming and construction workers will be required to enter the water to complete some of the proposed construction activities. Human exposure to sediment is considered incomplete as there would not be any opportunity for direct contact with sediment (this differs from a lake, where swimmers may have contact with sediment when wading). Construction workers/divers contacting sediment during repairs would be wearing thermal protection (wet suit/dry suit) and would not have direct contact with the sediment. Some sediment may become suspended in the water column, in particular during the proposed construction activities. Exposure to suspended sediment particles is generally considered nominal as USEPA (2004) notes that suspended sediment particles are much less available for dermal absorption due to inefficient adsorption of suspended particles onto the skin surface and a slower rate of absorption into the skin. Therefore, human exposure to the COCs in sediment is not evaluated further.

Surface water: As shown in Table 30, the maximum measured concentrations of the unfiltered surface water COCs are compared with guidelines relevant to aquatic receptors (CCME FAL, MOECC PWQO, and MOECC aquatic protection values). Due to the potential for a human receptor to incidentally ingest surface water, the maximum measured concentrations and detection limits are conservatively compared with the GCDWQ in Table 30. The maximum measured concentration of cyanide (free) and the detection limits for cadmium, mercury, and selenium are much less than their respective GCDWQs and human exposure to these COCs does not require further evaluation. GCDWQs are not available for acrolein or un-ionized ammonia. Acrolein has not been detected; however, the detection limit exceeded the MOECC PWQO. Acrolein as a parameter was only included in the general list of analytes by the lab, but there is no background supporting information nor reason to believe that it is a contaminant of potential concern, therefore, it was not carried forward in the RA and therefore, potential human exposure to acrolein in surface water is not considered further. Health Canada (2013) completed a review of ammonia in drinking water and determined that it was not necessary to establish a GCDWQ due to the low toxicity of ammonia. Potential human exposure to ammonia in surface water is not evaluated further.

6.2.3 Receptor Identification

The human receptors potentially exposed to the COCs at the Site are members of the public of all ages using the park or the Lockstation, including for fishing and swimming; long-term and short-term workers operating the Lockstation or completing routine maintenance of the Site; and construction workers completing the proposed construction activities.

6.2.4 Exposure Pathway Identification

COCs at the Site are believed to be due to the presence of buried landfill materials. The soil COCs identified as requiring further human evaluation include PAHs, semi-VOCs, and inorganic parameters and the groundwater COCs requiring further evaluation are PHCs (F3 and F4 fractions), benzo[a]pyrene, fluoranthene, and arsenic. The COCs may be adsorbed to soil particles and leach from soil to groundwater due to infiltration of precipitation. Operation of the Lockstation causes vertical movement of groundwater in addition to flushing COCs into and out of surface water. In addition, dewatering during maintenance and construction activities may draw groundwater to the dewatered area. As discussed in Section 6.2.2, human exposure to sediment at the Site is considered incomplete and no surface water COCs were identified as requiring further evaluation of human exposure due to incidental ingestion of surface water.

There are three receptor types identified for the Site: Site visitors, Long-term workers, and Construction workers. The exposure pathways for all three receptor types are the same; however, the frequency and duration of exposure will differ. For the soil COCs, the exposure pathways are incidental ingestion of soil, dermal contact with soil, and inhalation of particulate matter. None of the soil COCs are sufficiently volatile for inhalation of vapours outdoors to be a concern. For the groundwater COCs, the exposure pathways are incidental ingestion of groundwater and dermal contact with groundwater. As for soil, the groundwater COCs are not sufficiently volatile for inhalation of vapours outdoors to be a concern. Roots of vegetation will contact the soil and groundwater and may uptake the COCs; however, ingestion of vegetation is not typically considered complete for human receptors at a site used for parkland as it would not provide a substantial source of food. Old Slys Lockstation surface vegetation such as occasional berry bushes, do not operate as a significant food source for visitors or on site workers.

6.2.5 Site Conceptual Model

The Site is an island, located within the Rideau River, and is used as parkland. The Site historically operated as a landfill in the mid-1960's, and potential environmental concerns at the Site were identified due to the presence of buried landfill materials. The results of ESAs completed at the Site have identified PHCs, VOCs, PAHs, and inorganic parameters as COCs in soil and/or groundwater. PAHs and inorganic parameters have been identified as COCs in sediment and inorganic parameters have been identified as COCs in surface water.

The objective of the HHRA is to evaluate human exposure to users of the Site, including members of the public and workers, to the COCs in soil, groundwater, sediment, and surface water and to identify the need for any risk management measures. In addition, construction activities are planned for the Site and the HHRA is to evaluate the risks associated with those activities.

There are no buildings or structures on-Site. The entire Site is covered with grasses and trees/shrubs. The Site is publicly accessible and access is not restricted. No change in land use is proposed. The Site is not serviced by utilities; however, the surrounding properties are serviced by the municipality for water and sewage. Groundwater at the Site is very shallow.

The human receptors potentially exposed to the COCs at the Site are members of the public of all ages using the park or the Lockstation, including for fishing and swimming; long-term and short-term workers operating the Lockstation or completing routine maintenance of the Site; and construction workers completing the proposed construction activities. The exposure pathways for all three receptor types are the same; however, the frequency and duration of exposure will differ. For the soil COCs, the exposure pathways are incidental ingestion of soil, dermal contact with soil, and inhalation of particulate matter. None of the soil COCs are sufficiently volatile for inhalation of vapours outdoors to be a concern. For the groundwater COCs, the exposure pathways are incidental ingestion of groundwater and dermal contact with groundwater. As for soil, the groundwater COCs are not sufficiently volatile for inhalation of vapours outdoors to be a concern. Roots of vegetation will contact the soil and groundwater and may uptake the COCs; however, ingestion of vegetation is not typically considered complete for human receptors at a site used for parkland.

Comparative criteria are used to screen the COCs for exposure pathways relevant to the Site. The results of the screening identified the following soil COCs as requiring further evaluation of human exposure to contaminated soil: anthracene, benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, methylnaphthalene, naphthalene, phenanthrene; methoxychlor; antimony, arsenic, lead, nickel, tin, and zinc. The following groundwater COCs require further evaluation of human exposure to contaminated groundwater: PHCs (F3 and F4 fractions), benzo[a]pyrene, fluoranthene, and arsenic. Human exposure to sediment is considered incomplete and no surface water COCs were identified as requiring further evaluation of human exposure to surface water contaminants.

The human health conceptual site model is shown on Figure 10a.

6.3 Exposure Assessment

The exposure assessment consists of the following steps: characterization of the potentially exposed receptors, identification of the pathways of exposure, and estimation of exposure of the receptors to the COCs.

6.3.1 Characterization of Contaminant Concentrations

PHCs, PAHs, methoxychlor, and inorganic parameters have been measured in samples of soil and/or groundwater collected from the Site at concentrations requiring further evaluation for human exposure. The maximum measured concentrations in soil and groundwater are summarized in Tables 27 and 28, respectively. The maximum measured concentrations are used for all calculations and, as described in Section 6.5.1, for COCs for which the predicted risk exceeds the target level, risks are also calculated using average concentrations (described in more detail in Section 6.5.1).

6.3.2 Characterization of Parameters Governing Contaminant Fate and Transport

Soil and groundwater are the relevant media evaluated for human exposure and concentrations of the COCs in these media have been determined.

Chemical-specific information is required in order to evaluate dermal exposure to soil and groundwater and it is summarized in Table 31.

6.3.3 Fate and Transport Modelling

Fate and transport modelling was not required as the media of concern, soil and groundwater, have been characterized. None of the COCs are volatile, which would require modelling of air concentrations. As mentioned in Section 6.3.1, the maximum measured concentrations of each COC in soil and groundwater are initially used in the exposure calculations. For COCs for which the predicted risk exceeds the target level, risks are also calculated using average concentrations.

6.3.4 Receptor Characterization

As discussed in Section 6.2.5, there are three types of receptors to be evaluated: Site visitors (all ages), Long-term outdoor workers, and Construction workers.

In accordance with the protocol for conducting human health risk assessments established by the CCME (2006), toddlers (age 7 months to 4 years of age) are the selected receptors for evaluation of exposure to threshold chemicals (i.e., non-carcinogenic effects). Children in this age group generally have the highest inhalation and ingestion rates, per unit of body weight, compared with other age groups, resulting in a higher potential for exposure to chemicals in the environment. Also, the behavioural characteristics of toddlers (e.g. increased hand to mouth activity) enhance the exposure of children to chemicals in soil or dust. For evaluation of exposure to non-threshold chemicals (carcinogens), the weighted average chronic daily intake (CDI) is calculated by summing the exposures for each of the five life stages (adult, teen, child, toddler, and infant). As indicated in Table 34, the toxicological reference value for nickel is based on developmental effects and, therefore, exposure to nickel is not pro-rated, i.e., the receptors are assumed to be on the Site for 365 days per year.

The assumed receptor characteristics for each receptor are summarized in Table 32 and are discussed below. Inputs for physical characteristics such as body weight, soil ingestion rate, skin surface area, and inhalation rate are average values obtained from Health Canada (2010a). The rationale for selection of the other receptor characteristics is described below.

Site visitor: The Site visitor is assumed to be outdoors for 1.5 hours per day (Health Canada, 2010a) and to spend this entire period at the Site, which is very conservative. Due to snow cover and the protective effect of clothing in the cooler months, outdoor exposure is assumed to occur for 26 weeks per year. The adult, toddler, and infant visitors are assumed to visit the Site five days per week, while the teen and child are assumed to visit on weekends only (two days per week). The toddler is assumed to wade in groundwater pooled at the ground surface once per week for 0.25 hours (as described in Section 6.3.5, only toddler exposure to groundwater is quantified). The Virginia

Department of Environmental Quality (VDEQ, 2016) recommends a water ingestion rate of 5 mL per hour for wading in surface water, which corresponds to 10% of the USEPA value for ingestion of surface water when swimming. Lifetime exposure is conservatively assumed and the exposure duration is set equal to the duration of the life stage (60 y for adult, 8 y for teen, 7 y for child, 4.5 y for toddler, and 0.5 y for infant).

Long-term workers: The Long-term worker is quantitatively evaluated for routine, daily exposure to soil and groundwater. Approximately every 15 to 20 years, the Long-term worker may assist with clearing material from the lock chamber. Occasional, short-term activities not quantitatively evaluated for the Long-term worker in the HHRA and it is recommended that, if these activities result in direct contact with sediment, then measures to limit dermal contact with sediment be employed (i.e., wearing of long pants, sleeves, and gloves). The Long-term worker is assumed to be present ten hours per day, five days per week, 26 weeks of the year (the locks are operational from May to October). The exposure duration of the worker is assumed to be 35 years, consistent with Health Canada (2010a) for a worker. The Long-term worker is assumed to have occasional contact with groundwater (once per day for 0.5 h). The rate of incidental ingestion of groundwater is assumed to be 0.02 L/d based on guidance provided by the State of Virginia (VDEQ, 2016) for construction workers, due to splashing and hand-to-mouth contact.

Construction workers: The following construction activities are proposed for the Site: construction of upstream and downstream cofferdams; de-watering of work areas; removal of algae, debris and zebra mussels; saw-cutting and raking mortar joints; removal of deteriorated stones/materials; potential for excavation behind lock/approach walls; masonry/grouting; and, landscaping, site reinstatement to previous condition. The receptor characteristics of the Construction worker are similar to those of the Long-term worker; however, longer contact with groundwater is assumed for the Construction worker. The Construction worker is assumed to be present ten hours per day, five days per week, 26 weeks per year for two years. The Construction worker is assumed to have contact with groundwater once per day for 2.0 h. The rate of incidental ingestion of groundwater is assumed to be 0.02 L/d, the same as for the Long-term worker (VDEQ, 2016).

6.3.5 Exposure Estimation

The exposure pathways to be evaluated are:

- Incidental ingestion of soil,
- Dermal contact with soil,
- Inhalation of particulate matter,
- Incidental ingestion of groundwater, and
- Dermal contact with groundwater.

The COCs were screened for evaluation of human exposure by comparing the maximum measured concentrations to components of the guidelines, as shown in Tables 27 and 28. As a result of this screening, exposure of the following soil COCs will be quantified: anthracene, benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, methylnaphthalene, naphthalene, phenanthrene, methoxychlor, antimony, arsenic, lead, nickel, tin, and zinc. The following groundwater COCs were identified as requiring further evaluation: PHCs (F3 and F4 fractions), benzo[a]pyrene, fluoranthene, and arsenic. The receptor characterization described in Section 6.3.4 is used to further reduce the list of groundwater COCs requiring evaluation. Groundwater is not used for potable purposes and the assumed incidental ingestion rate of groundwater (from VDEQ, 2016) is approximately 1% of the total drinking water ingestion rate of 1.5 L/d for adults and 0.6 L/d for toddlers in Health Canada (2010a). As shown in Table 28, the maximum measured concentrations of benzo[a]pyrene, fluoranthene, and arsenic are less than ten times their respective drinking water guidelines and, therefore, incidental ingestion and dermal contact are not quantified for these COCs. PHCs (F3 and F4 fractions) are the only groundwater COCs requiring quantification.

The equations used to calculate the dose of each COC, to each receptor, are presented in Appendix 5. The maximum measured concentrations in soil and groundwater, summarized in Tables 27 and 28, respectively, are used in the calculations. The composition of the PHCs in groundwater is not known and, therefore, the assumptions employed in CCME (2008a) were used to estimate the relative proportion of aliphatics and aromatics: 80% aliphatics and 20% aromatics for both the F3 and F4 fractions. The receptor characteristics are summarized in Table 32 and the relative absorption factors used in the calculations are listed in Table 31. The estimated doses for each COC and each receptor are presented in Table 33.

6.3.6 Summary of Exposure Assessment

Exposure to the soil COCs was quantified for the pathways of incidental soil ingestion, dermal contact with soil, and inhalation of particulate matter. The maximum measured concentration of each COC was assumed to be present across the Site and at the ground surface. For ingestion of groundwater and dermal contact with groundwater, contact with the highest measured concentrations in groundwater was assumed. These assumptions will overestimate exposures. The concentrations of all COCs are assumed not to change with time. Reasonable maximum values were used for the exposure frequency and exposure duration for all pathways and will also overestimate exposure. The estimated doses are presented in Table 33 and are used in combination with the toxicity assessment to characterize the risk of exposure, as described in Section 6.5.

6.4 Toxicity Assessment

The toxicity assessment is typically conducted in two stages: the hazard assessment and the dose response assessment. In the hazard assessment, the potential adverse human health effects due to exposure to the COCs are described. In the dose response assessment, quantitative information, which establishes a relationship between the magnitude of exposure and the potential for adverse health effects, is reviewed in order to select toxicological reference values (TRVs). For this HHRA, the rationale for selection of the TRVs was based on the following order of preference: Health Canada's preferred values for contaminated sites (Health Canada, 2010a), Health Canada drinking water supporting documents, CCME soil quality guideline supporting documents, USEPA Integrated Risk Information System (IRIS), and the Agency for Toxic Substances and Disease Registry (ATSDR).

6.4.1 Threshold Contaminants (by contaminant)

Threshold chemicals are chemicals for which a safe level of exposure (one which does not produce adverse health effects when exposed daily over a lifetime) can be defined. Exposure to chemicals via ingestion is usually evaluated using a reference dose (RfD), while exposure via inhalation is evaluated using a reference concentration (RfC). The reference dose may be derived from a no observed adverse effect level (NOAEL), lowest observed adverse effect level (LOAEL), or a benchmark dose, with uncertainty factors generally applied to reflect limitations of the data used. The following COCs are evaluated as threshold chemicals: PHCs (F3 and F4 fractions), anthracene, 1- and 2-methylnaphthalene, naphthalene, methoxychlor, antimony, lead, nickel, tin, and zinc. The RfDs and RfCs, for each of the COCs, along with the critical health effects, are summarised in Table 34. As indicated in Table 34, the oral TRV for nickel is based on a developmental effect.

6.4.2 Non-threshold Contaminants (by contaminant)

Non-threshold chemicals are believed to present a risk of adverse health effects at any dose. In Canada, this class of chemicals is currently restricted to mutagens and genotoxic carcinogens. For chemicals considered carcinogenic, any dose is believed to present some risk and a slope factor, which represents the risk per unit dose of chemical, is derived by regulatory agencies. The relationship between the risk of adverse health effects and dose is termed an inhalation unit risk factor or, for ingestion, a slope factor. The following COCs are evaluated as non-threshold chemicals: anthracene, benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, phenanthrene, arsenic, and nickel. The slope factors and unit risk factors, for each of the COCs, are summarised in Table 34. In addition, lead is considered a non-threshold toxicant for exposure to children; exposure is evaluated by comparison with the background soil concentration.

6.4.3 Evaluation of Potential Toxic Interactions

The potential adverse human health effects for each COC, including the potential carcinogenicity, are identified in Table 34. Some groups of chemicals may produce similar toxic effects; however, in general, there is not sufficient information in the literature to determine whether the result of exposure to mixtures of these chemicals may result in additive, synergistic, or antagonistic effects. Exposure to the carcinogenic PAHs is summed and exposure to aliphatic and aromatic sub-fractions comprising PHC F3 or PHC F4 are considered to result in additive effects.

6.5 Risk Characterization

Risk characterization combines the results of the exposure assessment and the toxicity assessment to evaluate the potential human health effects associated with exposure to the COCs in soil and groundwater.

6.5.1 Threshold Contaminants (by contaminant)

For chemicals with threshold effects, the hazard due to ingestion of soil and dermal contact with soil is evaluated by calculating a hazard quotient from the following equation:

$$HQ = (Dose_{Ing} + Dose_{Derm\ Soil})/RfD$$

where:
HQ = Hazard quotient (unitless)
RfD = Reference dose (mg/kg/d)

The hazard due to inhalation of particulate matter is calculated from the following equation:

$$HQ = (Dose_{Inh\ PM})/RfC \times BW/INH$$

where:
RfC = Reference concentration (mg/m^3)

To evaluate the hazard due to dermal contact with groundwater and incidental ingestion of groundwater the hazard quotient is calculated from the following equation:

$$HQ = (Dose_{Derm\ W} + Dose_{Ing\ W})/RfD$$

The estimated doses for each COC and each receptor are presented in Table 33 using the equations presented in Appendix 5. The calculated hazard quotients are shown in Table 35. As shown, the estimated hazard quotient exceeds the values considered acceptable by Health Canada (0.5 for PHCs or 0.2 for COCs other than PHCs) for the following COCs and receptors/pathways:

- PHCs F3 (aromatic), PHCs F4 (aromatic) and total PHCs for incidental groundwater ingestion and dermal contact with groundwater by the toddler and the long-term worker.
- PHCs F3 (aliphatic and aromatic), PHCs F4 (aromatic) and total PHCs for incidental groundwater ingestion and dermal contact with groundwater by the construction worker.
- Nickel for incidental ingestion of soil and dermal contact with soil by the toddler.

All doses and HQs were calculated using the maximum measured concentrations in soil or groundwater, which is very conservative. For the COCs resulting in HQs greater than the allowable levels, the doses and HQs were re-calculated using average concentrations, as follows:

PHCs: PHCs were analysed in groundwater samples collected in 2017 only; no historical information is available. The maximum measured concentrations of the F3 and F4 fractions were 19,000 and 9,700 ug/L, respectively. These concentrations were measured in a sample collected from MW8/17; however, the duplicate sample had much lower concentrations: 4,100 and 7,300 ug/L, for F3 and F4, respectively. The laboratory noted that there was sediment present in all the bottles, which was included in the analysis.

Average Site-wide concentrations are more representative of actual exposures. The average PHC concentrations, from all nine locations tested (ten samples including the duplicate at MW8/17), are 3,062 and 2,283 ug/L for F3 and F4, respectively. The HQs were re-calculated using these average concentrations and the results are shown in parentheses in Table 35. As shown, the HQ for total PHCs is less than 0.5 for the toddler. The HQ for total PHCs is slightly larger than 0.5 for the long-term worker (0.68). The HQ for total PHCs for the construction worker is 1.4.

Nickel: Nickel was analysed in soil samples collected from the Site historically and in 2017. Figure 4c presents the exceedances of the CCME guideline of 45 µg/g. As shown, nickel was measured in excess of the guideline in only one sample (at MW7/17 at a depth of 1.52 to 3.05 m; nickel was measured at a concentration of 17 ug/g in the shallow sample at this location). The average concentration of nickel is 50 µg/g, which was used to re-calculate the HQ. As shown in Table 35, the HQ for the toddler was 0.024, which is less than the allowable level. Average concentrations are considered more representative of exposure.

Lead: Lead was analysed in soil samples collected from the Site historically and in 2017. Figure 4c presents the exceedances of the CCME guideline of 140 µg/g. As shown, lead was measured in excess of the guideline in seven samples. The average concentration of lead in surface soil (upper 1.5 m) was 105 µg/g and the average concentration in subsurface soil (below 1.5 m) was 126 ug/g. Average concentrations are considered more representative of exposure than maxima. When compared with the background concentration of lead in Ontario soil of 120 ug/g (MOE, 2011c), the average concentration of lead in surface soil is less than the background concentration and the average concentration in subsurface soil is only slightly larger than background..

6.5.2 Non-Threshold Contaminants (by contaminant)

For non-threshold chemicals, incremental lifetime cancer risks (ILCRs) due to soil ingestion and dermal contact with soil are calculated using the following equation:

$$ILCR = (\mathrm{Dose}_{\mathrm{Ing}} + \mathrm{Dose}_{\mathrm{Derm\ Soil}})\ x\ SF$$

where:
ILCR = Incremental lifetime cancer risk (dimensionless)
SF = Slope factor $(\mathrm{mg/kg/d})^{-1}$

The risk due to inhalation of particulate matter is calculated from:

$$\mathrm{ILCR} = (\mathrm{Dose}_{\mathrm{Inh\ air}}) \times \mathrm{IUR} \times 70\ \mathrm{kg} / 20\ \mathrm{m^3/d}$$

where:
IUR = Inhalation unit risk $(\mathrm{mg/m^3})^{-1}$

The estimated doses for each COC and each receptor are presented in Table 33 using the equations presented in Appendix 5. The calculated ILCRs are compared to Health Canada's target of 1×10^{-5} (Health Canada, 2010b). If the calculated ILCR is below the target, then the risk is considered essentially negligible. As shown in Table 36, the ILCRs for all COCs and receptors are less than the essentially negligible level.

6.5.3 Uncertainties

The types of uncertainties in the foregoing analyses are identified below, along with a discussion of the influence on the results.

Site Characterization: A comprehensive Site investigation program was completed in 2017, which used information obtained in previous Site investigations to select sample locations and included testing of soil, groundwater, sediment, and surface water for a wide range of parameters. The maximum measured concentrations of the COCs were used in the calculations and these concentrations were assumed to be homogeneously distributed across all areas of the Site and to be at the ground surface. These concentrations were assumed to remain constant with time. The use of maximum measured concentrations is very conservative and, for PHCs, nickel and lead, average concentrations were also used to characterize the risk of exposure.

Exposure assessment: Where available, the receptor characteristics used in this HHRA are the values selected by Health Canada (2010a). For parameters such as body weight and inhalation rate, these values are representative of the average for the Canadian population. There is variation in these parameters among the population; however, the influence on the calculated doses will not be large. Reasonable maximum values were used for the exposure frequency and exposure duration. The rationale for these assumptions is to avoid underestimating exposures for certain individuals who may have higher than average exposure frequencies or durations; however, it is likely that these assumptions overestimate exposure. For example, for the Site visitor, the exposure frequency is two to five days per week (depending upon the age class), for an entire lifetime.

The skin surface area in contact with soil or groundwater is assumed to be the hands and arms for adults, teens, Long-term workers, and Construction workers (i.e., no account is taken of the effect of protective covering of gloves or sleeves likely worn by the workers). For the child, toddler, and infants, exposure of legs to soil or groundwater is assumed in addition to arms and hands. Guidance from the State of Virginia (VDEQ, 2016) was used for the rate of incidental ingestion of groundwater.

Standard equations were used for estimating the dose of each COC to the receptors. These equations contain parameters to estimate the relative absorption of the COC from that medium. These absorption factors are uncertain as they are based on limited experimental data or extrapolated from other chemicals. Also, there is individual variability in the fraction of chemical absorbed.

Toxicity assessment: The TRVs are derived by regulatory agencies, on the basis of mammalian and/or human studies, and incorporate uncertainty, safety or modifying factors. They are intended to be conservative and protective of the general population. Uncertainty in the TRVs may overestimate or underestimate actual risks; however, the selected TRVs are typical of the values used to derive generic standards for contaminated sites. The TRVs have been selected from those derived by regulatory agencies, with preference given to the values selected by Health Canada and are considered to represent the most toxicologically defensible TRVs for each compound. As such, the TRVs utilized in this HHRA are considered to represent the best available or current science. Inhalation TRVs are lacking for many of the COCs; however, none of the COCs are volatile and inhalation of particulate matter is generally a minor exposure pathway compared with incidental ingestion of soil and dermal contact with soil.

In general, there is not sufficient information in the literature to determine whether the result of exposure to mixtures of chemicals may result in additive, synergistic, or antagonistic effects. In this HHRA, the effects are assumed to be additive and the hazard quotients are summed for the PHCs and the ILCRs are summed for the carcinogenic PAHs.

Major factors influencing uncertainty: The most important parameters influencing the uncertainty in the risk estimates are the concentrations of the COCs, the exposure frequency and duration, and the absorption factors for soil and groundwater.

6.5.4 Discussion

The use of maximum measured concentrations resulted in the calculation of hazard quotients higher than the allowable level for PHCs for all receptors via incidental ingestion of groundwater and dermal contact with groundwater and for nickel for the toddler via incidental ingestion of soil and dermal contact with soil. These calculations are very conservative, especially considering the assumptions related to exposure frequency and duration. Using average concentrations, the hazard quotients for PHCs and nickel were less than the allowable level for the toddler. There was one anomalous measurement of PHCs (F3 fraction); if this result were omitted from the average concentration calculation and only the duplicate sample result was included, the hazard quotient is less than the allowable level for the Long-term worker, but not for the Construction worker. For the non-threshold chemicals, the calculated ILCRs were essentially negligible for all COCs and receptors.

6.5.5 Summary of Risk Characterization

Exposure to three types of receptors, Site visitors, Long-term workers, and Construction workers, was evaluated for the pathways of incidental soil ingestion, dermal contact with soil, inhalation of particulate matter, incidental ingestion of groundwater and dermal contact with groundwater. For chemicals having threshold effects, the estimated hazard quotients using the maximum measured concentrations were less than the allowable level for all COCs and receptors/pathways, with the exception of incidental ingestion of groundwater and dermal contact with groundwater containing PHCs for all receptors and incidental ingestion of soil and dermal contact with soil containing nickel for the toddler. Use of average concentrations in the calculations results in hazard quotients less than the allowable level, except for exposure of the Long-term worker and the Construction worker to groundwater. These calculations are considered very conservative because of the high frequency and duration of exposure and, for PHCs, they incorporate an anomalous measurement in one sample); if this result were omitted from the average concentration calculation and only the duplicate sample result was included, the hazard quotient is less than the allowable level for the Long-term worker, but not the Construction worker. For lead, the average concentration in surface soil is less than the background concentration and the average concentration in subsurface soil is only slightly larger than background. For chemicals having non-threshold effects, the calculated incremental lifetime cancer risks are less than the allowable level for all COCs and receptors/pathways.

6.6 Recommendations

6.6.1 Additional Data Collection Requirements

As PHCs were analysed in groundwater samples collected in 2017 only; no historical information was available for comparison. Concentrations measured in a duplicate sample collected from MW8/17 varied from it's base sample. During future sampling events for PHCs on site, another duplicate sample should be obtained for comparison from MW8/17.

6.6.2 Recommended Risk Management Measures

The results of the HHRA indicate that risk management measures are not required for the protection of site visitors or Long-term workers due to exposure to the identified COCs in soil, groundwater, surface water, or sediment. The estimated hazard to Construction workers, due to dermal contact with groundwater containing PHCs, exceeds allowable levels and typical Health and Safety measures (i.e., the wearing of pants, long sleeves, and gloves) are recommended to limit dermal contact with groundwater; no risk management measures are required for the other COCs/exposure pathways. In the evaluation of the potential for exposure of construction workers to sediment, it was assumed that the workers would be wearing thermal protection, which would also limit contact with sediment; this is considered a risk management measure.

7. Ecological Risk Assessment

7.1 Introduction

7.1.1 Background and Objectives

The Site is an island, located within the Rideau River, and is used as parkland. The Site historically operated as a landfill in the mid-1960's, and potential environmental concerns at the Site were identified due to the presence of buried landfill materials. COCs identified in soil and/or groundwater at the Site include PHCs, VOCs, PAHs, and inorganic parameters. PAHs and inorganic parameters have been identified as COCs in sediment and inorganic parameters have been identified as COCs in surface water.

The objective of the ecological risk assessment (ERA) is to evaluate potential risks to terrestrial and aquatic ecological receptors (the valued ecosystem components, or VECs) due to exposure to the COCs in soil, groundwater, sediment, and surface water and to identify the need for any risk management measures. In addition, the potential impact on the VECs of the proposed construction activities is evaluated.

7.1.2 Site Description

The Site consists of an island, approximately 11,700 m^2 (1.17 Ha) in size, located within the Rideau River. The Site is used as parkland and is part of the Old Slys Lockstation grounds. The Rideau River is present to the east and west of the Site, and the Old Slys Lockstation and associated weir are present to the north and south of the Site. Surrounding land uses include parkland and residential to the northeast.

The entire Site is covered with grasses and trees/shrubs. A gated vehicle access point is located at the southwest corner of the Site and access is not restricted. No change in land use is proposed.

In the 1960's, the Site was used as a landfill by the Town of Smiths Falls. There is no liner for the landfill and it is not capped. There is a thin layer of topsoil overlying fill or sand/gravel and the Site is vegetated with grass and trees. Groundwater at the Site is very shallow (0.64 m bgs). Old Slys Island is graded down towards the east, creating up to a 4 m head of water from the west side of the Island to the east. As the CP rail line is present at the east side of the Island, this creates a dam-like structure, forcing groundwater to flow to the north and south, around the rail line. Groundwater flow at the north side of the Site is likely influenced by the operation of the lock system at the north side of the Site. Operational from May to October, the locks are opened and closed, reportedly causing vertical groundwater fluctuations on the island of between 1.5 m near the lock, and 0.4 m away from the lock. This operation effectively "flushes" water into the landfill when the locks are filled, and allows groundwater to seep out when the locks are emptied.

As discussed in Section 2.2, several ESAs have been completed at the Site, from 1994 to 2017. The ESAs have included collection and laboratory analysis of samples of soil, groundwater, sediment, and surface water for a broad range of parameters. Consistent with the source of the COCs being a landfill, the COCs are heterogeneously distributed, both laterally and vertically. These ESAs have identified the following parameters as COCs:

Soil: Ethylbenzene, toluene, xylenes, PHCs (F2 to F4 fractions); trichloroethylene; anthracene, benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, methylnaphthalene, naphthalene, phenanthrene; methoxychlor, DDD; antimony, arsenic, cadmium, copper, lead, nickel, tin, and zinc were measured in excess of the applicable soil guidelines.

Groundwater: PHCs (F3 and F4 fractions); chlorobenzene; anthracene, benzo[a]anthracene, benzo[a]pyrene, fluoranthene, naphthalene, phenanthrene, pyrene; arsenic, chloride, cyanide (free), and iron were measured in excess of the applicable guidelines. Cadmium and selenium were not detected; however, the detection limits exceeded guidelines.

Sediment: Arsenic and lead were measured in excess of CCME Probable Effect Levels (PELs). Acenaphthene, acenaphthylene, benzo[a]anthracene, benzo[a]pyrene, chrysene, dibenzo[a,h]anthracene, fluoranthene, methylnaphthalene, phenanthrene, pyrene, and mercury were measured in excess of ISQGs. Sediment concentrations of cobalt, cyanide (free), nickel, and silver were measured in excess of MOECC sediment standards (no CCME guidelines are available). Acetone, toluene, benzo[b/j]fluoranthene, antimony, barium, beryllium, boron, molybdenum, selenium, thallium, uranium, vanadium were detected in analysed samples; however no sediment guidelines are available. PCBs were not detected; however, the detection limit exceeded the ISQG.

Surface water: Cyanide (free) and un-ionized ammonia were measured in excess of surface water guidelines. Acrolein, cadmium, mercury, and selenium were not detected; however, the detection limits exceeded guidelines.

7.1.3 Scope of Ecological Risk Assessment

The ERA uses a combination of qualitative and quantitative approaches. The COCs in soil, groundwater, sediment, and surface water are identified, as described above, based on comparison with applicable guidelines. The components considered in derivation of the guidelines are then examined for their relevance to the VECs. This process qualitatively eliminates many of the COCs as a concern for ecological exposure at the Site. Exposures to the COCs remaining following this screening process are then quantified. Tables 27 to 30 present comparative criteria for the COCs for soil, groundwater, sediment, and surface water, respectively, used to screen the COCs for receptors and exposure pathways relevant to the Site. The results of this comparison are discussed in Section 7.2.

7.2 Problem Formulation

Problem formulation comprises the identification of COCs at the Site, the VECs that may be exposed to those contaminants, the Site-specific exposure pathways, and how the contaminants move through the environment. The conceptual risk model is developed during the problem formulation stage.

7.2.1 Site Characterization

The results of ESAs completed at the Site have identified PHCs, VOCs, PAHs, and inorganic parameters as COCs in soil and/or groundwater. PAHs and inorganic parameters have been identified as COCs in sediment and inorganic parameters have been identified as COCs in surface water. Tables 6, 7, 13, 19, and 24 summarize the maximum measured concentrations of all parameters analysed in samples of surface soil, subsurface soil, groundwater, sediment, and surface water, respectively, and identifies those parameters that exceed guidelines. The locations of the exceedances are presented on Figures 4 to 8. Figures 9a to 9y present the exceedances in soil and groundwater as cross-sections.

7.2.2 Hazard Identification

The maximum measured concentrations of the COCs are presented in Tables 27 to 30 for soil, groundwater, sediment, and surface water, respectively, along with comparative criteria used to screen the COCs for receptors and exposure pathways relevant to the Site. Note that for soil and groundwater, the maximum concentrations are presented separately for locations within 10 m of surface water and more than 10 m from surface water as the CCME guidelines are not applicable within 10 m of surface water. As discussed in Section 1.4, MOECC standards developed for sites adjacent to water bodies are applied within 10 m of surface water. Note, also, that for this initial screening, the soil evaluation does not distinguish between COCs identified in surface soil and subsurface soil; all soil COCs are considered accessible. The results of the screening are as follows:

Soil: The CCME soil quality guidelines for the protection of environmental health are based on consideration of multiple ecological exposure pathways as shown in Table 27. For the current and future use of the Site, the relevant exposure pathways for evaluating exposure to terrestrial VECs are soil contact, soil and food ingestion, and soil nutrient and energy cycling, and the COCs measured in excess of one or more of these components are: PHCs (F3 fraction), anthracene, benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, methylnaphthalene, naphthalene, phenanthrene; methoxychlor; antimony, cadmium, copper, lead, nickel, tin, and zinc. These are the soil COCs carried forward for further evaluation of exposure to terrestrial VECs. The following COCs exceed the aquatic life check components and are evaluated for exposure to aquatic VECs: toluene, xylenes, PHCs (F2 fraction), trichloroethylene, methylnaphthalene, naphthalene, phenanthrene; methoxychlor, DDD; antimony, arsenic, cadmium, copper, lead, nickel, tin, and zinc.

Groundwater: As for soil, the applicable groundwater guidelines are based on consideration of multiple ecological exposure pathways, as shown in Table 28. The following COCs are identified as exceeding guideline values protective of aquatic receptors and require further exposure evaluation: PHCs (F3 and F4 fractions), anthracene, chloride, and iron.

Sediment: VOCs, PAHs, PCBs, and inorganic parameters have been identified as COCs in sediment based on comparison with CCME or MOECC guidelines protective of ecological receptors. Two of the COCs, arsenic and lead, have been measured in excess of the PELs. As a second line of evidence of potential impacts to the aquatic community, AEL undertook a benthic invertebrate survey to determine the health of benthic communities on-site, as well as up-stream. Due to conditions at the time of the survey, a down-stream location could not be surveyed. The results of the survey indicated that it is unlikely that the historical landfill has impacted the benthic invertebrate community in the area of the Old Sly Locks. There is some indication that the area of SED7 is experiencing anthropogenic impacts which are likely unrelated to the presence of the historic landfill.

Surface water: As shown in Table 30, the maximum measured concentrations of the surface water COCs are compared with guidelines relevant to aquatic receptors (CCME FAL, MOECC PWQO, and MOECC aquatic protection values). The maximum measured concentrations of free cyanide and un-ionized ammonia exceed values protective of aquatic receptors and are carried forward for evaluation. Cadmium, mercury, and selenium were not detected and, although the detection limits exceeded the CCME FAL guidelines, they are less than the MOECC aquatic protection values and are not evaluated further. As noted in Section 5.6.2, if acrolein is present (it has not been detected), it is not likely associated with the Site and, therefore, potential exposure to acrolein in surface water is not considered further.

7.2.3 Receptor Identification

Potential terrestrial ecological receptors on the Site include plants, soil invertebrates, mammals and avian species. Aquatic receptors include invertebrates, plants, fish, and turtles.

A Species at Risk (SAR) evaluation for the vicinity of the Old Slys Lockstation Site was completed and is presented in Appendix 6. Sources used were the Ministry of Natural Resources and Forestry Natural Heritage Information Centre (NHIC) interactive mapping site, which shows species that are provincially tracked, and the Department of Fisheries and Oceans SAR mapping website.

Provincially Tracked Species on NHIC Database and Additional Species Considered

Provincially tracked species that have been recorded within approximately 1 km of the Site are listed below. Two of these, Butternut and Gray Ratsnake, are considered federal Species at Risk. Habitat for all these species occurs within the study area. Although habitat for all these species is present on the Site, given the main objective for the ERA is to evaluate potential risks to terrestrial and aquatic ecological receptors due to exposure to the COCs during the proposed construction activities, habitat would be considered for the area of the lock and which would be within the immediate downstream pathway, where disturbed soil or sediment could migrate. Given this objective, habitat would not be present.

Table 7-1 Potential Species at Risk and Provincially Rare Species on the Site

Common Name	Scientific Name	Federal Status	Habitat Elements on Site
Butternut	*Juglans cinerea*	END, Schedule 1	Open woodlands, though rarely in manicured parks; no Butternut noted in site investigations.
Little Brown Myotis	*Myotis lucifugus*	END, Schedule 1	Roosts in buildings and tree cavities.
Northern Myotis	*Myotis septentrionalis*	END, Schedule 1	Roosts in tree cavities.
Western Chorus Frog (Great Lakes-St. Lawrence Population) and other amphibians	*Pseudacris triseriata*	THR, Schedule 1 (Western Chorus Frog); no other amphibian Species at Risk in this area	Western Chorus Frogs have specific habitat preferences for breeding, generally areas with shallow water in flooded shrubby fields and shallow wetlands with abundant emergent vegetation. There is no suitable habitat for this species near the site. Green Frog (not a Species at Risk) would likely be present in the shallow bay east of the site, as they are highly adaptable and are found in most vegetated aquatic

Table 7-1 Potential Species at Risk and Provincially Rare Species on the Site			
Common Name	Scientific Name	Federal Status	Habitat Elements on Site
			environments with permanent water. This area is over 500 m east of the site and around a bend in the river, and it is unlikely that it would be affected by sediment during construction
Gray Ratsnake (Frontenac Axis population)	*Pantherophis spiloides pop. 1*	THR, Schedule 1	Mosaic of forest and open habitat (fields; bedrock outcrops) with a high amount of edge; potential to hibernate in building foundations. The potential for rock wall foundations to support this SAR was examined. These areas are flooded for boat traffic on the inside and due to seepage, were flooded on the land side above surface as well, not offering hospitable environments for snake habitat.
Eastern Musk Turtle	*Sternotherus odoratus*	SC, Schedule 1	It is not likely that Eastern Musk Turtle would inhabit the Rideau River within the range of sediment deposition. The river is fast-flowing near the site, with almost no floating vegetation. Eastern Musk Turtles prefer shallow, slow-moving streams and rivers with muddy bottoms and dense aquatic vegetation. They burrow into pond substrates during overwintering, so they would be exposed to sediment in that case, but they will only overwinter in areas where sediment is sufficient to provide cover for them, and they need oxygen in the

Table 7-1 Potential Species at Risk and Provincially Rare Species on the Site			
Common Name	Scientific Name	Federal Status	Habitat Elements on Site
			water/sediment. They forage on freshwater mussels, snails, crayfish, aquatic insects, worms, small fish, tadpoles, carrion, and aquatic vegetation. These would be likely only found in areas where the water was very slow moving. The aquatic habitat in the Rideau River near the site is appropriate for Eastern Musk Turtle only in the shallow bay downstream of the site (to the east), over 500 m from the site, and around a bend in the river. It appears unlikely that sediment released by the construction would migrate to this area. This species is rare and highly aquatic so there would likely be no information on effect levels available, and no similar species to provide a model
Northern Map Turtle	*Graptemys geographica*	SC, Schedule 1	It is not likely that this species would inhabit the river near the site. The river near the site is fast-flowing. Northern Map Turtle are turtles of slow water. Their overwintering sites are typically deep, oxygen-rich lake or river bottoms that are sheltered from ice, with sand or gravel substrate and varied bottom features, such as exposed ledges, boulders, and tree trunks. They often overwinter in areas of groundwater discharge. This species feeds

Table 7-1 Potential Species at Risk and Provincially Rare Species on the Site			
Common Name	Scientific Name	Federal Status	Habitat Elements on Site
			primarily on molluscs (bivalves, snails); insects and crayfish are also important food sources for the species. The habitat in the vicinity of the construction is not suitable for Map Turtles. This species has not been reported in the Ontario Herpetofaunal Summary in this area. It would be difficult to suggest a species as a surrogate for risk assessment. As a comparison Snapping Turtles (for which there might be more information on effects of contaminants) are omnivores while Northern Map Turtles are carnivores. Snapping Turtles overwinter in pond sediments – but they do not require much oxygen, unlike Northern Map Turtle. Painted Turtles are herbivores so would not be a good surrogate. It is possible that Northern Map Turtles would be somewhere in the Rideau system but the aquatic habitat near the site is appropriate for this species only in one area – the shallow bay downstream of the site (to the east), over 500 m from the site, and around a bend in the river. It is unlikely that sediment released by the construction would migrate to this area.
Barn Swallow	*Hirundo rustica*	THR, Schedule 1	Nests on human buildings and bridges.

Table 7-1 Potential Species at Risk and Provincially Rare Species on the Site			
Common Name	Scientific Name	Federal Status	Habitat Elements on Site
Eastern Whip-poor-will	*Antrostomus vociferus*	THR, Schedule 1	Semi-open or patchy forests, with clearings.
Bridle Shiner	*Notropis bifrenatus*	SC, Schedule 1	Quiet areas of streams and occasionally in lakes. It is usually found where there is an abundance of aquatic vegetation, where it feeds and spawns.
Grass Pickerel	*Esox americanus vermiculatus*	SC, Schedule 1	Warm, slow moving streams, isolated pools of such streams, and shallow bays of lakes.
Eastern Wood-pewee	*Contopus virens*	SC, Schedule 1	Nests in trees in a variety of woodland habitats.

Aquatic Species at Risk mapping

Aquatic Species at Risk mapping indicates two aquatic (fish) Species at Risk, with a status of Special Concern, in the Rideau River upstream and downstream of the Site. However, neither of these species is known to occur within the Site.

7.2.4 Exposure Pathway Identification

COCs at the Site are believed to be due to the presence of buried landfill materials. The soil COCs identified as requiring further evaluation include VOCs, PHCs, PAHs, semi-VOCs, and inorganic parameters and the groundwater COCs requiring further evaluation are PHCs (F3 and F4 fractions), anthracene, chloride, and iron. The COCs may be adsorbed to soil particles and leach from soil to groundwater due to infiltration of precipitation. Operation of the Lockstation causes vertical movement of groundwater in addition to flushing COCs into and out of surface water. VOCs, PAHs, PCBs, and inorganic parameters have been identified as COCs in sediment based on comparison with guidelines protective of ecological receptors and free cyanide and un-ionized ammonia have been identified as COCs in surface water.

Mammals and avian species may be exposed to COCs in soil through incidental soil ingestion and ingestion of impacted food items. Soil invertebrates may be exposed to soil COCs through direct contact, including ingestion. Terrestrial plants may be exposed to soil COCs through direct root contact and root uptake. The COCs in groundwater are identified on the basis of their potential to affect aquatic receptors. Although the roots of vegetation may contact the shallow groundwater at the Site, chemical-specific information to quantify this exposure pathway is generally lacking. Also, mammals and birds may ingest water that occasionally pools at the ground surface. Exposure pathways of aquatic receptors include contact with surface water and sediment by invertebrates, root uptake from surface water and sediment by plants, gill uptake and food ingestion by fish.

7.2.5 Site Conceptual Model

The Site is an island, located within the Rideau River, and is used as parkland. The Site historically operated as a landfill in the mid-1960's, and potential environmental concerns at the Site were identified due to the presence of buried landfill materials. The results of ESAs completed at the Site have identified PHCs, VOCs, PAHs, and inorganic parameters as COCs in soil and/or groundwater. PAHs and inorganic parameters have been identified as COCs in sediment and inorganic parameters have been identified as COCs in surface water.

The objective of the ERA is to evaluate potential risks from exposure of terrestrial and aquatic ecological receptors to the COCs in soil, groundwater, sediment, and surface water and to identify the need for any risk management measures. In addition, the potential impact on the VECs of the proposed construction activities is evaluated.

The entire Site is covered with grasses and trees/shrubs. A gated vehicle access point is located at the southwest corner of the Site and access is not restricted. No change in land use is proposed. Groundwater at the Site is very shallow.

Potential terrestrial ecological receptors on the Site include plants, soil invertebrates, mammals and avian species such as a diversity of trees, shrubs and grasses, earthworms, Meadow Vole; American Robin and Song Sparrow; all of which would be potentially exposed to COCs, at least at certain times of the year. Aquatic receptors include invertebrates, plants, and fish such as Largemouth Bass, Smallmouth Bass, Northern Pike, Lake Trout, Yellow Perch, Black Crappie, Muskellunge, and Walleye. A SAR evaluation identified eight potential SAR and Provincially Rare Species on the Site. However, there is a very low potential for SAR to be exposed to contaminants in soil or groundwater. The one tree species, Butternut, was not noted on the Site. Two bat species and two birds (Barn Swallow and Eastern Wood-pewee), which feed on aerial insects, would likely have a low probability of exposure. The SAR also included one snake species: Gray Ratsnake. The probability that this species is present in areas where soils will be excavated is very low: the soils on the landward side of the lock walls, the only area of potential habitat in areas of contamination, are generally saturated, which makes them unsuitable as snake habitat. In addition, critical habitat is mapped by Environment

Canada only to the south of the Site, though the Ontario Ministry of Natural Resources has records for the 1 km square surrounding the Site. Two aquatic SAR, with a status of Special Concern, were identified in the Rideau River upstream and downstream of the Site; however, neither of these species is known to occur within the Site.

Mammalian and avian species may be exposed to COCs in soil through incidental soil ingestion and ingestion of impacted food items.

Soil invertebrates may be exposed to soil COCs through direct contact, including ingestion. Terrestrial plants may be exposed to soil COCs through direct root contact and root uptake. The COCs in groundwater are identified on the basis of their potential to affect aquatic receptors. Although the roots of vegetation may contact the shallow groundwater at the Site, chemical-specific information to quantify this exposure pathway is generally lacking. Mammalian and avian species may also ingest water that occasionally pools at the ground surface; however, this exposure pathway is likely minor compared with ingestion of food and soil. Exposure pathways of aquatic receptors include contact with surface water and sediment by invertebrates, root uptake from surface water and sediment by plants, gill uptake and food ingestion by fish.

Comparative criteria are used to screen the COCs for exposure pathways relevant to the Site. The results of the screening identified the following soil COCs as requiring further evaluation for terrestrial ecological exposure: PHCs (F3 fraction), anthracene, benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, methylnaphthalene, naphthalene, phenanthrene; methoxychlor; antimony, cadmium, copper, lead, nickel, tin, and zinc. The following soil COCs exceed the aquatic life check components and are evaluated for exposure to aquatic receptors: toluene, xylenes, PHCs (F2 fraction), trichloroethylene, methylnaphthalene, naphthalene, phenanthrene; methoxychlor, DDD; antimony, arsenic, cadmium, copper, lead, nickel, tin, and zinc. The following groundwater COCs are identified as exceeding guideline values protective of aquatic receptors and require further exposure evaluation: PHCs (F3 and F4 fractions), anthracene, chloride, and iron. VOCs, PAHs, PCBs, and inorganic parameters have been identified as COCs in sediment based on comparison with guidelines protective of ecological receptors; two of the COCs (arsenic and lead) have been measured in excess of the PELs. In surface water, free cyanide and un-ionized ammonia exceed values protective of aquatic receptors and are carried forward for evaluation.

The ecological conceptual site model is shown on Figure 10b.

7.3 Receptor Characterization

VECs are resources or environmental features that exhibit one or more of the following attributes: they are important to human populations; have economic and/or social significance; have intrinsic ecological significance; and/or serve as a baseline from which the impacts of development can be evaluated, including changes in management or regulatory policies (CCME, 2006).

A SAR evaluation identified eight potential SAR and Provincially Rare Species on the Site. However, there is a very low potential for SAR to be exposed to contaminants in soil or groundwater. The one tree species, Butternut, was not noted on the Site. Two bat species and two birds (Barn Swallow and Eastern Wood-pewee), which feed on aerial insects, would likely have a low probability of exposure. The SAR also included one snake species: Gray Ratsnake; the critical habitat is mapped by Environment Canada only to the south of the Site, though the Ontario Ministry of Natural Resources has records for the 1 km square surrounding the Site. Two aquatic SAR, with a status of Special Concern, were identified in the Rideau River upstream and downstream of the Site; however, neither of these species is known to occur within the Site.

VECs in the Terrestrial Environment: The Site is used as parkland and terrestrial VECs that are likely to be at the Site include trees, shrubs, grasses, soil invertebrates, mammals, and avian species. Consistent with the approaches of CCME (2006) and MOE (2011c), plants and soil organisms will be protected to preserve their principal ecological functions. Relevant effects-based endpoints used to evaluate whether ecological functions have been affected include reduced plant growth, yield, seed germination or productivity, and reduced growth or fecundity in soil invertebrates.

Mammals and birds selected as VECs in the ERA are consistent with those recommended by the MOE (2011c) for sites used as parkland and are summarized below.

The following typical or common receptors are considered to be present at the Site:

<u>*Soil Invertebrates*</u> - Earthworms are common soil invertebrates. They are in direct contact with soil and ingest soil.

<u>*Mammalian Insectivore*</u> – A short-tailed shrew (*Blarina brevicauda*) is an example of a common species, which feeds on soil invertebrates.

<u>*Mammalian Herbivore (small)*</u> – A meadow vole (*Microtus pennsylvanicus*) is an example of a common, small mammalian herbivore. They live in grassy fields, woodlands and marshes. They consume large amounts of vegetation and are prey to larger mammals (e.g. fox).

<u>*Mammalian Carnivore*</u> – A red fox (*Vulpes vulpes*) is an example of a larger mammalian carnivore. The fox preys on field voles, invertebrates, amphibians, reptiles, fish, and bird's eggs.

<u>*Avian Insectivore*</u> – An American woodcock (*Scolopax minor*) is an example of a sensitive avian ground insectivore. It consumes soil invertebrates and has a high ingestion rate of soil.

Avian Herbivore – A red-winged blackbird (*Agelarius phoeniceus*) is an example of a common herbivorous bird. It consumes grains and seeds.

Avian Carnivore – A red-tailed hawk (*Buteo jamaicensis*) is an example of a larger avian carnivore. It consumes small mammals.

Terrestrial vegetation –trees, ornamental shrubs, grasses.

Exposure parameters for the avian and mammalian species evaluated in the ERA, including body weight, food and soil ingestion rates, are summarized in Table 37.

VECs in the Aquatic Environment: Aquatic receptors include invertebrates, plants, and fish and are assumed to be exposed to COCs in surface water via direct contact and ingestion of food and water.

7.4 Exposure Assessment

The exposure assessment includes an analysis of the pathways through which VECs may be exposed to COCs and an estimate of the levels to which they are exposed.

7.4.1 Pathway Analysis

Ecological receptors may be exposed to the COCs via ingestion, inhalation and dermal contact. The exposure pathways evaluated are described below for terrestrial plants, soil invertebrates, birds, mammals, and aquatic VECs.

Terrestrial plants: Vegetation may be exposed to the soil COCs primarily via uptake through the roots. Roots of sod and ground vegetation do not usually penetrate much more than 150 mm (Craul, 1992). Most roots of trees occur within the upper 1 m of soil. Himelick (1986) reports that as much as 90% of roots of urban trees less than 3 mm in diameter grow in the top 150 mm of soil and most tree species will have 80% of their roots in the upper 300 mm of soil. Contact of roots of vegetation with subsurface soil (more than 1.5 m bgs) is, therefore, considered incomplete. Plants may also be exposed to the soil COCs through deposition of particulate matter on the foliage; however, at most locations, the impacted soil is covered by topsoil and this pathway is likely negligible compared with root uptake. Deposition of particulate matter would typically only be evaluated for a constant long-term source. Effects (if any) from construction activities would be short-term/transient and negligible. Impacted soils should be removed from the Site during construction activities and disposed of as a registered landfill. Groundwater at the Site is shallow (0.64 m bgs) and, therefore, roots of vegetation may also be in contact with impacted groundwater; however, quantitative information with which to evaluate chemical uptake from groundwater is generally lacking. Exposure and risks to terrestrial plants are predicted by comparing COC concentrations in soil with concentrations determined to be acceptable for growing plants. The direct contact component values protective of terrestrial plants and soil invertebrates from CCME Soil Quality Guidelines or MOE (2011c) were used as the screening benchmark.

Soil Invertebrates: Earthworms are often selected as suitable representative species due to their feeding and burrowing behaviour. They move through the soil, providing aeration necessary for the healthy development of plants, and absorb nutrients and contaminants through the skin from direct contact with the soil. Earthworms are important in promoting soil fertility (Efroymson et al., 1997). Through their feeding and burrowing, they break down organic matter and release nutrients. They also improve aeration, drainage, and aggregation of soil and are important in the diet of many higher-level organisms (Efroymson et al., 1997). Earthworms turn over soil from below the surface by expelling their castings at the surface. Large volumes of subsoil can be overturned by this activity. Earthworms typically feed on decaying organic matter and are found mainly within the upper 10 cm to 15 cm of soil. During winter and dry periods, earthworms may burrow to greater depths; however, the fill beneath the topsoil will have less organic matter and will not be used for feeding by earthworms. Earthworms would not likely have contact with the impacted groundwater at the Site. Soil invertebrates may be exposed to soil COCs through direct contact and ingestion; none of the soil COCs are volatile. To assess exposure and risk to soil invertebrates, soil concentrations were compared to concentrations determined to be acceptable for soil invertebrate populations. The direct contact component values protective of terrestrial plants and soil invertebrates from CCME Soil Quality Guidelines or MOE (2011c) were used as the screening benchmark.

Terrestrial Wildlife: Wildlife may be exposed to soil COCs via ingestion of soil and food, inhalation, and dermal contact. None of the soil COCs are volatile and inhalation of particulate matter is likely negligible compared with the ingestion pathways as the Site is mainly covered with topsoil. Also, inhalation toxicity data for mammalian and avian wildlife are limited. Therefore, the inhalation exposure pathway is not considered for terrestrial wildlife. Dermal exposure is generally assumed to be negligible for birds and mammals because feathers on birds and fur on mammals reduce dermal exposure by limiting the contact of skin with chemicals in soil (Sample et al., 1997). Therefore, ingestion of food and soil are the only exposure pathways considered in this ERA for mammalian and avian receptors. Groundwater at the Site is a minimum of 0.64 m bgs and, therefore, contact of mammals or avian species with COCs in groundwater is possible; however, this is considered to be minor compared with ingestion of soil and food.

Aquatic VECs: Aquatic VECs may be exposed to the COCs via direct contact with surface water and ingestion of water and food as a result of leaching of COCs from soil to groundwater and transport of groundwater to surface water. Exposure and risks to aquatic VECs are evaluated by comparison with aquatic protection values. In order to assess potential pathways, a study of the benthic communities was undertaken, to address the health of the benthic invertebrate communities on-site, as compared to those up- and down-stream of the Site. Due to conditions at the time of the survey, a down-stream location could not be surveyed. The results of the survey indicated that it is unlikely that the historical landfill has impacted the benthic invertebrate community in the area of the Old Sly Locks. This suggests that there are limited potential effects on the exposure of Aquatic VECs to COCs. There is some indication that the area of SED7 is experiencing anthropogenic impacts which are likely unrelated to the presence of the historic landfill.

7.4.2 Exposure Estimates

Soil

The soil COCs were screened for evaluation of ecological exposure by comparing the maximum measured concentrations to components of the guidelines, as shown in Table 27. A secondary screening, using relevant components of the CCME soil quality guidelines as well as the MOECC Site Condition Standards was conducted as shown in Table 38. Maximum concentrations in surface soil (the upper 1.5 m) were used for this screening as exposure to soil at greater depths is considered incomplete for all the ecological receptors. For most of the PAHs, the maximum concentrations were measured in a sample collected from a depth of 0 to 3.0 m in 1994; these PAHs are retained for the analysis. As a result of this screening, exposure of the following soil COCs will be further evaluated for plants and soil organisms: PHCs F3 fraction, anthracene, benzo[a]anthracene, benzo[b]fluoranthene, methylnaphthalene, naphthalene, methoxychlor, and zinc. Exposure to mammals and birds will be further evaluated for PHCs F3 fraction, methylnaphthalene, methoxychlor, lead, and zinc.

Terrestrial Wildlife

Exposure of mammalian and avian wildlife to the soil COCs is calculated using the following equation:

$$E_{total} = E_{food} + E_{soil\ ingestion}$$

where:

E_{total}	=	Total exposure (mg/kg/d)
E_{food}	=	Exposure from food consumption (mg/kg/d)
$E_{soil\ ingestion}$	=	Exposure from soil ingestion (mg/kg/d)

Exposure from food consumption is calculated by the following equation:

$$E_{food} = C_{food} \times IR_{food} / BW$$

where:

C_{food}	=	Concentration of COC in food (mg/kg)
IR_{food}	=	Food ingestion rate (kg/d)

BW = Body weight (kg)

Exposure from soil ingestion is calculated by the following equation:

$$E_{soil\ ingestion} = C_{soil} \times IR_{soil} / BW$$

where:
C_{soil} = Concentration of COC in soil (mg/kg)
IR_{soil} = Soil ingestion rate (kg/d)

The COC concentrations in food (vegetation, earthworms, and small mammals) were estimated using the equations in USEPA (2007) as shown in Table 39. The water content of the food items was assumed to be: 85% for vegetation, 84% for earthworms, 68% for small mammals (USEPA, 2007). The exposure parameters for the avian and mammalian receptors are presented in Table 37. Maximum measured concentrations in surface soil were used in the calculations and, although birds and mammals are mobile, 100% of their diet was assumed to be obtained from the Site. The estimated exposures of each soil COC are summarized in Table 40.

Groundwater

The groundwater COCs were screened for evaluation of ecological exposure by comparing the maximum measured concentrations to aquatic protection values, as shown in Table 28. The following groundwater COCs were identified as requiring further evaluation: PHCs (F3 and F4 fractions), anthracene, chloride, and iron.

Sediment

As shown in Table 29, VOCs, PAHs, PCBs, and inorganic parameters have been identified as COCs in sediment based on comparison with guidelines protective of ecological receptors; two of the COCs (arsenic and lead) have been measured in excess of the PELs. A study of the benthic communities was undertaken in November 2017, to address the health of the benthic communities on-Site, as compared to those up- and down-stream of the Site. The study concluded that it is unlikely that the historical landfill has impacted the benthic invertebrate community in the Old Sly Lock area.

Surface Water

As shown in Table 30, free cyanide and un-ionized ammonia were measured in surface water in excess of values protective of aquatic receptors and are carried forward for evaluation.

7.5 Hazard Assessment

Assessment endpoints selected for evaluation are survival, growth, and reproduction. Benchmark concentrations and TRVs selected for use in this ERA for the terrestrial receptors are presented in Table 41.

Plants and Soil Invertebrates: The benchmark concentrations for terrestrial plants and soil invertebrates are the component values protective of plants and soil invertebrates from MOE (2011c).

Avian and Mammalian Wildlife: The TRVs developed in MOE (2011c) were used. For both lead and zinc, the TRVs for the Short-Tailed Shrew, Meadow Vole, and Red Fox are based on laboratory studies of rats and represent chronic lowest observed effect levels (LOELs) for reproduction. For lead, the TRVs for the American Woodcock and Red-Winged Blackbird are based on studies of chickens with a reproduction endpoint and, for the Red-Tailed Hawk, the TRV is based on a no observed effect level (NOEL) for survival and reduced body weight for the American Kestrel. For zinc, the TRVs for the American Woodcock, Red-Winged Blackbird, and Red-Tailed Hawk are based on studies of chickens with a reproduction endpoint.

Aquatic Receptors: The Aquatic Protection Values (APVs) presented in MOE (2011c) were selected as the benchmark concentrations for groundwater, protective of aquatic receptors. Because surface water is adjacent to the Site, no dilution of groundwater was assumed in this calculation, which is very conservative. The APVs represent the lowest toxicity effects-based values for freshwater organisms and are listed in Table 28. APVs are not available for PHCs (F3 and F4 fractions) because MOE (2011c) considers these fractions to be sufficiently insoluble that movement via dissolution in groundwater is not likely to be an operable exposure pathway to aquatic receptors. APVs were also used to evaluate the surface water COCs (Table 30).

7.6 Risk Characterization

Ecological risks are characterized by a dimensionless hazard quotient (HQ) calculated as follows:

Plants and Soil Invertebrates:

$$HQ = C_S / C_B$$

where:

C_S	=	Concentration in soil (ug/g)
C_B	=	Benchmark Concentration (ug/g)

Avian or Mammalian Receptors:

$$HQ = E_{total} / TRV$$

where:

E_{total} = Total estimated exposure (mg/kg/d)
TRV = Toxicological reference value (mg/kg/d)

Aquatic Receptors:

$$HQ = C_{GW} / APV \quad \text{or} \quad HQ = C_{SW} / APV$$

where:
C_{GW} = Concentration in groundwater (ug/L)
C_{SW} = Concentration in surface water (ug/L)
APV = Aquatic protection value (ug/L)

Terrestrial Receptors

The hazard quotients for the terrestrial receptors are presented in Table 42. As shown, the hazard quotient exceeds 1 (the value considered acceptable) for the following receptors and COCs:

- Plants and soil invertebrates: PHCs F3, anthracene, benzo[a]anthracene, naphthalene, and zinc.
- American Woodcock: lead.
- Red-Winged Blackbird: lead and zinc.

Maximum measured concentrations in surface soil were used for these calculations. For anthracene, benzo[a]anthracene, lead, and zinc, the concentrations were determined in 1994 and were measured in a sample collected over a depth of 0 to 3.0 m bgs. Neither anthracene nor benzo[a]anthracene was measured in excess of the applicable guidelines at any other location and, in particular, not in the 2017 ESA. Lead and zinc were each measured in excess of guidelines at six locations. The average concentration of lead in surface soil is 94 ug/g (versus the maximum of 239 ug/g obtained in 1994) and is less than the applicable CCME soil guideline. The average concentration of zinc in surface soil is 330 ug/g and the maximum value measured in the 2017 ESA is 310 ug/g. Using the 2017 maximum for zinc, the HQs for plants and invertebrates are less than 1 and the HQ for the Red-winged blackbird slightly exceeds 1 (value of 1.3).

As shown in Table 42, benchmark concentrations were not available for plants and invertebrates, to evaluate risk to benzo[b]fluoranthene, methylnaphthalene, and methoxychlor. TRVs and/or information to estimate concentrations in food were not available to evaluate risk to avian or mammalian receptors for PHCs F3, methylnaphthalene, and methoxychlor. In the development of the Canada Wide Standards for PHCs, CCME (2008b) notes that a guideline for exposure of livestock and wildlife to PHCs through ingestion of contaminated soil and via food chain-mediated exposure was not calculated due to insufficient available data and the assumption that the bioconcentration/biomagnification of PHCs into livestock and wildlife food items was unlikely to be significant. CCME (2008b) states that it is unlikely this exposure pathway would control risk management decisions at PHC contaminated sites.

Aquatic Receptors:

The hazard quotients for the aquatic receptors are presented in Table 43. As shown, the HQs marginally exceed 1 for anthracene and chloride, but only when based on groundwater samples obtained more than 10 m from surface water. The HQs for groundwater within 10 m of surface water are less than 1, indicating the concentrations of these substances do not present an unacceptable risk to aquatic receptors. The HQ for iron is much greater than 1 (value of 31 for groundwater within 10 m of surface water), suggesting possible adverse effects on aquatic receptors; however, iron was not identified as a surface water COC. The HQs for free cyanide and un-ionized ammonia, based on the maximum measured surface water concentrations marginally exceed 1 (values of 1.2 and 1.8, respectively). Cyanide was measured in surface water at only one location in excess of the applicable guideline (at SW1); this location is upstream of the Site suggesting that the Site is not the source, and work undertaken at the Site does not present an unacceptable risk to aquatic receptors. Un-ionized ammonia was measured at several locations in excess of the guideline, both upstream and downstream of the Site. The locations of exceedances of un-ionized ammonia would suggest that the Site may be a contributing source of un-ionized ammonia, but these impacts are localized, and an additional source is present downstream.

7.6.1 Summary of Risk Characterization

Exposure to the terrestrial VECs, plants, soil invertebrates, mammals and avian species, was evaluated for the pathways of soil contact, root uptake, and ingestion of soil and food. The estimated HQs, using the maximum measured concentrations in surface soil, were less than the allowable value of 1 for all receptors and COCs except: plants and soil invertebrates (PHCs F3, anthracene, benzo[a]anthracene, naphthalene, and zinc); American Woodcock (lead); and Red-Winged Blackbird (lead and zinc). For anthracene, benzo[a]anthracene, lead, and zinc, these maximum concentrations were determined in 1994 and were measured in a sample collected over a depth greater than would be contacted by terrestrial VECs (0 to 3.0 m bgs). Neither anthracene nor benzo[a]anthracene was measured in excess of the applicable guidelines at any other location and, in particular, not in the 2017 ESA. Lead and zinc were each measured in excess of applicable guidelines at six locations. The average concentration of lead in surface soil is less than the applicable CCME soil guideline. For zinc, the 2017 maximum measured surface soil concentration results in HQs for plants and invertebrates less than 1 and, for the Red-winged blackbird, a HQ slightly larger than 1 (value of 1.3). These calculations are considered very conservative as they employ a maximum measured concentration to evaluate exposure to a mobile VEC, who would have a home range beyond the confines of the Site.

Aquatic VECs, including invertebrates, plants, and fish, may be exposed to the COCs via direct contact with surface water and ingestion of water and food. With the exception of iron, HQs for COCs in groundwater within 10 m of surface water are less than 1, indicating the concentrations of these substances do not present an unacceptable risk to aquatic receptors. The HQ for iron in groundwater within 10 m of surface water is much greater than 1 suggesting possible adverse effects on aquatic receptors; however, iron was not identified as a surface water COC. The HQs for free cyanide and un-ionized ammonia, based on the maximum measured surface water concentrations marginally exceeded 1. Cyanide was measured in surface water at only one location in excess of the applicable guideline; this location is upstream of the Site suggesting that the Site is not the source. Un-ionized ammonia was measured at several locations in excess of the guideline, both upstream and downstream of the Site. The locations of exceedances of un-ionized ammonia would suggest that the Site may be a contributing source of un-ionized ammonia, but these impacts are localized, and an additional source is present downstream.

7.6.2 Uncertainties

The types of uncertainties in the foregoing analyses are identified below, along with a discussion of the influence on the results.

Site Characterization: A comprehensive Site investigation program was completed in 2017, which used information obtained in previous Site investigations to select sample locations and included testing of soil, groundwater, sediment, and surface water for a wide range of parameters. The maximum measured concentrations of the COCs in surface soil (the upper 1.5 m where available) were used in the calculations and these concentrations were assumed to be homogeneously distributed across all areas. The maxima for many of the soil COCs were based on the results of the 1994 ESA; these concentrations were assumed to remain constant with time. The use of maximum measured concentrations is very conservative and, for lead and zinc, average concentrations were also used to characterize the risk of exposure.

Exposure Assessment: Equations from the scientific literature were used to predict COC concentrations in food items. These predictions may over- or under-estimate actual concentrations. Equations to predict concentrations of PHCs F3 fraction, methylnaphthalene, and methoxychlor were not identified. It was assumed that all COCs in soil were 100% bioavailable and it was assumed that the mammalian and avian wildlife would only consume food items living and growing on-Site; whereas, it is likely that they would forage throughout a larger area.

1705 Argentia Road, Unit 3 | Mississauga, Ontario, L5N 3A9
Tel/Fax: 416-657-2367 Toll free: 1-800-267-4797
info@aelenv.com | www.aelenv.com

Hazard Assessment: Screening benchmarks, derived by regulatory agencies, were employed for soil invertebrates and plants. These benchmarks are intended to be conservative and are used to identify the potential for adverse effects. Benchmark concentrations were not available for benzo[b]fluoranthene, methylnaphthalene, or methoxychlor. The TRVs for mammalian and avian wildlife are based on limited available data and are derived based on species-to-species extrapolation. These TRVs may over- or under-estimate risk. TRVs were lacking for PHCs F3 fraction and methylnaphthalene.

Risk Characterization: Risks predicted in this ERA apply to individual organisms, whereas the assessment endpoint for the ERA is the protection of populations and communities of wildlife, plants and invertebrates.

7.7 Recommendations

7.7.1 Additional Data Collection Requirements

As part of the benthic invertebrate study, the location of SED10 was originally chosen to be sampled, as a downstream control; however, this location was found to be frozen over at the time of sampling, so SED7 was selected for sampling instead, as flow was typical of that sampled in CABIN reference datasets. If a future benthic invertebrate study is undertaken, a down-stream control should be included, and sampling be undertaken at a time when freezing conditions are not occurring.

7.7.2 Recommended Risk Management Measures

The results of the ERA suggest the possibility of some adverse effects on plants and soil invertebrates in the vicinity of MW10/17, due to the presence of naphthalene in surface soil. The results of the ERA do not indicate that risk management measures are required for the protection of terrestrial VECs due to exposure to the remaining identified COCs in soil. It is recommended that the surface soils in the vicinity of MW10/17 be excavated as part of the construction activities on-site, and closure samples from the sidewalls and floor of the excavation taken to confirm the concentration of naphthalene in surface soil meets the CCME Soil Quality Guidelines applicable to the Site. Soil that is removed during construction should be transported off site to a registered landfill.

The results of the benthic invertebrate survey indicated that it is unlikely that the historical landfill has impacted the benthic invertebrate community in the area of the Old Sly Locks, and as such risk management measures are not required for the protection of aquatic VECs due to exposure to identified COCs in surface water and sediment. There is some indication that the area of SED7 is experiencing anthropogenic impacts which are likely unrelated to the presence of the historic landfill.

1705 Argentia Road, Unit 3 | Mississauga, Ontario, L5N 3A9
Tel/Fax: 416-657-2367 Toll free: 1-800-267-4797
info@aelenv.com | www.aelenv.com

8. Conclusions and Recommendations

Based on the analysis undertaken at the Site, impacts in soil, groundwater, sediment and surface water at the Site likely occurred, at least in part, due to the historical placement of fill. Historical records indicate the Old Sly Lock was built in the mid-1800's. Construction activities caused the formation of an Island south of the Lock. Infill of the Island likely took place from the creation of the Island onwards, but the Site also acted as a landfill for the town between 1965 and 1966. Due to the absence of a competent cap material over the landfill portion of the Site, and the deteriorating condition of the lock, precipitation and water seeping through the lock onto the Site are contributing to ongoing impacts in groundwater, surface water and sediment on-Site, and are likely impacting off-Site media down-stream.

Groundwater, surface water and sediment sampling undertaken both on- and off-Site indicate that off-Site sources up-stream of the Site (to the west) may be a contributing factor to on-Site impacts. Historical records indicate that Lower Reach Park, located to the southwest of the Site, was also historically used as a landfill site, at the same time as the Site, in the mid-1960's, and the Site may be impacted to some degree by the Lower Reach Park historic landfill.

The conclusions and recommendations of the DQ HHERA are based upon the following assumptions:

- The current and future use of the Site is for parkland purposes and there are no buildings on the Site.
- The Site is an island, surrounded by surface water.
- The Site is located in a non-potable groundwater area.
- The human receptors potentially exposed to the COCs at the Site are members of the public of all ages using the park or the Lockstation; long-term and short-term workers operating the Lockstation or completing routine maintenance of the Site; and construction workers completing the proposed construction activities.
- The exposure pathways for the human receptors are incidental ingestion of soil, dermal contact with soil, inhalation of particulate matter, incidental ingestion of groundwater, and dermal contact with groundwater.
- Terrestrial VECs include plants, soil invertebrates, mammals and avian species. Aquatic VECs include invertebrates, plants, and fish.
- The primary exposure pathways for terrestrial VECs are contact with soil, root uptake, and ingestion of soil and food. Aquatic VECs may be exposed to the COCs via direct contact with surface water and ingestion of water and food.

The conclusions of the HHRA are that, for chemicals having threshold effects, the estimated HQs using the maximum measured concentrations were less than the allowable level for all COCs and receptors/pathways, with the exception of incidental ingestion of groundwater and dermal contact with groundwater containing PHCs for all receptors and incidental ingestion of soil and dermal contact with soil containing lead for the toddler. Use of average concentrations in the calculations results in HQs less than the allowable level, except for exposure of the Long-term worker and the Construction worker to PHCs in groundwater. These calculations are considered very conservative because of the high frequency and duration of exposure assumed and, for PHCs, they incorporate an anomalous measurement in one sample; if this anomalous result were omitted from the average concentration calculation and only the duplicate sample result was included, the HQ is less than the allowable level for the Long-term worker. For the Construction worker, the estimated HQ due to contact with groundwater containing PHCs exceeds the allowable level and Health and Safety measures to limit contact are recommended (i.e., wearing of pants, long sleeves, and gloves). For chemicals having non-threshold effects, the calculated incremental lifetime cancer risks are less than the allowable level for all COCs and receptors/pathways.

The conclusions of the ERA are that the estimated HQs, using the maximum measured concentrations in surface soil, were less than the allowable value for all receptors and COCs except: plants and soil invertebrates (PHCs F3, anthracene, benzo[a]anthracene, naphthalene, and zinc); American Woodcock (lead); and Red-Winged Blackbird (lead and zinc). For anthracene, benzo[a]anthracene, lead, and zinc, these maximum concentrations were determined in 1994 and were measured in a sample collected over a depth greater than would be contacted by terrestrial VECs. Neither anthracene nor benzo[a]anthracene was measured in excess of the applicable guidelines at any other location and, in particular, not in the 2017 ESA. Lead and zinc were each measured in excess of applicable guidelines at six locations. The average concentration of lead in surface soil is less than the applicable CCME soil guideline. For zinc, the 2017 maximum measured surface soil concentration results in HQs for plants and invertebrates less than 1 and, for the Red-winged blackbird, a HQ slightly larger than 1. These calculations are considered very conservative as they employ a maximum measured concentration to evaluate exposure to a mobile VEC, who would have a home range beyond the confines of the Site.

For the aquatic VECs, with the exception of iron, the HQs for COCs in groundwater within 10 m of surface water are less than the allowable level, indicating the concentrations of these substances do not present an unacceptable risk to aquatic receptors. The HQ for iron in groundwater within 10 m of surface water is much greater than 1 suggesting possible adverse effects on aquatic receptors; however, iron was not identified as a surface water COC. The HQs for free cyanide and un-ionized ammonia, based on the maximum measured surface water concentrations marginally exceeded the allowable level. Cyanide was measured in surface water at only one location in excess of the applicable guideline; this location is upstream of the Site suggesting that the Site is not the source. Un-ionized ammonia was measured at several locations in excess of the guideline, both upstream and downstream of the Site.

The results of the HHRA indicate that risk management measures are not required for the protection of site visitors or Long-term workers due to exposure to the identified COCs in soil, groundwater, surface water, or sediment. For Construction workers, typical Health and Safety measures (i.e., the wearing of pants, long sleeves, and gloves) are recommended to limit dermal contact with groundwater containing PHCs; no risk management measures are required for the other COCs/exposure pathways.

Personal Protective Equipment (PPE), above the ministry of labour mandated construction site PPE, should be worn by the following workers on site:

- Construction workers who come into contact with subsurface groundwater should wear gloves, long pants, and sleeves to minimize dermal contact with groundwater in areas containing PHCs.
- Construction workers acting as divers contacting sediment during repairs should wear a wet suit while submerged in the lock water body to minimize dermal contact with sediment.

The results of the ERA suggest the possibility of some adverse effects on plants and soil invertebrates in the vicinity of MW10/17, due to the presence of naphthalene in surface soil. The results of the ERA do not indicate that risk management measures are required for the protection of terrestrial VECs due to exposure to the remaining identified COCs in soil. It is recommended that the surface soils in the vicinity of MW10/17 be excavated as part of the construction activities on-site, disposed of at a registered disposal site, and closure samples from the sidewalls and floor of the excavation be taken to confirm the concentration of naphthalene in surface soil meets the CCME Soil Quality Guidelines applicable to the Site.

The results of the benthic invertebrate survey indicated that it is unlikely that the historical landfill has impacted the benthic invertebrate community in the area of the Old Sly Locks, and as such risk management measures are not required for the protection of aquatic VECs due to exposure to identified COCs in surface water and sediment. There is some indication that the area of SED7 is experiencing anthropogenic impacts which are likely unrelated to the presence of the historic landfill.

9. Site Closure Tool Evaluation

The Site Closure Tool (SCT) was completed for the Site. Results can be viewed in Appendix 7. The Site status remains active, due to the need for a Remedial/Risk Management Plan and Remedial Action.

10. Signatures

10.1 Closure

AEL are of the opinion the work and report above, as implemented by AEL with the assistance of the client, meets the applicable requirements for a Phase II ESA, to the extent deemed reasonable and applicable in our sole engineering judgment and met the sampling plan requirements. AEL notes that the work represents a fulfillment of the requirements. Areas of the Site not sampled or explored between the test holes may vary significantly and may contain important issues not identified by the work to date. None of the work completed by AEL shall be taken to mean the Site is or is not suitable for any purpose. AEL will not be responsible for loss or gain of value of the Site due to the findings or opinions expressed in the report, those losses or gains belonging solely to the owner or to others.

10.2 Limitations

The present work is for the sole use of AEL and the client. Others with an interest in the Site such as owners, contractors, purchasers, etc., must undertake their own investigations respecting the Site, and are advised that the work is to the terms of reference only. Neither AEL nor the client warrant or represent the report has found, detected or reported on all site conditions or site environmental conditions. The limitations (Appendix 8) shall apply.

AELenvironment
A division of Aeon Egmond Ltd.

Charna Kozole, P. Eng.

Senior Engineer

Paul Wilson, P. Eng., Project Manager

Principal

11. References

AEL environment used or considered the following materials respecting the work reported herein:

1. Agency for Toxic Substances and Disease Registry (ATSDR). 2005. Toxicological Profile for Tin and Tin Compounds. US Department of Health and Human Services, Atlanta, GA. August.

2. Canadian Council of Ministers of the Environment (CCME). 1999. Canadian soil quality guidelines for the protection of environmental and human health: Summary tables. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg, MB.

3. CCME. 1999. Canadian water quality guidelines for the protection of aquatic life: Summary tables. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg, MB.

4. CCME. 2001. Canadian sediment quality guidelines for the protection of aquatic life: Summary tables. Updated. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg, MB.

5. CCME. 2006. A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines. PN1332, Winnipeg, MB.

6. CCME. 2008a. Canada-Wide Standard for Petroleum Hydrocarbons (PHC) in Soil – User Guidance. PN1398, Winnipeg, MB. January.

7. CCME. 2008b. Canada-Wide Standard for Petroleum Hydrocarbons (PHC) in Soil – Technical Supplement. Winnipeg, MB. January.

8. CCME. 2010. Canadian soil quality guidelines for the protection of environmental and human health: Polycyclic Aromatic Hydrocarbons. Winnipeg, MB.

9. CCME. 2015. Canadian soil quality guidelines for the protection of environmental and human health: Nickel. Winnipeg, MB.

10. Chapman & Putnam. *The Physiography of Southern Ontario*. 1966.

11. Craul, P.J. 1992. Urban Soil in Landscape Design. John Wiley & Sons, Inc., New York.

12. Edwards, D.A., M.D. Androit, M.A. Amoruso, A.C. Tummey, C.J. Bevan, A. Tveit, L.A. Hayes, S.H. Youngren and D.V. Nakles. 1997. Development of Fraction- Specific Reference Doses (RfDs) and Reference Concentrations (RfCs) for Total Petroleum Hydrocarbons (TPH). Volume 4 of the Total Petroleum Hydrocarbon Criteria Working Group Series, Amherst Scientific Publishers, Amherst, MA. 137p.

13. Environment Canada. 2012. Federal Contaminated Sites Action Plan (FCSAP) Ecological Risk Assessment Guidance. Ottawa, ON.

14. Efroymson, R.A., M.E. Will, G.W. Suter II. 1997. Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision. Lockheed Martin Energy Systems Inc., Oak Ridge, TN. ES/ER/TM-126/R2. November.

15. Government of Canada. 2012. Federal Contaminated Sites Action Plan (FCSAP) Guidance Document on Federal Interim Groundwater Quality Guidelines for Federal Contaminated Sites. May 2010. Table 2 Generic Guidelines for Residential/Parkland Land Use, Tier 1, Coarse Soil.

16. Health Canada. 1992. Guidelines for Canadian Drinking Water Quality: Guideline Technical Document – Lead. Ottawa, ON.

17. Health Canada. 1999. Guidelines for Canadian Drinking Water Quality: Guideline Technical Document – Antimony. Ottawa, ON.

18. Health Canada. 2004. Federal Contaminated Site Risk Assessment in Canada, Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA). Environmental Health Assessment Services, Safe Environments Programme. Ottawa, ON. September.

19. Health Canada. 2010a. Federal Contaminated Site Risk Assessment in Canada, Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA), Version 2.0. Ottawa, ON.

20. Health Canada. 2010b. Federal Contaminated Site Risk Assessment in Canada, Part II: Health Canada Toxicological Reference Values (TRVs) and Chemical-Specific Factors, Version 2.0. Ottawa, ON.

21. Health Canada. 2010c. Federal Contaminated Site Risk Assessment in Canada, Part V: Guidance on Human Health Detailed Quantitative Risk Assessment for Chemicals (DQRAChem). Ottawa, ON.

22. Health Canada. 2013. Guidelines for Canadian Drinking Water Quality: Guideline Technical Document –Ammonia. Ottawa, ON.

23. Himelick, E.B. 1986. Root development of trees growing in an urban environment. Illinois Natural History Survey Report No. 262, December.

24. Ontario Ministry of the Environment (MOE). 2011a. O. Reg 153, as amended Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act. April 15, 2011.

25. Ontario Ministry of the Environment (MOE). 2011b. Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act. April 15.

26. Ontario Ministry of the Environment (MOE). 2011c. Rationale for the Development of Soil and Ground Water Standards for Use at Contaminated Sites in Ontario. Standards Development Branch. Toronto, ON. April 15.

27. Ontario Ministry of Environment and Energy (MOEE). 1999. Provincial Water Quality Objectives. 1994.

28. Ontario Ministry of Natural Resources and Forestry (MNRF).

29. Risk Assessment Information System (RAIS). 2017. Online database, available at: http://rais.ornl.gov/ (accessed November 20, 2017).

30. Sample, B.E., M.S. Aplin, R.A. Efroymson, G.W. Suter II, and C.J.E. Welsh. 1997. Methods and tools for estimation of the exposure of terrestrial wildlife to contaminants. Oak Ridge National Laboratory Oak Ridge TN. ORNL/TM-13391.

31. United States Environmental Protection Agency (US EPA). 2004. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment, OSWER 9285.7-02EP), Washington, DC.

32. USEPA. 2007. Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs), Attachment 4-1, Exposure Factors and Bioaccumulation Models for Derivation of Wildlife Eco-SSLs. OSWER Directive 9285.7-55.

33. USEPA. Integrated Risk Information System (IRIS). Various dates. Available online: www.epa.gov/iris

34. Virginia Department of Environmental Quality (VDEQ). 2016. Voluntary Remediation Program Risk Assessment Guidance.

35. Selected Topographical Maps.

36. Ontario Geological Survey (OGS). Selected Geological and Soils Maps.

37. Site plans and reports supplied by client.

Table 1 - BTEX and PHC in Soil

Location			MW5/17		MW7/17		MW8/17	MW9/17		MW10/17		CCME Residential/ Parkland Property Use Surface Soil	CCME Residential/ Parkland Property Use Subsurface Soil	MOECC Table 9*
Sample ID			A0241	A0244	A0215	A0217	A0235	A0252	A0255	A219	A0221			
Sample Date			2017-08-31	2017-08-31	2017-08-30	2017-08-30	2017-08-30	2017-08-31	2017-08-31	2017-08-30	2017-08-30			
Sample Time			8:26:00 AM	8:34:00 AM	9:40:00 AM	9:54:00 AM	2:38:00 PM	10:00:00 AM	10:15:00 AM	11:04:00 AM	11:12:00 AM			
Depth (m)		From	0.00	3.05	0.76	3.05	1.52	0.76	3.05	0.76	3.05			
		To	0.76	3.35	1.52	3.81	3.05	1.52	4.11	1.22	3.81			
Chemicals	Units	RDL	Results	Results	Results	Results	Results	Results	Results	Results	Results			
Analysis Date			2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08			
Benzene	µg/g	0.006	<0.006	0.014	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	0.03	0.03	0.02
Ethylbenzene	µg/g	0.01	<0.01	0.034	<0.01	<0.01	0.048	<0.01	<0.01	0.44	0.24	0.082	0.082	0.05
Toluene	µg/g	0.02	<0.02	0.045	<0.02	<0.02	0.72	<0.02	<0.02	0.024	<0.02	0.37	0.37	0.2
o-Xylene	µg/g	0.02	<0.02	0.058	<0.02	<0.02	0.053	<0.02	<0.02	2.3	1.2			
p+m-Xylene	µg/g	0.02	0.022	1.2	<0.02	<0.02	0.48	<0.02	<0.02	2.7	1.6	11	11	0.05
Xylene (Total)	µg/g	0.02	0.022	1.3	<0.02	<0.02	0.53	<0.02	<0.02	5	2.8			
F1 (C6-C10)	µg/g	10	<10	<10	<10	<10	<10	<10	<10	20	12	30	30	25
F1 (C6-C10) - BTEX	µg/g	10	<10	<10	<10	<10	<10	<10	<10	15	<10			
Analysis Date			2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	-	-	
F2 (C10-C16 Hydrocarbons)	µg/g	10	<10	79	<10	<10	110	<10	<10	130	74	150	150	10
F3 (C16-C34 Hydrocarbons)	µg/g	50	<50	1400	140	130	1400	<50	<50	520	170	300	2500	240
F4 (C34-C50 Hydrocarbons)	µg/g	50	<50	1700	95	190	530	<50	<50	190	110	2800	10000	120
Reached Baseline at C50		-	Yes	No	No	No	No	Yes	Yes	No	No	-	-	
Analysis Date			-	2017-09-09	2017-09-09	2017-09-09	2017-09-09	-	-	2017-09-09	2017-09-09	-	-	
F4G-sg (Grav. Heavy Hydrocarbons)	µg/g	100	-	7300	390	560	1500	-	-	440	240	2800	10000	120
Analysis Date			2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	-	-	
Moisture	%	1.0	15	29	21	17	32	6	17	27	25	-	-	

BTEX - Benzene, Toluene, Ethylbenzene, Xylenes

*MOECC Table 9 used within 10m of surface water

PHC - Petroleum Hydrocarbons

RDL - Result Detection Limit

CCME - Canadian Council of Ministers of the Environment, Soil Quality Guidelines for the Protection of Environmental and Human Health, 1991 - 2015

MOECC Table 9 - Ministry of Environment and Climate Change, Soil, Ground Water And Sediment Standards For Use Under Part XV.1 of the Environmental Protection Act, Table 9 Generic Site Condition Standards for Use within 30 m of a Water Body in a Non-Potable Groundwater Condition, 2011

Results above applicable Standard or Guideline

Table 1 - BTEX and PHC in Soil, cont

Location			BH11/17		BH12/17		BH13/17			POND	CCME Residential/ Parkland Property Use Surface Soil	CCME Residential/ Parkland Property Use Subsurface Soil	MOECC Table 9*
Sample ID			A0228	A0229	A0223	A0224	A0230	A0232	A233 DUP of A0230	A0256			
Sample Date			2017-08-30	2017-08-30	2017-08-30	2017-08-30	2017-08-30	2017-08-30	2017-08-30	2017-08-31			
Sample Time			1:36:00 PM	1:48:00 PM	1:08:00 PM	1:19:00 PM	2:10:00 PM	2:25:00 PM	2:12:00 PM	8:00:00 AM			
Depth (m)		From	1.52	3.05	0.76	1.52	0.00	3.05	0.00	0.00			
		To	3.05	4.57	1.52	3.05	1.52	4.57	1.52	0.20			
Chemicals	Units	RDL	Results	Results	Results	Results	Results	Results	Results	Results			
Analysis Date			2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08			
Benzene	µg/g	0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	0.03	0.03	0.02
Ethylbenzene	µg/g	0.01	0.01	0.011	<0.01	<0.01	<0.01	0.015	<0.01	<0.01	0.082	0.082	0.05
Toluene	µg/g	0.02	0.03	0.024	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	0.37	0.37	0.2
o-Xylene	µg/g	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02			
p+m-Xylene	µg/g	0.02	0.08	0.07	0.026	0.11	<0.02	0.048	<0.02	<0.02	11	11	0.05
Xylene (Total)	µg/g	0.02	0.08	0.07	0.026	0.11	<0.02	0.048	<0.02	<0.02			
F1 (C6-C10)	µg/g	10	<10	<10	<10	<10	<10	<10	<10	<10	30	30	25
F1 (C6-C10) - BTEX	µg/g	10	<10	<10	<10	<10	<10	<10	<10	<10			
Analysis Date			2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	-	-	
F2 (C10-C16 Hydrocarbons)	µg/g	10	<10	32	<10	<10	<10	11	<10	13	150	150	10
F3 (C16-C34 Hydrocarbons)	µg/g	50	100	620	150	210	<50	410	<50	76	300	2500	240
F4 (C34-C50 Hydrocarbons)	µg/g	50	65	370	68	68	<50	78	<50	<50	2800	10000	120
Reached Baseline at C50		-	No	No	No	No	Yes	No	Yes	Yes	-	-	
Analysis Date			2017-09-09	2017-09-09	2017-09-09	2017-09-09	-	2017-09-09	-	-	-	-	
F4G-sg (Grav. Heavy Hydrocarbons)	µg/g	100	340	1000	<100	170	-	<100	-	-	2800	10000	120
Analysis Date			2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	-	-	
Moisture	%	1.0	24	25	18	20	19	24	27	41	-	-	

BTEX - Benzene, Toluene, Ethylbenzene, Xylenes

*MOECC Table 9 used within 10m of surface water

PHC - Petroleum Hydrocarbons

RDL - Result Detection Limit

CCME - Canadian Council of Ministers of the Environment, Soil Quality Guidelines for the Protection of Environmental and Human Health, 1991 - 2015

MOECC Table 9 - Ministry of Environment and Climate Change, Soil, Ground Water And Sediment Standards For Use Under Part XV.1 of the Environmental Protection Act, Table 9 Generic Site Condition Standards for Use within 30 m of a Water Body in a Non-Potable Groundwater Condition, 2011

Results above applicable Standard or Guideline

Table 2 - VOCs In Soil

Location			MW5/17		MW7/17		MW8/17	MW9/17		MW10/17		CCME Residential/ Parkland Property Use Surface Soil	CCME Residential/ Parkland Property Use Subsurface Soil	MOECC Table 9*
Sample ID			A0241	A0244	A0215	A0217	A0235	A0252	A0255	A219	A0221			
Sample Date			2017-08-31	2017-08-31	2017-08-30	2017-08-30	2017-08-30	2017-08-31	2017-08-31	2017-08-30	2017-08-30			
Sample Time			8:26:00 AM	8:34:00 AM	9:40:00 AM	9:54:00 AM	2:38:00 PM	10:00:00 AM	10:15:00 AM	11:04:00 AM	11:12:00 AM			
Depth (m)		From	0.00	3.05	0.76	3.05	1.52	0.76	3.05	0.76	3.05			
		To	0.76	3.35	1.52	3.81	3.05	1.52	4.11	1.22	3.81			
Chemicals	Units	RDL	Results	Results	Results	Results	Results	Results	Results	Results	Results			
Analysis Date			2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08			
Acetone (2-Propanone)	µg/g	0.5	<0.5	0.54	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	16¹	NV	0.5
Benzene	µg/g	0.006	<0.006	0.014	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	0.03	0.03	0.02
Bromodichloromethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NV	NV	0.05
Bromoform	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NV	NV	0.05
Bromomethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NV	NV	0.05
Carbon Tetrachloride	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	5	5	0.05
Chlorobenzene	µg/g	0.05	<0.05	0.35	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	1	1	0.05
Chloroform	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	5	5	0.05
Dibromochloromethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NV	NV	0.05
1,2-Dichlorobenzene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	1	1	0.05
1,3-Dichlorobenzene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	1	1	0.05
1,4-Dichlorobenzene	µg/g	0.05	<0.05	0.12	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	1	1	0.05
Dichlorodifluoromethane (FREON 12)	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NV	NV	0.05
1,1-Dichloroethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	5	5	0.05
1,2-Dichloroethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	5	5	0.05
1,1-Dichloroethylene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	5	5	0.05
cis-1,2-Dichloroethylene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	5	5	0.05
trans-1,2-Dichloroethylene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	5	5	0.05
1,2-Dichloropropane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	5	5	0.05
cis-1,3-Dichloropropene	µg/g	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	5	5	0.05
trans-1,3-Dichloropropene	µg/g	0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04			
Ethylbenzene	µg/g	0.01	<0.01	0.034	<0.01	<0.01	0.048	<0.01	<0.01	0.44	0.24	0.082	0.082	0.05
Ethylene Dibromide	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NV	NV	0.05
Hexane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.49	0.49	0.05
Methyl Ethyl Ketone (2-Butanone)	µg/g	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NV	NV	0.5
Methyl Isobutyl Ketone	µg/g	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NV	NV	0.5
Methyl t-butyl ether (MTBE)	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NV	NV	0.05
Methylene Chloride(Dichloromethane)	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	5	5	0.05
Styrene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	5	5	0.05
1,1,1,2-Tetrachloroethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NV	NV	0.05
1,1,2,2-Tetrachloroethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	5	5	0.05
Tetrachloroethylene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.2	0.2	0.05
Toluene	µg/g	0.02	<0.02	0.045	<0.02	<0.02	0.72	<0.02	<0.02	0.024	<0.02	0.37	0.37	0.2
1,1,1-Trichloroethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NV	NV	0.05
1,1,2-Trichloroethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	5	5	0.05
Trichloroethylene	µg/g	0.01	<0.01	0.047	<0.01	<0.01	0.011	<0.01	<0.01	<0.01	<0.01	0.01	0.01	0.05
Trichlorofluoromethane (FREON 11)	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NV	NV	0.25
Vinyl Chloride	µg/g	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	NV	NV	0.02
o-Xylene	µg/g	0.02	<0.02	0.058	<0.02	<0.02	0.053	<0.02	<0.02	2.3	1.2	11	11	0.05
p+m-Xylene	µg/g	0.02	0.022	1.2	<0.02	<0.02	0.48	<0.02	<0.02	2.7	1.6			
Xylene (Total)	µg/g	0.02	0.022	1.3	<0.02	<0.02	0.53	<0.02	<0.02	5	2.8			
Analysis Date			2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	-	-	-
Moisture	%		15	29	21	17	32	6	17	27	25	-	-	-

VOC - Volatile Organic Compounds

RDL - Result Detection Limit

NV - No Value

CCME - Canadian Council of Ministers of the Environment, Soil Quality Guidelines fort he Protection of Environmental and Human Health, 1991 - 2015

MOECC Table 9 - Ministry of Environment and Climate Change, Soil, Ground Water And Sediment Standards For Use Under Part XV.1 of the Environmental Protection Act, Table 9 Generic Site Condition Standards for Use within 30 m of a Water Body in a Non-Potable Groundwater Condition, 2011

*MOECC Table 9 used within 10m of surface water

¹MOECC Table 3 used due to CCME NV

Results above applicable Standard or Guideline

Table 2 - VOCs In Soil, cont

Location			BH11/17		BH12/17		BH13/17			POND	CCME Residential/ Parkland Property Use Surface Soil	CCME Residential/ Parkland Property Use Subsurface Soil	MOECC Table 9*
Sample ID			A0228	A0229	A0223	A0224	A0230	A0232	A233 DUP of A0230	A0256			
Sample Date			2017-08-30	2017-08-30	2017-08-30	2017-08-30	2017-08-30	2017-08-30	2017-08-30	2017-08-31			
Sample Time			1:36:00 PM	1:48:00 PM	1:08:00 PM	1:19:00 PM	2:10:00 PM	2:25:00 PM	2:12:00 PM	8:00:00 AM			
Depth (m)		From	1.52	3.05	0.76	1.52	0.00	3.05	0.00	0.00			
		To	3.05	4.57	1.52	3.05	1.52	4.57	1.52	0.20			
Chemicals	Units	RDL	Results	Results	Results	Results	Results	Results	Results	Results			
Analysis Date			2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08			
Acetone (2-Propanone)	µg/g	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.57	16[1]	NV	0.5
Benzene	µg/g	0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	0.03	0.03	0.02
Bromodichloromethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NV	NV	0.05
Bromoform	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NV	NV	0.05
Bromomethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NV	NV	0.05
Carbon Tetrachloride	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	5	5	0.05
Chlorobenzene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	1	1	0.05
Chloroform	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	5	5	0.05
Dibromochloromethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NV	NV	0.05
1,2-Dichlorobenzene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	1	1	0.05
1,3-Dichlorobenzene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	1	1	0.05
1,4-Dichlorobenzene	µg/g	0.05	0.06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	1	1	0.05
Dichlorodifluoromethane (FREON 12)	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NV	NV	0.05
1,1-Dichloroethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	5	5	0.05
1,2-Dichloroethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	5	5	0.05
1,1-Dichloroethylene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	5	5	0.05
cis-1,2-Dichloroethylene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	5	5	0.05
trans-1,2-Dichloroethylene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	5	5	0.05
1,2-Dichloropropane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	5	5	0.05
cis-1,3-Dichloropropene	µg/g	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	5	5	0.05
trans-1,3-Dichloropropene	µg/g	0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04			
Ethylbenzene	µg/g	0.01	0.01	0.011	<0.01	<0.01	<0.01	0.015	<0.01	<0.01	0.082	0.082	0.05
Ethylene Dibromide	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NV	NV	0.05
Hexane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.49	0.49	0.05
Methyl Ethyl Ketone (2-Butanone)	µg/g	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NV	NV	0.5
Methyl Isobutyl Ketone	µg/g	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NV	NV	0.5
Methyl t-butyl ether (MTBE)	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NV	NV	0.05
Methylene Chloride(Dichloromethane)	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	5	5	0.05
Styrene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	5	5	0.05
1,1,1,2-Tetrachloroethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NV	NV	0.05
1,1,2,2-Tetrachloroethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	5	5	0.05
Tetrachloroethylene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.2	0.2	0.05
Toluene	µg/g	0.02	0.03	0.024	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	0.37	0.37	0.2
1,1,1-Trichloroethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NV	NV	0.05
1,1,2-Trichloroethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	5	5	0.05
Trichloroethylene	µg/g	0.01	<0.01	0.48	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	0.05
Trichlorofluoromethane (FREON 11)	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NV	NV	0.25
Vinyl Chloride	µg/g	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	NV	NV	0.02
o-Xylene	µg/g	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	11	11	0.05
p+m-Xylene	µg/g	0.02	0.08	0.07	0.026	0.11	<0.02	0.048	<0.02	<0.02			
Xylene (Total)	µg/g	0.02	0.08	0.07	0.026	0.11	<0.02	0.048	<0.02	<0.02			
Analysis Date			2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	-	-	-
Moisture	%		24	25	18	20	19	24	27	41	-	-	-

VOC - Volatile Organic Compounds

*MOECC Table 9 used within 10m of surface water

RDL - Result Detection Limit

NV - No Value

CCME - Canadian Council of Ministers of the Environment, Soil Quality Guidelines fort he Protection of Environmental and Human Health, 1991 - 2015

MOECC Table 9 - Ministry of Environment and Climate Change, Soil, Ground Water And Sediment Standards For Use Under Part XV.1 of the Environmental Protection Act, Table 9 Generic Site Condition Standards for Use within 30 m of a Water Body in a Non-Potable Groundwater Condition, 2011

Results above applicable Standard or Guideline

Table 3 - Metals and Inorganics in Soil

Location			MH5/17		MW7/17			MW8/17	MW9/17		CCME Residential/ Parkland Property Use	MOECC Table 9*
Sample ID			A0241	A0245	A0215	A0216	A0217	A0234	A0254	A0251		
Sample Date			2017-08-31	2017-08-31	2017-08-30	2017-08-30	2017-08-30	2017-08-30	2017-08-31	2017-08-31		
Sample Time			8:26:00 AM	8:34:00 AM	9:40:00 AM	9:48:00 AM	9:54:00 AM	2:30:00 PM	10:10:00 AM	10:00:00 AM		
Depth (m)		From	0.00	3.35	0.76	1.52	3.05	1.52	2.29	0.00		
		To	0.76	3.66	1.52	3.05	3.81	3.05	3.05	0.76		
Chemicals	Units	RDL	Results	Results	Results	Results	Results	Results	Results	Results		
Analysis Date			2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08		
Acid Extractable Antimony (Sb)	µg/g	0.2	0.29	<0.20	0.58	5.9	0.42	1.3	<0.20	0.36	20	1.3
Acid Extractable Arsenic (As)	µg/g	1	2.6	13	3.5	17	7.7	3.2	3.2	4.5	12	18
Acid Extractable Barium (Ba)	µg/g	0.5	67	35	130	100	37	210	96	110	500	220
Acid Extractable Beryllium (Be)	µg/g	0.2	0.26	<0.20	0.53	0.37	<0.20	0.37	0.31	0.44	4	2.5
Acid Extractable Cadmium (Cd)	µg/g	0.1	0.18	<0.10	0.4	3.4	0.21	1.9	0.11	0.15	10	1.2
Acid Extractable Chromium (Cr)	µg/g	1	13	9.9	24	42	9.8	39	11	17	64	70
Acid Extractable Cobalt (Co)	µg/g	0.1	4.2	4.5	7.9	8.6	2.6	6.8	4.9	6.2	50	22
Acid Extractable Copper (Cu)	µg/g	0.5	16	18	66	110	320	47	7.4	22	63	92
Acid Extractable Lead (Pb)	µg/g	1	20	33	35	350	27	210	8.7	32	140	120
Acid Extractable Sulphur (S)	µg/g	50	720	4800	320	1700	1900	910	-	270	ND	NV
	µg/g	100	-	-	-	-	-	-	110	-		
Acid Extractable Mercury (Hg)	µg/g	0.05	<0.05	<0.05	0.12	0.64	<0.05	0.4	<0.05	0.085	6.6	0.27
Acid Extractable Molybdenum (Mo)	µg/g	0.5	1.7	3.4	1.5	4.1	2.6	3.4	1.4	1.4	10	2
Acid Extractable Nickel (Ni)	µg/g	0.5	8.6	18	17	-	13	21	7.8	13	45	82
	µg/g	2.5	-	-	-	550	-	-	-	-		
Acid Extractable Selenium (Se)	µg/g	0.5	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	1	1.5
Acid Extractable Silver (Ag)	µg/g	0.2	<0.20	<0.20	<0.20	0.36	<0.20	0.38	<0.20	0.4	20	0.5
Acid Extractable Thallium (Tl)	µg/g	0.05	0.14	0.13	0.14	0.19	0.11	0.14	0.14	0.24	1	1
Acid Extractable Tin (Sn)	µg/g	1	5.8	16	15	230	8.6	77	<1.0	1.9	50	NV
Acid Extractable Uranium (U)	µg/g	0.05	0.53	0.69	0.66	0.65	0.19	0.52	0.32	0.46	23	2.5
Acid Extractable Vanadium (V)	µg/g	5	18	8	35	27	6.9	46	21	25	130	86
Acid Extractable Zinc (Zn)	µg/g	5	32	37	82	590	53	310	13	54	200	290
Analysis Date			2017-09-08	2017-09-07	2017-09-07	2017-09-08	2017-09-07	2017-09-08	2017-09-07	2017-09-07	-	-
Hot Water Ext. Boron (B)	µg/g	0.050	0.3	0.12	0.17	0.32	0.12	0.38	0.17	0.22	ND	1.5
Analysis Date			2017-09-11	2017-09-11	2017-09-11	2017-09-11	2017-09-11	2017-09-11	2017-09-11	2017-09-11	-	-
Sodium Adsorption Ratio	-	-	0.19	0.31	0.21	0.12	0.29	0.15	0.27	0.23	5	-
Analysis Date			2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	-	-
Free Cyanide	µg/g	0.01	0.04	<0.01	0.18	0.26	0.05	0.06	<0.01	<0.01	0.9	0.051
Conductivity	mS/cm	0.002	0.28	0.24	0.19	0.68	0.33	0.47	0.13	0.15	2	0.7
Chromium (VI)	µg/g	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.4	0.66
Flouride (F-)	dS/m	5	<5	<5	<5	<5	<5	<5	<5	<5	400	NV
Analysis Date			2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	-	-
Available (CaCl2) pH	s.u.	-	7.52	7.61	6.8	7.27	7.37	7.55	7.83	7.5	6 to 8	-
Analysis Date			2017-09-06	2017-09-06	2017-09-07	2017-09-06	2017-09-07	2017-09-07	2017-09-06	2017-09-06	-	-
Moisture	%	1.0	15	11	21	31	17	20	13	12	-	-

RDL - Result Detection Limit

*MOECC Table 9 used within 10m of surface water

ND - No Data

NV - No Value

CCME - Canadian Council of Ministers of the Environment, Soil Quality Guidelines for the Protection of Environmental and Human Health, 1991 - 2015

MOECC Table 9 - Ministry of Environment and Climate Change, Soil, Ground Water And Sediment Standards For Use Under Part XV.1 of the Environmental Protection Act, Table 9 Generic Site Condition Standards for Use within 30 m of a Water Body in a Non-Potable Groundwater Condition, 2011

Results above applicable Standard or Guideline | Results above CCME Guideline (<10m to water)

Table 3 - Metals and Inorganics in Soil, cont

Location			MW10/17		BH11/17	BH12/17		BH13/17		POND		CCME Residential/ Parkland Property Use	MOECC Table 9*
Sample ID			A0219	A0220	A0228	A0224	A0225	A0231	A0232	A0256	A0257 DUP of A0256		
Sample Date			2017-08-30	2017-08-30	2017-08-30	2017-08-30	2017-08-30	2017-08-30	2017-08-31	2017-08-31	2017-08-30		
Sample Time			11:04:00 AM	11:09:00 AM	1:36:00 PM	1:19:00 PM	1:22:00 PM	2:18:00 PM	2:25:00 PM	8:00:00 AM	8:02:00 AM		
Depth (m)		From	0.76	1.52	1.52	1.52	3.05	1.52	3.05	0.00	0.00		
		To	1.22	3.05	3.05	3.05	4.57	3.05	4.57	0.20	0.20		
Chemicals	Units	RDL	Results	Results	Results	Results	Results	Results	Results	Results	Results		
Analysis Date			2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08		
Acid Extractable Antimony (Sb)	µg/g	0.2	1.4	9.8	4.7	0.42	1.4	0.73	3.5	0.46	0.3	20	1.3
Acid Extractable Arsenic (As)	µg/g	1	3.4	12	7.6	2.3	4	3	4.4	2.4	2.1	12	18
Acid Extractable Barium (Ba)	µg/g	0.5	130	280	160	69	140	120	87	120	100	500	220
Acid Extractable Beryllium (Be)	µg/g	0.2	0.39	0.38	0.47	0.21	<0.20	0.39	0.3	0.31	0.25	4	2.5
Acid Extractable Cadmium (Cd)	µg/g	0.1	1.7	1.7	13	0.38	4.3	0.49	0.86	0.29	0.25	10	1.2
Acid Extractable Chromium (Cr)	µg/g	1	38	51	39	14	20	25	23	15	13	64	70
Acid Extractable Cobalt (Co)	µg/g	0.1	7.1	9.5	7	2.9	4.1	5.8	4.9	5.2	4.7	50	22
Acid Extractable Copper (Cu)	µg/g	0.5	62	210	62	23	51	30	710	17	14	63	92
Acid Extractable Lead (Pb)	µg/g	1	190	530	200	73	330	110	90	47	40	140	120
Acid Extractable Sulphur (S)	µg/g	50	1400	1800	1700	570	1800	890	4100	530	470	ND	NV
	µg/g	100	-	-	-	-	-	-	-	-	-		
Acid Extractable Mercury (Hg)	µg/g	0.05	0.23	0.27	0.21	0.087	0.16	0.15	0.12	0.071	0.052	6.6	0.27
Acid Extractable Molybdenum (Mo)	µg/g	0.5	3.4	6.7	2.3	1.4	3.2	1.9	3.1	1.2	1	10	2
Acid Extractable Nickel (Ni)	µg/g	0.5	17	43	20	9.5	18	14	13	13	11	45	82
	µg/g	2.5	-	-	-	-	-	-	-	-	-		
Acid Extractable Selenium (Se)	µg/g	0.5	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	1	1.5
Acid Extractable Silver (Ag)	µg/g	0.2	0.38	0.99	0.3	<0.20	<0.20	<0.20	0.84	0.24	0.23	20	0.5
Acid Extractable Thallium (Tl)	µg/g	0.05	0.18	0.21	0.24	0.097	0.16	0.13	0.19	0.2	0.18	1	1
Acid Extractable Tin (Sn)	µg/g	1	16	210	130	50	150	57	15	11	1.4	50	NV
Acid Extractable Uranium (U)	µg/g	0.05	0.44	0.66	0.63	0.64	0.35	0.53	0.71	0.33	0.33	23	2.5
Acid Extractable Vanadium (V)	µg/g	5	29	23	31	19	13	32	21	19	19	130	86
Acid Extractable Zinc (Zn)	µg/g	5	310	880	150	180	4500	230	340	61	50	200	290
Analysis Date			2017-09-08	2017-09-07	2017-09-08	2017-09-07	2017-09-08	2017-09-08	2017-09-07	2017-09-07	2017-09-07	-	-
Hot Water Ext. Boron (B)	µg/g	0.050	0.24	0.61	0.3	0.11	0.21	0.3	0.36	1.2	1.1	ND	1.5
Analysis Date			2017-09-11	2017-09-11	2017-09-11	2017-09-11	2017-09-11	2017-09-11	2017-09-11	2017-09-11	2017-09-11	-	-
Sodium Adsorption Ratio	-	-	0.15	0.17	0.1	0.18	0.14	0.19	0.14	0.25	0.26	5	-
Analysis Date			2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	2017-09-08	-	-
Free Cyanide	µg/g	0.01	0.13	0.2	0.03	0.1	0.06	0.13	0.1	0.09	0.09	0.9	0.051
Conductivity	mS/cm	0.002	0.47	0.38	0.84	0.34	0.51	0.31	0.49	0.2	0.17	2	0.7
Chromium (VI)	µg/g	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.4	0.66
Flouride (F-)	dS/m	5	<5	<5	<5	<5	<5	<5	<5	<5	<5	400	NV
Analysis Date			2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	-	-
Available (CaCl2) pH	s.u.	-	7.19	6.82	11.6	7.48	7.32	7.29	8.9	5.78	5.99	6 to 8	5 to 9
Analysis Date			2017-09-07	2017-09-06	2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-06	2017-09-06	-	-
Moisture	%	1.0	27	38	24	20	26	36	24	41	42	-	-

RDL - Result Detection Limit

*MOECC Table 9 used within 10m of surface water

ND - No Data

NV - No Value

CCME - Canadian Council of Ministers of the Environment, Soil Quality Guidelines for the Protection of Environmental and Human Health, 1991 - 2015

MOECC Table 9 - Ministry of Environment and Climate Change, Soil, Ground Water And Sediment Standards For Use Under Part XV.1 of the Environmental Protection Act, Table 9 Generic Site Condition Standards for Use within 30 m of a Water Body in a Non-Potable Groundwater Condition, 2011

Results above applicable Standard or Guideline | Results above CCME Guideline (<10m to water)

Table 4 - PAH In Soils

Location			MW5/17		MW7/17		MW8/17	MW9/17	MW10/17	BH11/17		BH12/17		BH13/17		POND	CCME Residential/ Parkland Property Use	MOECC Table 9*
Sample ID			A0245		A0217		A0234	A0254	A0219	A0227		A0225		A0230		A0256		
Sample Date			2017-08-31		2017-08-30		2017-08-30	2017-08-31	2017-08-30	2017-08-30		2017-08-30		2017-08-30		2017-08-31		
Sample Time			8:34:00 AM		9:54:00 AM		2:30:00 PM	10:10:00 AM	11:04:00 AM	1:30:00 PM		1:22:00 PM		2:10:00 PM		8:00:00 AM		
Depth (m)		From	3.35		3.05		0.00	2.29	0.76	0.76		3.05		0.00		0.00		
		To	3.66		3.81		1.52	3.05	1.22	1.52		4.57		1.52		0.20		
Chemicals	Units	RDL	Results		Results		Results	Results	Results	Results		Results		Results		Results		
Analysis Date			2017-09-08	RDL-->	2017-09-08	RDL-->	2017-09-08	2017-09-08	2017-09-08	2017-09-08	RDL-->	2017-09-08	RDL-->	2017-09-08	RDL-->	2017-09-08		
Acenaphthene	µg/g	0.0050	0.0058	0.0050	<0.005	0.0050	0.013	<0.005	0.099	<0.005	0.050	<0.05	0.0050	<0.005	0.010	<0.01	0.28	0.072
Acenaphthylene	µg/g	0.0050	<0.005	0.0050	<0.005	0.0050	<0.005	<0.005	0.018	<0.005	0.050	<0.05	0.0050	<0.005	0.010	<0.01	320	0.093
Anthracene	µg/g	0.0050	<0.005	0.010	<0.01	0.0050	0.023	<0.005	0.015	0.011	0.050	<0.05	0.0050	0.010	0.020	<0.02	2.5	0.22
Benzo(a)anthracene	µg/g	0.0050	<0.005	0.0050	<0.005	0.0050	0.062	<0.005	0.032	0.043	0.050	<0.05	0.0050	0.039	0.010	0.035	1	0.36
Benzo(a)pyrene	µg/g	0.0050	<0.005	0.0050	0.029	0.0050	0.053	<0.005	0.029	0.043	0.050	<0.05	0.0050	0.039	0.010	0.041	20	0.3
Benzo(b/j)fluoranthene	µg/g	0.0050	<0.005	0.0050	0.017	0.0050	0.078	<0.005	0.044	0.061	0.050	<0.05	0.0050	0.053	0.010	0.059	1	0.47
Benzo(g,h,i)perylene	µg/g	0.0050	<0.005	0.0050	0.043	0.0050	0.033	<0.005	0.020	0.024	0.050	<0.05	0.0050	0.021	0.010	0.031	NV	0.68
Benzo(k)fluoranthene	µg/g	0.0050	<0.005	0.0050	<0.005	0.0050	0.024	<0.005	0.016	0.019	0.050	<0.05	0.0050	0.017	0.010	0.020	1	0.48
Chrysene	µg/g	0.0050	<0.005	0.010	<0.01	0.0050	0.052	<0.005	0.036	0.044	0.050	<0.05	0.0050	0.035	0.010	0.036	NV	2.8
Dibenz(a,h)anthracene	µg/g	0.0050	<0.005	0.0050	<0.005	0.0050	0.0077	<0.005	<0.005	0.0062	0.050	<0.05	0.0050	0.0062	0.010	<0.01	1	0.1
Fluoranthene	µg/g	0.0050	0.012	0.0050	0.0054	0.0050	0.14	<0.005	0.073	0.076	0.050	0.10	0.0050	0.069	0.010	0.077	50	0.69
Fluorene	µg/g	0.0050	0.0063	0.0050	<0.005	0.0050	0.014	<0.005	0.21	<0.005	0.050	<0.05	0.0050	<0.005	0.010	<0.01	0.25	0.19
Indeno(1,2,3-cd)pyrene	µg/g	0.0050	<0.005	0.0050	0.014	0.0050	0.034	<0.005	0.020	0.028	0.050	<0.05	0.0050	0.023	0.010	0.029	1	0.23
1-Methylnaphthalene	µg/g	0.0050	0.012	0.0050	<0.005	0.0050	0.021	<0.005	2.3	<0.005	0.050	<0.05	0.0050	0.0051	0.010	<0.01		
2-Methylnaphthalene	µg/g	0.020	<0.02	0.0050	<0.005	0.0050	0.036	<0.005	2.9	<0.005	0.20	<0.2	0.0050	0.0081	0.010	<0.01	NV	0.59
Methylnaphthalene, 2-(1-)	µg/g	0.021	<0.021	0.0071	<0.0071	0.0071	0.057	<0.0071	5.3	<0.0071	0.21	<0.21	0.0071	0.013	0.014	<0.014		
Naphthalene	µg/g	0.0050	<0.005	0.0050	<0.005	0.0050	0.054	<0.005	3.7	<0.005	0.050	<0.05	0.0050	<0.005	0.010	<0.01	0.013	0.09
Phenanthrene	µg/g	0.0050	0.018	0.0050	0.0085	0.0050	0.088	<0.005	0.055	0.042	0.050	0.073	0.0050	0.041	0.010	0.037	0.046	0.69
Pyrene	µg/g	0.0050	0.011	0.0050	0.021	0.0050	0.12	<0.005	0.076	0.065	0.050	0.10	0.0050	0.058	0.010	0.062	10	1
Benzo[a]pyrene Total Potency Equivalents	µg/g		0.012		0.039		0.081	0.012	0.046	0.065		0.121		0.059		0.066	0.6	
Analysis Date			2017-09-06		2017-09-07		2017-09-07	2017-09-06	2017-09-07	2017-09-07		2017-09-06		2017-09-07		2017-09-07	-	-
Moisture	%	1	11		17		20	13	27	16		26		19		41	-	-

PAH - Polycyclic Aromatic Hydrocarbons

*MOECC Table 9 used within 10m of surface water

RDL - Result Detection Limit

ND - No Data

NV - No Value

CCME - Canadian Council of Ministers of the Environment, Soil Quality Guidelines for the Protection of Environmental and Human Health, 1991 - 2015

MOECC Table 9 - Ministry of Environment and Climate Change, Soil, Ground Water And Sediment Standards For Use Under Part XV.1 of the Environmental Protection Act, Table 9 Generic Site Condition Standards for Use within 30 m of a Water Body in a Non-Potable Groundwater Condition, 2011

Results above applicable Standard or Guideline

RDL above applicable Standard or Guideline

Table 5 - PCBs In Soil

Location			MW5/17	MW7/17	MW8/17	MW9/17	MW10/17	BH11/17	BH12/17	BH13/17	POND	CCME Residential/ Parkland Property Use	MOECC Table 9*
Sample ID			A0245	A0217	A0234	A0254	A0219	A0227	A0225	A0230	A0256		
Sample Date			2017-08-31	2017-08-30	2017-08-30	2017-08-31	2017-08-30	2017-08-30	2017-08-30	2017-08-30	2017-08-31		
Sample Time			8:34:00 AM	9:54:00 AM	2:30:00 PM	10:10:00 AM	11:04:00 AM	1:30:00 PM	1:22:00 PM	2:10:00 PM	8:00:00 AM		
Depth (m)		From	3.35	3.05	0.00	2.29	0.76	0.76	3.05	0.00	0.00		
		To	3.66	3.81	1.52	3.05	1.22	1.52	4.57	1.52	0.20		
Chemicals	Units	RDL	Results	Results	Results	Results	Results	Results	Results	Results	Results		
Analysis Date			2017-09-08	2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-08	2017-09-08	2017-09-08	2017-09-07		
Total PCBs	μg/g	0.01	<0.01	<0.01	0.027	<0.01	0.19	<0.01	0.099	<0.01	-	1.3	0.3
	μg/g	0.02	-	-	-	-	-	-	-	-	<0.02		

PCB - Polychlorinated Biphenyl

*MOECC Table 9 used within 10m of surface water

RDL - Result Detection Limit

MOECC Table 9 - Ministry of Environment and Climate Change, Soil, Ground Water And Sediment Standards For Use Under Part XV.1 of the Environmental Protection Act, Table 9 Generic Site Condition Standards for Use within 30 m of a Water Body in a Non-Potable Groundwater Condition, 2011

CCME - Canadian Council of Ministers of the Environment, Soil Quality Guidelines for the Protection of Environmental and Human Health, 1991 - 2015

Results above Guideline

Table 6 Surface Soil Contaminant Inventory

Contaminant	Result Detection Limit (RDL)	Units	Maximum Measured Concentration	Location Name	Distance from Surface Water	Sampling Date	Sampling Depth	Applicable Guideline/Standard Value	Exceedance
PHC F1 (C6-C10)	10	µg/g	15	MW10/17	>10 m	2017-08-31	0.76 - 1.22 m	30	N
	10	µg/g	<10	Not Detected On Site	< 10 m	N/A	N/A	25	N
PHC F2 (C10-C16)	10	µg/g	130	MW10/17	>10 m	2017-08-30	0.76 - 1.22 m	150	N
	10	µg/g	<10	Not Detected On Site	< 10 m	N/A	N/A	10	N
PHC F3 (C16-C34)	50	µg/g	520	MW10/17	>10 m	2017-08-31	0.76 - 1.22 m	300	Y
	50	µg/g	150	BH12/17	< 10 m	2017-08-30	0.76 - 1.52 m	240	N
PHC F4 (C34-C50)	50	µg/g	190	MW10/17	>10 m	2017-08-31	0.76 - 1.22 m	2800	N
	50	µg/g	95	MW7/17	< 10 m	2017-08-30	0.76 - 1.52 m	120	N
PHC F4 (Grav. Heavy Hydrocarbons)	100	µg/g	440	MW10/17	>10 m	2017-08-31	0.76 - 1.22 m	2800	N
	100	µg/g	390	MW7/17	< 10 m	2017-08-30	0.76 - 1.52 m	120	Y

Table 6 Surface Soil Contaminant Inventory

Contaminant	Result Detection Limit (RDL)	Units	Maximum Measured Concentration	Location Name	Distance from Surface Water	Sampling Date	Sampling Depth	Applicable Guideline/Standard Value	Exceedance
Sodium Adsorption Ratio (SAR)	N/A	N/A	0.25	Pond	>10 m	2017-08-31	0.00 - 0.20	5	N
	N/A	N/A	0.21	MW7/17	< 10 m	2017-08-30	0.76 - 1.52 m	5	N
pH	N/A	s.u.	7.56	SS1	>10 m	1994-10-17	N/A	6-8	N
	N/A	s.u.	6.8	MW7/17	< 10 m	2017-08-30	0.76 - 1.52 m	6-8	N
Cyanide (Free)	0.01	µg/g	0.18	MW10/17	> 10 m	2017-08-31	0.76 - 1.22 m	0.9	N
	0.01	µg/g	0.13	MW7/17	< 10 m	2017-08-30	0.76 - 1.52 m	0.051	N
Electrical Conductivity	0.002	mS/cm	0.47	MW10/17	> 10 m	2017-08-31	0.76 - 1.22 m	2	N
	0.002	mS/cm	0.19	MW7/17	< 10 m	2017-08-30	0.76 - 1.52 m	0.7	N
Fluoride	5	dS/m	<5	Not Detected On Site	< 10 m	N/A	N/A	400	N
	5	dS/m	<5	Not Detected On Site	< 10 m	N/A	N/A	NV	N
Alunimum	N/A	N/A	N/A	N/A	> 10 m	N/A	N/A	NV	N
	1	ppm	10800	SS1	>10 m	1994-10-17	Surface	NV	N
Antimony	0.2	µg/g	1.4	MW10/17	> 10 m	2017-08-31	0.76 - 1.22 m	20	N
	0.2	µg/g	0.58	MW7/17	< 10 m	2017-08-30	0.76 - 1.52 m	1.3	N
Arsenic	1	µg/g	4.5	MW9/17	>10 m	2017-08-31	0.00 - 0.76 m	12	N
	1	µg/g	3.5	MW7/17	< 10 m	2017-08-30	0.76 - 1.52 m	18	N
Barium	0.5	µg/g	130	MW10/17	> 10 m	2017-08-31	0.76 - 1.22 m	500	N
	0.5	µg/g	130	MW7/17	< 10 m	2017-08-30	0.76 - 1.52 m	220	N
Beryllium	0.2	µg/g	0.44	MW9/17	>10 m	2017-08-31	0.00 - 0.76 m	4	N
	0.2	µg/g	0.53	MW7/17	< 10 m	2017-08-30	0.76 - 1.52 m	2.5	N
Boron (HWS)	0.05	µg/g	1.20	Pond	>10 m	2017-08-31	0.00 - 0.20	NV	N
	0.05	µg/g	0.17	MW7/17	< 10 m	2017-08-30	0.76 - 1.52 m	1.5	N
Boron (total)	0.5	µg/g	1.8	SS1	>10 m	1994-10-17	Surface	1.5	Y
	N/A	N/A	N/A	N/A	< 10 m	N/A	N/A	NV	N
Cadmium	0.1	µg/g	1.7	MW10/17	> 10 m	2017-08-31	0.76 - 1.22 m	10	N
	0.1	µg/g	0.4	MW7/17	< 10 m	2017-08-30	0.76 - 1.52 m	1.2	N
Chromium (Total)	1	µg/g	38	MW10/17	> 10 m	2017-08-31	0.76 - 1.22 m	64	N
	1	µg/g	24	MW7/17	< 10 m	2017-08-30	0.76 - 1.52 m	70	N
Chromium (VI)	0.2	µg/g	<0.2	Not Detected On Site	> 10 m	N/A	N/A	0.4	N
	0.2	µg/g	<0.2	Not Detected On Site	< 10 m	N/A	N/A	0.66	N
Cobalt	0.1	µg/g	7.1	MW10/17	> 10 m	2017-08-31	0.76 - 1.22 m	50	N
	0.1	µg/g	7.9	MW7/17	< 10 m	2017-08-30	0.76 - 1.52 m	22	N
Copper	0.5	µg/g	62	MW10/17	> 10 m	2017-08-31	0.76 - 1.22 m	63	N
	0.5	µg/g	66	MW7/17	< 10 m	2017-08-30	0.76 - 1.52 m	92	N
Iron	0.3	ppm	14300	SS2	>10 m	1994-11-15	Surface	NV	N
	N/A	N/A	N/A	N/A	< 10 m	N/A	N/A	NV	N
Lead	1	µg/g	190	MW10/17	> 10 m	2017-08-31	0.76 - 1.22 m	140	Y
	1	µg/g	35	MW7/17	< 10 m	2017-08-30	0.76 - 1.52 m	120	N
Manganese	0.3	ppm	850	SS1	>10 m	1994-10-17	Surface	NV	N
	N/A	N/A	N/A	N/A	< 10 m	N/A	N/A	NV	N
Mercury	0.05	µg/g	0.23	MW10/17	> 10 m	2017-08-31	0.76 - 1.22 m	6.6	N
	0.05	µg/g	0.12	MW7/17	< 10 m	2017-08-30	0.76 - 1.52 m	0.27	N
Molybdenum	0.5	µg/g	3.4	MW10/17	> 10 m	2017-08-31	0.76 - 1.22 m	10	N
	0.5	µg/g	1.5	MW7/17	< 10 m	2017-08-30	0.76 - 1.52 m	2	N
Nickel	0.5	µg/g	17	MW10/17	> 10 m	2017-08-31	0.76 - 1.22 m	45	N
	0.5	µg/g	17	MW7/17	< 10 m	2017-08-30	0.76 - 1.52 m	82	N
Phosphorous	3.0	ppm	667	SS1	>10 m	1994-10-17	Surface	NV	N
	N/A	N/A	N/A	N/A	< 10 m	N/A	N/A	NV	N
Potassium	20	ppm	1330	SS1	>10 m	1994-10-17	Surface	NV	N
	N/A	N/A	N/A	N/A	< 10 m	N/A	N/A	NV	N
Sodium	0.5	ppm	76.2	SS1	>10 m	1994-10-17	Surface	NV	N
	N/A	N/A	N/A	N/A	< 10 m	N/A	N/A	NA	N
Selenium	0.5	µg/g	<0.5	Not Detected On Site	> 10 m	N/A	N/A	1	N
	0.5	µg/g	<0.5	Not Detected On Site	< 10 m	N/A	N/A	1.5	N
Silver	0.5	µg/g	0.6	SS1	>10 m	1994-10-17	Surface	20	N
	0.2	µg/g	<0.2	Not Detected On Site	< 10 m	N/A	N/A	0.5	N
Strontium	0.3	ppm	19	SS1	>10 m	1994-10-17	Surface	NV	N
	N/A	N/A	N/A	N/A	< 10 m	N/A	N/A	NV	N
Sulphur	50	µg/g	1400	MW10/17	> 10 m	2017-08-31	0.76 - 1.22 m	NV	N
	50	µg/g	320	MW7/17	< 10 m	2017-08-30	0.76 - 1.52 m	NV	N
Thallium	0.05	µg/g	0.24	MW9/17	>10 m	2017-08-31	0.00 - 0.76 m	1	N
	0.05	µg/g	0.14	MW7/17	< 10 m	2017-08-30	0.76 - 1.52 m	1	N
Tin	1	µg/g	16	MW10/17	> 10 m	2017-08-31	0.76 - 1.22 m	50	N
	1	µg/g	15	MW7/17	< 10 m	2017-08-30	0.76 - 1.52 m	NV	N
Titanium	0.3	ppm	523	SS1	>10 m	1994-10-17	Surface	NV	N
	N/A	N/A	N/A	N/A	< 10 m	N/A	N/A	NV	N
Uranium	0.05	µg/g	0.53	MW5/17	>10 m	2017-08-31	0.00 - 0.76 m	23	N
	0.05	µg/g	0.66	MW7/17	< 10 m	2017-08-30	0.76 - 1.52 m	2.5	N
Vanadium	5	µg/g	29	MW10/17	> 10 m	2017-08-31	0.76 - 1.22 m	130	N
	5	µg/g	35	MW7/17	< 10 m	2017-08-30	0.76 - 1.52 m	86	N
Zinc	5	µg/g	310	MW10/17	> 10 m	2017-08-31	0.76 - 1.22 m	200	Y
	5	µg/g	82	MW7/17	< 10 m	2017-08-30	0.76 - 1.52 m	290	N

Table 6 Surface Soil Contaminant Inventory

Contaminant	Result Detection Limit (RDL)	Units	Maximum Measured Concentration	Location Name	Distance from Surface Water	Sampling Date	Sampling Depth	Applicable Guideline/Standard Value	Exceedance
Acetone (2-Propanone)	0.5	µg/g	0.57	Pond	>10 m	2017-08-31	0.00 - 0.20	NV	N
	0.5	µg/g	<0.5	Not Detected On Site	< 10 m	N/A	N/A	0.5	N
Benzene	0.006	µg/g	<0.006	Not Detected On Site	> 10 m	N/A	N/A	0.0095	N
	0.006	µg/g	<0.006	Not Detected On Site	< 10 m	N/A	N/A	0.02	N
Bromodichloromethane	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	NV	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Bromoform	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	NV	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Bromomethane	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	NV	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Carbon Tetrachloride	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	5	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Chlorobenzene	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	1	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Chloroform	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	5	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Dibromochloromethane	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	NV	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
1,2-Dichlorobenzene	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	1	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
1,3-Dichlorobenzene	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	1	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
1,4-Dichlorobenzene	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	1	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Dichlorodifluoromethane (FREON 12)	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	NV	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
1,1-Dichloroethane	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	5	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
1,2-Dichloroethane	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	5	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
1,1-Dichloroethylene	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	5	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
cis-1,2-Dichloroethylene	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	5	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
trans-1,2-Dichloroethylene	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	5	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
1,2-Dichloropropane	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	5	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
cis-1,3-Dichloropropene	0.03	µg/g	<0.03	Not Detected On Site	> 10 m	N/A	N/A	5	N
	0.03	µg/g	<0.03	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
trans-1,3-Dichloropropene	0.04	µg/g	<0.04	Not Detected On Site	> 10 m	N/A	N/A	5	N
	0.04	µg/g	<0.04	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Ethylbenzene	0.01	µg/g	0.44	MW10/17	>10 m	2017-08-31	0.76 - 1.22 m	0.082	Y
	0.01	µg/g	<0.01	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Ethylene Dibromide	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	NV	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Hexane	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	0.49	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Methyl Ethyl Ketone (2-Butanone)	0.5	µg/g	<0.5	Not Detected On Site	> 10 m	N/A	N/A	NV	N
	0.5	µg/g	<0.5	Not Detected On Site	< 10 m	N/A	N/A	0.5	N
Methyl Isobutyl Ketone	0.5	µg/g	<0.5	Not Detected On Site	> 10 m	N/A	N/A	NV	N
	0.5	µg/g	<0.5	Not Detected On Site	< 10 m	N/A	N/A	0.5	N
Methyl t-butyl ether (MTBE)	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	NV	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Methylene Chloride(Dichloromethane)	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	5	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Styrene	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	5	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
1,1,1,2-Tetrachloroethane	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	NV	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
1,1,2,2-Tetrachloroethane	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	5	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Tetrachloroethylene	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	0.2	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Toluene	0.02	µg/g	0.024	MW10/17	>10 m	2017-08-31	0.76 - 1.22 m	0.37	N
	0.02	µg/g	<0.02	Not Detected On Site	< 10 m	N/A	N/A	0.2	N
1,1,1-Trichloroethane	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	NV	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
1,1,2-Trichloroethane	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	5	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Trichloroethylene	0.01	µg/g	<0.01	Not Detected On Site	> 10 m	N/A	N/A	0.01	N
	0.01	µg/g	<0.01	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Trichlorofluoromethane (FREON 11)	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	NV	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.25	N
Vinyl Chloride	0.02	µg/g	<0.02	Not Detected On Site	> 10 m	N/A	N/A	NV	N
	0.02	µg/g	<0.02	Not Detected On Site	< 10 m	N/A	N/A	0.02	N
o-Xylene	0.02	µg/g	2.3	MW10/17	>10 m	2017-08-31	0.76 - 1.22 m	11	N
	0.02	µg/g	<0.02	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
p+m-Xylene	0.02	µg/g	2.7	MW10/17	>10 m	2017-08-31	0.76 - 1.22 m	11	N
	0.02	µg/g	0.026	BH12/17	< 10 m	2017-08-30	0.76 - 1.52 m	0.05	N
Xylene (Total)	0.02	µg/g	5.0	MW10/17	>10 m	2017-08-31	0.76 - 1.22 m	11	N
	0.02	µg/g	0.026	BH12/17	< 10 m	2017-08-30	0.76 - 1.52 m	0.05	N

Table 6 Surface Soil Contaminant Inventory

Contaminant	Result Detection Limit (RDL)	Units	Maximum Measured Concentration	Location Name	Distance from Surface Water	Sampling Date	Sampling Depth	Applicable Guideline/Standard Value	Exceedance
Acenaphthene	0.005	µg/g	0.013	MW8/17	>10 m	2017-08-30	0.00 - 1.52 m	0.28	N
	0.005	µg/g	<0.005	Not Detected On Site	< 10 m	N/A	N/A	0.072	N
Acenaphthylene	0.005	µg/g	0.018	MW10/17	>10 m	2017-08-31	0.76 - 1.22 m	320	N
	0.005	µg/g	<0.005	Not Detected On Site	< 10 m	N/A	N/A	0.093	N
Anthracene	0.1	µg/g	0.29	SS1	>10 m	1994-10-17	Surface	2.5	N
	0.005	µg/g	0.011	BH11/17	< 10 m	2017-08-30	0.76 - 1.52 m	0.22	N
Benzo[a]anthracene	0.1	µg/g	0.3	SS1	>10 m	1994-10-17	Surface	1	N
	0.005	µg/g	0.043	BH11/17	< 10 m	2017-08-30	0.76 - 1.52 m	0.36	N
Benzo[a]pyrene	0.1	µg/g	0.24	SS1	>10 m	1994-10-17	Surface	20	N
	0.005	µg/g	0.043	BH11/17	< 10 m	2017-08-30	0.76 - 1.52 m	0.3	N
Benzo[b]fluoranthene	0.1	µg/g	0.22	SS1	>10 m	1994-10-17	Surface	1	N
	0.005	µg/g	0.061	BH11/17	< 10 m	2017-08-30	0.76 - 1.52 m	0.47	N
Benzo[ghi]perylene	0.005	µg/g	0.033	MW8/17	>10 m	2017-08-30	0.00 - 1.52 m	NV	N
	0.005	µg/g	0.024	BH11/17	< 10 m	2017-08-30	0.76 - 1.52 m	0.68	N
Benzo[k]fluoranthene	0.1	µg/g	0.25	SS1	>10 m	1994-10-17	Surface	1	N
	0.005	µg/g	0.019	BH11/17	< 10 m	2017-08-30	0.76 - 1.52 m	0.48	N
Chrysene	0.1	µg/g	0.30	SS1	>10 m	1994-10-17	Surface	NV	N
	0.005	µg/g	0.044	BH11/17	< 10 m	2017-08-30	0.76 - 1.52 m	2.8	N
Dibenz[a,h]anthracene	0.005	µg/g	0.0077	MW8/17	>10 m	2017-08-30	0.00 - 1.52 m	1	N
	0.005	µg/g	0.0062	BH11/17/BH13/17	< 10 m	2017-08-30/2017-08-30	0.76 - 1.52 m/0.00 - 1.52 m	0.1	N
Fluoranthene	0.1	µg/g	0.63	SS1	>10 m	1994-10-17	Surface	50	N
	0.005	µg/g	0.076	BH11/17	< 10 m	2017-08-30	0.76 - 1.52 m	0.69	N
Fluorene	0.005	µg/g	0.21	MW10/17	>10 m	2017-08-31	0.76 - 1.22 m	0.25	N
	0.005	µg/g	<0.005	Not Detected On Site	< 10 m	N/A	N/A	0.19	N
Ideno[1,2,3-cd]pyrene	0.005	µg/g	0.034	MW8/17	>10 m	2017-08-30	0.00 - 1.52 m	1	N
	0.005	µg/g	0.028	BH11/17	< 10 m	2017-08-30	0.76 - 1.52 m	0.23	N
Methylnaphthalene, 2-(1-)	0.0071	µg/g	5.3	MW10/17	>10 m	2017-08-31	0.76 - 1.22 m	NV	Y
	0.0071	µg/g	0.013	BH13/17	< 10 m	2017-08-30	0.00 - 1.52 m	0.59	N
Naphthalene	0.005	µg/g	3.7	MW10/17	>10 m	2017-08-31	0.76 - 1.22 m	0.013	Y
	0.005	µg/g	<0.005	Not Detected On Site	< 10 m	N/A	N/A	0.09	N
Phenanthrene	0.1	µg/g	0.43	SS1	>10 m	1994-10-17	Surface	0.046	Y
	0.005	µg/g	0.042	BH11/17	< 10 m	2017-08-30	0.76 - 1.52 m	0.69	N
Pyrene	0.1	µg/g	0.17	SS1/SS2	>10 m	1994-10-17/1994-11-15	Surface	10	N
	0.005	µg/g	0.065	BH11/17	< 10 m	2017-08-30	0.76 - 1.52 m	1	N
Benzo[a]pyrene Total Potency Equivalents	-	µg/g	0.081	MW8/17	> 10 m	2017-08-30	0.00 - 1.52 m	0.6	N
	-	µg/g	0.065	BH11/17	< 10 m	2017-08-30	0.76 - 1.52 m	NV	N
Total PCBs	0.01	µg/g	0.027	MW8/17	>10 m	2017-08-30	0.00 - 1.52 m	1.3	N
	0.01	µg/g	<0.01	Not Detected On Site	< 10 m	N/A	N/A	0.3	N

N/A - Not Applicable

Table 7 Subsurface Soil Contaminant Inventory

Contaminant	Result Detection Limit (RDL)	Units	Maximum Measured Concentration	Location Name	Distance from Surface Water	Sampling Date	Sampling Depth	Applicable Guideline/Standard Value	Exceedance
PHC F1 (C6-C10)	10	µg/g	<10	Not Detected On Site	>10 m	N/A	N/A	30	N
	10	µg/g	<10	Not Detected On Site	< 10 m	N/A	N/A	25	N
PHC F2 (C10-C16)	10	µg/g	110	MW8/17	>10 m	2017-08-30	1.52 - 3.05 m	150	N
	10	µg/g	32	BH11/17	< 10 m	2017-08-30	3.05 - 4.57 m	10	Y
PHC F3 (C16-C34)	50	µg/g	1400	MW5/17/MW8/17	>10 m	2017-08-31/2017-08-30	3.05 - 3.35 m/1.52 - 3.05 m	2500	N
	50	µg/g	620	BH11/17	< 10 m	2017-08-30	3.05 - 4.57 m	240	Y
PHC F4 (C34-C50)	50	µg/g	1700	MW5/17	>10 m	017-08-31	3.05 - 3.35 m	10000	N
	50	µg/g	370	BH11/17	< 10 m	2017-08-30	3.05 - 4.57 m	120	Y
PHC F4 (Grav. Heavy Hydrocarbons)	100	µg/g	7300	MW5/17	>10 m	017-08-31	3.05 - 3.35 m	10000	N
	100	µg/g	1000	BH11/17	< 10 m	2017-08-30	3.05 - 4.57 m	120	Y

Table 7 Subsurface Soil Contaminant Inventory

Contaminant	Result Detection Limit (RDL)	Units	Maximum Measured Concentration	Location Name	Distance from Surface Water	Sampling Date	Sampling Depth	Applicable Guideline/Standard Value	Exceedance
Sodium Adsorption Ratio (SAR)	N/A	N/A	0.31	MW5/17	>10 m	2017-08-31	3.35 - 3.66 m	5	N
	N/A	N/A	0.29	MW7/17	< 10 m	2017-08-30	3.05 - 3.81 m	5	N
pH	N/A	s.u.	7.83	MW9/17	>10 m	2017-08-31	2.29 - 3.05 m	6-8	N
	N/A	s.u.	8.9	BH13/17	< 10 m	2017-08-31	3.05 - 4.57 m	6-8	N
Cyanide (Free)	0.01	µg/g	0.2	MW10/17	> 10 m	2017-08-31	1.52 - 3.05 m	0.9	N
	0.01	µg/g	0.26	MW7/17	< 10 m	2017-08-30	1.52 - 3.05 m	0.051	Y
Electrical Conductivity	0.002	mS/cm	0.47	MW8/17	> 10 m	2017-08-30	1.52 - 3.05 m	2	N
	0.002	mS/cm	0.68	MW7/17	< 10 m	2017-08-30	1.52 - 3.05 m	0.7	N
Fluoride	5	dS/m	<5	Not Detected On Site	< 10 m	N/A	N/A	400	N
	5	dS/m	<5	Not Detected On Site	< 10 m	N/A	N/A	NV	N
Alunimum	1	ppm	13400	MW-4	> 10 m	1994-11-14	0 - 4.94 m	NV	N
	1	ppm	8290	MW-1	>10 m	1994-11-14	0 - 4.49 m	NV	N
Antimony	0.2	µg/g	9.8	MW10/17	> 10 m	2017-08-31	1.52 - 3.05 m	20	N
	0.2	µg/g	5.9	MW7/17	< 10 m	2017-08-30	1.52 - 3.05 m	1.3	Y
Arsenic	1	µg/g	13	MW5/17	>10 m	2017-08-31	3.35 - 3.66 m	12	Y
	1	µg/g	17	MW7/17	< 10 m	2017-08-30	1.52 - 3.05 m	18	N
Barium	0.5	µg/g	280	MW10/17	> 10 m	2017-08-31	1.52 - 3.05 m	500	N
	0.2	µg/g	155	MW-1	< 10 m	1994-11-14	0 - 4.49 m	220	N
Beryllium	0.2	µg/g	0.38	MW10/17	>10 m	2017-08-31	1.52 - 3.05 m	4	N
	0.2	µg/g	0.37	MW7/17	< 10 m	2017-08-30	1.52 - 3.05 m	2.5	N
Boron (HWS)	0.05	µg/g	0.61	MW10/17	>10 m	2017-08-31	1.52 - 3.05 m	NV	N
	0.05	µg/g	0.36	BH13/17	< 10 m	2017-08-31	3.05 - 4.57 m	1.5	N
Boron (total)	0.5	µg/g	4.7	MW-3	>10 m	1994-11-14	0 - 4.94 m	1.5	Y
	0.5	N/A	N/A	Not Detected On Site	< 10 m	N/A	N/A	NV	N
Cadmium	0.1	µg/g	1.9	MW8/17	> 10 m	2017-08-30	1.52 - 3.05 m	10	N
	0.1	µg/g	13	BH11/17	< 10 m	2017-08-30	1.52 - 3.05 m	1.2	Y
Chromium (Total)	1	µg/g	51	MW10/17	> 10 m	2017-08-31	1.52 - 3.05 m	64	N
	1	µg/g	42	MW7/17	< 10 m	2017-08-30	1.52 - 3.05 m	70	N
Chromium (VI)	0.2	µg/g	<0.2	Not Detected On Site	> 10 m	N/A	N/A	0.4	N
	0.2	µg/g	<0.2	Not Detected On Site	< 10 m	N/A	N/A	0.66	N
Cobalt	0.3	µg/g	11.8	MW-5	> 10 m	1994-11-14	0 - 3.0 m	50	N
	0.1	µg/g	8.6	MW7/17	< 10 m	2017-08-30	1.52 - 3.05 m	22	N
Copper	0.5	µg/g	210	MW10/17	> 10 m	2017-08-31	1.52 - 3.05 m	63	Y
	0.5	µg/g	710	BH13/17	< 10 m	2017-08-31	3.05 - 4.57 m	92	Y
Iron	0.3	ppm	19100	MW-3	>10 m	1994-11-14	0 - 4.94 m	NV	N
	0.3	ppm	28200	MW-1	< 10 m	1994-11-14	0 - 4.49 m	NV	N
Lead	1	µg/g	530	MW10/17	> 10 m	2017-08-31	1.52 - 3.05 m	140	Y
	1	µg/g	350	MW7/17	< 10 m	2017-08-30	1.52 - 3.05 m	120	Y
Manganese	0.3	ppm	796	MW-3	>10 m	1994-11-14	0 - 4.94 m	NV	N
	0.3	ppm	722	MW-1	< 10 m	1994-11-14	0 - 4.49 m	NV	N
Mercury	0.05	µg/g	0.4	MW8/17	> 10 m	2017-08-30	1.52 - 3.05 m	6.6	N
	0.05	µg/g	0.64	MW7/17	< 10 m	2017-08-30	1.52 - 3.05 m	0.27	Y
Molybdenum	0.5	µg/g	6.7	MW10/17	> 10 m	2017-08-31	1.52 - 3.05 m	10	N
	0.5	µg/g	4.1	MW7/17	< 10 m	2017-08-30	1.52 - 3.05 m	2	Y
Nickel	0.5	µg/g	43	MW10/17	> 10 m	2017-08-31	1.52 - 3.05 m	45	N
	2.5	µg/g	550	MW7/17	< 10 m	2017-08-30	1.52 - 3.05 m	82	Y
Selenium	0.5	µg/g	<0.5	Not Detected On Site	> 10 m	N/A	N/A	1	N
	0.5	µg/g	<0.5	Not Detected On Site	< 10 m	N/A	N/A	1.5	N
Silver	0.2	µg/g	0.99	MW10/17	>10 m	2017-08-31	1.52 - 3.05 m	20	N
	0.2	µg/g	0.84	BH13/17	< 10 m	2017-08-31	3.05 - 4.57 m	0.5	Y
Sulphur	50	µg/g	4800	MW5/17	> 10 m	2017-08-31	3.35 - 3.66 m	NV	N
	50	µg/g	4100	BH13/17	< 10 m	2017-08-31	3.05 - 4.57 m	NV	N
Thallium	0.05	µg/g	0.21	MW10/17	> 10 m	2017-08-31	1.52 - 3.05 m	1	N
	0.05	µg/g	0.19	MW7/17/BH13/17	< 10 m	2017-08-30/2017-08-31	1.52 - 3.05 m/3.05 - 4.57 m	1	N
Tin	1	µg/g	210	MW10/17	> 10 m	2017-08-31	1.52 - 3.05 m	50	Y
	1	µg/g	230	MW7/17	< 10 m	2017-08-30	1.52 - 3.05 m	NV	N
Uranium	0.05	µg/g	0.69	MW5/17	>10 m	2017-08-31	3.35 - 3.66 m	23	N
	0.05	µg/g	0.71	BH13/17	< 10 m	2017-08-31	3.05 - 4.57 m	2.5	N
Vanadium	5	µg/g	46	MW8/17	> 10 m	2017-08-30	1.52 - 3.05 m	130	N
	5	µg/g	27	MW7/17	< 10 m	2017-08-30	1.52 - 3.05 m	86	N
Zinc	0.3	µg/g	1440	MW-3	> 10 m	1994-11-14	0 - 4.94 m	200	Y
	5	µg/g	4500	BH12/17	< 10 m	2017-08-30	3.05 - 4.57 m	290	Y

Table 7 Subsurface Soil Contaminant Inventory

Contaminant	Result Detection Limit (RDL)	Units	Maximum Measured Concentration	Location Name	Distance from Surface Water	Sampling Date	Sampling Depth	Applicable Guideline/Standard Value	Exceedance
Acetone (2-Propanone)	0.5	µg/g	0.54	MW5/17	>10 m	2017-08-31	3.05 - 3.35 m	NV	N
	0.5	µg/g	<0.5	Not Detected On Site	< 10 m	N/A	N/A	0.5	N
Benzene	0.006	µg/g	0.014	MW5/17	> 10 m	2017-08-31	3.05 - 3.35 m	0.03	N
	0.006	µg/g	<0.006	Not Detected On Site	< 10 m	N/A	N/A	0.02	N
Bromodichloromethane	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	NV	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Bromoform	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	NV	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Bromomethane	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	NV	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Carbon Tetrachloride	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	5	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Chlorobenzene	0.05	µg/g	0.35	MW5/17	> 10 m	2017-08-31	3.05 - 3.35 m	1	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Chloroform	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	5	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Dibromochloromethane	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	NV	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
1,2-Dichlorobenzene	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	1	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
1,3-Dichlorobenzene	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	1	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
1,4-Dichlorobenzene	0.05	µg/g	0.12	MW5/17	> 10 m	2017-08-31	3.05 - 3.35 m	1	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Dichlorodifluoromethane (FREON 12)	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	NV	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
1,1-Dichloroethane	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	5	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
1,2-Dichloroethane	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	5	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
1,1-Dichloroethylene	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	5	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
cis-1,2-Dichloroethylene	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	5	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
trans-1,2-Dichloroethylene	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	5	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
1,2-Dichloropropane	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	5	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
cis-1,3-Dichloropropene	0.03	µg/g	<0.03	Not Detected On Site	> 10 m	N/A	N/A	5	N
	0.03	µg/g	<0.03	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
trans-1,3-Dichloropropene	0.04	µg/g	<0.04	Not Detected On Site	> 10 m	N/A	N/A	5	N
	0.04	µg/g	<0.04	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Ethylbenzene	0.01	µg/g	0.24	MW10/17	>10 m	2017-08-31	3.05 - 3.81 m	0.082	Y
	0.01	µg/g	0.015	BH13/17	< 10 m	2017-08-30	3.05 - 4.57 m	0.05	N
Ethylene Dibromide	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	NV	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Hexane	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	0.49	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Methyl Ethyl Ketone (2-Butanone)	0.5	µg/g	<0.5	Not Detected On Site	> 10 m	N/A	N/A	NV	N
	0.5	µg/g	<0.5	Not Detected On Site	< 10 m	N/A	N/A	0.5	N
Methyl Isobutyl Ketone	0.5	µg/g	<0.5	Not Detected On Site	> 10 m	N/A	N/A	NV	N
	0.5	µg/g	<0.5	Not Detected On Site	< 10 m	N/A	N/A	0.5	N
Methyl t-butyl ether (MTBE)	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	NV	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Methylene Chloride(Dichloromethane)	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	5	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Styrene	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	5	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
1,1,1,2-Tetrachloroethane	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	NV	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
1,1,2,2-Tetrachloroethane	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	5	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Tetrachloroethylene	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	0.2	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Toluene	0.02	µg/g	0.72	MW8/17	>10 m	2017-08-30	1.52 - 3.05 m	0.37	Y
	0.02	µg/g	0.03	BH11/17	< 10 m	2017-08-30	1.52 - 3.81 m	0.2	N
1,1,1-Trichloroethane	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	NV	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
1,1,2-Trichloroethane	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	5	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
Trichloroethylene	0.05	µg/g	0.047	MW5/17	> 10 m	2017-08-31	3.05 - 3.35 m	0.01	Y
	0.01	µg/g	0.48	BH11/17	< 10 m	2017-08-30	3.05 - 4.57 m	0.05	Y
Trichlorofluoromethane (FREON 11)	0.05	µg/g	<0.05	Not Detected On Site	> 10 m	N/A	N/A	NV	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.25	N
Vinyl Chloride	0.02	µg/g	<0.02	Not Detected On Site	> 10 m	N/A	N/A	NV	N
	0.02	µg/g	<0.02	Not Detected On Site	< 10 m	N/A	N/A	0.02	N
o-Xylene	0.02	µg/g	2.8	MW10/17	>10 m	2017-08-31	3.05 - 3.81	11	N
	0.02	µg/g	<0.02	Not Detected On Site	< 10 m	N/A	N/A	0.05	N
p+m-Xylene	0.02	µg/g	1.6	MW10/17	>10 m	2017-08-31	3.05 - 3.81	11	N
	0.02	µg/g	0.11	BH12/17	< 10 m	2017-08-30	1.52 - 3.05 m	0.05	Y
Xylene (Total)	0.02	µg/g	2.8	MW10/17	>10 m	2017-08-31	3.05 - 3.81	11	N
	0.02	µg/g	0.11	BH12/17	< 10 m	2017-08-30	1.52 - 3.05 m	0.05	Y

Table 7 Subsurface Soil Contaminant Inventory

Contaminant	Result Detection Limit (RDL)	Units	Maximum Measured Concentration	Location Name	Distance from Surface Water	Sampling Date	Sampling Depth	Applicable Guideline/Standard Value	Exceedance
Acenaphthene	0.005	µg/g	0.0058	MW5/17	>10 m	2017-08-31	3.35 - 3.66 m	0.28	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.072	N
Acenaphthylene	0.005	µg/g	<0.005	Not Detected On Site	> 10 m	N/A	N/A	320	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.093	N
Anthracene	0.1	µg/g	2.94	MW-5	>10 m	1994-11-14	0 - 3.0 m	2.5	Y
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.22	N
Benzo[a]anthracene	0.1	µg/g	1.63	MW-5	>10 m	1994-11-14	0 - 3.0 m	1	Y
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.36	N
Benzo[a]pyrene	0.1	µg/g	1.42	MW-5	>10 m	1994-11-14	0 - 3.0 m	20	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.3	N
Benzo[b]fluoranthene	0.1	µg/g	1.16	MW-5	>10 m	1994-11-14	0 - 3.0 m	1	Y
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.47	N
Benzo[ghi]perylene	0.005	µg/g	<0.005	Not Detected On Site	> 10 m	N/A	N/A	NV	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.68	N
Benzo[k]fluoranthene	0.1	µg/g	1.3	MW-5	>10 m	1994-11-14	0 - 3.0 m	1	Y
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.48	N
Chrysene	0.1	µg/g	1.79	MW-5	>10 m	1994-11-14	0 - 3.0 m	NV	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	2.8	N
Dibenz[a,h]anthracene	0.005	µg/g	<0.005	Not Detected On Site	> 10 m	N/A	N/A	1	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.1	N
Fluoranthene	0.1	µg/g	2.93	MW-5	>10 m	1994-11-14	0 - 3.0 m	50	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.69	N
Fluorene	0.005	µg/g	0.0063	MW5/17	>10 m	2017-08-31	3.35 - 3.66 m	0.25	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.19	N
Ideno[1,2,3-cd]pyrene	0.005	µg/g	<0.005	Not Detected On Site	> 10 m	N/A	N/A	1	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.23	N
Methylnaphthalene, 2-(1-)	0.021	µg/g	<0.021	Not Detected On Site	> 10 m	N/A	N/A	NV	N
	0.21	µg/g	<0.21	Not Detected On Site	< 10 m	N/A	N/A	0.59	N
Naphthalene	0.005	µg/g	<0.005	Not Detected On Site	> 10 m	N/A	N/A	0.013	N
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.09	N
Phenanthrene	0.1	µg/g	3.04	MW5/17	>10 m	2017-08-31	3.35 - 3.66 m	0.046	Y
	0.05	µg/g	<0.05	Not Detected On Site	< 10 m	N/A	N/A	0.69	N
Pyrene	0.1	µg/g	3.9	MW5/17	>10 m	2017-08-31	3.35 - 3.66 m	10	N
	0.005	µg/g	0.065	BH11/17	< 10 m	2017-08-30	0.76 - 1.52 m	1	N
Benzo[a]pyrene Total Potency Equivalents	-	µg/g	0.012	MW5/17/MW9/17	> 10 m	2017-08-31/2017-08-31	3.35 - 3.66 m/2.29 - 3.05 m	0.6	N
	-	µg/g	0.121	BH12/17	< 10 m	2017-08-30	3.05 - 4.57 m	NV	N
Total PCBs	0.01	µg/g	<0.01	Not Detected On Site	>10 m	N/A	N/A	1.3	N
	0.01	µg/g	0.099	BH12/17	< 10 m	2017-08-30	3.05 - 4.57 m	0.3	N
4,4-DDD	0.6	ppm	0.048	MW-3	>10 m	1994-11-14	0 - 4.94 m	NV	N
	0.6	ppm	0.062	MW-1	< 10 m	1994-11-14	0 - 4.49 m	0.05	Y
4,4-DDT	1.8	ppm	0.102	MW-5	> 10 m	1994-11-14	0 - 3.0 m	0.7	N
	1.8	ppm	<1.8	Not Detected On Site	< 10 m	N/A	N/A	1.4	N
Dieldrin	0.3	ppm	<0.3	Not Detected On Site	>10 m	N/A	N/A	NV	N
	0.3	ppm	0.013	MW-1	< 10 m	1994-11-14	0 - 4.49 m	0.05	N
Methoxychlor	2.4	ppm	1.31	MW-5	> 10 m	1994-11-14	0 - 3.0 m	NV	N
	2.4	ppm	<2.4	Not Detected On Site	< 10 m	N/A	N/A	0.05	N

N/A - Not Applicable

Table 8 - BTEX and PHC in Groundwater

Location			MW1	MW3D	MW3S	MW5/17	MW6	MW7/17	MW8/17		MW9/17	MW10/17	FCSAP Residential/ Parkland Land Use Coarse	MOECC Table 9*
Sample ID			A0192	A0193	A0194	A0261	A0191	A0240	A0246	A0247 DUP of A0246	A0262	A0248		
Sample Date			2017-08-28	2017-08-28	2017-08-28	2017-09-01	2017-08-28	2017-08-31	2017-08-31	2017-08-31	2017-09-01	2017-08-31		
Sample Time			3:00:00 PM	5:15:00 PM	5:45:00 PM	8:05:00 AM	1:40:00 PM	9:10:00 AM	11:20:00 AM	11:25:00 AM	8:40:00 AM	12:35:00 PM		
Depth (m)		From	-	-	-	2.13	-	2.13	1.22	1.22	2.59	2.29		
		To	5.2	5.75	2.39	3.66	3.17	3.66	4.27	4.27	4.11	3.81		
Chemicals	Units	RDL	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results		
Analysis Date			2017-09-02	2017-09-02	2017-09-02	2017-09-07	2017-09-02	2017-09-05	2017-09-05	2017-09-05	2017-09-07	2017-09-05		
Benzene	µg/L	0.20	<0.20	<0.20	<0.20	0.30	<0.20	<0.20	<0.20	<0.20	<0.20	0.71	140	44
Ethylbenzene	µg/L	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	29	11000	1800
Toluene	µg/L	0.20	<0.20	<0.20	<0.20	0.26	<0.20	<0.20	0.27	0.30	<0.20	2.7	83	14000
o-Xylene	µg/L	0.20	<0.20	<0.20	<0.20	0.37	<0.20	<0.20	<0.20	<0.20	<0.20	170	3900	3300
p+m-Xylene	µg/L	0.20	<0.20	<0.20	<0.20	14	<0.20	0.34	<0.20	<0.20	<0.20	160		
Xylene (Total)	µg/L	0.20	<0.20	<0.20	<0.20	15	<0.20	0.34	<0.20	<0.20	<0.20	340		
F1 (C6-C10)	µg/L	25	<25	<25	<25	<25	<25	<25	<25	<25	<25	690	810	420
F1 (C6-C10) - BTEX	µg/L	25	<25	<25	<25	<25	<25	<25	<25	<25	<25	320		
Analysis Date			2017-09-05	2017-09-05	2017-09-05	2017-09-08	2017-09-05	2017-09-07	2017-09-07	2017-09-07	2017-09-08	2017-09-07	-	-
F2 (C10-C16 Hydrocarbons)	µg/L	100	<100	<100	<100	390	<100	<100	270	340	<100	530	1300	150
F3 (C16-C34 Hydrocarbons)	µg/L	200	260	<200	310	2600	<200	3700	4100	19000	<200	350	NV	500
F4 (C34-C50 Hydrocarbons)	µg/L	200	<200	<200	<200	2700	<200	2100	7300	9700	<200	530	NV	500
Reached Baseline at C50		-	Yes	Yes	Yes	No	Yes	No	No	No	Yes	No	-	-
Analysis Date			-	-	-	2017-09-11	-	2017-09-08	-	2017-09-08	-	2017-09-08	-	-
F4G-sg (Grav. Heavy Hydrocarbons)	µg/L	200	-	-	-	6000	-	6400	-	30000	-	1600	NV	500

BTEX - Benzene, Toluene, Ethylbenzene, Xylenes

PHC - Petroleum Hydrocarbons

RDL - Result Detection Limit

ND - No Data

NV - No Value

FCSAP Coarse - Federal Contaminated Sites Action Plan, Guidance Document on Federal Interim Groundwater Quality Guidelines for Federal Contaminated Sites, November 2012

MOECC Table 9 - Ministry of Environment and Climate Change, Soil, Ground Water And Sediment Standards For Use Under Part XV.1 of the Environmental Protection Act, Table 9 Generic Site Condition Standards for Use within 30 m of a Water Body in a Non-Potable Groundwater Condition, 2011

*MOECC Table 9 used within 10m of surface water

Results above applicable Standard

Table 9 - VOCs In Groundwater

Location			MW1	MW3D	MW3S	MW5/17	MW6	MW7/17	MW8/17		MW9/17	MW10/17	FCSAP Residential/ Parkland Land Use Coarse	MOECC Table 9*
Sample ID			A0192	A0193	A0194	A0261	A0191	A0240	A0246	A0247 DUP of A0246	A0262	A0248		
Sample Date			2017-08-28	2017-08-28	2017-08-28	2017-09-01	2017-08-28	2017-08-31	2017-08-31	2017-08-31	2017-09-01	2017-08-31		
Sample Time			3:00:00 PM	5:15:00 PM	5:45:00 PM	8:05:00 AM	1:40:00 PM	9:10:00 AM	11:20:00 AM	11:25:00 AM	8:40:00 AM	12:35:00 PM		
Depth (m)		From	-	-	-	2.13	-	2.13	1.22	1.22	2.59	2.29		
		To	5.2	5.75	2.39	3.66	3.17	3.66	4.27	4.27	4.11	3.81		
Chemicals	Units	RDL	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results		
Analysis Date			2017-09-02	2017-09-02	2017-09-02	2017-09-07	2017-09-02	2017-09-05	2017-09-05	2017-09-05	2017-09-07	2017-09-05		
Acetone (2-Propanone)	µg/L	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	15	13000	100000
Benzene	µg/L	0.20	<0.20	<0.20	<0.20	0.30	<0.20	<0.20	<0.20	<0.20	<0.20	0.71	140	44
Bromodichloromethane	µg/L	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	8500	67000
Bromoform	µg/L	1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	380	380
Bromomethane	µg/L	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	5.6	5.6
Carbon Tetrachloride	µg/L	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.56	0.79
Chlorobenzene	µg/L	0.20	3.1	0.73	<0.20	5.4	<0.20	0.37	<0.20	<0.20	<0.20	2.2	1.3	500
Chloroform	µg/L	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	1.8	2.4
Dibromochloromethane	µg/L	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	1100	65000
1,2-Dichlorobenzene	µg/L	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.7	4600
1,3-Dichlorobenzene	µg/L	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	42	7600
1,4-Dichlorobenzene	µg/L	0.50	<0.50	<0.50	<0.50	1.1	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	26	8
Dichlorodifluoromethane (FREON 12)	µg/L	1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	NV	3500
1,1-Dichloroethane	µg/L	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	320	320
1,2-Dichloroethane	µg/L	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	10	1.6
1,1-Dichloroethylene	µg/L	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	39	1.6
cis-1,2-Dichloroethylene	µg/L	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	1.6	1.6
trans-1,2-Dichloroethylene	µg/L	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	1.6	1.6
1,2-Dichloropropane	µg/L	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	16	16
cis-1,3-Dichloropropene	µg/L	0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	5.2	5.2
trans-1,3-Dichloropropene	µg/L	0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40		
Ethylbenzene	µg/L	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	29	11000	1800
Ethylene Dibromide	µg/L	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.25	0.25
Hexane	µg/L	1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	NV	51
Methyl Ethyl Ketone (2-Butanone)	µg/L	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	150000	470000
Methyl Isobutyl Ketone	µg/L	5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	58000	140000
Methyl t-butyl ether (MTBE)	µg/L	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	340	190
Methylene Chloride(Dichloromethane)	µg/L	2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	98	610
Styrene	µg/L	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	72	1300
1,1,1,2-Tetrachloroethane	µg/L	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	3.4	3.3
1,1,2,2-Tetrachloroethane	µg/L	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	3.2	3.2
Tetrachloroethylene	µg/L	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	110	1.6
Toluene	µg/L	0.20	<0.20	<0.20	<0.20	0.26	<0.20	<0.20	0.27	0.30	<0.20	2.7	83	14000
1,1,1-Trichloroethane	µg/L	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	640	640
1,1,2-Trichloroethane	µg/L	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	4.7	4.7
Trichloroethylene	µg/L	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	20	1.6
Trichlorofluoromethane (FREON 11)	µg/L	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	NV	2000
Vinyl Chloride	µg/L	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	1.1	0.5
o-Xylene	µg/L	0.20	<0.20	<0.20	<0.20	0.37	<0.20	<0.20	<0.20	<0.20	<0.20	170	3900	3300
p+m-Xylene	µg/L	0.20	<0.20	<0.20	<0.20	14	<0.20	0.34	<0.20	<0.20	<0.20	160		
Xylene (Total)	µg/L	0.20	<0.20	<0.20	<0.20	15	<0.20	0.34	<0.20	<0.20	<0.20	340		
Analysis Date			2017-09-06	2017-09-06	2017-09-06	2017-09-08	2017-09-06	2017-09-07	2017-09-07	2017-09-07	2017-09-08	2017-09-07	-	-
1,3-Dichloropropene (cis+trans)	µg/L	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	5.2	5.2

VOC - Volatile Organic Compounds

RDL - Result Detection Limit   ND - No Data   NV - No Value   *MOECC Table 9 used within 10m of surface water

FCSAP Coarse - Federal Contaminated Sites Action Plan, Guidance Document on Federal Interim Groundwater Quality Guidelines for Federal Contaminated Sites, November 2012

MOECC Table 9 - Ministry of Environment and Climate Change, Soil, Ground Water And Sediment Standards For Use Under Part XV.1 of the Environmental Protection Act, Table 9 Generic Site Condition Standards for Use within 30 m of a Water Body in a Non-Potable Groundwater Condition, 2011

Results above applicable Standard or Guideline   Results above CCME Guideline (<10m to water)

Table 10 - Metals and Inorganics In Groundwater

Location			MW1	MW3D	MW3S	MW5/17	MW6	MW7/17	MW8/17		MW9/17	MW10/17	FCSAP Residential/ Parkland Land Use Coarse	MOECC Table 9*
Sample ID			A0192	A0193	A0194	A0261	A0191	A0240	A0246	A0247 DUP of A0246	A0262	A0248		
Sample Date			2017-08-28	2017-08-28	2017-08-28	2017-09-01	2017-08-28	2017-08-31	2017-08-31	2017-08-31	2017-09-01	2017-08-31		
Sample Time			3:00:00 PM	5:15:00 PM	5:45:00 PM	8:05:00 AM	1:40:00 PM	9:10:00 AM	11:20:00 AM	11:25:00 AM	8:40:00 AM	12:35:00 PM		
Depth (m)		From	-	-	-	2.13	-	2.13	1.22	1.22	2.59	2.29		
		To	5.2	5.75	2.39	3.66	3.17	3.66	4.27	4.27	4.11	3.81		
Chemicals	Units	RDL	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results		
Analysis Date			2017-09-05	2017-09-05	2017-09-05	2017-09-08	2017-09-05	2017-09-07	2017-09-07	2017-09-07	2017-09-08	2017-09-07		
Dissolved Aluminum (Al)	µg/L	3.0	-	-	-	<3.0	-	8.10	6.70	7.50	6.20	6.40	NV	-
Dissolved Antimony (Sb)	µg/L	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	2.63	2000	16000
Dissolved Arsenic (As)	µg/L	0.10	-	-	-	3.33	-	2.19	0.43	0.31	2.16	4.74	5	1500
		1.0	<1.0	12	<1.0	-	<1.0	-	-	-	-	-		
Dissolved Barium (Ba)	µg/L	1.0	-	-	-	399	-	182	152	149	410	581	500	23000
		2.0	120	500	150	-	110	-	-	-	-	-		
Dissolved Beryllium (Be)	µg/L	0.1	-	-	-	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	5.3	53
		0.50	<0.50	<0.50	<0.50	-	<0.50	-	-	-	-	-		
Dissolved Bismuth (Bi)	µg/L	1.0	-	-	-	<1.0	-	<1.0	<1.0	<1.0	<1.0	<1.0	NV	NV
Dissolved Boron (B)	µg/L	10	23	33	24	-	25	-	-	-	-	-	5000	36000
		50	-	-	-	52	-	<50	<50	<50	55	109		
Dissolved Cadmium (Cd)	µg/L	0.01	-	-	-	<0.010	-	<0.010	<0.010	<0.010	0.024	<0.010	0.017	2.1
		0.10	<0.10	<0.10	<0.10	-	<0.10	-	-	-	-	-		
Dissolved Chromium (Cr)	µg/L	1.0	-	-	-	<1.0	-	<1.0	<1.0	<1.0	<1.0	<1.0	8.9	640
		5.0	<5.0	<5.0	<5.0	-	<5.0	-	-	-	-	-		
Dissolved Cobalt (Co)	µg/L	0.20	-	-	-	0.81	-	1.19	<0.20	<0.20	7.78	2.15	NV	52
		0.50	<0.50	1.9	0.71	-	0.56	-	-	-	-	-		
Dissolved Copper (Cu)	µg/L	0.20	-	-	-	<0.20	-	<0.20	<0.20	<0.20	0.23	<0.20	NV	69
		1.0	<1.0	<1.0	<1.0	-	<1.0	-	-	-	-	-		
Dissolved Iron (Fe)	µg/L	5.0	-	-	-	19800	-	18700	8790	8770	138	24800	300	-
		100	9400	34000	10000	-	1700	-	-	-	-	-		
Dissolved Lead (Pb)	µg/L	0.20	-	-	-	<0.20	-	0.29	<0.20	<0.20	<0.20	0.24	NV	20
		0.50	<0.50	<0.50	<0.50	-	<0.50	-	-	-	-	-		
Dissolved Lithium (Li)	µg/L	2.0	-	-	-	3.30	-	<2.0	<2.0	<2.0	<2.0	7.60	NV	NV
Mercury (Hg)	µg/L	0.1	<0.10	<0.10	<0.10	-	<0.10	-	-	-	-	-	NV	0.29
Dissolved Manganese (Mn)	µg/L	1.0	-	-	-	666	-	1100	684	691	4930	1330	NV	NV
Dissolved Molybdenum (Mo)	µg/L	0.50	0.57	0.81	<0.50	-	0.86	-	-	-	-	-	73	7300
		1.0	-	-	-	1.1	-	1.60	<1.0	<1.0	1.8	3.30		
Dissolved Nickel (Ni)	µg/L	1.0	<1.0	<1.0	7.9	1.5	1.2	1.30	<1.0	<1.0	7.1	1.80	NV	390
Dissolved Selenium (Se)	µg/L	0.10	-	-	-	<0.10	-	<0.10	<0.10	<0.10	0.11	<0.10	1	50
		2.0	<2.0	<2.0	<2.0	-	<2.0	-	-	-	-	-		
Dissolved Silicon (Si)	µg/L	100	-	-	-	6360	-	5040	5300	5370	5650	12200	NV	NV
Dissolved Silver (Ag)	µg/L	0.02	-	-	-	<0.020	-	<0.020	<0.020	<0.020	<0.020	<0.020	0.1	1.2
		0.10	<0.10	<0.10	<0.10	-	<0.10	-	-	-	-	-		
Dissolved Strontium (Sr)	µg/L	1.0	-	-	-	253	-	162	168	171	259	323	NV	NV
Dissolved Sodium (Na)	µg/L	100	6700	120000	6600	-	15000	-	-	-	-	-	NV	1800000
	mg/L	0.050	-	-	-	40.4	-	10.9	89.9	89.0	141	14.1		
Dissolved Thallium (Tl)	µg/L	0.01	-	-	-	<0.01	-	<0.01	<0.01	<0.01	0.287	<0.01	0.8	400
		0.05	<0.50	<0.50	<0.50	-	<0.50	-	-	-	-	-		
Dissolved Tin (Sn)	µg/L	5.0	-	-	-	<5.0	-	<5.0	<5.0	<5.0	<5.0	<5.0	NV	NV
Dissolved Titanium (Ti)	µg/L	5.0	-	-	-	<5.0	-	<5.0	<5.0	<5.0	<5.0	<5.0	NV	NV
Dissolved Uranium (U)	µg/L	0.10	<0.10	<0.10	<0.10	0.16	0.31	<0.10	<0.10	<0.10	0.66	0.13	15	330
Dissolved Vanadium (V)	µg/L	0.50	<0.50	<0.50	<0.50	-	<0.50	-	-	-	-	-	NV	200
		5.0	-	-	-	<5.0	-	<5.0	<5.0	<5.0	<5.0	<5.0		
Dissolved Zinc (Zn)	µg/L	5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	10	890
Dissolved Zirconium (Zr)	µg/L	0.1	-	-	-	<0.1	-	<0.1	<0.1	<0.1	0.24	<0.10	NV	NV
Dissolved Calcium (Ca)	mg/L	0.05	-	-	-	82.5	-	58.9	67.2	65.5	148	109	NV	NV
Dissolved Magnesium (Mg)	mg/L	0.05	-	-	-	10.7	-	10.9	11.5	11.5	22.8	14.4	NV	NV
Dissolved Potassium (K)	mg/L	0.05	-	-	-	1.68	-	1.28	1.46	1.49	3.07	3.52	NV	NV
Dissolved Sulphur (S)	mg/L	3.0	-	-	-	<3.0	-	<3.0	<3.0	<3.0	7.30	<3.0	NV	NV
Analysis Date			2017-09-01	2017-09-01	2017-09-01	-	2017-09-01	-	-	-	-	-	-	-
Chloride (Cl)	mg/L	1.0	11	-	11	-	15	-	-	-	-	-	120	1800
	mg/L	3.0	-	220	-	-	-	-	-	-	-	-		
Analysis Date			2017-09-01	2017-09-01	2017-09-01	-	2017-09-01	-	-	-	-	-	-	-
Free Cyanide	µg/L	1	<1	<1	<1	-	<1	-	-	-	-	-	0.001	52
Analysis Date			2017-08-13	2017-08-13	2017-08-13	-	2017-08-13	-	-	-	-	-	-	-
Chromium (VI)	µg/L	0.5	<0.5	<0.5	<0.5	-	<0.5	-	-	-	-	-	NV	110
Analysis Date			-	-	-	2017-09-11	-	2017-09-08	2017-09-08	2017-09-08	2017-09-11	2017-09-08	-	-
Dissolved Hardness	mg/L	0.5	-	-	-	463	-	192	215	211	250	332	NV	-

RDL - Result Detection Limit　　*MOECC Table 9 used within 10m of surface water

ND - No Data

NV - No Value

FCSAP Coarse - Federal Contaminated Sites Action Plan, Guidance Document on Federal Interim Groundwater Quality Guidelines for Federal Contaminated Sites, November 2012

MOECC Table 9 - Ministry of Environment and Climate Change, Soil, Ground Water And Sediment Standards For Use Under Part XV.1 of the Environmental Protection Act, Table 9 Generic Site Condition Standards for Use within 30 m of a Water Body in a Non-Potable Groundwater Condition, 2011

Results above applicable Standard or Guideline	Result above FCSAP Guideline (<10m to water)
RDL above applicable Standard or Guideline	

Table 10 - Metals and Inorganics In Groundwater con't

Location			MW5/17	MW7/17	MW8/17		MW9/17	MW10/17	FCSAP Residential/ Parkland Land Use Coarse	MOECC Table 9*
Sample ID			A0261	A0240	A0246	A0247 DUP of A0246	A0262	A0248		
Sample Date			2017-09-01	2017-08-31	2017-08-31	2017-08-31	2017-09-01	2017-08-31		
Sample Time			8:05:00 AM	9:10:00 AM	11:20:00 AM	11:25:00 AM	8:40:00 AM	12:35:00 PM		
Depth (m)		From	2.13	2.13	1.22	1.22	2.59	2.29		
		To	3.66	3.66	4.27	4.27	4.11	3.81		
Chemicals	Units	RDL	Results	Results	Results	Results	Results	Results		
Analysis Date			2017-09-08	2017-09-07	2017-09-07	2017-09-07	2017-09-08	2017-09-07		
Mercury (Hg)	µg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NV	0.29
Analysis Date			2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	2017-09-07	-	-
Flouride (F-)	mg/L	0.1	0	0.12	<0.1	<0.1	<0.1	<0.1	0.12	-
Chromium (VI)	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NV	110
Analysis Date			2017-09-07	2017-09-05	2017-09-05	2017-09-05	2017-09-07	2017-09-05	-	-
Dissolved Chloride (Cl)	mg/L	1.0	68	9.5	140	140	-	22	120	1800
	mg/L	3.0	-	-	-	-	220	-		
Analysis Date			2017-09-07	2017-09-08	2017-09-08	2017-09-08	2017-09-07	2017-09-08	-	-
Free Cyanide	µg/L	1	1.2	2.3	<1	<1	<1	<1	0.001	52
Analysis Date			2017-09-07	2017-09-06	2017-09-06	2017-09-06	2017-09-07	2017-09-06	-	-
Available (CaCl2) pH	s.u.	-	7.42	6.93	6.97	7.21	7.61	6.81	6.5 to 9	5 to 9
Dissolved Sulphate (SO4)	mg/L	1.0	1.2	6.3	6.3	6.2	22	5.2	100	-
Nitrate + Nitrite (N)	mg/L	0.1	<0.1	<0.1	<0.1	<0.1	0.15	<0.1	13	-

RDL - Result Detection Limit

*MOECC Table 9 used within 10m of surface water

ND - No Data

NV - No Value

FCSAP Coarse - Federal Contaminated Sites Action Plan, Guidance Document on Federal Interim Groundwater Quality Guidelines for Federal Contaminated Sites, November 2012

MOECC Table 9 - Ministry of Environment and Climate Change, Soil, Ground Water And Sediment Standards For Use Under Part XV.1 of the Environmental Protection Act, Table 9 Generic Site Condition Standards for Use within 30 m of a Water Body in a Non-Potable Groundwater Condition, 2011

Results above applicable Standard or Guideline

Results above CCME Guideline (<10m to water)

RDL above applicable Standard or Guideline

Table 11 - PAH In Groundwater

Location			MW1	MW3D		MW5/17	MW9/17	MW10/17	FCSAP Residential/ Parkland Land Use Coarse	MOECC Table 9*
Sample ID			A0192	A0193		A0261	A0262	A0248		
Sample Date			2017-08-28	2017-08-28		2017-09-01	2017-09-01	2017-08-31		
Sample Time			3:00:00 PM	5:15:00 PM		8:05:00 AM	8:40:00 AM	12:35:00 PM		
Depth (m)		From	-	-		2.13	2.59	2.29		
		To	5.2	5.75		3.66	4.11	3.81		
Chemicals	Units	RDL	Results	Results		Results	Results	Results		
Analysis Date			2017-09-02	2017-09-02	RDL-->	2017-09-07	2017-09-07	2017-09-07		
Acenaphthene	µg/L	0.050	0.59	0.11	0.01	1.0	<0.01	0.46	5.8	600
Acenaphthylene	µg/L	0.050	<0.050	<0.050	0.01	0.024	<0.01	0.013	46	1.4
Anthracene	µg/L	0.050	0.085	<0.050	0.01	0.12	<0.01	0.053	0.012	1
Benzo(a)anthracene	µg/L	0.050	<0.050	<0.050	0.01	0.063	<0.01	0.060	0.018	1.8
Benzo(a)pyrene	µg/L	0.010	<0.050	<0.050	0.01	0.060	<0.01	0.055	0.01	0.81
Benzo(b/j)fluoranthene	µg/L	0.050	<0.050	<0.050	0.01	0.079	<0.01	0.055	0.48	0.75
Benzo(g,h,i)perylene	µg/L	0.050	<0.050	<0.050	0.01	0.061	<0.01	0.059	0.17	0.2
Benzo(k)fluoranthene	µg/L	0.050	<0.050	<0.050	0.01	0.032	<0.01	0.022	0.48	0.4
Chrysene	µg/L	0.050	<0.050	<0.050	0.01	0.068	<0.01	0.062	0.1	0.7
Dibenz(a,h)anthracene	µg/L	0.050	<0.050	<0.050	0.01	0.015	<0.01	<0.01	0.26	0.4
Fluoranthene	µg/L	0.050	0.11	<0.050	0.01	0.42	0.010	0.18	0.04	73
Fluorene	µg/L	0.050	0.53	<0.050	0.01	0.87	<0.01	0.45	3	290
Indeno(1,2,3-cd)pyrene	µg/L	0.050	<0.050	<0.050	0.01	0.054	<0.01	0.049	0.21	0.2
1-Methylnaphthalene	µg/L	0.050	0.26	0.23	0.01	2.1	0.012	6.0	180	1500
2-Methylnaphthalene	µg/L	0.050	<0.050	<0.050	0.01	0.19	0.015	7.8		
Naphthalene	µg/L	0.050	<0.050	<0.050	0.01	0.31	0.016	27	1.1	1400
Phenanthrene	µg/L	0.030	0.56	0.051	0.01	0.94	0.016	0.33	0.4	380
Pyrene	µg/L	0.050	0.072	<0.050	0.01	0.24	0.013	0.12	0.025	6
Analysis Date			2017-09-07	2017-09-07	-	-	-	-	-	-
Methylnaphthalene, 2-(1-)	µg/L	0.0710	0.26	0.23	0.0710	-	-	-	180	1500

PAH - Polycyclic Aromatic Hydrocarbons

*MOECC Table 9 used within 10m of surface water

RDL - Result Detection Limit

ND - No Data

NV - No Value

FCSAP Coarse - Federal Contaminated Sites Action Plan, Guidance Document on Federal Interim Groundwater Quality Guidelines for Federal Contaminated Sites, November 2012

MOECC Table 9 - Ministry of Environment and Climate Change, Soil, Ground Water And Sediment Standards For Use Under Part XV.1 of the Environmental Protection Act, Table 9 Generic Site Condition Standards for Use within 30 m of a Water Body in a Non-Potable Groundwater Condition, 2011

Results above applicable Standard or Guideline

Results above CCME Guideline (<10m to water)

RDL above applicable Standard or Guideline

Table 12 - PCBs In Groundwater

Location			MW1	MW3D	MW5/17	MW9/17	MW10/17	MOECC Table 9
Sample ID			A0192	A0193	A0261	A0262	A0248	
Sample Date			2017-08-28	2017-08-28	2017-09-01	2017-09-01	2017-08-31	
Sample Time			3:00:00 PM	5:15:00 PM	8:05:00 AM	8:40:00 AM	12:35:00 PM	
Depth (m)		From	-	-	2.13	2.59	2.29	
		To	5.2	5.75	3.66	4.11	3.81	
Chemicals	Units	RDL	Results	Results	Results	Results	Results	
Analysis Date			2017-09-01	2017-09-01	2017-09-07	2017-09-07	2017-09-06	
Total PCBs	µg/L	0.01	-	-	0.79[1]	-	0.51[1]	0.2
	µg/L	0.05	0.17	-	-	<0.05[1]	-	
	µg/L	0.5	-	<0.5[1]	-	-	-	

PCB - Polychlorinated Biphenyl

RDL - Result Detection Limit

[1]MOECC Table 3 (7.8 µg/L) used due to >10m from water

MOECC Table 9 - Ministry of Environment and Climate Change, Soil, Ground Water And Sediment Standards For Use Under Part XV.1 of the Environmental Protection Act, Table 9 Generic Site Condition Standards for Use within 30 m of a Water Body in a Non-Potable Groundwater Condition, 2011

Results above applicable Standard

RDL above applicable Standard

Table 13 Groundwater Contaminant Inventory

Contaminant	Result Detection Limit (RDL)	Units	Maximum Measured Concentration	Location Name	Distance from Surface Water	Sampling Date	Applicable Guideline/Standard Value	Exceedance
PHC F1 (C6-C10)	25	µg/L	320	MW10/17	>10 m	2017-08-31	810	N
	25	µg/L	<25	Not Detected On Site	< 10 m	N/A	420	Y
PHC F2 (C10-C16)	100	µg/L	530	MW10/17	>10 m	2017-08-31	1300	N
	100	µg/L	<100	Not Detected On Site	< 10 m	N/A	150	Y
PHC F3 (C16-C34)	200	µg/L	19000	MW8/17	>10 m	2017-08-31	NV	N
	200	µg/L	3700	MW7/17	< 10 m	2017-08-31	500	Y
PHC F4 (C34-C50)	200	µg/L	9700	MW8/17	>10 m	2017-08-31	NV	N
	200	µg/L	2100	MW7/17	< 10 m	2017-08-31	500	Y
PHC F4 (Grav. Heavy Hydrocarbons)	200	µg/L	30000	MW8/17	>10 m	2017-08-31	NV	N
	200	µg/L	6400	MW7/17	< 10 m	2017-08-31	500	Y

Table 13 Groundwater Contaminant Inventory

Contaminant	Result Detection Limit (RDL)	Units	Maximum Measured Concentration	Location Name	Distance from Surface Water	Sampling Date	Applicable Guideline/Standard Value	Exceedance
Hardness	1.0	mg/L	473	MW-4	> 10 m	2006-08-02	NV	N
	0.5	mg/L	192	MW7/17	< 10 m	2017-08-31	NV	N
Dissolved Sulphate	1.0	mg/L	22	MW9/17	> 10 m	2017-09-01	100	N
	1.0	mg/L	6.3	MW7/17	< 10 m	2017-08-31	NV	N
Nitrate + Nitrite	0.1	mg/L	0.15	MW9/17	> 10 m	2017-09-01	13	N
	0.1	mg/L	<0.1	Not Detected On Site	< 10 m	N/A	NV	N
Cyanide (Free)	1.0	µg/L	1.2	MW5/17	> 10 m	2017-09-01	0.001	Y
	1.0	µg/L	2.3	MW7/17	< 10 m	2017-08-31	52	N
Fluoride	0.1	mg/L	0.12	MW5/17	> 10 m	2017-09-01	0.12	N
	0.1	mg/L	0.12	MW7/17	< 10 m	2017-08-31	NV	N
Chloride	3.0	mg/L	220	MW-3D/MW9/17	> 10 m	2017-08-28/2017-09-01	120	Y
	1.0	mg/L	11	MW-1	< 10 m	2017-08-28	1800	N
Calcium	0.5	mg/L	198	MW-3	> 10 m	2000-09-19	NV	N
	0.5	mg/L	90	MW-1	< 10 m	2000-06-28	NV	N
Alunimum	10	µg/L	850	MW-6	> 10 m	1999-08-12	NV	N
	10	µg/L	137	MW-1	< 10 m	1994-11-20	NV	N
Antimony	0.5	µg/L	70.6	MW-3	> 10 m	2000-09-19	2000	N
	0.5	µg/L	6	MW-1	< 10 m	2000-06-28	16000	N
Arsenic	0.2	µg/L	47.2	MW-3	>10 m	2011-07-19	5	Y
	0.1	µg/L	2.19	MW7/17	< 10 m	2017-08-31	1500	N
Barium	5.0	µg/L	2400	MW-3D	> 10 m	2000-06-28	500	Y
	5.0	µg/L	1640	MW-1	< 10 m	2000-06-28	23000	N
Beryllium	5.0	µg/L	<5.0	Not Detected On Site	> 10 m	N/A	5.3	N
	5.0	µg/L	<5.0	Not Detected On Site	< 10 m	N/A	53	N
Bismuth	2.0	µg/L	<2.0	Not Detected On Site	> 10 m	N/A	NV	N
	2.0	µg/L	<2.0	Not Detected On Site	< 10 m	N/A	NV	N
Boron (total)	6.0	µg/L	2870	MW-3	>10 m	2000-09-19	5000	N
	5.0	µg/L	251	MW-1	< 10 m	2000-06-28	36000	N
Cadmium	0.5	µg/L	<0.5	Not Detected On Site	> 10 m	N/A	0.017	N
	0.5	µg/L	<0.5	Not Detected On Site	< 10 m	N/A	2.1	N
Chromium (Total)	5.0	µg/L	71	MW-6	> 10 m	2000-06-28	8.9	Y
	5.0	µg/L	6	MW-1	< 10 m	2000-06-28	640	N
Chromium (VI)	1.0	µg/L	<1.0	Not Detected On Site	> 10 m	N/A	NV	N
	1.0	µg/L	<1.0	Not Detected On Site	< 10 m	N/A	110	N
Cobalt	0.1	µg/L	220	MW-3	>10 m	2011-07-19	NV	N
	0.2	µg/L	1.19	MW7/17	< 10 m	2017-08-31	52	N
Copper	2.0	µg/L	100	MW-3	> 10 m	1999-08-12	NV	N
	2.0	µg/L	<2.0	Not Detected On Site	< 10 m	N/A	69	N
Iron	30.0	µg/L	72000	MW-4	>10 m	2000-09-19	300	Y
	30.0	µg/L	34750	MW-1	< 10 m	2000-06-28	NV	N
Lead	0.5	µg/L	6.3	MW-3D	> 10 m	2000-06-28	NV	N
	0.1	µg/L	9.2	MW-1	< 10 m	1999-08-12	20	N
Lithium	2.0	µg/L	7.6	MW10/17	> 10 m	2017-08-31	NV	N
	0.5	µg/L	2.1	MW-1	< 10 m	2011-07-19	NV	N
Manganese	1.0	µg/L	4930	MW9/17	>10 m	2017-09-01	NV	N
	1.0	µg/L	1100	MW7/17	< 10 m	2017-08-31	NV	N
Magnesium	0.1	mg/L	75.1	MW-3	> 10 m	2000-09-19	NV	N
	0.1	mg/L	13.4	MW-1	< 10 m	2000-06-28	NV	N
Mercury	0.1	µg/L	1.07	MW-2	> 10 m	2006-08-02	NV	N
	0.1	µg/L	<0.1	Not Detected On Site	< 10 m	N/A	0.29	N
Molybdenum	1.0	µg/L	12	MW-3	> 10 m	2000-09-19	73	N
	2.0	µg/L	10	MW-1	< 10 m	1994-11-20	7300	N
Nickel	2.0	µg/L	16	MW-3	> 10 m	1999-08-12	NV	N
	10	µg/L	<10	Not Detected On Site	< 10 m	N/A	390	N
Phosphorous	0.1	mg/L	25	MW-3	>10 m	2011-07-19	NV	N
	0.01	mg/L	1.26	MW-1	< 10 m	2006-08-02	NV	N
Potassium	100	µg/L	6800	MW-4	>10 m	2000-09-19	NV	N
	100	µg/L	12650	MW-1	< 10 m	2000-09-19	NV	N
Sodium	100	µg/L	184000	MW-3	>10 m	2000-09-19	NV	N
	100	µg/L	30700	MW-1	< 10 m	2000-06-28	1800000	N
Selenium	2.0	µg/L	<2.0	Not Detected On Site	> 10 m	N/A	1	N
	2.0	µg/L	<2.0	Not Detected On Site	< 10 m	N/A	50	N
Silicon	100	µg/L	12200	MW10/17	>10 m	2017-08-31	NV	N
	100	µg/L	5040	MW7/17	< 10 m	2017-08-31	NV	N
Silver	0.5	µg/L	<0.5	Not Detected On Site	> 10 m	N/A	0.1	N
	0.1	µg/L	<0.1	Not Detected On Site	< 10 m	N/A	1.2	N
Strontium	1.0	µg/L	3370	MW-3	>10 m	2000-09-19	NV	N
	1.0	µg/L	459.5	MW-1	< 10 m	2000-06-28	NV	N
Sulphur	3.0	mg/L	7.3	MW9/17	> 10 m	2017-09-01	NV	N
	3.0	mg/L	<3.0	MW7/17	< 10 m	2017-08-31	NV	N
Thallium	0.1	µg/L	<0.1	Not Detected On Site	> 10 m	N/A	0.8	N
	0.5	µg/L	<0.5	Not Detected On Site	< 10 m	N/A	400	N
Tin	2.0	µg/L	3	MW-4	> 10 m	1999-08-12	NV	N
	5.0	µg/L	<5.0	Not Detected On Site	< 10 m	N/A	NV	N
Titanium	2.0	µg/L	26	MW-6	>10 m	1999-08-12	NV	N
	2.0	µg/L	10	MW-1	< 10 m	1999-08-12	NV	N
Tungsten	10	µg/L	<10	Not Detected On Site	> 10 m	N/A	NV	N
	10	µg/L	<10	Not Detected On Site	< 10 m	N/A	NV	N
Uranium	0.1	µg/L	1.1	MW-2	>10 m	1999-08-12	15	N
	0.1	µg/L	<0.1	Not Detected On Site	< 10 m	N/A	330	N
Vanadium	0.2	µg/L	0.7	MW-4	> 10 m	2011-07-19	NV	N
	5.0	µg/L	<5.0	Not Detected On Site	< 10 m	N/A	200	N
Zinc	5.0	µg/L	574	MW-4	> 10 m	2000-09-19	10	Y
	5.0	µg/L	388	MW-1	< 10 m	2000-06-28	890	N
Zirconium	3.0	µg/L	<3.0	Not Detected On Site	> 10 m	N/A	NV	N
	3.0	µg/L	<3.0	Not Detected On Site	< 10 m	N/A	NV	N

Table 13 Groundwater Contaminant Inventory

Contaminant	Result Detection Limit (RDL)	Units	Maximum Measured Concentration	Location Name	Distance from Surface Water	Sampling Date	Applicable Guideline/Standard Value	Exceedance
Acetone (2-Propanone)	10	µg/L	15	MW10/17	>10 m	2017-08-31	13000	N
	10	µg/L	<10	Not Detected On Site	< 10 m	N/A	100000	N
Benzene	1.0	µg/L	3.8	MW-3D	> 10 m	1994-11-20	140	N
	0.1	µg/L	0.9	MW-1	< 10 m	1999-08-12	44	N
Bromodichloromethane	0.5	µg/L	<0.5	Not Detected On Site	> 10 m	N/A	8500	N
	0.5	µg/L	<0.5	Not Detected On Site	< 10 m	N/A	67000	N
Bromoform	1.0	µg/L	<1.0	Not Detected On Site	> 10 m	N/A	380	N
	1.0	µg/L	<1.0	Not Detected On Site	< 10 m	N/A	380	N
Bromomethane	0.5	µg/L	<0.5	Not Detected On Site	> 10 m	N/A	5.6	N
	0.5	µg/L	<0.5	Not Detected On Site	< 10 m	N/A	5.6	N
Carbon Tetrachloride	0.2	µg/L	<0.2	Not Detected On Site	> 10 m	N/A	0.56	N
	0.2	µg/L	<0.2	Not Detected On Site	< 10 m	N/A	0.79	N
Chlorobenzene	0.2	µg/L	13.4	MW-2	> 10 m	1994-11-20	1.3	Y
	0.2	µg/L	11.4	MW-1	< 10 m	1999-08-12	500	N
Chloroethane	0.5	µg/L	<0.5	Not Detected On Site	> 10 m	N/A	NV	N
	0.5	µg/L	<0.5	Not Detected On Site	< 10 m	N/A	NV	N
Chloroform	0.2	µg/L	<0.2	Not Detected On Site	> 10 m	N/A	1.8	N
	0.2	µg/L	<0.2	Not Detected On Site	< 10 m	N/A	2.4	N
Chloromethane	1.0	µg/L	<1.0	Not Detected On Site	> 10 m	N/A	NV	N
	1.0	µg/L	<1.0	Not Detected On Site	< 10 m	N/A	NV	N
Dibromochloromethane	0.5	µg/L	<0.5	Not Detected On Site	> 10 m	N/A	1100	N
	0.5	µg/L	<0.5	Not Detected On Site	< 10 m	N/A	65000	N
1,2-Dichlorobenzene	0.2	µg/L	1	MW-2	> 10 m	1994-11-20	0.7	Y
	0.5	µg/L	<0.5	Not Detected On Site	< 10 m	N/A	4600	N
1,3-Dichlorobenzene	0.2	µg/L	2.9	MW-5	> 10 m	1994-11-20	42	N
	0.5	µg/L	<0.5	Not Detected On Site	< 10 m	N/A	7600	N
1,4-Dichlorobenzene	0.2	µg/L	2.6	MW-5	> 10 m	1994-11-20	56	N
	0.2	µg/L	0.8	MW-1	< 10 m	1999-08-12	8	N
Dichlorodifluoromethane (FREON 12)	1.0	µg/L	<1.0	Not Detected On Site	> 10 m	N/A	NV	N
	1.0	µg/L	<1.0	Not Detected On Site	< 10 m	N/A	3500	N
1,1-Dichloroethane	0.2	µg/L	<0.2	Not Detected On Site	> 10 m	N/A	320	N
	0.2	µg/L	<0.2	Not Detected On Site	< 10 m	N/A	320	N
1,2-Dichloroethane	0.5	µg/L	<0.5	Not Detected On Site	> 10 m	N/A	10	N
	0.5	µg/L	<0.5	Not Detected On Site	< 10 m	N/A	1.6	N
1,1-Dichloroethylene	0.2	µg/L	<0.2	Not Detected On Site	> 10 m	N/A	39	N
	0.2	µg/L	<0.2	Not Detected On Site	< 10 m	N/A	1.6	N
cis-1,2-Dichloroethylene	0.5	µg/L	<0.5	Not Detected On Site	> 10 m	N/A	1.6	N
	0.5	µg/L	<0.5	Not Detected On Site	< 10 m	N/A	1.6	N
trans-1,2-Dichloroethylene	0.5	µg/L	<0.5	Not Detected On Site	> 10 m	N/A	1.6	N
	0.5	µg/L	<0.5	Not Detected On Site	< 10 m	N/A	1.6	N
1,2-Dichloropropane	0.2	µg/L	<0.2	Not Detected On Site	> 10 m	N/A	16	N
	0.2	µg/L	<0.2	Not Detected On Site	< 10 m	N/A	16	N
cis-1,3-Dichloropropene	0.3	µg/L	<0.3	Not Detected On Site	> 10 m	N/A	5.2	N
	0.3	µg/L	<0.3	Not Detected On Site	< 10 m	N/A	5.2	N
trans-1,3-Dichloropropene	0.4	µg/L	<0.4	Not Detected On Site	> 10 m	N/A	5.2	N
	0.4	µg/L	<0.4	Not Detected On Site	< 10 m	N/A	5.2	N
1,3-Dichloropropene (cis+trans)	0.5	µg/L	<0.5	Not Detected On Site	> 10 m	N/A	5.2	N
	0.5	µg/L	<0.5	Not Detected On Site	< 10 m	N/A	5.2	N
Ethylbenzene	0.2	µg/L	29	MW10/17	>10 m	2017-08-31	11000	N
	1.0	µg/L	18.4	MW-1	< 10 m	1994-11-20	1800	N
Ethylene Dibromide	0.2	µg/L	<0.2	Not Detected On Site	> 10 m	N/A	0.25	N
	0.2	µg/L	<0.2	Not Detected On Site	< 10 m	N/A	0.25	N
Hexane	1.0	µg/L	<1.0	Not Detected On Site	> 10 m	N/A	NV	N
	1.0	µg/L	<1.0	Not Detected On Site	< 10 m	N/A	51	N
2-Hexanone	5.0	µg/L	<5.0	Not Detected On Site	> 10 m	N/A	NV	N
	5.0	µg/L	<5.0	Not Detected On Site	< 10 m	N/A	NV	N
Methyl Ethyl Ketone (2-Butanone)	10	µg/L	<10	Not Detected On Site	> 10 m	N/A	150000	N
	10	µg/L	<10	Not Detected On Site	< 10 m	N/A	470000	N
Methyl Isobutyl Ketone	5.0	µg/L	<5.0	Not Detected On Site	> 10 m	N/A	58000	N
	5.0	µg/L	<5.0	Not Detected On Site	< 10 m	N/A	140000	N
Methyl t-butyl ether (MTBE)	0.5	µg/L	<0.5	Not Detected On Site	> 10 m	N/A	340	N
	0.5	µg/L	<0.5	Not Detected On Site	< 10 m	N/A	190	N
Methylene Chloride(Dichloromethane)	2.0	µg/L	<2.0	Not Detected On Site	> 10 m	N/A	98	N
	2.0	µg/L	<2.0	Not Detected On Site	< 10 m	N/A	610	N
Styrene	0.6	µg/L	<0.6	Not Detected On Site	> 10 m	N/A	72	N
	0.6	µg/L	<0.6	Not Detected On Site	< 10 m	N/A	1300	N
1,1,1,2-Tetrachloroethane	0.5	µg/L	<0.5	Not Detected On Site	> 10 m	N/A	3.4	N
	0.5	µg/L	<0.5	Not Detected On Site	< 10 m	N/A	3.3	N
1,1,2,2-Tetrachloroethane	0.5	µg/L	<0.5	Not Detected On Site	> 10 m	N/A	3.2	N
	0.5	µg/L	<0.5	Not Detected On Site	< 10 m	N/A	3.2	N
Tetrachloroethylene	0.2	µg/L	<0.2	Not Detected On Site	> 10 m	N/A	110	N
	0.2	µg/L	<0.2	Not Detected On Site	< 10 m	N/A	1.6	N
Toluene	0.2	µg/L	2.7	MW10/17	>10 m	2017-08-31	83	N
	0.2	µg/L	<0.20	Not Detected On Site	< 10 m	N/A	14000	N
1,1,1-Trichloroethane	0.2	µg/L	<0.2	Not Detected On Site	> 10 m	N/A	640	N
	0.2	µg/L	<0.2	Not Detected On Site	< 10 m	N/A	640	N
1,1,2-Trichloroethane	0.5	µg/L	<0.5	Not Detected On Site	> 10 m	N/A	4.7	N
	0.5	µg/L	<0.5	Not Detected On Site	< 10 m	N/A	4.7	N
Trichloroethylene	0.2	µg/L	3.3	MW-2	> 10 m	1994-11-20	20	N
	0.2	µg/L	<0.2	Not Detected On Site	< 10 m	N/A	1.6	N
Trichlorofluoromethane (FREON 11)	0.5	µg/L	<0.5	Not Detected On Site	> 10 m	N/A	NV	N
	0.5	µg/L	<0.5	Not Detected On Site	< 10 m	N/A	2000	N
Vinyl Chloride	0.5	µg/L	<0.5	Not Detected On Site	> 10 m	N/A	1.1	N
	0.5	µg/L	<0.5	Not Detected On Site	< 10 m	N/A	0.5	N
o-Xylene	0.2	µg/L	170	MW10/17	>10 m	2017-08-31	NV	N
	1.0	µg/L	38.7	MW-1	< 10 m	1994-11-20	NV	N
p+m-Xylene	0.2	µg/L	338	MW-4	>10 m	1999-08-12	NV	N
	1.0	µg/L	133	MW-1	< 10 m	1994-11-20	NV	N
Xylene (Total)	0.2	µg/L	340	MW10/17	>10 m	2017-08-31	3900	N
	0.2	µg/L	0.34	MW7/17	< 10 m	2017-08-31	3300	N

Table 13 Groundwater Contaminant Inventory

Contaminant	Result Detection Limit (RDL)	Units	Maximum Measured Concentration	Location Name	Distance from Surface Water	Sampling Date	Applicable Guideline/Standard Value	Exceedance
Acenaphthene	0.01	µg/L	1.0	MW5/17	>10 m	2017-09-01	5.8	N
	0.05	µg/L	0.59	MW-1	< 10 m	2017-09-02	600	N
Acenaphthylene	0.01	µg/L	1.0	MW5/17	>10 m	2017-09-01	46	N
	0.05	µg/L	<0.05	Not Detected On Site	< 10 m	N/A	1.4	N
Anthracene	0.01	µg/L	0.12	MW5/17	>10 m	2017-09-01	0.012	Y
	0.05	µg/L	0.085	MW-1	< 10 m	2017-09-02	1.0	N
Benzo[a]anthracene	0.01	µg/L	0.063	MW5/17	>10 m	2017-09-01	0.018	Y
	0.05	µg/L	<0.05	Not Detected On Site	< 10 m	N/A	1.8	N
Benzo[a]pyrene	0.01	µg/L	0.06	MW5/17	>10 m	2017-09-01	0.01	Y
	0.01	µg/L	<0.01	Not Detected On Site	< 10 m	N/A	0.81	N
Benzo[b]fluoranthene	0.01	µg/L	0.079	MW5/17	>10 m	2017-09-01	0.48	N
	0.05	µg/L	<0.05	Not Detected On Site	< 10 m	N/A	0.75	N
Benzo[ghi]perylene	0.01	µg/L	0.061	MW5/17	>10 m	2017-09-01	0.17	N
	0.05	µg/L	<0.05	Not Detected On Site	< 10 m	N/A	0.2	N
Benzo[k]fluoranthene	0.01	µg/L	0.032	MW5/17	>10 m	2017-09-01	0.48	N
	0.05	µg/L	<0.05	Not Detected On Site	< 10 m	N/A	0.4	N
Chrysene	0.01	µg/L	0.07	MW5/17	>10 m	2017-09-01	0.1	N
	0.05	µg/L	<0.05	Not Detected On Site	< 10 m	N/A	0.7	N
Dibenz[a,h]anthracene	0.01	µg/L	0.015	MW5/17	>10 m	2017-09-01	0.26	N
	0.05	µg/L	<0.05	Not Detected On Site	< 10 m	N/A	0.4	N
Fluoranthene	0.01	µg/L	0.42	MW5/17	>10 m	2017-09-01	0.04	Y
	0.05	µg/L	0.11	MW-1	< 10 m	2017-09-02	73	N
Fluorene	0.01	µg/L	0.87	MW5/17	>10 m	2017-09-01	3.0	N
	0.05	µg/L	0.53	MW-1	< 10 m	2017-09-02	290	N
Ideno[1,2,3-cd]pyrene	0.01	µg/L	0.054	MW5/17	>10 m	2017-09-01	0.21	N
	0.05	µg/L	<0.05	Not Detected On Site	< 10 m	N/A	0.2	N
Methylnaphthalene, 2-(1-)	0.071	µg/L	0.23	MW-3D	>10 m	2017-08-28	180	N
	0.071	µg/L	0.26	MW-1	< 10 m	2017-09-02	1500	N
Naphthalene	0.01	µg/L	27	MW10/17	>10 m	2017-08-31	1.1	Y
	0.05	µg/L	<0.05	Not Detected On Site	< 10 m	N/A	1400	N
Phenanthrene	0.01	µg/L	0.94	MW5/17	>10 m	2017-09-01	0.4	Y
	0.03	µg/L	0.56	MW-1	< 10 m	2017-09-02	380	N
Pyrene	0.01	µg/L	0.24	MW5/17	>10 m	2017-09-01	0.025	Y
	0.05	µg/L	0.072	MW-1	< 10 m	2017-09-02	6.0	N
Total PCBs	0.01	µg/L	0.79	MW5/17	>10 m	2017-09-01	NV	N
	0.05	µg/L	0.74	MW-1	< 10 m	2006-08-02	0.2	Y

N/A - Not Applicable

Table 14 - BTEX and PHC in Sediment

Location			SED2	SED2		SED3	SED5		SED6		SED7		SED10	MOECC Table 9
Sample ID			A0197	A0213 DUP of A0197		A0206	A0204		A0202		A0198		A0200	
Sample Date			2017-08-29	2017-08-29		2017-08-29	2017-08-29		2017-08-29		2017-08-29		2017-08-29	
Sample Time			9:30:00 AM	9:32:00 AM		12:20:00 PM	12:00:00 PM		11:10:00 AM		9:45:00 AM		10:40:00 AM	
Depth (m)		From	0	0		0	0		0		0		0	
		To	0.1	0.1		0.1	0.1		0.1		0.1		0.1	
Chemicals	Units	RDL	Results	Results		Results	Results		Results		Results		Results	
Analysis Date			2017-09-01	2017-09-01	RDL-->	2017-09-01	2017-09-01	RDL-->	2017-09-01	RDL-->	2017-09-01	RDL-->	2017-09-01	
Benzene	µg/g	0.02	<0.02	<0.02	0.02	<0.02	<0.02	0.06	<0.06	0.02	<0.02	0.1	<0.1	NV
Ethylbenzene	µg/g	0.02	<0.02	<0.02	0.02	<0.02	<0.02	0.06	<0.06	0.02	<0.02	0.1	<0.1	NV
Toluene	µg/g	0.02	<0.02	0.13	0.02	<0.02	<0.02	0.06	0.079	0.02	<0.02	0.1	<0.1	NV
o-Xylene	µg/g	0.02	<0.02	<0.02	0.02	<0.02	<0.02	0.06	<0.06	0.02	<0.02	0.1	<0.1	NV
p+m-Xylene	µg/g	0.02	<0.02	<0.02	0.02	<0.02	<0.02	0.06	<0.06	0.02	<0.02	0.1	<0.1	
Xylene (Total)	µg/g	0.02	<0.02	<0.02	0.02	<0.02	<0.02	0.06	<0.06	0.02	<0.02	0.1	<0.1	
F1 (C6-C10)	µg/g	10	<10	<10	10	<10	<10	30	<30	10	<10	20	<20	NV
F1 (C6-C10) - BTEX	µg/g	10	<10	<10	10	<10	<10	30	<30	10	<10	20	<20	
Analysis Date			2017-09-02	2017-09-02		2017-09-02	2017-09-02		2017-09-02		2017-09-02		2017-09-02	-
F2 (C10-C16 Hydrocarbons)	µg/g	20	<20	<20	10	<10	<10	50	<50	10	<10	20	<20	NV
F3 (C16-C34 Hydrocarbons)	µg/g	100	110	<100	50	<50	<50	250	270	50	<50	100	<100	NV
F4 (C34-C50 Hydrocarbons)	µg/g	100	<100	<100	50	<50	<50	250	<250	50	<50	100	<100	NV
Reached Baseline at C50		-	Yes	Yes	-	Yes	Yes	-	Yes	-	Yes	-	Yes	-
Analysis Date			2017-09-01	2017-09-01		2017-09-01	2017-09-01		2017-09-01		2017-09-01		2017-09-01	-
Moisture	%	1.0	47	56	1.0	21	27	1.0	80	1.0	21	1.0	59	-

BTEX - Benzene, Toluene, Ethylbenzene, Xylenes

PHC - Petroleum Hydrocarbons

RDL - Result Detection Limit

MOECC Table 9 - Ministry of Environment and Climate Change, Soil, Ground Water And Sediment Standards For Use Under Part XV.1 of the Environmental Protection Act, Table 9 Generic Site Condition Standards for Use within 30 m of a Water Body in a Non-Potable Groundwater Condition, 2011

Results above Table 9 criteria

Table 15 - VOCs In Sediment

Location			SED2	SED2	SED3	SED5		SED6		SED7		SED10	CCME Freshwater ISQG	CCME Freshwater PEL	MOECC Table 9
Sample ID			A0197	A0213 DUP of A0197	A0206	A0204		A0202		A0198		A0200			
Sample Date			2017-08-29	2017-08-29	2017-08-29	2017-08-29		2017-08-29		2017-08-29		2017-08-29			
Sample Time			9:30:00 AM	9:32:00 AM	12:20:00 PM	12:00:00 PM		11:10:00 AM		9:45:00 AM		10:40:00 AM			
Depth (m)		From	0	0	0	0		0		0		0			
		To	0.1	0.1	0.1	0.1		0.1		0.1		0.1			
Chemicals	Units	RDL	Results	Results	Results	Results	RDL	Results	RDL	Results	RDL	Results			
Analysis Date			2017-09-01	2017-09-01	2017-09-01	2017-09-01	-->	2017-09-01	-->	2017-09-01	-->	2017-09-01			
Acetone (2-Propanone)	µg/g	0.5	<0.5	<0.5	<0.5	<0.5	1.5	1.5	0.5	<0.5	1.0	<1.0	NV	NV	NV
Benzene	µg/g	0.02	<0.02	<0.02	<0.02	<0.02	0.060	<0.06	0.02	<0.02	0.040	<0.04	ND	ND	NV
Bromodichloromethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	NV	NV	NV
Bromoform	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	NV	NV	NV
Bromomethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	NV	NV	NV
Carbon Tetrachloride	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	NV	NV	NV
Chlorobenzene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	NV	NV	NV
Chloroform	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	NV	NV	NV
Dibromochloromethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	NV	NV	NV
1,2-Dichlorobenzene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	ND	ND	NV
1,3-Dichlorobenzene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	ND	ND	NV
1,4-Dichlorobenzene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	ND	ND	NV
Dichlorodifluoromethane (FREON 12)	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	NV	NV	NV
1,1-Dichloroethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	NV	NV	NV
1,2-Dichloroethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	ND	ND	NV
1,1-Dichloroethylene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	NV	NV	NV
cis-1,2-Dichloroethylene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	NV	NV	NV
trans-1,2-Dichloroethylene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	NV	NV	NV
1,2-Dichloropropane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	NV	NV	NV
cis-1,3-Dichloropropene	µg/g	0.03	<0.03	<0.03	<0.03	<0.03	0.090	<0.09	0.03	<0.03	0.060	<0.06	NV	NV	NV
trans-1,3-Dichloropropene	µg/g	0.04	<0.04	<0.04	<0.04	<0.04	0.12	<0.12	0.04	<0.04	0.080	<0.08	NV	NV	NV
Ethylbenzene	µg/g	0.02	<0.02	<0.02	<0.02	<0.02	0.060	<0.06	0.02	<0.02	0.040	<0.04	ND	ND	NV
Ethylene Dibromide	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	NV	NV	NV
Hexane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	ND	ND	NV
Methyl Ethyl Ketone (2-Butanone)	µg/g	0.5	<0.5	<0.5	<0.5	<0.5	1.5	<1.5	0.5	<0.5	1.0	<1.0	NV	NV	NV
Methyl Isobutyl Ketone	µg/g	0.5	<0.5	<0.5	<0.5	<0.5	1.5	<1.5	0.5	<0.5	1.0	<1.0	NV	NV	NV
Methyl t-butyl ether (MTBE)	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	ND	ND	NV
Methylene Chloride(Dichloromethane)	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	ND	ND	NV
Styrene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	ND	ND	NV
1,1,1,2-Tetrachloroethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	NV	NV	NV
1,1,2,2-Tetrachloroethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	ND	ND	NV
Tetrachloroethylene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	NV	NV	NV
Toluene	µg/g	0.02	<0.02	0.13	<0.02	<0.02	0.060	0.079	0.02	<0.02	0.040	<0.04	ND	ND	NV
1,1,1-Trichloroethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	ND	ND	NV
1,1,2-Trichloroethane	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	ND	ND	NV
Trichloroethylene	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	NV	NV	NV
Trichlorofluoromethane (FREON 11)	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.10	<0.10	NV	NV	NV
Vinyl Chloride	µg/g	0.02	<0.02	<0.02	<0.02	<0.02	0.060	<0.06	0.02	<0.02	0.040	<0.04	NV	NV	NV
o-Xylene	µg/g	0.02	<0.02	<0.02	<0.02	<0.02	0.060	<0.06	0.02	<0.02	0.040	<0.04	NV	NV	NV
p+m-Xylene	µg/g	0.02	<0.02	<0.02	<0.02	<0.02	0.060	<0.06	0.02	<0.02	0.040	<0.04	NV	NV	NV
Xylene (Total)	µg/g	0.02	<0.02	<0.02	<0.02	<0.02	0.060	<0.06	0.02	<0.02	0.040	<0.04	NV	NV	NV
Analysis Date			2017-09-01	2017-09-01	2017-09-01	2017-09-01		2017-09-01		2017-09-01		2017-09-01	-	-	-
Moisture	%	1.0	47	56	21	27	1.0	80	1.0	21	1.0	59	-	-	-
Analysis Date			2017-09-05	2017-09-05	2017-09-05	2017-09-05		2017-09-05		2017-09-05		2017-09-05	-	-	-
1,3-Dichloropropene (cis+trans)	µg/g	0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.15	0.05	<0.05	0.1	<0.1	NV	NV	NV

VOC - Volatile Organic Compounds

RDL - Result Detection Limit

ND - No Data

NV - No Value

CCME - Canadian Council of Ministers of the Environment, Sediment Quality Guidelines for the Protection of Aquatic Life, 1998

ISQG - Interim sediment quality guidelines

PEL - Probable effect level

MOECC Table 9 - Ministry of Environment and Climate Change, Soil, Ground Water And Sediment Standards For Use Under Part XV.1 of the Environmental Protection Act, Table 9 Generic Site Condition Standards for Use within 30 m of a Water Body in a Non-Potable Groundwater Condition, 2011

Results above applicable Guideline (ISQG)

Results above applicable Standard or Guideline (PEL or MOECC Table 9)

Table 16 - Metals and Inorganics in Sediment

Location			SED2		SED3	SED5	SED6	SED7	SED10	CCME Freshwater ISQG	CCME Freshwater PEL	MOECC Table 9
Sample ID			A0197	A0213 DUP of A0197	A0206	A0204	A0202	A0198	A0200			
Sample Date			2017-08-29	2017-08-29	2017-08-29	2017-08-29	2017-08-29	2017-08-29	2017-08-29			
Sample Time			9:30:00 AM	9:32:00 AM	12:20:00 PM	12:00:00 PM	11:10:00 AM	9:45:00 AM	10:40:00 AM			
Depth (m)		From	0	0	0	0	0	0	0			
		To	0.1	0.1	0.1	0.1	0.1	0.1	0.1			
Chemicals	Units	RDL	Results	Results	Results	Results	Results	Results	Results			
Analysis Date			2017-09-05	2017-09-05	2017-09-05	2017-09-05	2017-09-05	2017-09-05	2017-09-05			
Acid Extractable Antimony (Sb)	µg/g	0.20	0.21	0.22	0.47	0.77	0.27	0.64	0.42	NV	NV	NV
Acid Extractable Arsenic (As)	µg/g	1.0	<1.0	<1.0	1.3	2.5	1.5	1.6	82	5.9	17	-
Acid Extractable Barium (Ba)	µg/g	0.50	55	60	28	79	76	34	210	NV	NV	NV
Acid Extractable Beryllium (Be)	µg/g	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.33	ND	ND	NV
Acid Extractable Boron (B)	µg/g	5.0	<5.0	<5.0	<5.0	<5.0	5.8	<5.0	<5.0	NV	NV	NV
Acid Extractable Cadmium (Cd)	µg/g	0.10	0.18	0.17	<0.10	<0.10	0.30	<0.10	0.46	0.6	3.5	-
Soluble Calcium (Ca)	mg/L	0.50	29.6	39.4	12.7	8.4	43.0	17.6	19.8	NV	NV	NV
Acid Extractable Chromium (Cr)	µg/g	1.0	8.2	8.3	10	5.8	12	4.0	8.8	37.3	90	-
Acid Extractable Cobalt (Co)	µg/g	0.10	1.5	1.6	2.6	2.2	2.0	0.85	54	NV	NV	50
Acid Extractable Copper (Cu)	µg/g	0.50	7.8	7.5	14	6.1	20	4.5	15	35.7	197	-
Acid Extractable Lead (Pb)	µg/g	1.0	29	33	50	110	100	15	31	35	91.3	-
Soluble Magnesium (Mg)	mg/L	0.5	6.3	7.4	2.7	1.9	11.3	1.4	3.0	NV	NV	NV
Acid Extractable Mercury (Hg)	µg/g	0.05	0.19	0.11	<0.05	0.13	0.16	<0.05	0.057	0.17	0.486	-
Acid Extractable Molybdenum (Mo)	µg/g	0.50	<0.50	<0.50	<0.50	0.61	<0.50	<0.50	4.9	NV	NV	NV
Acid Extractable Nickel (Ni)	µg/g	0.50	4.0	3.9	5.2	3.7	6.1	2.6	38	NV	NV	16
Acid Extractable Selenium (Se)	µg/g	0.50	<0.50	<0.50	<0.50	<0.50	0.68	<0.50	1.1	NV	NV	NV
Acid Extractable Silver (Ag)	µg/g	0.20	<0.20	<0.20	<0.20	<0.20	0.27	<0.20	<0.20	NV	NV	0.5
Soluble Sodium (Na)	mg/L	5.0	5	7	<5.0	<5.0	8	<5.0	5	NV	NV	NV
Acid Extractable Thallium (Tl)	µg/g	0.05	0.067	0.064	<0.05	0.086	0.11	<0.05	0.95	NV	NV	NV
Acid Extractable Uranium (U)	µg/g	0.05	0.58	0.61	0.42	0.17	1.3	0.19	2.6	NV	NV	NV
Acid Extractable Vanadium (V)	µg/g	5.0	9.8	11	32	5.5	9.2	8.9	15	NV	NV	NV
Acid Extractable Zinc (Zn)	µg/g	5.0	46	37	27	35	71	7.9	52	123	315	-
Analysis Date			2017-09-05	2017-09-05	2017-09-05	2017-09-05	2017-09-05	2017-09-05	2017-09-05	-	-	-
Hot Water Ext. Boron (B)	µg/g	0.050	0.37	0.13	0.16	0.22	0.32	0.11	0.67	NV	NV	NV
Analysis Date			2017-09-05	2017-09-05	2017-09-05	2017-09-05	2017-09-05	2017-09-05	2017-09-05	-	-	-
Sodium Adsorption Ratio	-	-	0.22	0.25	0.33	0.40	0.28	0.31	0.28	NV	NV	NV
Analysis Date			2017-09-05	2017-09-05	2017-09-05	2017-09-05	2017-09-05	2017-09-05	2017-09-05	-	-	-
Free Cyanide	µg/g	0.01	0.07	0.10	0.01	0.02	0.20	0.02	0.20	NV	NV	0.1
Analysis Date			2017-09-05	2017-09-05	2017-09-05	2017-09-05	2017-09-05	2017-09-05	2017-09-05	-	-	-
Conductivity	mS/cm	0.002	0.20	0.29	0.091	0.067	0.36	0.10	0.11	NV	NV	NV
Analysis Date			2017-09-05	2017-09-01	2017-09-02	2017-09-01	2017-09-01	2017-09-01	2017-09-01	-	-	-
Chromium (VI)	µg/g	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	NV	NV	NV
Analysis Date			2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	-	-	-
Available (CaCl2) pH	s.u.	-	6.37	6.54	7.25	6.50	6.16	6.61	5.87	NV	NV	NV
Analysis Date			2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	-	-	-
Moisture	%	1.0	47	56	21	27	80	21	59	-	-	-

RDL - Result Detection Limit

ND - No Data

NV - No Value

CCME - Canadian Council of Ministers of the Environment, Sediment Quality Guidelines for the Protection of Aquatic Life, 1997 - 2015

ISQG - Interim sediment quality guidelines

PEL - Probable effect level

MOECC Table 9 - Ministry of Environment and Climate Change, Soil, Ground Water And Sediment Standards For Use Under Part XV.1 of the Environmental Protection Act, Table 9 Generic Site Condition Standards for Use within 30 m of a Water Body in a Non-Potable Groundwater Condition, 2011

Results above applicable Guideline (ISQG)

Results above applicable Standard or Guideline (PEL or MOECC Table 9)

Table 17 - PAH In Sediment

Location			SED2		SED3	SED5	SED6	SED7	SED10	CCME Freshwater ISQG	CCME Freshwater PEL	MOECC Table 9
Sample ID			A0197	A0213 DUP of A0197	A0206	A0204	A0202	A0198	A0200			
Sample Date			2017-08-29	2017-08-29	2017-08-29	2017-08-29	2017-08-29	2017-08-29	2017-08-29			
Sample Time			9:30:00 AM	9:32:00 AM	12:20:00 PM	12:00:00 PM	11:10:00 AM	9:45:00 AM	10:40:00 AM			
Depth (m)		From	0	0	0	0	0	0	0			
		To	0.1	0.1	0.1	0.1	0.1	0.1	0.1			
Chemicals	Units	RDL	Results	Results	Results	Results	Results	Results	Results			
Analysis Date			2017-09-02	2017-09-02	2017-09-02	2017-09-02	2017-09-02	2017-09-02	2017-09-02			
Acenaphthene	µg/g	0.005	-	-	<0.005	0.0098	-	0.0078	-	0.00671	0.0889	-
	µg/g	0.01	<0.01	<0.01	-	-	-	-	<0.01			
	µg/g	0.02	-	-	-	-	<0.02	-	-			
Acenaphthylene	µg/g	0.005	-	-	<0.005	0.0086	-	<0.005	-	0.00587	0.128	-
	µg/g	0.01	<0.01	<0.01	-	-	-	-	<0.01			
	µg/g	0.02	-	-	-	-	<0.02	-	-			
Anthracene	µg/g	0.005	-	-	<0.005	0.021	-	0.0062	-	0.0469	0.245	-
	µg/g	0.01	0.011	<0.01	-	-	-	-	<0.01			
	µg/g	0.02	-	-	-	-	0.024	-	-			
Benzo(a)anthracene	µg/g	0.005	-	-	0.015	0.073	-	<0.005	-	0.0317	0.385	-
	µg/g	0.01	0.050	0.036	-	-	-	-	<0.01			
	µg/g	0.02	-	-	-	-	0.073	-	-			
Benzo(a)pyrene	µg/g	0.005	-	-	0.012	0.063	-	<0.005	-	0.0319	0.782	-
	µg/g	0.01	0.043	0.030	-	-	-	-	<0.01			
	µg/g	0.02	-	-	-	-	0.065	-	-			
Benzo(b/j)fluoranthene	µg/g	0.005	-	-	0.032	0.097	-	0.009	-	NV	NV	NV
	µg/g	0.01	0.062	0.040	-	-	-	-	0.019			
	µg/g	0.02	-	-	-	-	0.11	-	-			
Benzo(g,h,i)perylene	µg/g	0.005	-	-	0.0095	0.042	-	<0.005	-	NV	NV	0.17
	µg/g	0.01	0.034	0.019	-	-	-	-	0.012			
	µg/g	0.02	-	-	-	-	0.057	-	-			
Benzo(k)fluoranthene	µg/g	0.005	-	-	0.0078	0.036	-	<0.005	-	NV	NV	0.24
	µg/g	0.01	0.024	0.016	-	-	-	-	<0.01			
	µg/g	0.02	-	-	-	-	0.039	-	-			
Chrysene	µg/g	0.005	-	-	0.026	0.07	-	0.0062	-	0.0571	0.862	-
	µg/g	0.01	0.043	0.029	-	-	-	-	0.012			
	µg/g	0.02	-	-	-	-	0.071	-	-			
Dibenz(a,h)anthracene	µg/g	0.005	-	-	<0.005	0.011	-	<0.005	-	0.00622	0.135	-
	µg/g	0.01	<0.01	<0.01	-	-	-	-	<0.01			
	µg/g	0.02	-	-	-	-	<0.02	-	-			
Fluoranthene	µg/g	0.005	-	-	0.056	0.14	-	0.025	-	0.111	2.355	-
	µg/g	0.01	0.095	0.065	-	-	-	-	0.031			
	µg/g	0.02	-	-	-	-	0.15	-	-			
Fluorene	µg/g	0.005	-	-	<0.005	0.0094	-	0.01	-	0.0212	0.144	-
	µg/g	0.01	<0.01	<0.01	-	-	-	-	<0.01			
	µg/g	0.02	-	-	-	-	<0.02	-	-			
Indeno(1,2,3-cd)pyrene	µg/g	0.005	-	-	0.0093	0.046	-	<0.005	-	NV	NV	0.2
	µg/g	0.01	0.037	0.020	-	-	-	-	0.011			
	µg/g	0.02	-	-	-	-	0.055	-	-			
1-Methylnaphthalene	µg/g	0.005	-	-	<0.005	<0.005	-	<0.005	-	0.0202	0.201	-
	µg/g	0.01	<0.01	<0.01	-	-	-	-	<0.01			
	µg/g	0.02	-	-	-	-	<0.02	-	-			
2-Methylnaphthalene	µg/g	0.005	-	-	0.0052	<0.005	-	<0.005	-			
	µg/g	0.01	<0.01	<0.01	-	-	-	-	<0.01			
	µg/g	0.02	-	-	-	-	0.028	-	-			
Methylnaphthalene, 2-(1-)	µg/g	0.0074	-	-	<0.005	<0.005	-	<0.005	-			
	µg/g	0.014	<0.014	<0.01	-	-	-	-	<0.01			
	µg/g	0.028	-	-	-	-	0.028	-	-			
Naphthalene	µg/g	0.005	-	-	<0.005	<0.005	-	<0.005	-	0.0346	0.391	-
	µg/g	0.01	<0.01	<0.01	-	-	-	-	<0.01			
	µg/g	0.02	-	-	-	-	<0.02	-	-			
Phenanthrene	µg/g	0.005	-	-	0.019	0.083	-	0.0088	-	0.0419	0.515	-
	µg/g	0.01	0.042	0.027	-	-	-	-	0.010			
	µg/g	0.02	-	-	-	-	0.053	-	-			
Pyrene	µg/g	0.005	-	-	0.042	0.11	-	0.021	-	0.053	0.875	-
	µg/g	0.01	0.077	0.052	-	-	-	-	0.026			
	µg/g	0.02	-	-	-	-	0.12	-	-			
Analysis Date			2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	-	-	-
Moisture	%	1	47	56	21	27	80	21	59	-	-	-

PAH - Polycyclic Aromatic Hydrocarbons

ND - No Data NV - No Value RDL - Result Detection Limit

CCME - Canadian Council of Ministers of the Environment, Sediment Quality Guidelines for the Protection of Aquatic Life, 1998

ISQG - Interim sediment quality guidelines

PEL - Probable effect level

MOECC Table 9 - Ministry of Environment and Climate Change, Soil, Ground Water And Sediment Standards For Use Under Part XV.1 of the Environmental Protection Act, Table 9 Generic Site Condition Standards for Use within 30 m of a Water Body in a Non-Potable Groundwater Condition, 2011

Results above applicable Guideline (ISQG)

Results above applicable Standard or Guideline (PEL or MOECC Table 9)

RDL above applicable Standard or Guideline

Table 18 - PCBs In Sediment

Location			SED2	SED2	SED3	SED5	SED6	SED7	SED10	CCME Freshwater ISQG	CCME Freshwater PEL
Sample ID			A0197	A0213 DUP of A0197	A0206	A0204	A0202	A0198	A0200		
Sample Date			2017-08-29	2017-08-29	2017-08-29	2017-08-29	2017-08-29	2017-08-29	2017-08-29		
Sample Time			9:30:00 AM	9:32:00 AM	12:20:00 PM	12:00:00 PM	11:10:00 AM	9:45:00 AM	10:40:00 AM		
Depth (m)		From	0	0	0	0	0	0	0		
		To	0.1	0.1	0.1	0.1	0.1	0.1	0.1		
Chemicals	Units	RDL	Results	Results	Results	Results	Results	Results	Results		
Analysis Date			2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01		
Total PCBs	µg/g	0.01	-	-	<0.01	<0.01	-	<0.01	-	0.0341	0.277
	µg/g	0.02	<0.02	-	-	-	-	-	-		
	µg/g	0.03	-	<0.03	-	-	-	-	<0.03		
	µg/g	0.05	-	-	-	-	<0.05	-	-		

PCB - Polychlorinated Biphenyl

RDL - Result Detection Limit

ND - No Data

NV - No Value

CCME - Canadian Council of Ministers of the Environment, Sediment Quality Guidelines for the Protection of Aquatic Life, 1998

ISQG - Interim sediment quality guidelines

PEL - Probable effect level

MOECC Table 9 - Ministry of Environment and Climate Change, Soil, Ground Water And Sediment Standards For Use Under Part XV.1 of the Environmental Protection Act, Table 9 Generic Site Condition Standards for Use within 30 m of a Water Body in a Non-Potable Groundwater Condition, 2011

Results above applicable Guideline (ISQG)

Results above applicable Standard or Guideline (PEL or MOECC Table 9)

RDL above applicable Standard or Guideline

Table 19 Sediment Contaminant Inventory

Contaminant	Result Detection Limit (RDL)	Units	Maximum Measured Concentration	Location Name	Sampling Date	Applicable Guideline/Standard Value	Exceedance
Sodium Adsorption Ratio (SAR)	N/A	N/A	0.4	SED5	2017-08-29	NV	N
pH	N/A	s.u.	7.25	SED3	2017-08-29	NV	N
Cyanide (Free)	0.01	µg/g	0.2	SED6/SED10	2017-08-29/2017-08-29	0.1	Y
Electrical Conductivity	0.002	mS/cm	0.36	SED6	2017-08-29	NV	N
Alunimum	1.0	mg/kg	18000	SED3	1994-11-15	NV	N
Antimony	0.2	µg/g	2.2	SED4	2011-08-09	NV	N
Arsenic	1.0	µg/g	82	SED10	2017-08-29	17	Y
Barium	0.2	mg/kg	248	SED3	1994-11-15	NV	N
Beryllium	0.2	µg/g	0.50	SED2	2011-08-09	NV	N
Boron (total)	5.0	µg/g	5.8	SED6	2017-08-29	NV	N
Cadmium	0.1	mg/kg	1.2	SED2	2011-08-09	3.5	N
Chromium (Total)	0.3	mg/kg	28.8	SED3	1994-11-15	90	N
Chromium (VI)	0.2	µg/g	0.5	SED4	2011-08-09	NV	N
Cobalt	0.1	µg/g	54	SED10	2017-08-29	50	Y
Copper	0.5	mg/kg	51	SED2	2011-08-09	197	N
Iron	0.3	mg/kg	74900	SED1	1999-08-12	NV	N
Lead	1.0	mg/kg	539	SED1	1994-11-15	91.3	Y
Manganese	1.0	mg/kg	539	SED1	1994-11-15	NV	N
Magnesium	20	mg/kg	19500	SED3	2000-09-19	NV	N
Mercury	0.05	mg/kg	1.3	SED2	2011-08-09	0.486	Y
Molybdenum	0.5	µg/g	4.9	SED10	2017-08-29	NV	N
Nickel	0.5	µg/g	38	SED10	2017-08-29	16	Y
Phosphorous	20	ppm	962	SED3	1999-08-12	NV	N
Potassium	100	mg/kg	556	SED3	2000-06-28	NV	N
Sodium	50	mg/kg	103	SED3	2000-09-19	NV	N
Selenium	0.5	µg/g	1.7	SED2	2011-08-09	NV	N
Silver	0.2	µg/g	1.4	SED2	2011-08-09	0.5	Y
Strontium	0.3	mg/kg	55.7	SED3	2000-09-19	NV	N
Thallium	0.05	µg/g	0.95	SED10	2017-08-29	NV	N
Titanium	1.0	mg/kg	298	SED3	1999-08-12	NV	N
Uranium	0.05	µg/g	2.6	SED10	2017-08-29	NV	N
Vanadium	0.5	mg/kg	46	SED3	1994-11-15	NV	N
Zinc	5.0	mg/kg	250	SED2	2011-08-09	315	N

Table 19 Sediment Contaminant Inventory

Contaminant	Result Detection Limit (RDL)	Units	Maximum Measured Concentration	Location Name	Sampling Date	Applicable Guideline/Standard Value	Exceedance
Acetone (2-Propanone)	1.5	µg/g	1.5	SED6	2017-08-29	NV	N
Benzene	0.06	µg/g	<0.06	Not Detected On Site	N/A	NV	N
Bromodichloromethane	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
Bromoform	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
Bromomethane	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
Carbon Tetrachloride	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
Chlorobenzene	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
Chloroform	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
Dibromochloromethane	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
1,2-Dichlorobenzene	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
1,3-Dichlorobenzene	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
1,4-Dichlorobenzene	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
Dichlorodifluoromethane (FREON 12)	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
1,1-Dichloroethane	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
1,2-Dichloroethane	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
1,1-Dichloroethylene	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
cis-1,2-Dichloroethylene	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
trans-1,2-Dichloroethylene	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
1,2-Dichloropropane	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
cis-1,3-Dichloropropene	0.09	µg/g	<0.09	Not Detected On Site	N/A	NV	N
trans-1,3-Dichloropropene	0.12	µg/g	<0.12	Not Detected On Site	N/A	NV	N
Ethylbenzene	0.06	µg/g	<0.06	Not Detected On Site	N/A	NV	N
Ethylene Dibromide	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
Hexane	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
Methyl Ethyl Ketone (2-Butanone)	1.5	µg/g	<1.5	Not Detected On Site	N/A	NV	N
Methyl Isobutyl Ketone	1.5	µg/g	<1.5	Not Detected On Site	N/A	NV	N
Methyl t-butyl ether (MTBE)	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
Methylene Chloride(Dichloromethane)	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
Styrene	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
1,1,1,2-Tetrachloroethane	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
1,1,2,2-Tetrachloroethane	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
Tetrachloroethylene	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
Toluene	0.02	µg/g	0.13	SED2	2017-08-29	NV	N
1,1,1-Trichloroethane	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
1,1,2-Trichloroethane	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
Trichloroethylene	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
Trichlorofluoromethane (FREON 11)	0.15	µg/g	<0.15	Not Detected On Site	N/A	NV	N
Vinyl Chloride	0.06	µg/g	<0.06	Not Detected On Site	N/A	NV	N
o-Xylene	0.06	µg/g	<0.06	Not Detected On Site	N/A	NV	N
p+m-Xylene	0.06	µg/g	<0.06	Not Detected On Site	N/A	NV	N
Xylene (Total)	0.06	µg/g	<0.06	Not Detected On Site	N/A	NV	N
Acenaphthene	0.005	µg/g	0.0098	SED5	2017-08-29	0.0889	N
Acenaphthylene	0.005	µg/g	0.0086	SED5	2017-08-29	0.128	N
Anthracene	0.02	µg/g	0.024	SED6	2017-08-29	0.245	N
Benzo(a)anthracene	0.02	µg/g	0.073	SED5/SED6	2017-08-29/2017-08-29	0.385	N
Benzo(a)pyrene	0.02	µg/g	0.065	SED6	2017-08-29	0.782	N
Benzo(b/j)fluoranthene	0.02	µg/g	0.11	SED6	2017-08-29	NV	N
Benzo(g,h,i)perylene	0.02	µg/g	0.057	SED6	2017-08-29	0.17	N
Benzo(k)fluoranthene	0.02	µg/g	0.039	SED6	2017-08-29	0.24	N
Chrysene	0.02	µg/g	0.071	SED6	2017-08-29	0.862	N
Dibenz(a,h)anthracene	0.005	µg/g	0.011	SED5	2017-08-29	0.135	N
Fluoranthene	0.02	µg/g	0.15	SED6	2017-08-29	2.355	N
Fluorene	0.02	µg/g	<0.02	Not Detected On Site	N/A	0.144	N
Indeno(1,2,3-cd)pyrene	0.02	µg/g	0.055	SED6	2017-08-29	0.2	N
Methylnaphthalene, 2-(1-)	0.028	µg/g	0.028	SED6	2017-08-29	0.201	N
Naphthalene	0.02	µg/g	<0.02	Not Detected On Site	N/A	0.391	N
Phenanthrene	0.005	µg/g	0.083	SED5	2017-08-29	0.515	N
Pyrene	0.02	µg/g	0.12	SED6	2017-08-29	0.875	N
Total PCBs	0.05	µg/g	<0.05	Not Detected On Site	N/A	0.277	N

N/A - Not Applicable

Table 20 - VOCs In Seepage

Location			SW3	LOCK1		CCME Freshwater Long Term	PWQO
Sample ID			A0237	A0239	A0249 DUP of A0239		
Sample Date			2017-08-31	2017-08-31	2017-08-31		
Sample Time			7:30:00 AM	1:10:00 PM	1:12:00 PM		
Chemicals	Units	RDL	Results	Results	Results		
Analysis Date			2017-09-06	2017-09-06	2017-09-06		
Acrolein	ug/L	10	<10	<10	<10	-	0.03
Benzene	ug/L	0.10	<0.10	<0.10	<0.10	370	100
Bromodichloromethane	ug/L	0.10	<0.10	<0.10	<0.10	-	200
Bromoform	ug/L	0.20	<0.20	<0.20	<0.20	-	60
Bromomethane	ug/L	0.50	<0.50	<0.50	<0.50	-	0.9
Chlorobenzene	ug/L	0.10	<0.10	<0.10	<0.10	1.3	15
Chloromethane	ug/L	0.50	<0.50	<0.50	<0.50	-	700
Dibromochloromethane	ug/L	0.20	<0.20	<0.20	<0.20	-	NV
1,2-Dichlorobenzene	ug/L	0.20	<0.20	<0.20	<0.20	0.7	2.5
1,3-Dichlorobenzene	ug/L	0.20	<0.20	<0.20	<0.20	150	2.5
1,4-Dichlorobenzene	ug/L	0.20	<0.20	<0.20	<0.20	26	4
1,1-Dichloroethane	ug/L	0.10	<0.10	<0.10	<0.10	-	200
1,2-Dichloroethane	ug/L	0.20	<0.20	<0.20	<0.20	100	100
1,1-Dichloroethylene	ug/L	0.10	<0.10	<0.10	<0.10	-	40
cis-1,2-Dichloroethylene	ug/L	0.10	<0.10	<0.10	<0.10	-	200
trans-1,2-Dichloroethylene	ug/L	0.10	<0.10	<0.10	<0.10		
1,2-Dichloropropane	ug/L	0.10	<0.10	<0.10	<0.10	-	0.7
trans-1,3-Dichloropropene	ug/L	0.20	<0.20	<0.20	<0.20	-	7
Ethylbenzene	ug/L	0.10	<0.10	<0.10	<0.10	90	8
Ethylene Dibromide	ug/L	0.20	<0.20	<0.20	<0.20	-	5
Methyl Ethyl Ketone (2-Butanone)	ug/L	5.0	<5.0	<5.0	<5.0	-	400
Methyl t-butyl ether (MTBE)	ug/L	0.20	<0.20	<0.20	<0.20	10000	200
Methylene Chloride(Dichloromethane)	ug/L	0.50	<0.50	<0.50	<0.50	98.1	100
Styrene	ug/L	0.20	<0.20	<0.20	<0.20	72	4
1,1,1,2-Tetrachloroethane	ug/L	0.20	<0.20	<0.20	<0.20	-	20
1,1,2,2-Tetrachloroethane	ug/L	0.20	<0.20	<0.20	<0.20	-	70
Tetrachloroethylene	ug/L	0.10	<0.10	<0.10	<0.10	-	50
Toluene	ug/L	0.20	0.30	<0.20	<0.20	2	0.8
1,1,1-Trichloroethane	ug/L	0.10	<0.10	<0.10	<0.10	-	10
1,1,2-Trichloroethane	ug/L	0.20	<0.20	<0.20	<0.20	-	800
Trichloroethylene	ug/L	0.10	<0.10	<0.10	<0.10	-	20
Vinyl Chloride	ug/L	0.20	<0.20	<0.20	<0.20	-	600
o-Xylene	ug/L	0.10	<0.10	<0.10	<0.10	-	40
p+m-Xylene	ug/L	0.10	<0.10	<0.10	<0.10	-	2

VOC - Volatile Organic Compounds
RDL - Result Detection Limit
NV - No Value
PWQO - Ontario Provincial Water Quality Objectives, February 1999
CCME - Canadian Council of Ministers of the Environment, Water Quality Guidelines for the Protection of Aquatic Life
Results above applicable Standard or Guideline
RDL above applicable Standard or Guideline

Table 21 - Metals and Inorganics In Seepage

Location			SW3	LOCK1		CCME Freshwater Long Term	PWQO
Sample ID			A0237	A0239	A0249 DUP of A0239		
Sample Date			2017-08-31	2017-08-31	2017-08-31		
Sample Time			7:30:00 AM	1:10:00 PM	1:12:00 PM		
Chemicals	Units	RDL	Results	Results	Results		
Analysis Date			2017-09-07	2017-09-07	2017-09-07		
Mercury (Hg)	µg/L	0.1	<0.1	<0.1	<0.1	0.026	0.2
Analysis Date			2017-09-06	2017-09-06	2017-09-06		-
Dissolved (0.2u) Aluminum (Al)	ug/L	5.0	<5.0	7	7	100*	75
Analysis Date			2017-09-07	2017-09-07	2017-09-07		-
Chromium (VI)	ug/L	0.5	<0.5	<0.5	<0.5	1	1
Analysis Date			2017-09-07	2017-09-06	2017-09-07		-
Total Un-ionized Ammonia	ug/L	Var	46	14	<5.1	Note**	20
Analysis Date			2017-09-01	2017-09-01	2017-09-01		-
Dissolved Oxygen	mg/L		4.57	8.44	8.52	>5.5	>5
Analysis Date			2017-09-06	2017-09-06	2017-09-06		-
pH	pH		7.81	8.04	8.04	6.5 - 9.0	6.5-8.5
Analysis Date			2017-09-06	2017-09-06	2017-09-06		-
Phenols-4AAP	mg/L	0.0010	<0.001	0.0024	0.0021	4	1
Analysis Date			2017-09-05	2017-09-05	2017-09-05		-
Total Phosphorus	mg/L	0.004	0.025	0.013	0.019	-	20
Analysis Date			2017-09-02	2017-09-02	2017-09-02		-
Sulphide	mg/L	0.020	<0.02	<0.02	<0.02	-	NV
Analysis Date			2017-09-01	2017-09-01	2017-09-01		-
Turbidity	NTU	0.1	8.4	0.6	0.5	-	NV
Analysis Date			2017-09-06	2017-09-06	2017-09-06		-
WAD Cyanide (Free)	ug/L	1	<1	<1	<1	5	5
Analysis Date			2017-09-06	2017-09-06	2017-09-05		-
Alkalinity (Total as CaCO3)	mg/L	1.0	160	92	92	-	>69
Analysis Date			2017-09-06	2017-09-06	2017-09-06		-
Total Antimony (Sb)	ug/L	0.50	<0.50	<0.50	<0.50	-	20
Total Arsenic (As)	ug/L	1.0	<1.0	<1.0	<1.0	5	100
Total Beryllium (Be)	ug/L	0.50	<0.50	<0.50	<0.50	-	1100
Total Boron (B)	ug/L	10	20	13	13	1500	200
Total Cadmium (Cd)	ug/L	0.10	<0.10	<0.10	<0.10	0.09	0.2
Total Chromium (Cr)	ug/L	5.0	<5.0	<5.0	<5.0	8.9	NV
Total Cobalt (Co)	ug/L	0.50	0.51	<0.50	<0.50	-	0.9
Total Copper (Cu)	ug/L	1.0	<1.0	<1.0	<1.0	2.2 - 3.53	5
Total Iron (Fe)	ug/L	100	2800	150	140	300	300
Total Lead (Pb)	ug/L	0.50	<0.50	<0.50	<0.50	2.86 - 5.79	25
Total Molybdenum (Mo)	ug/L	0.50	<0.50	<0.50	<0.50	73	40
Total Nickel (Ni)	ug/L	1.0	1.6	<1.0	<1.0	89.71 - 136.61	25
Total Selenium (Se)	ug/L	2.0	<2.0	<2.0	<2.0	1	100
Total Silver (Ag)	ug/L	0.10	<0.10	<0.10	<0.10	0.25	0.1
Total Thallium (Tl)	ug/L	0.050	<0.05	<0.05	<0.05	0.8	0.3
Total Tungsten (W)	ug/L	1.0	<1.0	<1.0	<1.0	-	30
Total Uranium (U)	ug/L	0.10	<0.10	0.11	0.11	15	5
Total Vanadium (V)	ug/L	0.50	0.64	0.78	0.88	-	6
Total Zinc (Zn)	ug/L	5.0	5.5	<5.0	<5.0	30	30
Total Zirconium (Zr)	ug/L	1.0	<1.0	<1.0	<1.0	-	4

RDL - Result Detection Limit *100µg/L if pH > 6.5

NV - No Value

CCME - Canadian Council of Ministers of the Environment,
Water Quality Guidelines for the Protection of Aquatic Life

PWQO - Ontario Provincial Water Quality Objectives, February 1999

Results above applicable Standard or Guideline

RDL above applicable Standard or Guideline

Table 22 - VOCs In Surface Water

Location			SW1	RR2		RR3	SW7	SW8	SW9	SW10	CCME Freshwater Long Term	PWQO
Sample ID			A0211	A0196	A0210 DUP of A0196	A0207	A0205	A0201	A0203	A0199		
Sample Date			2017-08-29	2017-08-29	2017-08-29	2017-08-29	2017-08-29	2017-08-29	2017-08-29	2017-08-29		
Sample Time			2:30:00 PM	9:00:00 AM	9:10:00 AM	12:40:00 PM	12:00:00 PM	10:40:00 AM	11:10:00 AM	10:00:00 AM		
Chemicals	Units	RDL	Results	Results	Results	Results	Results	Results	Results	Results		
Analysis Date			2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01		
Acrolein	ug/L	10	<10	<10	<10	<10	<10	<10	<10	<10	-	0.03
Benzene	ug/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	370	100
Bromodichloromethane	ug/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.12	<0.10	<0.10	-	200
Bromoform	ug/L	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	60
Bromomethane	ug/L	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-	0.9
Chlorobenzene	ug/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	1.3	15
Chloromethane	ug/L	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-	700
Dibromochloromethane	ug/L	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	NV
1,2-Dichlorobenzene	ug/L	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.7	2.5
1,3-Dichlorobenzene	ug/L	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	150	2.5
1,4-Dichlorobenzene	ug/L	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	26	4
1,1-Dichloroethane	ug/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	200
1,2-Dichloroethane	ug/L	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	100	100
1,1-Dichloroethylene	ug/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	40
cis-1,2-Dichloroethylene	ug/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	200
trans-1,2-Dichloroethylene	ug/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10		
1,2-Dichloropropane	ug/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	0.7
trans-1,3-Dichloropropene	ug/L	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	7
Ethylbenzene	ug/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	90	8
Ethylene Dibromide	ug/L	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	5
Methyl Ethyl Ketone (2-Butanone)	ug/L	5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	-	400
Methyl t-butyl ether (MTBE)	ug/L	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	10000	200
Methylene Chloride(Dichloromethane)	ug/L	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	98.1	100
Styrene	ug/L	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	72	4
1,1,1,2-Tetrachloroethane	ug/L	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	20
1,1,2,2-Tetrachloroethane	ug/L	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	70
Tetrachloroethylene	ug/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	50
Toluene	ug/L	0.20	<0.20	0.22	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	2	0.8
1,1,1-Trichloroethane	ug/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	10
1,1,2-Trichloroethane	ug/L	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	800
Trichloroethylene	ug/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	20
Vinyl Chloride	ug/L	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	600
o-Xylene	ug/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	40
p+m-Xylene	ug/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	2

VOC - Volatile Organic Compounds
RDL - Result Detection Limit
NV - No Value
PWQO - Ontario Provincial Water Quality Objectives, February 1999
CCME - Canadian Council of Ministers of the Environment, Water Quality Guidelines for the Protection of Aquatic Life

Results above applicable Standard or Guideline
RDL above applicable Standard or Guideline

Table 23 - Metals and Inorganics In Surface Water

Location			SW1	RR2		RR3	SW7	SW8	SW9	SW10	CCME Freshwater Long Term	PWQO
Sample ID			A0211	A0196	A0210 DUP of A0196	A0207	A0205	A0201	A0203	A0199		
Sample Date			2017-08-29	2017-08-29	2017-08-29	2017-08-29	2017-08-29	2017-08-29	2017-08-29	2017-08-29		
Sample Time			2:30:00 PM	9:00:00 AM	9:10:00 AM	12:40:00 PM	12:00:00 PM	10:40:00 AM	11:10:00 AM	10:00:00 AM		
Chemicals	Units	RDL	Results	Results	Results	Results	Results	Results	Results	Results		
Analysis Date			2017-09-05	2017-09-05	2017-09-05	2017-09-05	2017-09-05	2017-09-05	2017-09-05	2017-09-05		
pH (Field)	s.u.	-	8.43	7.2	7.2	8.35	8.30	8.29	8.36	8.22	-	8.5
Temperature (Field)	°C	-	22.44	21.08	21.08	21.41	21.30	21.00	21.28	21.27	-	-
Conductivity (Field)	mS/cm	-	0.22	0.225	0.225	0.231	0.243	0.269	0.228	0.228	-	-
Analysis Date			2017-09-05	2017-09-05	2017-09-05	2017-09-05	2017-09-05	2017-09-05	2017-09-05	2017-09-05	-	-
Mercury (Hg)	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.026	0.2
Analysis Date			2017-09-05	2017-09-05	2017-09-05	2017-09-05	2017-09-05	2017-09-05	2017-09-05	2017-09-05	-	-
Dissolved (0.2u) Aluminum (Al)	ug/L	5.0	5	<5.0	6	7	5	8	7	<5.0	100*	75
Analysis Date			2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	-	-
Chromium (VI)	ug/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1	1
Analysis Date			2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01		-
Total Un-ionized Ammonia	ug/L	Var	20	2.0	3.2	30	<4.9	26	34	4.2	19	20
Total Ammonia-N	mg/L	0.05	0.15	0.25	0.38	0.28	<0.05	0.28	0.31	0.051	Note**	-
Analysis Date			2017-08-30	2017-09-01	2017-08-30	2017-08-30	2017-08-30	2017-08-30	2017-08-30	2017-08-30	-	-
Dissolved Oxygen	mg/L		9.45	8.63	9.22	9.00	8.97	9.07	9.36	8.85	>5.5	>5
Analysis Date			2017-08-31	2017-08-31	2017-09-01	2017-08-31	2017-08-31	2017-08-31	2017-08-31	2017-08-31	-	-
pH	pH		8.11	8.01	8.07	8.06	7.90	8.03	8.07	8.01	6.5 - 9.0	6.5-8.5
Analysis Date			2017-08-31	2017-08-31	2017-09-05	2017-09-05	2017-09-05	2017-08-31	2017-08-31	2017-08-31	-	-
Phenols-4AAP	mg/L	0.0010	0.0023	0.0025	0.0020	<0.001	<0.001	0.0022	0.0027	0.0021	4	1
Analysis Date			2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	-	-
Total Phosphorus	mg/L	0.004	0.011	0.011	0.015	0.016	0.017	0.015	0.021	0.013	-	20
Analysis Date			2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	-	-
Sulphide	mg/L	0.020	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	NV
Analysis Date			2017-08-31	2017-08-31	2017-08-31	2017-08-31	2017-08-31	2017-08-31	2017-08-31	2017-08-31	-	-
Turbidity	NTU	0.1	0.7	0.4	0.5	1.2	0.4	0.6	1.2	0.7	-	NV
Analysis Date			2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	2017-09-01	-	-
WAD Cyanide (Free)	ug/L	1	6	<1	<1	<1	<1	<1	<1	<1	5	5
Analysis Date			2017-09-01	2017-08-31	2017-09-01	2017-09-01	2017-09-01	2017-08-31	2017-09-01	2017-08-31	-	-
Alkalinity (Total as CaCO3)	mg/L	1.0	92	92	92	92	94	100	93	93	-	>69
Analysis Date			2017-08-31	2017-08-31	2017-08-31	2017-08-31	2017-08-31	2017-08-31	2017-08-31	2017-08-31	-	-
Total Antimony (Sb)	ug/L	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-	20
Total Arsenic (As)	ug/L	1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	5	100
Total Beryllium (Be)	ug/L	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-	1100
Total Boron (B)	ug/L	10	13	13	17	13	14	15	13	14	1500	200
Total Cadmium (Cd)	ug/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.09	0.2
Total Chromium (Cr)	ug/L	5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	8.9	NV
Total Cobalt (Co)	ug/L	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-	0.9
Total Copper (Cu)	ug/L	1.0	1.4	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	2.2 - 3.53	5
Total Iron (Fe)	ug/L	100	<100	<100	<100	<100	130	160	110	220	300	300
Total Lead (Pb)	ug/L	0.50	<0.50	<0.50	<0.50	<0.50	1.5	<0.50	1.4	<0.50	2.86 - 5.79	25
Total Molybdenum (Mo)	ug/L	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	73	40
Total Nickel (Ni)	ug/L	1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	89.71 - 136.61	25
Total Selenium (Se)	ug/L	2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	1	100
Total Silver (Ag)	ug/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.25	0.1
Total Thallium (Tl)	ug/L	0.050	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.8	0.3
Total Tungsten (W)	ug/L	1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	30
Total Uranium (U)	ug/L	0.10	0.10	0.12	0.11	0.11	0.13	0.18	0.13	0.12	15	5
Total Vanadium (V)	ug/L	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-	6
Total Zinc (Zn)	ug/L	5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	30	30
Total Zirconium (Zr)	ug/L	1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	4

RDL - Result Detection Limit

*100µg/L if pH > 6.5

Note** - Guideline value is based on Table 2 of the CCME Ammonia Water Quality Guidelines

NV - No Value

CCME - Canadian Council of Ministers of the Environment, Water Quality Guidelines for the Protection of Aquatic Life

PWQO - Ontario Provincial Water Quality Objectives, February 1999

Results above applicable Standard or Guideline

RDL above applicable Guideline

Table 24 Surface Water Contaminant Inventory

Contaminant	Result Detection Limit (RDL)	Units	Maximum Measured Concentration	Location Name	Sampling Date	Applicable Guideline/Standard Value	Exceedance
Alkalinity (Total as CaCO3)	1.0	mg/L	100	SW8	2017-08-29	>69	Y
pH	N/A	pH	8.11	SW1	2017-08-29	6.5 - 9.0	N
Cyanide (Free)	1.0	ug/L	6.0	SW1	2017-08-29	5	Y
Total Un-ionized Ammonia	NA	ug/L	34	SW9	2017-08-29	19	Y
Total Ammonia-N	0.05	mg/L	0.38	RR2	2017-08-29	4.82	N
Dissolved Oxygen	N/A	mg/L	9.45	SW1	2017-08-29	>5.5	N
Turbidity	0.1	NTU	1.2	RR3/SW9	2017-08-29	NV	N
Alunimum	0.5	µg/L	12.6	SW4	2011-07-19	NV	N
Antimony	0.5	µg/L	<0.5	Not Detected On Site	N/A	20	N
Arsenic	1.0	µg/L	<1.0	Not Detected On Site	N/A	5	N
Beryllium	0.5	µg/L	<0.5	Not Detected On Site	N/A	1100	N
Boron (total)	10	µg/L	17	RR2	2017-08-29	200	N
Cadmium	0.1	µg/L	<0.1	Not Detected On Site	N/A	0.09	N
Calcium	20	µg/L	24600	SW6	2011-07-19	NV	N
Chromium (Total)	5.0	µg/L	<5.0	Not Detected On Site	N/A	8.9	N
Chromium (VI)	0.5	mg/L	<0.5	Not Detected On Site	N/A	1	N
Cobalt	0.5	µg/L	<0.5	Not Detected On Site	N/A	0.9	N
Copper	1.0	µg/L	1.4	SW1	2017-08-29	2.2 - 3.53	N
Iron	100	µg/L	220	SW10	2017-08-29	300	N
Lead	0.5	µg/L	1.5	SW7	2017-08-29	2.86 - 5.79	N
Lithium	0.5	µg/L	0.6	SW1	2011-07-19	NV	N
Manganese	0.2	µg/L	39.3	SW4	2011-07-19	NV	N
Mercury	0.1	µg/L	<0.1	Not Detected On Site	N/A	0.026	Y
Molybdenum	0.5	µg/L	<0.5	Not Detected On Site	N/A	40	N
Nickel	1.0	µg/L	<1.0	Not Detected On Site	N/A	25	N
Phenols-4AAP	0.001	mg/L	0.0027	SW9	2017-08-29	1	N
Total Phosphorous	0.004	mg/L	0.021	SW9	2017-08-29	20	N
Selenium	2.0	µg/L	<2.0	Not Detected On Site	N/A	1	N
Silver	0.1	µg/L	<0.1	Not Detected On Site	N/A	0.1	N
Sulphide	0.02	mg/L	<0.02	Not Detected On Site	N/A	NV	N
Thallium	0.05	µg/L	<0.05	Not Detected On Site	N/A	0.3	N
Tungsten	1.0	µg/L	<1.0	Not Detected On Site	N/A	30	N
Uranium	0.1	µg/L	0.18	SW8	2017-08-29	5	N
Vanadium	0.5	µg/L	<0.5	Not Detected On Site	N/A	6	N
Zinc	5.0	µg/L	<5.0	Not Detected On Site	N/A	30	N
Zirconium	1.0	µg/L	<1.0	Not Detected On Site	N/A	4	N

Table 24 Surface Water Contaminant Inventory

Contaminant	Result Detection Limit (RDL)	Units	Maximum Measured Concentration	Location Name	Sampling Date	Applicable Guideline/Standard Value	Exceedance
Acrolein	10.0	ug/L	<10	Not Detected On Site	N/A	NV	N
Benzene	0.1	ug/L	<0.10	Not Detected On Site	N/A	100	N
Bromodichloromethane	0.1	ug/L	0.12	SW8	2017-08-29	200	N
Bromoform	0.2	ug/L	<0.20	Not Detected On Site	N/A	60	N
Bromomethane	0.5	ug/L	<0.50	Not Detected On Site	N/A	0.9	N
Chlorobenzene	0.1	ug/L	<0.10	Not Detected On Site	N/A	1.3	N
Chloromethane	0.5	ug/L	<0.50	Not Detected On Site	N/A	700	N
Dibromochloromethane	0.2	ug/L	<0.20	Not Detected On Site	N/A	NV	N
1,2-Dichlorobenzene	0.2	ug/L	<0.20	Not Detected On Site	N/A	0.7	N
1,3-Dichlorobenzene	0.2	ug/L	<0.20	Not Detected On Site	N/A	150	N
1,4-Dichlorobenzene	0.2	ug/L	<0.20	Not Detected On Site	N/A	4	N
1,1-Dichloroethane	0.1	ug/L	<0.10	Not Detected On Site	N/A	200	N
1,2-Dichloroethane	0.2	ug/L	<0.20	Not Detected On Site	N/A	100	N
1,1-Dichloroethylene	0.1	ug/L	<0.10	Not Detected On Site	N/A	40	N
cis-1,2-Dichloroethylene	0.1	ug/L	<0.10	Not Detected On Site	N/A	200	N
trans-1,2-Dichloroethylene	0.1	ug/L	<0.10	Not Detected On Site	N/A	200	N
1,2-Dichloropropane	0.1	ug/L	<0.10	Not Detected On Site	N/A	0.7	N
trans-1,3-Dichloropropene	0.2	ug/L	<0.20	Not Detected On Site	N/A	7	N
Ethylbenzene	0.1	ug/L	<0.10	Not Detected On Site	N/A	8	N
Ethylene Dibromide	0.2	ug/L	<0.20	Not Detected On Site	N/A	5	N
Methyl Ethyl Ketone (2-Butanone)	5.0	ug/L	<5.0	Not Detected On Site	N/A	400	N
Methyl t-butyl ether (MTBE)	0.2	ug/L	<0.20	Not Detected On Site	N/A	200	N
Methylene Chloride(Dichloromethane)	0.5	ug/L	<0.50	Not Detected On Site	N/A	98.1	N
Styrene	0.2	ug/L	<0.20	Not Detected On Site	N/A	4	N
1,1,1,2-Tetrachloroethane	0.2	ug/L	<0.20	Not Detected On Site	N/A	20	N
1,1,2,2-Tetrachloroethane	0.2	ug/L	<0.20	Not Detected On Site	N/A	70	N
Tetrachloroethylene	0.1	ug/L	<0.10	Not Detected On Site	N/A	50	N
Toluene	0.2	ug/L	0.22	RR2	2017-08-29	0.8	N
1,1,1-Trichloroethane	0.1	ug/L	<0.10	Not Detected On Site	N/A	10	N
1,1,2-Trichloroethane	0.2	ug/L	<0.20	Not Detected On Site	N/A	800	N
Trichloroethylene	0.1	ug/L	<0.10	Not Detected On Site	N/A	20	N
Vinyl Chloride	0.2	ug/L	<0.20	Not Detected On Site	N/A	600	N
o-Xylene	0.1	ug/L	<0.10	Not Detected On Site	N/A	40	N
p+m-Xylene	0.1	ug/L	<0.10	Not Detected On Site	N/A	2	N
Total PCBs	0.005	µg/L	0.11	RR2	1994-10-17	0.001	Y

N/A - Not Applicable

Table 25 - PID Field Screening Measurements

Sample Location	Sample Depth (m)	HC Reading† (ppm)	VOC Reading† (ppm)
MW5/17	0-0.76	0	2
MW5/17	0.76-1.52	0	0
MW5/17	1.52-3.05	0	0
MW5/17	3.05-3.35	0	2
MW5/17	3.35-3.66	0	0
MW7/17	0-0.76	0	0
MW7/17	0.76-1.52	0	4
MW7/17	1.52-3.05	0	2
MW7/17	3.05-3.81	5	0
MW8/17	0-1.52	0	0
MW8/17	1.52-3.05	0	2
MW8/17	3.05-4.27	0	0
MW9/17	0-0.76	0	0
MW9/17	0.76-1.52	0	0
MW9/17	1.52-2.29	0	0
MW9/17	2.29-3.05	0	0
MW9/17	3.05-4.11	0	0
MW10/17	0-0.76	0	0
MW10/17	0.76-1.52	15	28
MW10/17	1.52-3.05	0	8
MW10/17	3.05-3.81	5	4
BH11/17	0-0.76	0	0
BH11/17	0.76-1.52	0	0
BH11/17	1.52-3.05	0	2
BH11/17	3.05-4.57	0	0
BH12/17	0-0.76	0	0
BH12/17	0.76-1.52	0	2
BH12/17	1.52-3.05	0	0
BH12/17	3.05-4.57	0	0
BH13/17	0-1.52	0	0
BH13/17	1.52-3.05	0	0
BH13/17	3.05-4.57	10	0

† Samples measured using a RKI Eagle 2

HC - Hydrocarbon

VOC - Volatile Organic Compounds

Table 26 - XRF Screening Results

Location	MW5/17	MW5/17	MW5/17	MW5/17	MW5/17	MW7/17	MW7/17	MW7/17	MW7/17	MW8/17	Applicable Site Condition Standard XRF Limit
Sample Date	0-0.76	31-Aug-17	31-Aug-17	31-Aug-17	31-Aug-17	31-Aug-17	31-Aug-17	31-Aug-17	31-Aug-17	31-Aug-17	
Sample Depth (m)	0.76-1.52	0.76-1.52	1.52-3.05	3.05-3.35	3.35-3.66	0-0.76	0.76-1.52	1.52-3.05	3.05-3.81	0-1.52	
Arsenic (ppm)	<2	N/A	13	23	N/A	<2	8.1	15.1	6.1	<2	16
Lead (ppm)	<2	N/A	164	47	N/A	<2	58	112	<2	117	80
Zinc (ppm)	6.8	N/A	606	392	N/A	12.7	86	365	14.6	183	440

Location	MW8/17	MW8/17	MW9/17	MW9/17	MW9/17	MW9/17	MW9/17	MW10/17	MW10/17	MW10/17	Applicable Site Condition Standard XRF Limit
Sample Date	31-Aug-17	31-Aug-17	31-Aug-17	31-Aug-17	31-Aug-17	31-Aug-17	31-Aug-17	31-Aug-17	31-Aug-17	31-Aug-17	
Sample Depth (m)	1.52-3.05	3.05-4.27	0-0.76	0.76-1.52	1.52-2.29	2.29-3.05	3.05-4.11	0-0.76	0.76-1.52	1.52-3.05	
Arsenic (ppm)	9.2	N/A	<2	<2	<2	<2	<2	<2	6.7	<2	16
Lead (ppm)	139	N/A	5.6	<2	<2	<2	<2	<2	65	900	80
Zinc (ppm)	376	N/A	14.5	<2	<2	<2	<2	6.7	705	402	440

Location	MW10/17	BH11/17	BH11/17	BH11/17	BH11/17	BH12/17	BH12/17	BH12/17	BH12/17	BH13/17	Applicable Site Condition Standard XRF Limit
Sample Date	31-Aug-17	31-Aug-17	31-Aug-17	31-Aug-17	31-Aug-17	31-Aug-17	31-Aug-17	31-Aug-17	31-Aug-17	31-Aug-17	
Sample Depth (m)	3.05-3.81	0-0.76	0.76-1.52	1.52-3.05	3.05-4.57	0-0.76	0.76-1.52	1.52-3.05	3.05-4.57	0-1.52	
Arsenic (ppm)	<2	<2	<2	28.8	4.1	<2	<2	<2	<2	<2	16
Lead (ppm)	37.2	<2	80	82	50.7	4.6	9.6	12.6	30.6	23.9	80
Zinc (ppm)	40.5	32.5	92	121	47	21.8	<2	22.7	685	53	440

Location	BH13/17	BH13/17	Applicable Site Condition Standard XRF Limit
Sample Date	31-Aug-17	31-Aug-17	
Sample Depth (m)	1.52-3.05	3.05-4.57	
Arsenic (ppm)	<2	7.6	16
Lead (ppm)	28.1	127	80
Zinc (ppm)	184	726	440

XRF - X-Ray fluorescence

Applicable site condition standard XRF limit determined from Innove-X accuracy studies and in-house correlations

Values that exceeded site condition standard XRF limit

TABLE 27 COMPARATIVE CRITERIA FOR SOIL

Contaminant of Concern	Distance from Surface Water	Maximum Measured Concentration [a]	CCME Guideline	Components of CCME guideline										MOECC SCS	Carried forward to RA?
				Human Health						Ecological					
				Soil Ingestion	Soil Dermal	Soil Inhalation	Indoor Air (basement / slab-on-grade)	Drinking Water check	Produce, Meat, Dairy check	Soil Contact	Soil and Food Ingestion	Nutrient and Energy Cycling	Aquatic Life check		
BTEX and PHCs															
Ethylbenzene	> 10 m	0.44	0.082	10,000	58,000	NV	88 / 55	0.082	NV	55	NV	NV	50	-	No
	< 10 m	-	NV											0.05	
Toluene	> 10 m	0.72	0.37	22,000	220,000	NV	200 / 120	0.37	NV	75	NV	NV	0.1	-	Yes - aq
	< 10 m	-	NV											0.2	
Xylenes	> 10 m	-	11	150,000	<1,000,000	NV	22 / 14	11	NV	95	NV	NV	37	-	Yes - aq
	< 10 m	0.11	NV											0.05	
PHCs F2	> 10 m	-	150	6,800		NV	190 / 150	320	NV	150	NV	NV	380	-	Yes - aq
	< 10 m	32	NV											10	
PHCs F3	> 10 m	520	300	15,000		NV	NA	NA	NV	300	NV	NV	NA	-	Yes - terr. eco
	< 10 m	620	NV											240	
PHCs F4	> 10 m	-	2800	21,000		NV	NA	NA	NV	2800	NV	NV	NA	-	No
	< 10 m	370 (1000 grav)	NV											120	
VOCs															
Trichloroethylene	> 10 m	0.047	0.01	28		NV	0.058 / 0.036	0.01	0.14	3	NV	NV	0.05	-	Yes - aq
	< 10 m	0.48	NV											0.05	
PAHs and semi-VOCs															
Anthracene	> 10 m	2.94 (in 1994)	2.5	NV	NV	NV	NV	NV	NV	2.5	61.5	NV	NA	-	Yes - HH; terr.eco
	< 10 m	-	NV											0.22	
Benzo[a]anthracene	> 10 m	1.63 (in 1994)	1	NV	NV	NV	NV	NV	NV	NV	6.2	NV	NA	-	Yes - HH; terr.eco
	< 10 m	-	NV											0.36	
Benzo[b]fluoranthene	> 10 m	1.16 (in 1994)	1	NV	NV	NV	NV	NV	NV	NV	6.2	NV	NA	-	Yes - HH; terr.eco
	< 10 m	-	NV											0.47	
Benzo[k]fluoranthene	> 10 m	1.30 (in 1994)	1	NV	NV	NV	NV	NV	NV	NV	6.2	NV	NA	-	Yes - HH; terr.eco
	< 10 m	-	NV											0.48	
Methylnaphthalene	> 10 m	5.3	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	-	Yes - HH; terr.eco; aq
	< 10 m	-	NV											-	
Naphthalene	> 10 m	3.7	0.013	NV	NV	NV	NV	NV	NV	NV	8.8	NV	0.013	-	Yes - HH; terr.eco; aq
	< 10 m	-	NV											-	
Phenanthrene	> 10 m	0.088 (3.04 in 1994)	0.046	NV	NV	NV	NV	NV	NV	NV	43	NV	0.046	-	Yes - HH; terr.eco; aq
	< 10 m	-	NV											-	
Methoxychlor	> 10 m	1.31 (in 1994)	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	0.13	Yes - HH; terr.eco; aq
	< 10 m	-	NV											0.05	
DDD	> 10 m	-	0.7 (sum DDT)	NV [b]	NV [b]	NV	NV	NV	NV	12 (sum DDT)	0.7 (sum DDT)	NV	0.1 (sum DDT)	-	Yes - aq
	< 10 m	0.062 (in 1994) (DDT not detected)	NV											0.05	
Inorganic Parameters															
Antimony	> 10 m	-	20	NV	NV	NV	NA	NV	NV	NV	NV	NV	NV	-	Yes - HH; terr.eco; aq
	< 10 m	5.9	NV											1.3	
Arsenic	> 10 m	13	12	12	NV	NV	NA	NV	NV	17	NV	NV	NV	-	Yes - HH; aq
	< 10 m	17	NV											18	
Cadmium	> 10 m	-	10	14	NV	NV	NA	NV	NV	10	NV	54	NV	-	Yes - terr eco; aq
	< 10 m	13	NV											1.2	
Copper	> 10 m	210	63	1,100	NV	NV	NA	NV	NV	63	NV	430	NV	-	Yes - terr eco; aq
	< 10 m	710	NV											92	
Lead	> 10 m	530	140	140	NV	NV	NA	NV	NV	300	NV	723	NV	-	Yes - HH; terr.eco; aq
	< 10 m	350	NV											120	
Nickel	> 10 m	-	45	200		10,000	NA	NV	NV	45	NV	171	NV	-	Yes - HH; terr.eco; aq
	< 10 m	550	NV											82	
Tin	> 10 m	210	50	NV	NV	NV	NA	NV	NV	NV	NV	NV	NV	-	Yes - HH; terr.eco; aq
	< 10 m	230	NV											NV	
Zinc	> 10 m	880	200	NV	NV	NV	NA	NV	NV	200	NV	NV	NV	-	Yes - HH; terr.eco; aq
	< 10 m	4500	NV											290	

All data in units of µg/g; a - Measured in 2017 unless noted otherwise; b - 3.3 ug/g in MOE (2011c)

NA- Not applicable; NV - No value; HH - Human health; terr. eco - Terrestrial ecological receptors; aq - Aquatic receptors

TABLE 28 COMPARATIVE CRITERIA FOR GROUNDWATER

Contaminant of Concern	Distance from Surface Water	Maximum Measured Concentration [a]	FCSAP Residential/ Parkland Land Use Coarse	CCME Freshwater Aquatic Life	MOECC Table 9	MOECC Aquatic Protection Value	Components of FCSAP Guideline			Guideline for Canadian Drinking Water Quality [b]	Carried forward to RA?
							Inhalation	Soil Organisms Direct Contact	Freshwater Life		
PHCs											
PHCs F3	> 10 m	19,000	NV	NV		NV	NV	NV	NV	1,000 [b]	Yes (HH; aq)
	< 10 m	3,700			500						
PHCs F4	> 10 m	9,700	NV	NV		NV	NV	NV	NV	1,100 [b]	Yes (HH; aq)
	< 10 m	2,100			500						
VOCs											
Chlorobenzene	> 10 m	5.4	1.3	1.3		50	14	NV	1.3	30 [b]	No
	< 10 m	3.1			500						
PAHs											
Anthracene	> 10 m	0.12	0.012	0.012	1	0.1	>solubility	25	0.012	890 [b]	Yes (aq)
	< 10 m	0.085									
Benzo(a)anthracene	> 10 m	0.063	0.018	0.018	1.8	0.18	NV	NV	0.018	1 [b]	No
	< 10 m	<0.05									
Benzo(a)pyrene	> 10 m	0.06	0.01	0.015	0.81	0.21	NV	1.8	0.015	0.01 [b]	Yes (HH)
	< 10 m	<0.05									
Fluoranthene	> 10 m	0.42	0.04	0.04	73	7.3	>solubility	240	0.04	0.41 [b]	Yes (HH)
	< 10 m	0.11									
Naphthalene	> 10 m	27	1.1	1.1	1400	620	600	NV	1.1	59 [b]	No
	< 10 m	-									
Phenanthrene	> 10 m	0.94	0.4	0.4	380	38	NV	NV	0.4	1 [b]	No
	< 10 m	0.56									
Pyrene	> 10 m	0.24	0.025	0.025	5.7	0.57	>solubility	NV	0.025	4.1 [b]	No
	< 10 m	0.072									
Inorganic Parameters											
Arsenic	> 10 m	12	5	5		150	NA	NA	5	10	Yes (HH)
	< 10 m	-			1500						
Cadmium	> 10 m	<0.10	0.017	0.09		0.21	NA	NA	0.017	5	No
	< 10 m	<0.10			2.1						
Chloride	> 10 m	220,000	120,000	120,000		180,000	NA	NA	120,000	250,000	Yes (aq)
	< 10 m	-			1,800,000						
Cyanide, free	> 10 m	1.2	1	5		5.2	NA	NA	5	200	No
	< 10 m	2.3			52						
Iron	> 10 m	34,000	300	300		NV	NA	NA	300	300 (aesthetic)	Yes (aq)
	< 10 m	9,400			NV						
Selenium	> 10 m	<2.0	1	1		5	NA	NA	1	50	No
	< 10 m	<2.0			50						

All data in units of µg/L

NV - No value; NA - Not applicable; HH - Human health; aq - Aquatic receptors

a - Measured in 2017

b - No GCDWQ available; value shown is MOECC drinking water component

TABLE 29 COMPARATIVE CRITERIA FOR SEDIMENT

Contaminant of Concern	Maximum Measured Concentration [a]	CCME Freshwater ISQG	CCME Freshwater PEL	MOECC Table 9	Carried forward to RA? [b]
VOCs					
Acetone	1.5	NV	NV	NV	Yes
Toluene	0.13	NV	NV	NV	Yes
PAHs					
Acenaphthene	0.0098	0.00671	0.0889	-	Yes
Acenaphthylene	0.0086 (<0.02)	0.00587	0.128	-	Yes
Benzo(a)anthracene	0.073	0.0317	0.385	-	Yes
Benzo(a)pyrene	0.065	0.0319	0.782	-	Yes
Benzo(b/j)fluoranthene	0.11	NV	NV	NV	Yes
Chrysene	0.071	0.0571	0.862	-	Yes
Dibenz(a,h)anthracene	0.011 (<0.02)	0.00622	0.135	-	Yes
Fluoranthene	0.15	0.111	2.355	-	Yes
Methylnaphthalene, 2-(1-)	0.028	0.0202	0.201	-	Yes
Phenanthrene	0.083	0.0419	0.515	-	Yes
Pyrene	0.12	0.053	0.875	-	Yes
PCBs	<0.05	0.0341	0.277	-	Yes
Inorganic Parameters					
Antimony	0.77 (2.2 in 2011)	NV	NV	NV	Yes
Arsenic	82	5.9	17	-	Yes (>PEL)
Barium	210	NV	NV	NV	Yes
Beryllium	0.33	ND	ND	NV	Yes
Boron	5.8	NV	NV	NV	Yes
Cobalt	54	NV	NV	50	Yes
Cyanide (free)	0.2	NV	NV	0.1	Yes
Lead	110 (539 in 1994)	35	91.3	-	Yes (>PEL)
Mercury	0.19 (1.3 in 2011)	0.17	0.486	-	Yes
Molybdenum	4.9	NV	NV	NV	Yes
Nickel	38	NV	NV	16	Yes
Selenium	1.1	NV	NV	NV	Yes
Silver	1.4 (in 2011)	NV	NV	0.5	Yes
Thallium	0.95	NV	NV	NV	Yes
Uranium	2.6	NV	NV	NV	Yes
Vanadium	32	NV	NV	NV	Yes

All data in units of µg/g

a - Measured in 2017 unless noted otherwise

b - Aquatic receptors only

TABLE 30 COMPARATIVE CRITERIA FOR SURFACE WATER

Contaminant of Concern	Maximum Measured Concentration [a]	CCME Freshwater Aquatic Life	MOECC PWQO	MOECC Aquatic Protection Value	Guideline for Canadian Drinking Water Quality	Carried forward to RA?
VOCs						
Acrolein	<10	NV	0.03	NV	NV	No
Inorganic Parameters						
Cadmium	<0.10	0.09	0.2	0.21	5	No
Cyanide (free)	6	5	5	5.2	200	Yes (aquatic)
Mercury	<0.1	0.026	0.2	0.77	1	No
Selenium	<2.0	1	100	5	50	No
Ammonia, unionized	34	19	20	NV	NV	Yes (aquatic)

All data in units of µg/L
NV - No value
a - Measured in 2017

TABLE 31: CHEMICAL-SPECIFIC INFORMATION

COC	Relative Absorption Factors				Lag Time per event
	Dermal AF $_S$ (no units) [a]	GI Tract AF_{git} (no units)	Fraction Absorbed from Water FA (no units)[f]	Permeability Constant PC (cm/h) [b]	(h/event) [c]
PHCs (F3)					
Aliphatics	NA	1	1	1.96	0.82
Aromatics	NA	1	1	0.308	2.69
PHCs (F4)					
Aliphatics	NA	1	1	1.96	0.82
Aromatics	NA	1	1	0.308	2.69
Anthracene	0.13 [d]	NA	NA	NA	NA
Benzo[a]anthracene	0.13 [d]	NA	NA	NA	NA
Benzo[b]fluoranthene	0.13 [d]	NA	NA	NA	NA
Benzo[k]fluoranthene	0.13 [d]	NA	NA	NA	NA
Methylnaphthalene, 1- and 2-	0.148	NA	NA	NA	NA
Naphthalene	0.148	NA	NA	NA	NA
Phenanthrene	0.13 [d]	NA	NA	NA	NA
Methoxychlor	0.1 [b]	NA	NA	NA	NA
Antimony	0.1 [d]	NA	NA	NA	NA
Arsenic	0.03	NA	NA	NA	NA
Lead	0.006 [e]	NA	NA	NA	NA
Nickel	0.091	NA	NA	NA	NA
Tin	0.1 [e]	NA	NA	NA	NA
Zinc	0.1	NA	NA	NA	NA

Notes:
a - HC (2010b) except where noted
b - RAIS (2017)
c - USEPA (2004). Values not available for PHCs and surrogate chemicals were selected as follows: decanol and benzo[a]pyrene for F3 and F4 aliphatics and aromatics.
d - MOE (2011c)
e - HC (2004)
f - assumed
NA - pathway not applicable

TABLE 32: CHARACTERISTICS OF HUMAN RECEPTORS[a]

VARIABLE	UNITS	DESCRIPTION	SITE VISITOR					LONG-TERM WORKER	CONSTRUCTION WORKER
			ADULT (20 years and older)	TEEN (12 to 19 years)	CHILD (5 to 11 years)	TODDLER (7 months to 4 years)	INFANT (0 to 6 months)		
SIR	mg/day	Soil ingestion rate	20	20	20	80	20	100	100
SSA	cm^2	Skin surface area in contact with soil or groundwater	3390 (890: hands and 2500: arms)	3030 (800: hands and 2230: arms)	5140 (590: hands, 1480: arms, 3070: legs)	3010 (430: hands, 890: arms, 1690: legs)	1780 (320: hands, 550: arms, 910: legs)	3390 (890: hands and 2500: arms)	3390 (890: hands and 2500: arms)
SA	mg/cm^2/event	Soil adherence factor	0.1 (hands); 0.01 (other); 0.034 (calculated, combined)	0.1 (hands); 0.01 (other); 0.034 (calculated, combined)	0.1 (hands); 0.01 (other); 0.02 (calculated, combined)	0.1 (hands); 0.01 (other); 0.023 (calculated, combined)	0.1 (hands); 0.01 (other); 0.026 (calculated, combined)	1 (hands); 0.1 (other); 0.34 (calculated, combined)	1 (hands); 0.1 (other); 0.34 (calculated, combined)
INH	m^3/h	Inhalation rate	16.6 m^3/d (0.7 m^3/h)	15.6 m^3/d (0.7 m^3/h)	14.5 m^3/d (0.6 m^3/h)	8.3 m^3/d (0.35 m^3/h)	2.2 m^3/d (0.09 m^3/h)	1.4	1.4
C_{PM10}	$\mu g/m^3$	Concentration of particulate matter, 10 µm or less, in air	0.76 [b]	0.76 [b]	0.76 [b]	0.76 [b]	0.76 [b]	0.76 [b]	0.76 [b]
BW	kg	Body weight	70.7	59.7	32.9	16.5	8.2	70.7	70.7
IR_{GW}	L/d	Ingestion rate of groundwater	NA	NA	NA	0.005 [c]	NA	0.02[c]	0.02[c]
EF	h/d	Exposure frequency outdoors: Hours per day	1.5	1.5	1.5	1.5	1.5	10	10
EF_1	d/w	Exposure frequency: Days per week	5 [d]	2 [d]	2 [d]	5 [d]	5 [d]	5	5
EFout	w/y	Exposure frequency outdoors: Weeks per year	26 [d]	26 [d]	26 [d]	26 [d]	26 [d]	26 [d]	26 [d]
ET	h/d	Exposure time for contact with groundwater	NA	NA	NA	0.25 [d]	NA	0.5 [d]	2 [d]
E	events/d	Number of times per day soil contacted	1	1	1	1	1	1	1
EV	events/d	Number of times per day groundwater contacted	NA	NA	NA	0.2 [d] (equals once per week)	NA	1 [d]	1 [d]
ED	y	Exposure duration	60	8	7	4.5	0.5	35	2 [d]
AT	y	Averaging time - non-threshold effects	80	80	80	80	80	80	80
		Averaging time - threshold effects	60	8	7	4.5	0.5	35	2 [d]

NOTES:

a - Health Canada (2010a) except where noted

b - Health Canada (2004)

c - VDEQ (2016)

d - Assumed - refer to text in Section 6.3.4 for explanation

NA - Not applicable

TABLE 33: ESTIMATED DOSES

COC / EXPOSURE PATHWAY	ESTIMATED DOSE (mg/kg/d)						
	SITE VISITOR*					LONG-TERM WORKER	CONSTRUCTION WORKER
	ADULT	TEEN	CHILD	TODDLER	INFANT		
PHCs (F3) aliphatic							
Incidental ingestion of groundwater				1.64E-03		1.53E-03	1.53E-03
Dermal contact with groundwater				4.84E-01		9.00E-01	1.80E+00
PHCs (F3) aromatic							
Incidental ingestion of groundwater				4.10E-04		3.83E-04	3.83E-04
Dermal contact with groundwater				3.45E-02		6.41E-02	1.28E-01
PHCs (F4) aliphatic							
Incidental ingestion of groundwater				8.38E-04		7.82E-04	7.82E-04
Dermal contact with groundwater				2.47E-01		4.60E-01	9.19E-01
PHCs (F4) aromatic							
Incidental ingestion of groundwater				2.09E-04		1.95E-04	1.95E-04
Dermal contact with groundwater				1.76E-02		3.27E-02	6.54E-02
Anthracene - non-threshold effects							
Incidental ingestion of soil	2.22E-07	1.40E-08	2.23E-08	2.86E-07	1.60E-08	6.48E-07	3.70E-08
Dermal contact with soil	1.65E-07	9.33E-09	1.51E-08	3.19E-08	4.83E-09	9.60E-07	5.49E-08
Inhalation of particulate matter	8.86E-12	5.60E-13	7.62E-13	1.42E-12	8.19E-14	6.89E-11	3.94E-12
Anthracene - threshold effects							
Incidental ingestion of soil				5.08E-06		1.48E-06	1.48E-06
Dermal contact with soil				5.68E-07		2.19E-06	2.19E-06
Inhalation of particulate matter				2.53E-11		1.58E-10	1.58E-10
Benzo[a]anthracene							
Incidental ingestion of soil	1.23E-07	7.78E-09	1.24E-08	1.58E-07	8.85E-09	3.59E-07	2.05E-08
Dermal contact with soil	9.13E-08	5.17E-09	8.39E-09	1.77E-08	2.68E-09	5.32E-07	3.04E-08
Inhalation of particulate matter	4.91E-12	3.10E-13	4.22E-13	7.90E-13	4.54E-14	3.82E-11	2.18E-12
Benzo[b]fluoranthene							
Incidental ingestion of soil	8.77E-08	5.54E-09	8.79E-09	1.13E-07	6.30E-09	2.56E-07	1.46E-08
Dermal contact with soil	6.50E-08	3.68E-09	5.97E-09	1.26E-08	1.91E-09	3.79E-07	2.17E-08
Inhalation of particulate matter	3.50E-12	2.21E-13	3.01E-13	5.62E-13	3.23E-14	2.72E-11	1.55E-12
Benzo[k]fluoranthene							
Incidental ingestion of soil	9.82E-08	6.20E-09	9.85E-09	1.26E-07	7.06E-09	2.87E-07	1.64E-08
Dermal contact with soil	7.28E-08	4.13E-09	6.69E-09	1.41E-08	2.14E-09	4.25E-07	2.43E-08
Inhalation of particulate matter	3.92E-12	2.48E-13	3.37E-13	6.30E-13	3.62E-14	3.05E-11	1.74E-12
Methylnaphthalene, 1- and 2-							
Incidental ingestion of soil				9.15E-06		2.67E-06	2.67E-06
Dermal contact with soil				1.16E-06		4.50E-06	4.50E-06
Inhalation of particulate matter				4.56E-11		2.84E-10	2.84E-10
Naphthalene							
Incidental ingestion of soil				6.39E-06		1.86E-06	1.86E-06
Dermal contact with soil				8.13E-07		3.14E-06	3.14E-06
Inhalation of particulate matter				3.19E-11		1.98E-10	1.98E-10
Phenanthrene							
Incidental ingestion of soil	2.30E-07	1.45E-08	2.30E-08	2.95E-07	1.65E-08	6.70E-07	3.83E-08
Dermal contact with soil	1.70E-07	9.65E-09	1.56E-08	3.30E-08	5.00E-09	9.93E-07	5.67E-08
Inhalation of particulate matter	9.17E-12	5.79E-13	7.88E-13	1.47E-12	8.47E-14	7.13E-11	4.07E-12
Methoxychlor							
Incidental ingestion of soil				2.26E-06		6.60E-07	6.60E-07
Dermal contact with soil				1.95E-07		7.52E-07	7.52E-07
Inhalation of particulate matter				1.13E-11		7.02E-11	7.02E-11
Antimony							
Incidental ingestion of soil				1.02E-05		2.97E-06	2.97E-06
Dermal contact with soil				8.76E-07		3.39E-06	3.39E-06
Inhalation of particulate matter				5.08E-11		3.16E-10	3.16E-10
Arsenic							
Incidental ingestion of soil	1.28E-06	8.11E-08	1.29E-07	1.65E-06	9.23E-08	3.75E-06	2.14E-07
Dermal contact with soil	2.20E-07	1.25E-08	2.02E-08	4.26E-08	6.45E-09	1.28E-06	7.32E-08
Inhalation of particulate matter	5.13E-11	3.24E-12	4.41E-12	8.24E-12	4.73E-13	3.99E-10	2.28E-11
Lead							
Incidental ingestion of soil				9.15E-04		2.67E-04	2.67E-04
Dermal contact with soil				4.72E-06		1.83E-05	1.83E-05
Inhalation of particulate matter				4.56E-09		2.84E-08	2.84E-08
Nickel							
Incidental ingestion of soil				2.67E-03		7.78E-04	7.78E-04
Dermal contact with soil				2.09E-04		8.07E-04	8.07E-04
Inhalation of particulate matter - threshold effects				1.33E-08		8.28E-08	8.28E-08
Inhalation of particulate matter - non-threshold effects	1.66E-09	1.05E-10	1.43E-10	2.66E-10	1.53E-11	1.29E-08	7.37E-10
Tin							
Incidental ingestion of soil				3.97E-04		1.16E-04	1.16E-04
Dermal contact with soil				3.42E-05		1.32E-04	1.32E-04
Inhalation of particulate matter				1.98E-09		1.23E-08	1.23E-08
Zinc							
Incidental ingestion of soil				7.77E-03		2.27E-03	2.27E-03
Dermal contact with soil				6.68E-04		2.58E-03	2.58E-03
Inhalation of particulate matter				3.88E-08		2.41E-07	2.41E-07

Note:
* - Site visitor - toddlers are considered the critical receptors for threshold chemicals; all age classes are evaluated for non-threshold chemicals.

TABLE 34: HUMAN TOXICOLOGICAL INFORMATION

COC	Route	Toxicological Reference Value Type (units)	Value	Critical Effect	Study	Reference	Date
PHCs							
F3							
Aliphatics $C_{>16}$ - C_{21}	Oral	RfD (mg/kg/d)	2	Hepatic granuloma		Edwards et al.	1997
	Inhalation	RfC (mg/m^3)	NA	-			
Aliphatics $C_{>21}$ - C_{34}	Oral	RfD (mg/kg/d)	2	Hepatic granuloma		Edwards et al.	1997
	Inhalation	RfC (mg/m^3)	NA	-			
Aromatics $C_{>16}$ - C_{21}	Oral	RfD (mg/kg/d)	0.03	Nephrotoxicity		Edwards et al.	1997
	Inhalation	RfC (mg/m^3)	NA				
Aromatics $C_{>21}$ - C_{34}	Oral	RfD (mg/kg/d)	0.03	Nephrotoxicity		Edwards et al.	1997
	Inhalation	RfC (mg/m^3)	NA				
F4							
Aliphatics $C_{>34}$	Oral	RfD (mg/kg/d)	20	Hepatic granuloma		Edwards et al.	1997
	Inhalation	RfC (mg/m^3)	NA	-			
Aromatics $C_{>34}$	Oral	RfD (mg/kg/d)	0.03	Nephrotoxicity		Edwards et al.	1997
	Inhalation	RfC (mg/m^3)	NA				
Anthracene	Oral	RfD (mg/kg/d)	0.3	No effects observed	US EPA, 1989	USEPA IRIS	1993
		Slope factor $(mg/kg/d)^{-1}$	0.23	Gastric tumours (mice)	Neal and Rigdon, 1967	HC [b]	2010b
	Inhalation	RfC (mg/m^3)	NA				
		Unit risk $(mg/m^3)^{-1}$	0.0031	Respiratory tract tumours (hamsters)	Thyssen *et al.* , 1981	HC [b]	2010b
Benzo[a]anthracene	Oral	Slope factor $(mg/kg/d)^{-1}$	0.23	Gastric tumours (mice)	Neal and Rigdon, 1967	HC [b]	2010b
	Inhalation	Unit risk $(mg/m^3)^{-1}$	0.0031	Respiratory tract tumours (hamsters)	Thyssen *et al.* , 1981	HC [b]	2010b
Benzo[b]fluoranthene	Oral	Slope factor $(mg/kg/d)^{-1}$	0.23	Gastric tumours (mice)	Neal and Rigdon, 1967	HC [b]	2010b
	Inhalation	Unit risk $(mg/m^3)^{-1}$	0.0031	Respiratory tract tumours (hamsters)	Thyssen *et al.* , 1981	HC [b]	2010b
Benzo[k]fluoranthene	Oral	Slope factor $(mg/kg/d)^{-1}$	0.23	Gastric tumours (mice)	Neal and Rigdon, 1967	HC [b]	2010b
	Inhalation	Unit risk $(mg/m^3)^{-1}$	0.0031	Respiratory tract tumours (hamsters)	Thyssen *et al.* , 1981	HC [b]	2010b
Methylnaphthalene, 1- and 2-	Oral	RfD (mg/kg/d)	0.004 [a]	Pulmonary alveolar proteinosis (mice)	Murata *et al.,* 1997	USEPA IRIS	2003
	Inhalation	RfC (mg/m^3)	NA				
Naphthalene	Oral	RfD (mg/kg/d)	0.02 [a]	Decreased body weight (rats)	BCL, 1980	USEPA IRIS	1998
	Inhalation	RfC (mg/m^3)	NA				
Phenanthrene	Oral	Slope factor $(mg/kg/d)^{-1}$	0.0023	Gastric tumours (mice)	Neal and Rigdon, 1967	HC [b]	2010b
	Inhalation	Unit risk $(mg/m^3)^{-1}$	3.10E-05	Respiratory tract tumours (hamsters)	Thyssen *et al.* , 1981	HC [b]	2010b
Methoxychlor	Oral	RfD (mg/kg/d)	0.1			HC	2010b
	Inhalation	RfC (mg/m^3)	NA				
Antimony	Oral	RfD (mg/kg/d)	0.06	Histological changes (rats)	Poon *et al.,* 1998	HC	1999
	Inhalation	RfC (mg/m^3)	NA				
Arsenic	Oral	RfD (mg/kg/d)	NA				
		Slope factor $(mg/kg/d)^{-1}$	1.8	Cancer: bladder, lung, liver (epidemiological)	Morales et al., 2000	HC	2010b
	Inhalation	RfC (mg/m^3)	NA				
		Unit risk $(mg/m^3)^{-1}$	6.4	Lung cancer (human - occupational)	Several studies	HC	2010b
Lead	Oral	RfD (mg/kg/d)	NA	Neurobehavioural effects in children. Considered a non-threshold toxicant; soil concentrations screened with CCME guideline of 140 ug/g and background concentration of 120 ug/g. For adults, TRV of 1.2E-03 mg/kg/d, based on increased blood pressure, used (JECFA, 2011)			
	Inhalation	RfC (mg/m^3)	NA				
Nickel	Oral	RfD (mg/kg/d)	0.011 [a]	Developmental effects (rats)	SLI (2000)	CCME	2015
	Inhalation	RfC (mg/m^3)	NA				
		Unit risk $(mg/m^3)^{-1}$	1.3 [a]	Lung cancer (human)		CCME	2015
Tin	Oral	RfD (mg/kg/d)	0.3	Reduced hemoglobin concentration (rats)	DeGroot *et al.* 1973	ATSDR	2005
	Inhalation	RfC (mg/m^3)	NA				
Zinc	Oral	RfD (mg/kg/d)	0.5 (infant to teen); 0.6 (adult)	Reduced iron and copper status; increased growth of infant	Yadrick *et al.,* 1989; Walravens and Hambidge, 1976	HC	2010b
	Inhalation	RfC (mg/m^3)	NA				

Notes:

NA - Not available.

a - Preferred value in HC, 2010b

b - Benzo[a]pyrene Potency Equivalence Factors from HC (2010a) applied to HC (2010b) slope factor and unit risk for benzo[a]pyrene.

TABLE 35: ESTIMATED HAZARD QUOTIENTS

COC / EXPOSURE PATHWAY	HAZARD QUOTIENT (HQ) [a]						
	SITE VISITOR					LONG-TERM WORKER	CONSTRUCTION WORKER
	ADULT	TEEN	CHILD	TODDLER	INFANT		
PHCs (F3) aliphatic							
Groundwater: incidental ingestion and dermal contact				0.24 (0.039)		0.45 (0.073)	**0.90** (0.15)
PHCs (F3) aromatic							
Groundwater: incidental ingestion and dermal contact				**1.2** (0.19)		**2.1** (0.35)	**4.3** **(0.69)**
PHCs (F4) aliphatic							
Groundwater: incidental ingestion and dermal contact				0.012 (0.0029)		0.023 (0.0054)	0.046 (0.011)
PHCs (F4) aromatic							
Groundwater: incidental ingestion and dermal contact				**0.59** (0.14)		**1.1** (0.26)	**2.2** **(0.51)**
Total PHCs				**2.0** (0.37)		**3.7** **(0.68)**	**7.4** **(1.4)**
Anthracene							
Soil: incidental ingestion and dermal contact				1.9E-05		1.2E-05	1.2E-05
Inhalation of particulate matter				-		-	-
Methylnaphthalene, 1- and 2-							
Soil: incidental ingestion and dermal contact				2.6E-03		1.8E-03	1.8E-03
Inhalation of particulate matter				-		-	-
Naphthalene							
Soil: incidental ingestion and dermal contact				3.6E-04		2.5E-04	2.5E-04
Inhalation of particulate matter				-		-	-
Methoxychlor							
Soil: incidental ingestion and dermal contact				2.5E-05		1.4E-05	1.4E-05
Inhalation of particulate matter				-		-	-
Antimony							
Soil: incidental ingestion and dermal contact				1.8E-04		1.1E-04	1.1E-04
Inhalation of particulate matter				-		-	-
Lead							
Soil: incidental ingestion and dermal contact				NC		NC	NC
Inhalation of particulate matter				-		-	-
Nickel							
Soil: incidental ingestion and dermal contact				**0.26** (0.024)		0.14	0.14
Inhalation of particulate matter - threshold effects				-		-	-
Tin							
Soil: incidental ingestion and dermal contact				1.4E-03		8.3E-04	8.3E-04
Inhalation of particulate matter				-		-	-
Zinc							
Soil: incidental ingestion and dermal contact				0.014		8.1E-03	8.1E-03
Inhalation of particulate matter				-		-	-

Note:

BOLD - hazard quotient exceeds allowable level of 0.2 for COCs other than PHCs or 0.5 for PHCs

a - All HQs initially calculated using maximum measured concentrations. For HQs exceeding allowable levels, HQs re-calculated using average concentrations (shown in parentheses).
NC - Not calculated

TABLE 36: ESTIMATED INCREMENTAL LIFETIME CANCER RISKS

COC / EXPOSURE PATHWAY	INCREMENTAL LIFETIME CANCER RISK (ILCR) [a]							
	SITE VISITOR						LONG-TERM WORKER	CONSTRUCTION WORKER
	ADULT	TEEN	CHILD	TODDLER	INFANT	COMPOSITE		
Anthracene								
Soil: incidental ingestion and dermal contact	8.9E-08	5.4E-09	8.6E-09	7.3E-08	4.8E-09	1.8E-07	3.7E-07	2.1E-08
Inhalation of particulate matter	9.6E-14	6.1E-15	8.3E-15	1.5E-14	8.9E-16	1.3E-13	7.5E-13	4.3E-14
Benzo[a]anthracene								
Soil: incidental ingestion and dermal contact	4.9E-08	3.0E-09	4.8E-09	4.0E-08	2.7E-09	1.0E-07	2.1E-07	1.2E-08
Inhalation of particulate matter	5.3E-14	3.4E-15	4.6E-15	8.6E-15	4.9E-16	7.0E-14	4.1E-13	2.4E-14
Benzo[b]fluoranthene								
Soil: incidental ingestion and dermal contact	3.5E-08	2.1E-09	3.4E-09	2.9E-08	1.9E-09	7.1E-08	1.5E-07	8.3E-09
Inhalation of particulate matter	3.8E-14	2.4E-15	3.3E-15	6.1E-15	3.5E-16	5.0E-14	3.0E-13	1.7E-14
Benzo[k]fluoranthene								
Soil: incidental ingestion and dermal contact	3.9E-08	2.4E-09	3.8E-09	3.2E-08	2.1E-09	8.0E-08	1.6E-07	9.3E-09
Inhalation of particulate matter	4.3E-14	2.7E-15	3.7E-15	6.8E-15	3.9E-16	5.6E-14	3.3E-13	1.9E-14
Phenanthrene								
Soil: incidental ingestion and dermal contact	9.2E-10	5.6E-11	8.9E-11	7.6E-10	4.9E-11	1.9E-09	3.8E-09	2.2E-10
Inhalation of particulate matter	9.9E-16	6.3E-17	8.5E-17	1.6E-16	9.2E-18	1.3E-15	7.7E-15	4.4E-16
Total Carcinogenic PAHs								
Soil: incidental ingestion and dermal contact	-	-	-	-	-	4.3E-07	8.9E-07	5.1E-08
Inhalation of particulate matter	-	-	-	-	-	3.0E-13	1.8E-12	1.0E-13
Arsenic								
Soil: incidental ingestion and dermal contact	2.7E-06	1.7E-07	2.7E-07	3.0E-06	1.8E-07	6.4E-06	9.1E-06	5.2E-07
Inhalation of particulate matter	1.1E-09	7.3E-11	9.9E-11	1.8E-10	1.1E-11	1.5E-09	8.9E-09	5.1E-10
Nickel								
Inhalation of particulate matter	7.5E-09	4.8E-10	6.5E-10	1.2E-09	7.0E-11	1.0E-08	5.9E-08	3.4E-09

Note:
BOLD - ILCR exceeds allowable level of 1×10^{-5}
a - All ILCRs calculated using maximum measured concentrations

TABLE 37: EXPOSURE PARAMETERS FOR AVIAN AND MAMMALIAN WILDLIFE[a]

Species	Body Weight (kg)	Food Ingestion Rate (g ww/d)	Soil Ingestion Rate (g dw/d)	Food Source
Short-Tailed Shrew	0.015	9	0.187	Invertebrates
Meadow Vole	0.044	5	0.018	Plants
Red Fox	4.5	430	3.85	Mammals
American Woodcock	0.198	150	2.5	Invertebrates
Red-Winged Blackbird	0.064	91	1.09	Plants
Red-Tailed Hawk	1.13	98.7	1.8	Mammals

Note:
a - MOE (2011c)
ww - wet weight; dw - dry weight

TABLE 38: SCREENING OF SOIL COCS FOR ECOLOGICAL RECEPTORS

COC	Maximum Measured Concentration [a]	CCME Guideline	Components of CCME guideline				MOECC		Receptors to be evaluated in ERA
			Soil Contact	Soil and Food Ingestion	Nutrient and Energy Cycling	Aquatic Life check	Plants & Soil Organisms	Mammals & Birds	
PHCs									
PHCs F3	520 (1400)	300	**300**	NC	NC	NA	**300**	NC	Plants, Soil Organisms, Mammals, Birds
PAHs and semi-VOCs									
Anthracene	2.94 [b]	2.5	**2.5**	61.5	NC	NA	**2.5**	38000	Plants, Soil Organisms
Benzo[a]anthracene	1.63 [b]	1	NC	6.2	NC	NA	**0.5**	NC	Plants, Soil Organisms
Benzo[b]fluoranthene	1.16 [b]	1	NC	6.2	NC	NA	NC	NC	Plants, Soil Organisms
Benzo[k]fluoranthene	1.30 [b]	1	NC	6.2	NC	NA	7.6	NC	None
Methylnaphthalene	5.3	NC	NC	NC	NC	NC	NC	NC	Plants, Soil Organisms, Mammals, Birds
Naphthalene	3.7	0.013	NC	8.8	NC	0.013	**0.6**	380	Plants, Soil Organisms
Phenanthrene	3.04 [b]	0.046	NC	43	NC	0.046	6.2	2700	None
Methoxychlor	1.31 [b]	NC	NC	NC	NC	NC	NC	**0.13**	Plants, Soil Organisms, Mammals, Birds
Inorganic Parameters									
Antimony	1.4 (5.9)	20	NC	NC	NC	NC	20	25	None
Arsenic	4.5 (17	12	17	NC	NC	NC	20	51	None
Cadmium	1.7 (13)	10	10	NC	54	NC	12	1.9	None
Copper	66 (710)	63	63	NC	430	NC	140	770	None
Lead	239 [b] (530)	140	300	NC	723	NC	250	**32**	Mammals, Birds
Nickel	17 (550)	45	45	NC	171	NC	100	5000	None
Tin	16 (230)	50	NC	NC	NC	NC	NC	NC	None
Zinc	1440 [b] (4500)	200	**200**	NC	NC	NC	**400**	**340**	Plants, Soil Organisms, Mammals, Birds

Note:
All data in units of µg/g
a - Measured in 2017 unless noted otherwise; maximum concentration in surface soil shown followed by overall maximum in parentheses if greater than concentration in surface soil
b - Samples collected over a depth of 0 to 3.0 m in 1994
NA- Not applicable; NC - Not calculated

TABLE 39: CALCULATED CONCENTRATIONS OF SOIL COCS IN WILDLIFE FOOD

COC	Concentration in soil mg/kg dw	Concentration in Plants			Concentration in Earthworms			Concentration in Small Mammals		
		Equation [a]	mg/kg dw	mg/kg ww	Equation [a]	mg/kg dw	mg/kg ww	Equation [a]	mg/kg dw	mg/kg ww
PHC F3	520	NV			NV			NV		
Methylnaphthalene	5.3	NV			NV			NV		
Methoxychlor	1.31	NV			NV			NV		
Lead	239	exp(0.561*ln(Csoil)-1.328)	5.7	0.86	exp(0.807*ln(Csoil)-0.218)	67	11	exp(0.4422*ln(Csoil)+0.0761)	12	3.9
Zinc	1440	exp(0.554*ln(Csoil)+1.575)	271	41	exp(0.328*ln(Csoil)+4.449)	929	149	exp(0.0706*ln(Csoil)+4.3632)	131	42

Note:
a - USEPA (2007)
NV - No equation available
Dry weight to wet weight conversion based on water contents: 85% for vegetation, 84% for earthworms, 68% for small mammals (USEPA, 2007)

TABLE 40: ESTIMATED EXPOSURE TO AVIAN AND MAMMALIAN WILDLIFE

COC / Receptor	E food (mg/kg/d)	E soil (mg/kg/d)	E total (mg/kg/d)
Methoxychlor			
Short-Tailed Shrew	NC	0.016	0.016
Meadow Vole	NC	0.0005	0.0005
Red Fox	NC	0.0011	0.0011
American Woodcock	NC	0.017	0.017
Red-Winged Blackbird	NC	0.022	0.022
Red-Tailed Hawk	NC	0.0021	0.0021
Lead			
Short-Tailed Shrew	6.4	3.0	9.4
Meadow Vole	0.10	0.10	0.20
Red Fox	0.37	0.20	0.58
American Woodcock	8.1	3.0	11
Red-Winged Blackbird	8.1	4.1	12
Red-Tailed Hawk	0.34	0.38	0.72
Zinc			
Short-Tailed Shrew	89	18	107
Meadow Vole	4.6	0.6	5.2
Red Fox	4.0	1.2	5.2
American Woodcock	113	18	131
Red-Winged Blackbird	386	25	411
Red-Tailed Hawk	3.7	2.3	6.0

Note:
NC - Data not available to calculate

TABLE 41: BENCHMARK CONCENTRATIONS AND TOXICOLOGICAL REFERENCE VALUES[a]

COC	Plants Benchmark (mg/kg)	Invertebrates Benchmark (mg/kg)	TRV Short-tailed Shrew, Meadow Vole, Red Fox (mg/kg/d)	TRV American Woodcock and Red-Winged Blackbird (mg/kg/d)	TRV Red-Tailed Hawk (mg/kg/d)
PHCs F3	300	300	NV	NV	NV
Anthracene	2.5	2.5	NA	NA	NA
Benzo[a]anthracene	0.5	0.5	NA	NA	NA
Benzo[b]fluoranthene	NV	NV	NA	NA	NA
Methylnaphthalene	NV	NV	NV	NV	NV
Naphthalene	0.6	0.6	NA	NA	NA
Methoxychlor	NV	NV	8	NV	NV
Lead	NA	NA	80	3.3	28
Zinc	600	600	320	131	131

Note:
a - MOE (2011c)
NA - not applicable
NV - no value available

TABLE 42: HAZARD QUOTIENTS FOR TERRESTRIAL ECOLOGICAL RECEPTORS

COC	Plants	Invertebrates	Short-tailed Shrew	Meadow Vole	Red Fox	American Woodcock	Red-Winged Blackbird	Red-Tailed Hawk
PHCs F3	**1.7**	**1.7**	NV	NV	NV	NV	NV	NV
Anthracene	**1.2**	**1.2**	NA	NA	NA	NA	NA	NA
Benzo[a]anthracene	**3.3**	**3.3**	NA	NA	NA	NA	NA	NA
Benzo[b]fluoranthene	NV	NV	NA	NA	NA	NA	NA	NA
Methylnaphthalene	NV	NV	NV	NV	NV	NV	NV	NV
Naphthalene	**6.2**	**6.2**	NA	NA	NA	NA	NA	NA
Methoxychlor	NV	NV	0.002 [a]	0.00007 [a]	0.0001 [a]	NV	NV	NV
Lead	NA	NA	0.12	0.002	0.007	**3.4**	**3.7**	0.03
Zinc	**2.4**	**2.4**	0.33	0.016	0.016	1.0	**3.1**	0.05

Note:
NA - not applicable
NV - no value available
a - Based only on soil ingestion as information not available to calculate exposure via ingestion of food
BOLD - hazard quotient exceeds allowable level of 1

TABLE 43: HAZARD QUOTIENTS FOR AQUATIC RECEPTORS

COC	Distance from Surface Water	Maximum Measured Groundwater Concentration (ug/L)	Maximum Measured Surface Water Concentration (ug/L)	Aquatic Protection Value (ug/L)	Hazard Quotient
PHCs F3	> 10 m	19,000	-	NV	NC
	< 10 m	3,700	-		
PHCs F4	> 10 m	9,700	-	NV	NC
	< 10 m	2,100	-		
Anthracene	> 10 m	0.12	-	0.1	**1.2**
	< 10 m	0.085	-		0.85
Chloride	> 10 m	220,000	-	180,000	**1.2**
	< 10 m	11,000	-		0.1
Iron	> 10 m	34,000	-	300 [a]	**113**
	< 10 m	9,400	-		**31**
Cyanide (free)	-	-	6	5.2	**1.2**
Ammonia, unionized	-	-	34	19 [a]	**1.8**

Note:
a - No APV available; value is CCME Freshwater Aquatic Life criterion
NV - No value
NC - Not calculated
BOLD - hazard quotient exceeds allowable level of 1

AELenvironment

A division of Aeon Egmond Ltd.

Old Sly Locks

Site Investigation

Areas of Potential
Environmental Concern

#10888 Figure 1

Legend

- Seep
- Surface Water
- Borehole
- Monitoring Well
- Monitoring Well (Historical)
- Surface Water / Sediment
- Sediment
- APEC 1
- Site Boundary

Smiths Falls, ON

Source:

AELenvironment

A division of Aeon Egmond Ltd.

Old Sly Locks

Site Investigation

August 2017 Sampling Locations

Figure 2

#10888

Legend

- Borehole
- Monitoring Well
- Monitoring Well (Historical)
- Surface Water / Sediment
- Surface Water
- Sediment

Smiths Falls, ON

Source:

AELenvironment

A division of Aeon Egmond Ltd.

Old Sly Locks

Site Investigation

Groundwater Flow

Figure 3

#10888

Legend

- Borehole
- Monitoring Well
- Monitoring Well (Historical)
- Surface Water / Sediment
- Surface Water
- Sediment

Smiths Falls, ON

Source:

AELenvironment

A division of Aeon Egmond Ltd.

Old Sly Locks

Site Investigation

Sampling Overview

Soil Exceedances - BTEX/PHC

#10888 Figure 4a

Legend

- Exceedance
- No Exceedance

MOECC Table 9 Standard

Xylene - 0.05 μg/g
PHC F2 - 10 μg/g
PHC F3 - 240 μg/g
PHC F4 - 120 μg/g

CCME Soil Quality Guidelines

Ethylbenzene - 0.082 μg/g
Toluene - 0.37 μg/g
PHC F3 (Surface) - 300 μg/g

Source:

AELenvironment

A division of Aeon Egmond Ltd.

Old Sly Locks

Site Investigation

Sampling Overview

Soil Exceedances - VOC

#10888 Figure 4b

Legend

- Exceedance
- No Exceedance

MOECC Table 9 Standard
Trichloroethylene - 0.05 µg/g
Xylene - 0.05 µg/g

CCME Soil Quality Guidelines
Ethylbenzene - 0.082 µg/g
Toluene - 0.37 µg/g
Trichloroethylene - 0.01 µg/g
Xylenes - 11 µg/g

Source:

AELenvironment

A division of Aeon Egmond Ltd.

Old Sly Locks

Site Investigation

Sampling Overview

Soil Exceedances - Metals

#10888 Figure 4c

Legend

- No Exceedance
- Exceedance

MOECC Table 9 Standard
Cadmium - 1.2 µg/g
Copper - 92 µg/g
Lead - 120 µg/g
Nickel - 82 µg/g
Zinc - 290 µg/g
pH - 5 to 9

CCME Soil Quality Guidelines
Arsenic - 12 µg/g
Cadmium - 10 µg/g
Copper - 63 µg/g
Lead - 140 µg/g
Nickel - 45 µg/g
Tin - 50 µg/g
Zinc - 200 µg/g
pH - 6 to 8

* - flags samples exceeding CCME, but not Table 9

Source:

AELenvironment

A division of Aeon Egmond Ltd.

Old Sly Locks

Site Investigation

Sampling Overview

Soil Exceedances - PAH

#10888 Figure 4d

Legend

No Exceedance

Exceedance

MOECC Table 9 Standard
Methylnaphthalene, 2-(1-) - 0.59 µg/g

CCME Soil Quality Guidelines
Anthracene - 2.5 µg/g
Benz[a]anthracene - 1 µg/g
Benzo[a]pyrene - 20 µg/g
Benzo[b]fluoranthene - 1 µg/g
Benzo[k]fluoranthene - 1 µg/g
Naphthalene - 0.013 µg/g
Phenanthrene - 0.046 µg/g

Source:

AELenvironment

A division of Aeon Egmond Ltd.

Old Sly Locks

Site Investigation

Sampling Overview

Soil Exceedances - PCB

#10888 Figure 4e

Legend

- No Exceedance
- Exceedance

MOECC Table 9 Standard
DDD - 0.05 µg/g
Methoxyclhor - 0.05 µg/g

Source:

AELenvironment

A division of Aeon Egmond Ltd.

Old Sly Locks

Site Investigation

Sampling Overview

Groundwater Exceedances

BTEX/PHC

#10888

Figure 5a

Legend

No Exceedance

Smiths Falls, ON

MOECC Table 9 Standard
PHC F2 - 500 µg/L
PHC F3 - 500 µg/L
PHC F4/F4 Grav. - 500 µg/L

Source:

AELenvironment

A division of Aeon Egmond Ltd.

Old Sly Locks

Site Investigation

Sampling Overview

Groundwater Exceedances - VOC

#10888 Figure 5b

Legend

- Exceedance
- No Exceedance

Smiths Falls, ON

CCME ISQG Groundwater
Chlorobenzene - 1.3 µg/L

* - flags samples exceeding
CCME, but not Table 9

Source:

AELenvironment

A division of Aeon Egmond Ltd.

Old Sly Locks

Site Investigation

Sampling Overview

Groundwater Exceedances

Metals

#10888

Figure 5c

Legend

Exceedance

No Exceedance

Smiths Falls, ON

MOECC Table 9 Standard
Cobalt - 52 µg/L
Mercury - 0.29 µg/L

CCME ISQG Groundwater
Arsenic - 5 µg/L
Barium - 500 µg/L
Iron - 300 µg/L
Cadmium - 0.017 µg/L
Chloride - 120 mg/L
Cyanide - 0.001 µg/L
Zinc - 10 µg/L

* - flags samples exceeding CCME, but not Table 9

Source:

AELenvironment

A division of Aeon Egmond Ltd.

Old Sly Locks

Site Investigation

Sampling Overview

Groundwater Exceedances - PAH

#10888 Figure 5d

Legend

- Exceedance
- No Exceedance

Smiths Falls, ON

CCME ISQG Groundwater

Anthracene - 0.012 µg/L
Benzo(a)anthracene - 0.018 µg/L
Benzo(a)pyrene - 0.01 µg/L
Fluoranthene - 0.018 µg/L
Naphthalene - 1.1 µg/L
Phenanthrene - 0.4 µg/L
Pyrene - 0.025 µg/L

* - flags samples exceeding
CCME, but not Table 9

Source:

AELenvironment

A division of Aeon Egmond Ltd.

Old Sly Locks

Site Investigation

Sampling Overview

Groundwater Exceedances - PCB

#10888 Figure 5e

Legend

- Exceedance
- No Exceedance

Smiths Falls, ON

MOECC Table 9 Standard
Total PCB - 0.2 µg/L

Source:

AELenvironment

A division of Aeon Egmond Ltd.

Old Sly Locks

Site Investigation

Sampling Overview

Sediment Exceedances - Metals

#10888 Figure 6a

Legend

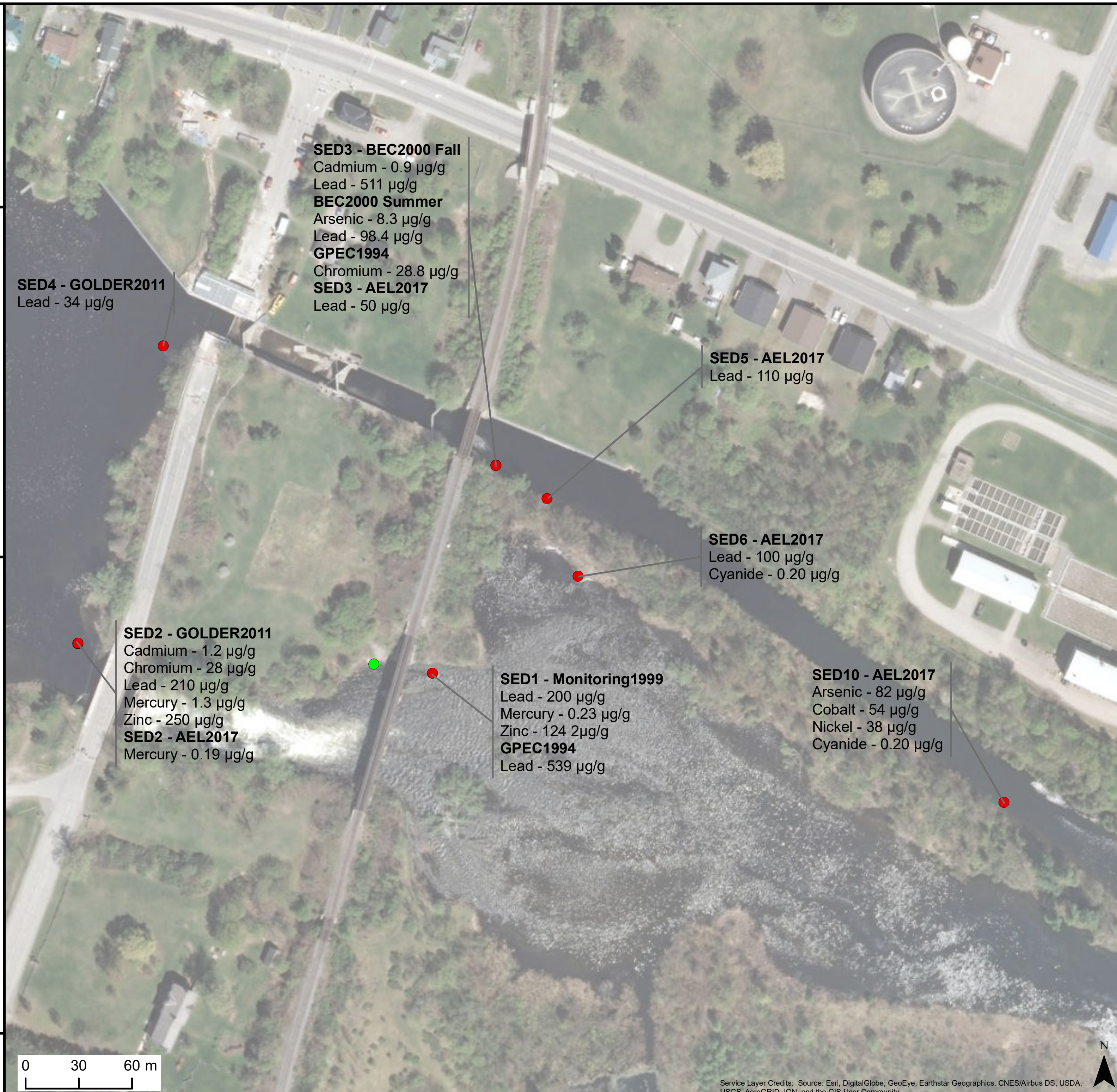
● Exceedance

Smiths Falls, ON

MOECC Table 9 Standard
Cobalt - 50 µg/g
Cyanide - 0.1 µg/g
Nickel - 16 µg/g

CCME Sediment Freshwater
Arsenic (ISQG) - 5.9 µg/g
Arsenic (PEL)- 17 µg/g
Cadmium - 0.6 µg/g
Chromium - 37.3 µg/g
Lead (ISQG) - 35 µg/g
Lead (PEL) - 91.3 µg/g
Mercury (ISQG) - 0.17 µg/g
Zinc - 123 µg/g

Source:



AELenvironment

A division of Aeon Egmond Ltd.

Old Sly Locks

Site Investigation

Sampling Overview

Sediment Exceedances - PAH

#10888 Figure 6b

Legend

- Exceedance
- No Exceedance

Smiths Falls, ON

CCME Sediment Freshwater

Acenaphthene (ISQG) - 0.00671 µg/g
Acenaphthylene (ISQG) - 0.00587 µg/g
Benzo(a)anthracene (ISQG) - 0.0317 µg/g
Benzo(a)pyrene (ISQG) - 0.0319 µg/g
Chrysene (ISQG) - 0.0571 µg/g
Dibenz(a,h)anthracene (ISQG) - 0.00622 µg/g
Fluoranthene (ISQG) - 0.111 µg/g
Methylnaphthalene, 2-(1-) (ISQG) - 0.0346 µg/g
Phenanthrene (ISQG) - 0.0419 µg/g
Pyrene (ISQG) - 0.053 µg/g

Source:

AELenvironment

A division of Aeon Egmond Ltd.

Old Sly Locks

Site Investigation

Sampling Overview

Sediment Exceedances - PCB

#10888 Figure 6c

Legend

- Exceedance (red)
- No Exceedance (green)

Smiths Falls, ON

CCME Sediment Freshwater
Total PCBs (ISQG) - 0.0341 µg/g

Source:

AELenvironment

A division of Aeon Egmond Ltd.

Old Sly Locks

Site Investigation

Sampling Overview

Seep Exceedances - VOCs

#10888 Figure 7a

Legend

- No Exceedance
- Exceedance

Smiths Falls, ON

PWQO Criteria
Toluene - 0.8 µg/L

CCME Aquatic Freshwater
Toluene - 2 µg/L

Source:

AELenvironment

A division of Aeon Egmond Ltd.

Old Sly Locks

Site Investigation

Sampling Overview

Seep Exceedances - Metals

#10888 Figure 7b

Legend

- No Exceedance
- Exceedance

Smiths Falls, ON

PWQO Criteria
Iron - 300 µg/L
Dissolved Oxygen - >5mg/L

CCME Aquatic Freshwater
Iron - 300 µg/L

Source:

AELenvironment
A division of Aeon Egmond Ltd.

Old Sly Locks
Site Investigation
Sampling Overview
Surface Water Exceedances
#10888 *Metals Figure 8*

Legend

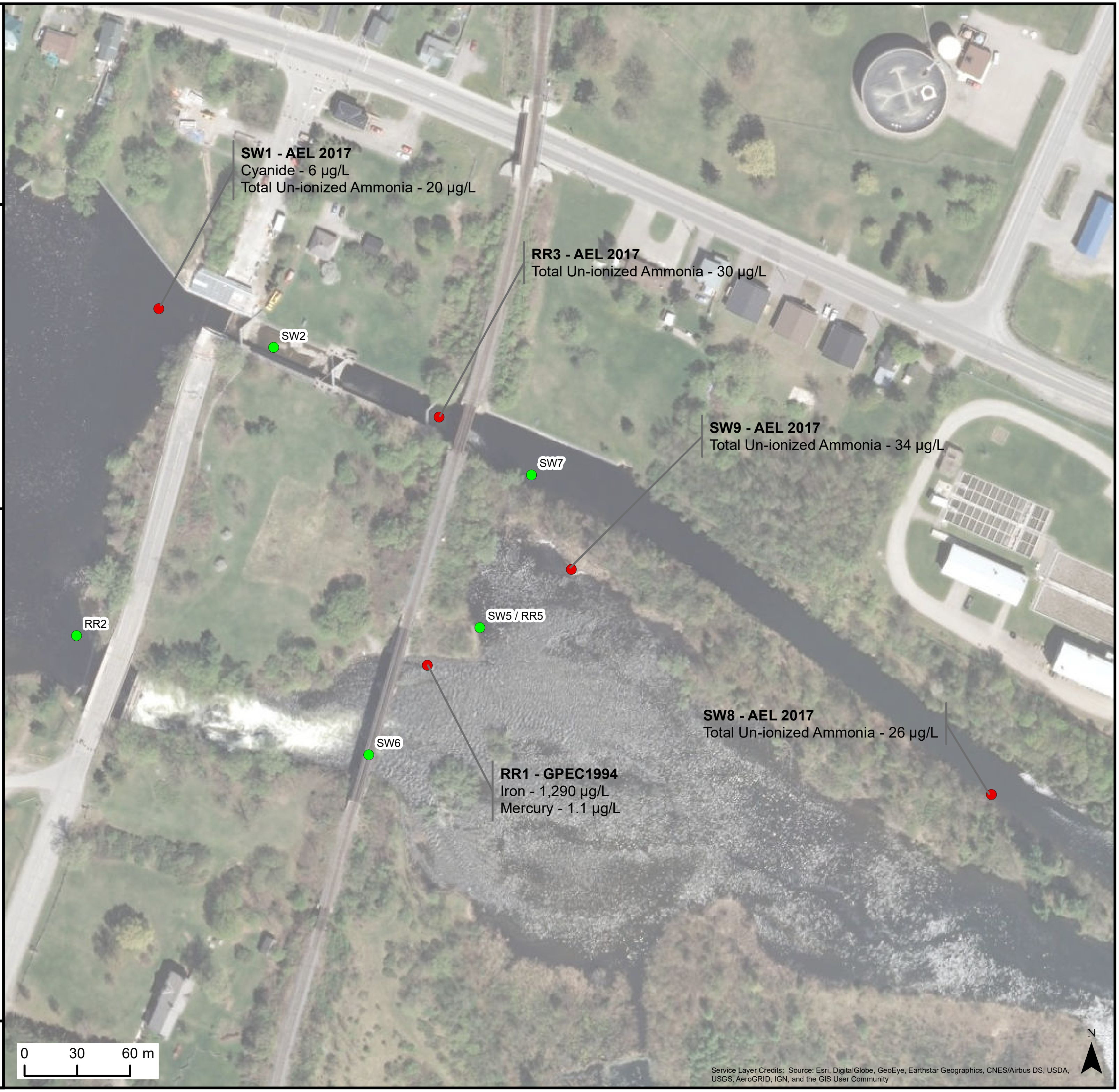
- No Exceedance
- Exceedance

Smiths Falls, ON

PWQO Criteria
Cyanide - 5 µg/L
Iron - 300 µg/L
Dissolved Oxygen - >5mg/L
Mercury - 0.2 µg/L
Total Un-ionized Ammonia - 20 µg/L

CCME Aquatic Freshwater
Iron - 300 µg/L
Mercury - 0.026 µg/L

Source:



AELenvironment

A division of Aeon Egmond Ltd.

Old Sly Locks

Site Investigation

Cross Section Overview

Figure 9a

#10888

Legend

- Borehole
- Monitoring Well
- Monitoring Well (Historical)
- Cross Section

Smiths Falls, ON

Source:

AEL environment
1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

Figure 9b
Cross Section AA'
BTEX/PHC Exceedances - Soil

Project: Old Sly Lockstation

Project No.: 10888

Date: October 2017

Location: Smiths Falls, ON

1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

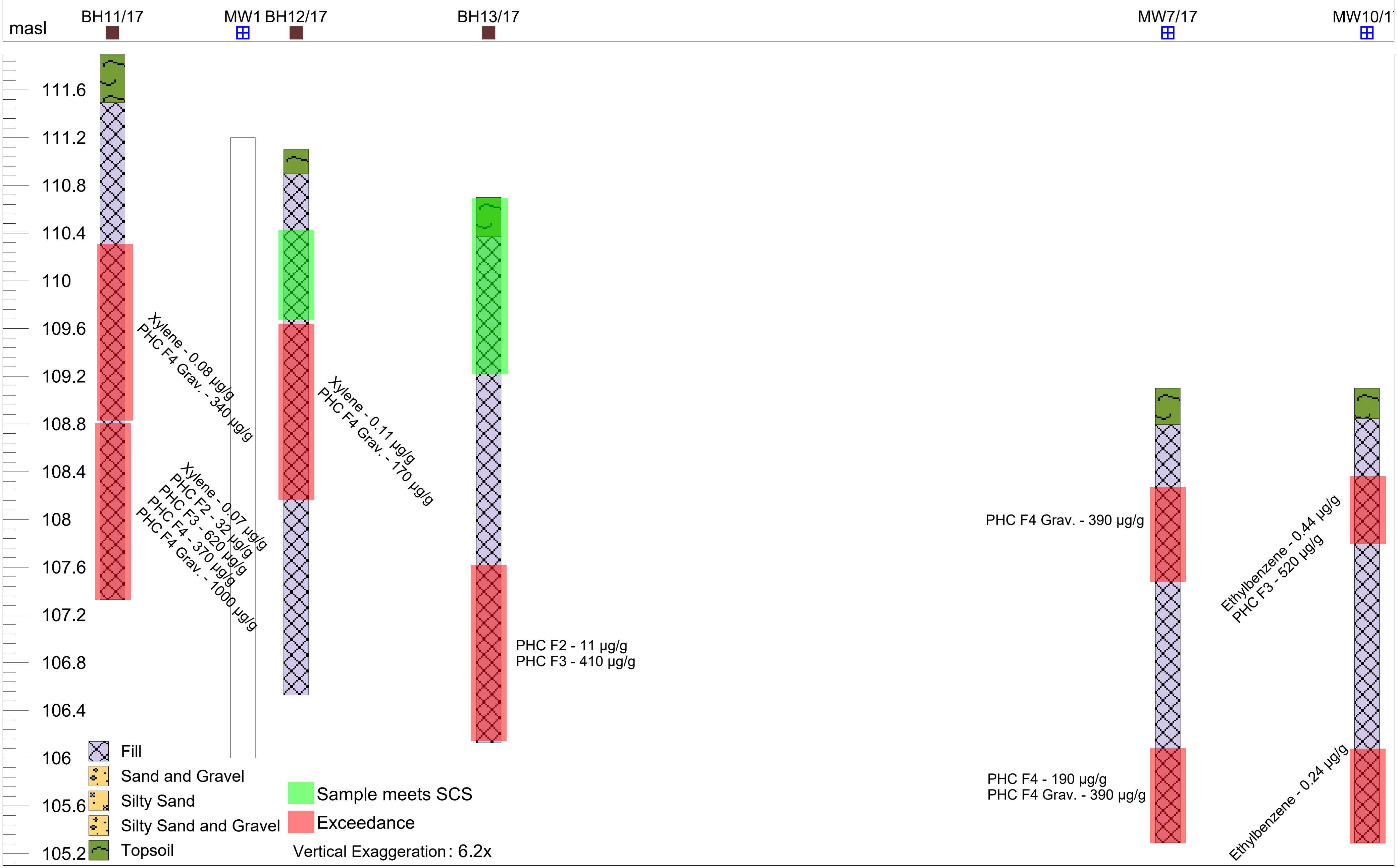
Figure 9c
Cross Section BB'
BTEX/PHC Exceedances - Soil

Project: Old Sly Lockstation

Project No.: 10888

Date: October 2017

Location: Smiths Falls, ON



AEL environment
1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

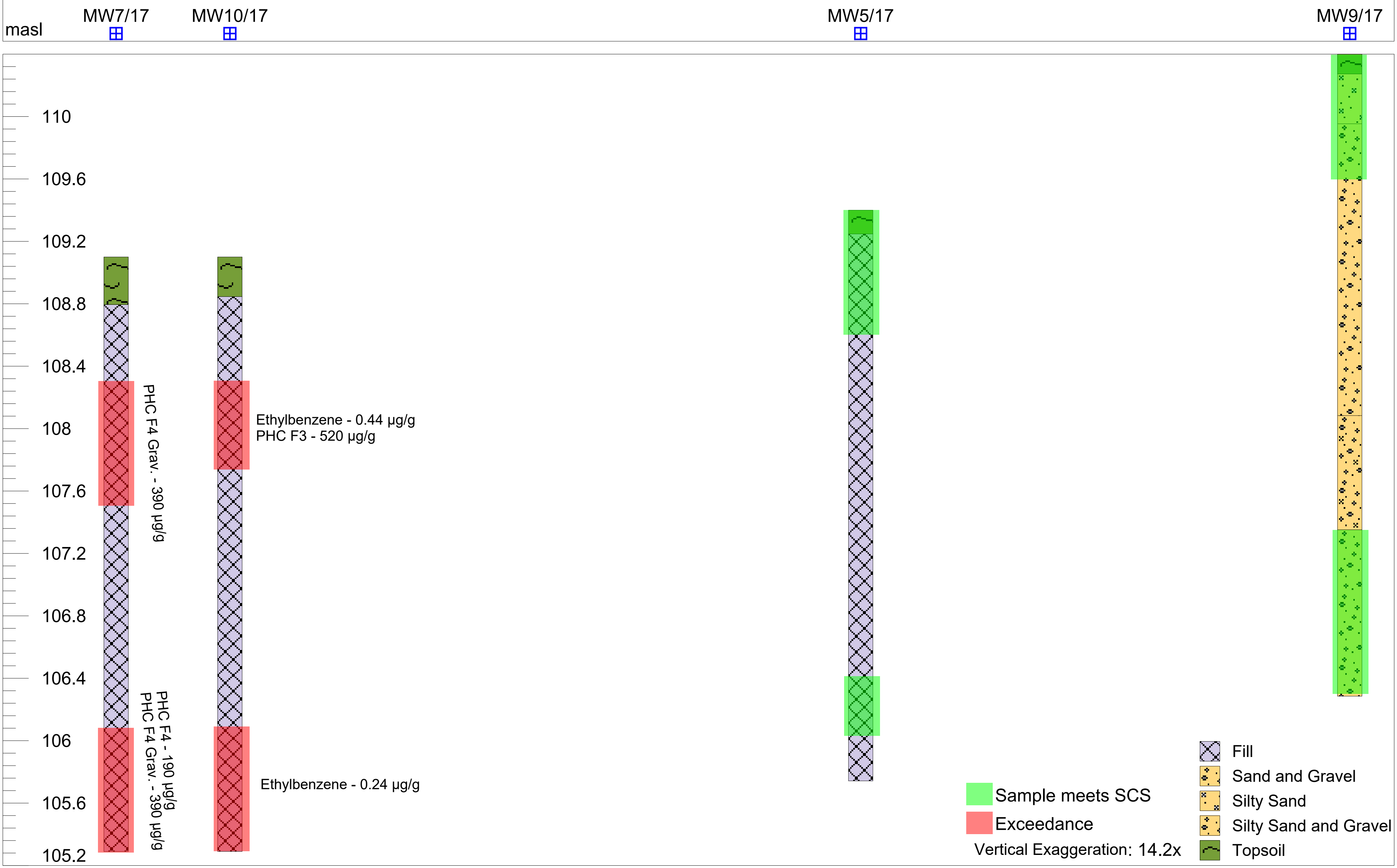
Figure 9d
Cross Section CC'
BTEX/PHC Exceedances - Soil

Project: Old Sly Lockstation

Project No.: 10888

Date: October 2017

Location: Smiths Falls, ON



1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

Figure 9e
Cross Section AA'
VOC Exceedances - Soil

Project: Old Sly Lockstation

Project No.: 10888

Date: October 2017

Location: Smiths Falls, ON

1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

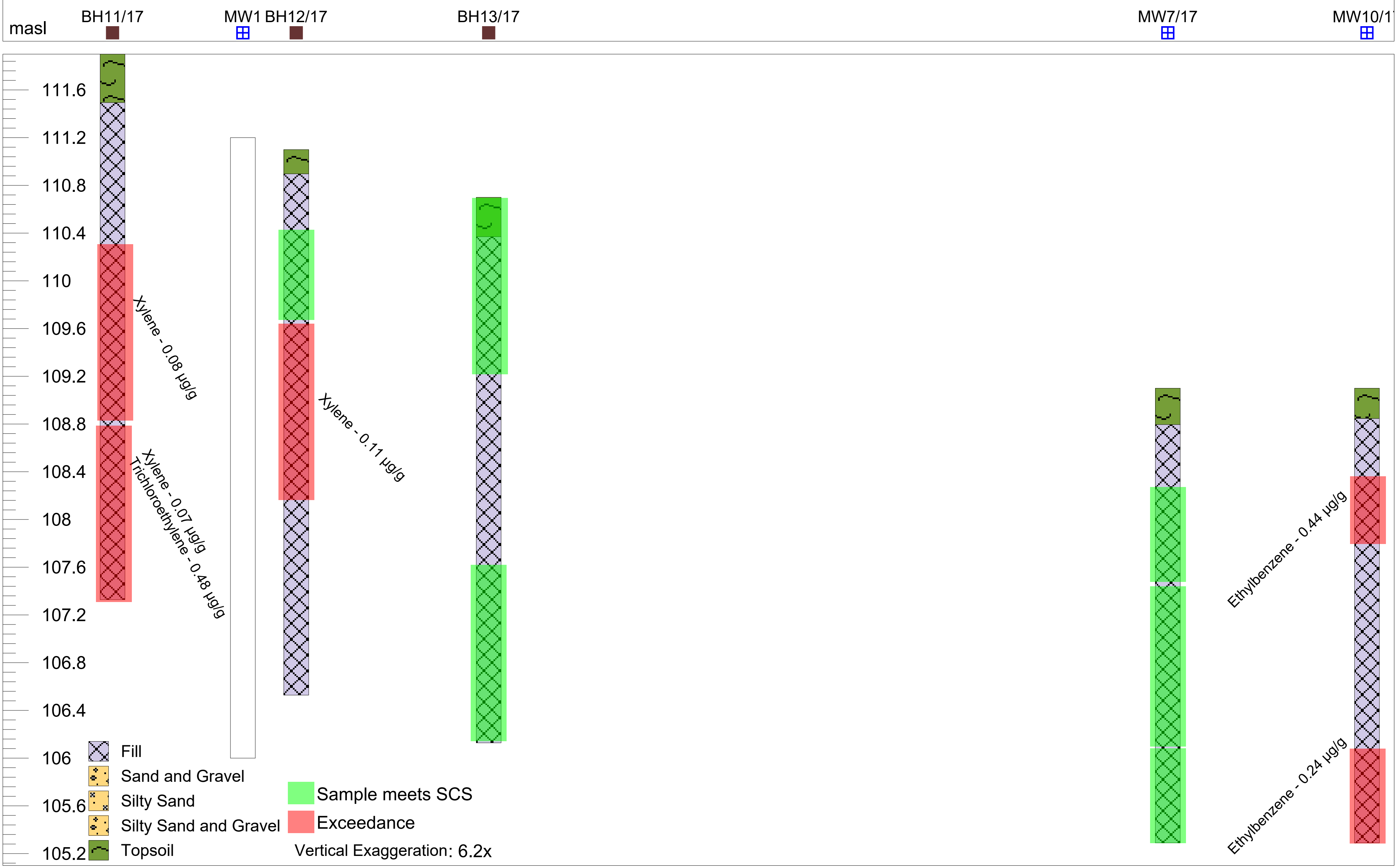
Figure 9f
Cross Section BB'
VOC Exceedances - Soil

Project: Old Sly Lockstation

Project No.: 10888

Date: October 2017

Location: Smiths Falls, ON



1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

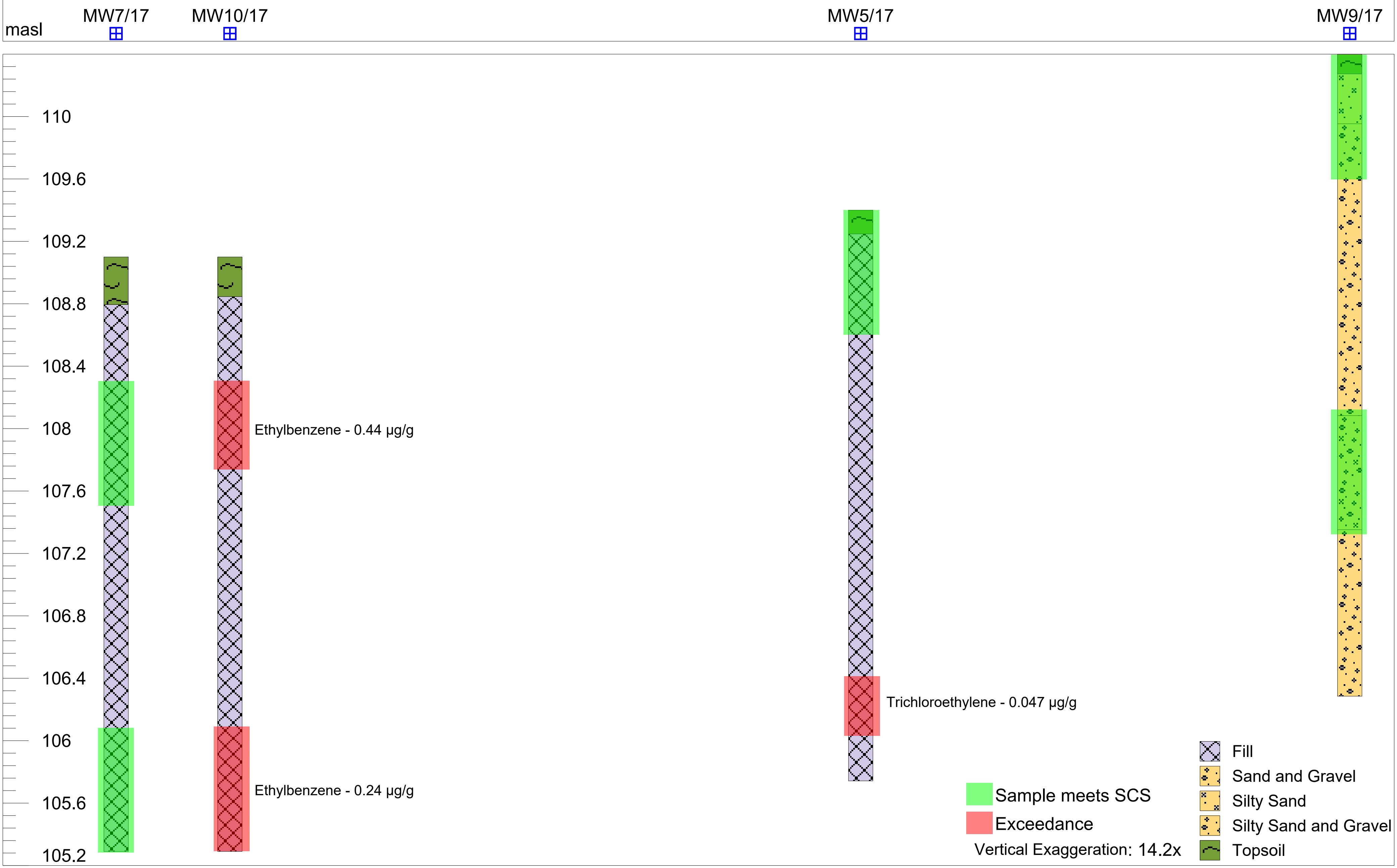
Figure 9g
Cross Section CC'
VOC Exceedances - Soil

Project: Old Sly Lockstation

Project No.: 10888

Date: October 2017

Location: Smiths Falls, ON



AEL environment
1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

Figure 9h
Cross Section AA'
Metal Exceedances - Soil

Project: Old Sly Lockstation

Project No.: 10888

Date: October 2017

Location: Smiths Falls, ON

1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

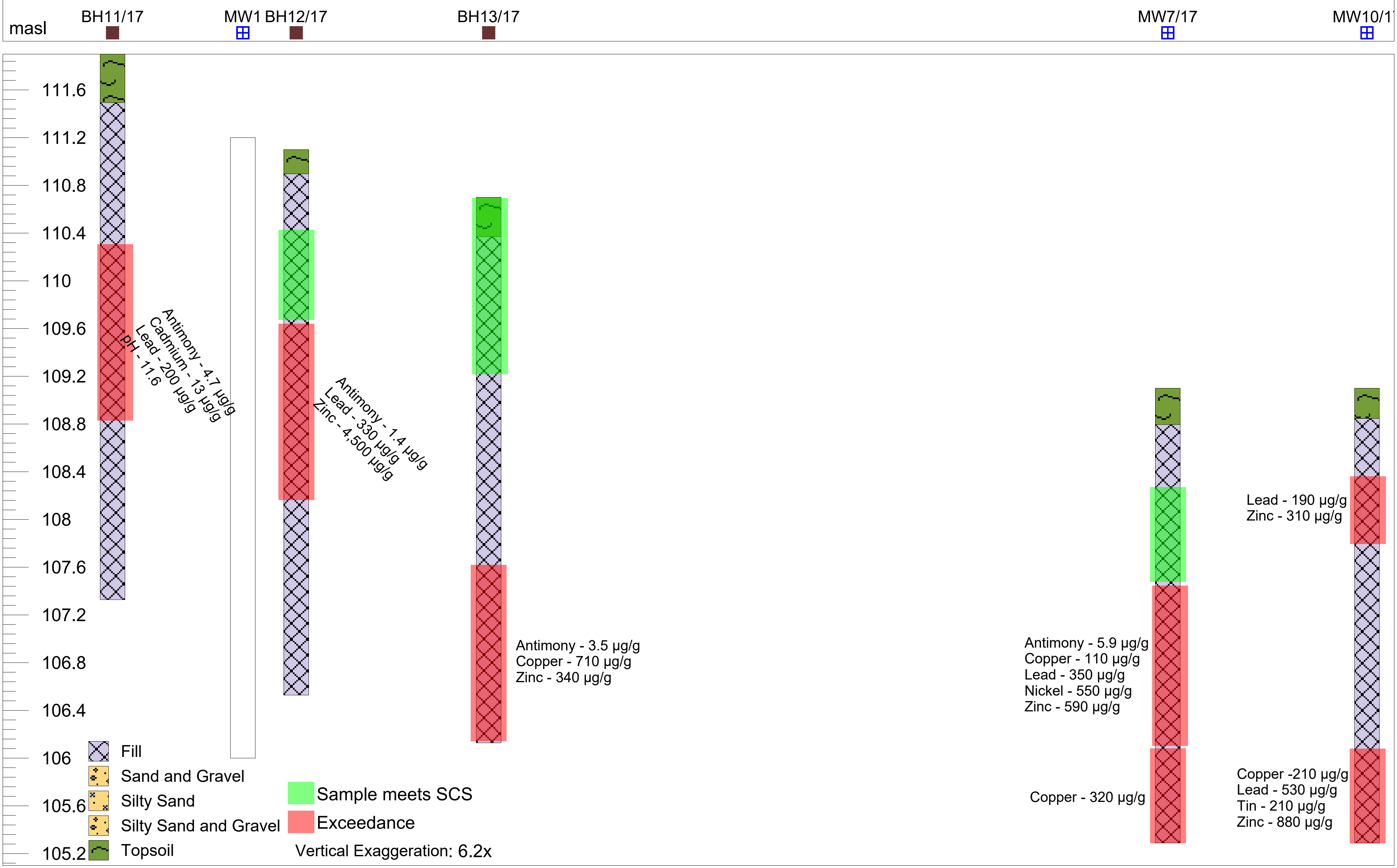
Figure 9i
Cross Section BB'
Metal Exceedances - Soil

Project: Old Sly Lockstation

Project No.: 10888

Date: October 2017

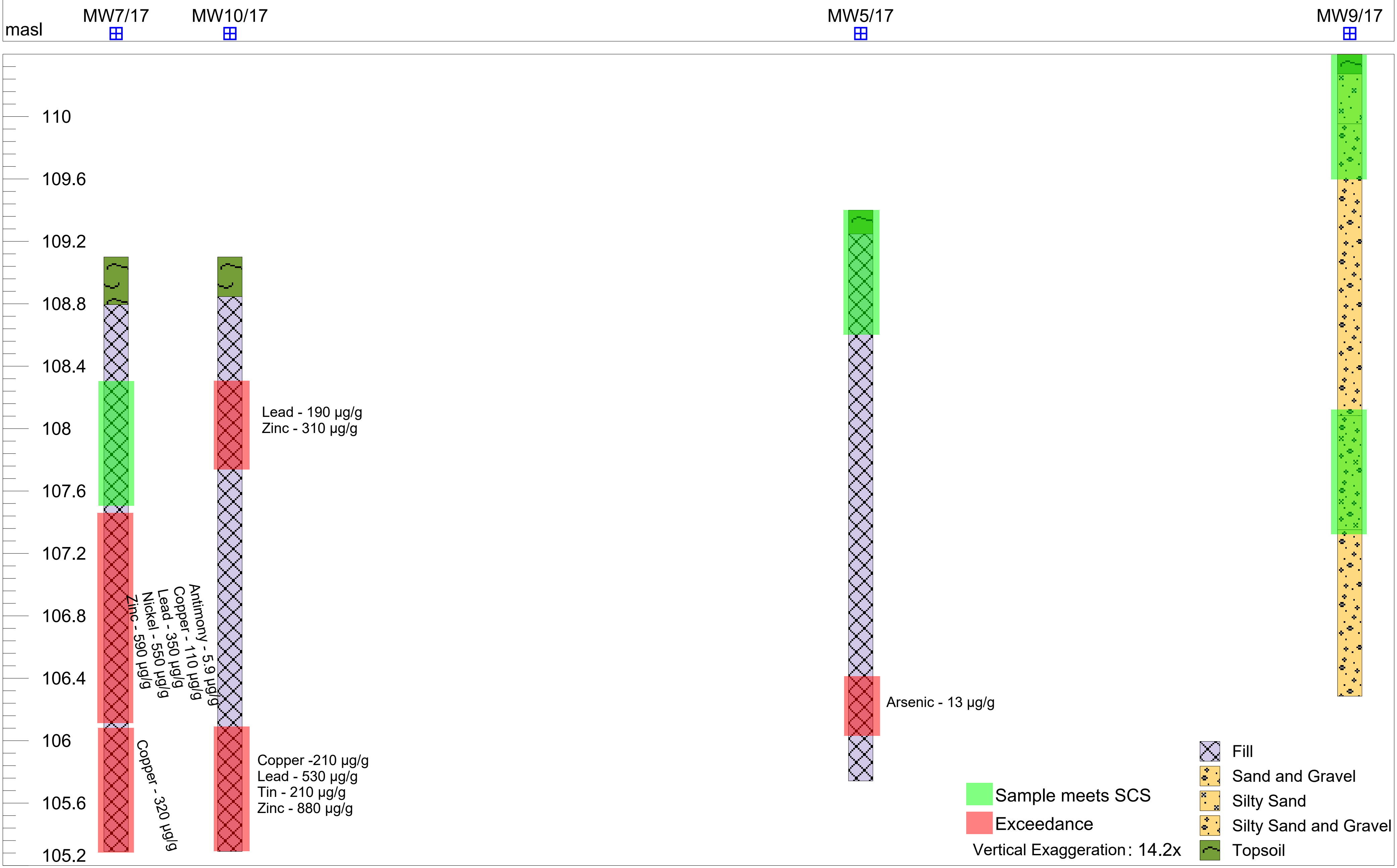
Location: Smiths Falls, ON



1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

Figure 9j
Cross Section CC'
Metal Exceedances - Soil

Project: Old Sly Lockstation
Project No.: 10888
Date: October 2017
Location: Smiths Falls, ON



1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

Figure 9k
Cross Section AA'
PAH Exceedances - Soil

Project: Old Sly Lockstation

Project No.: 10888

Date: October 2017

Location: Smiths Falls, ON

1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

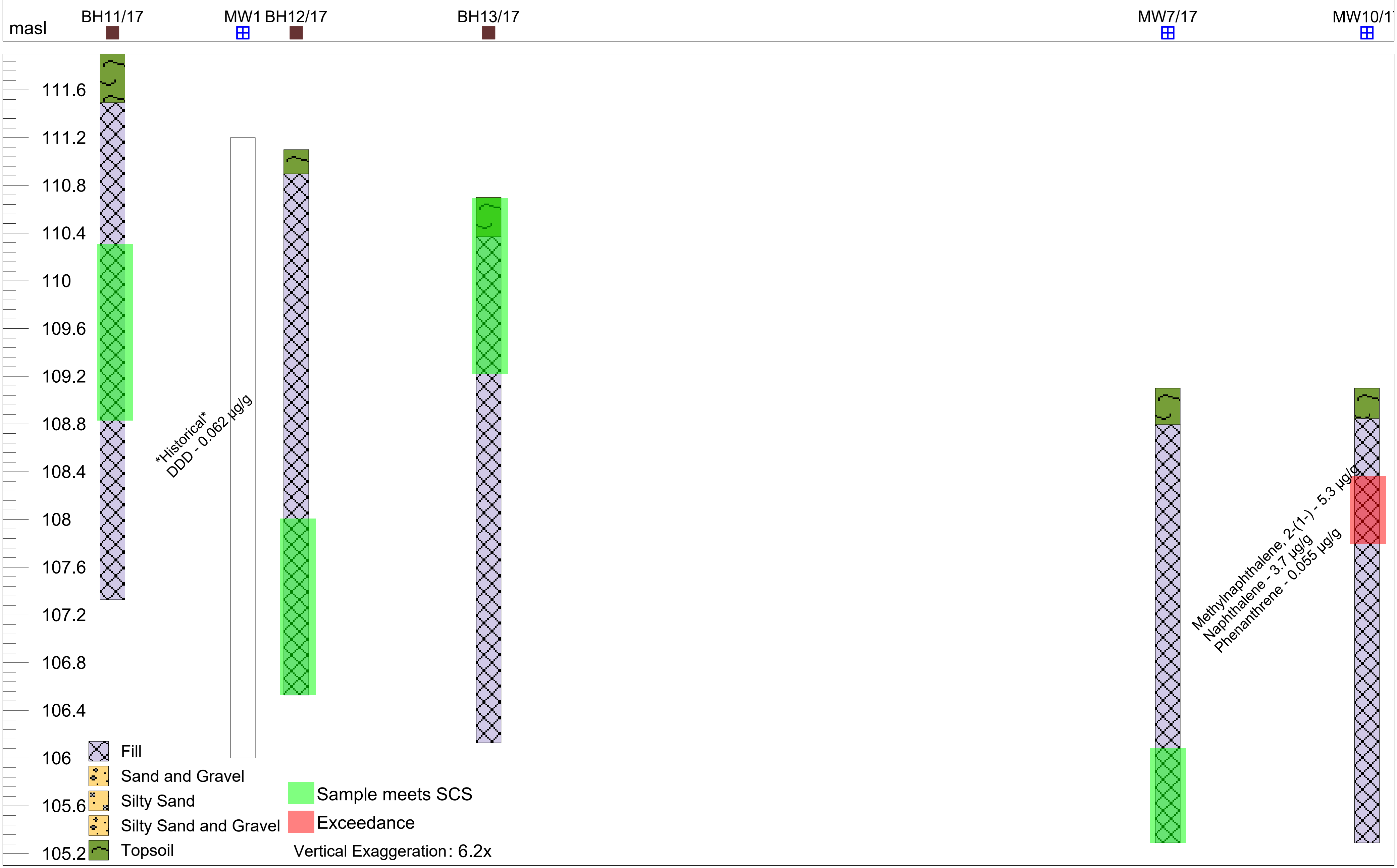
Figure 9I
Cross Section BB'
PAH Exceedances - Soil

Project: Old Sly Lockstation

Project No.: 10888

Date: October 2017

Location: Smiths Falls, ON



1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

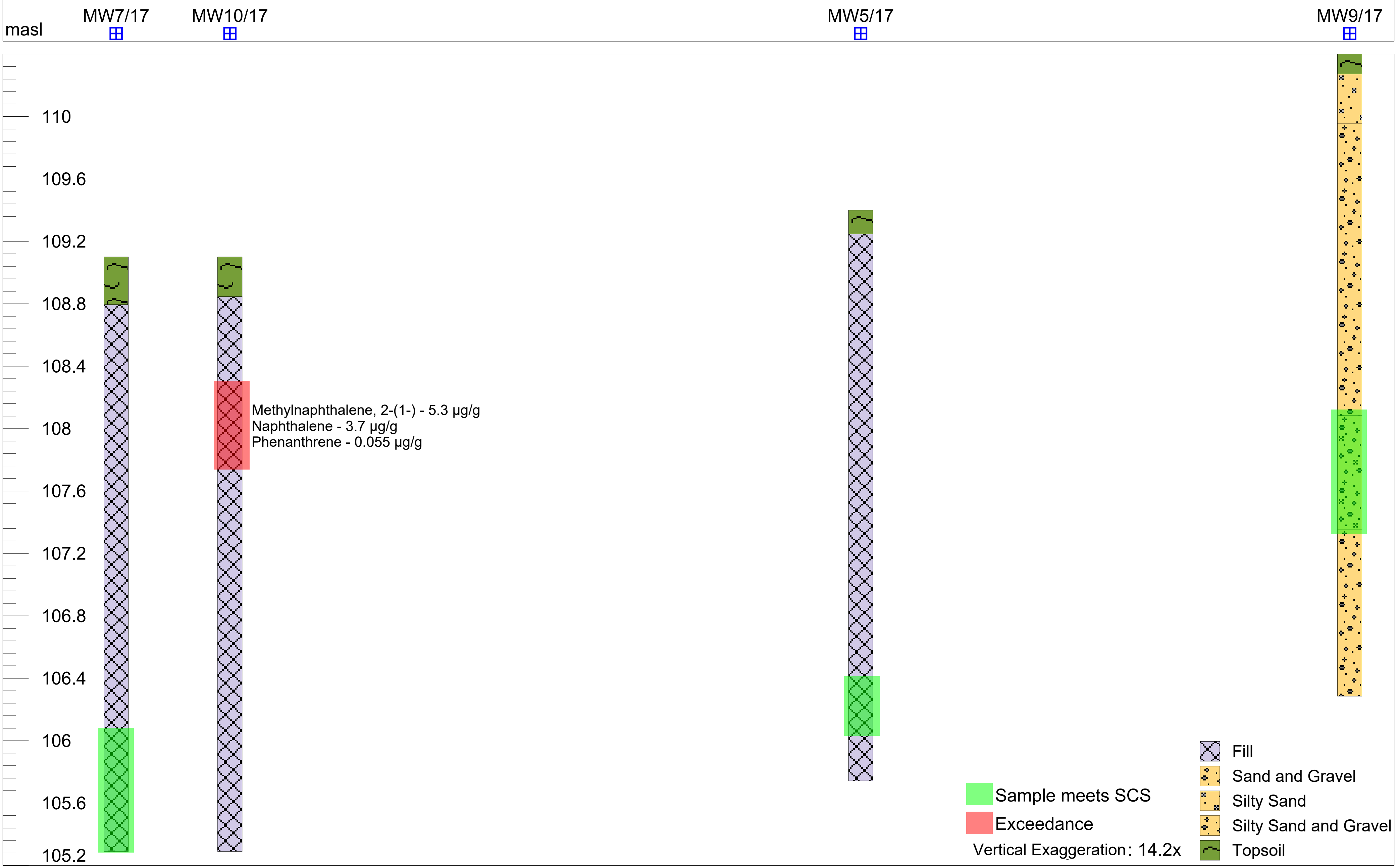
Figure 9m
Cross Section CC'
PAH Exceedances - Soil

Project: Old Sly Lockstation

Project No.: 10888

Date: October 2017

Location: Smiths Falls, ON



1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

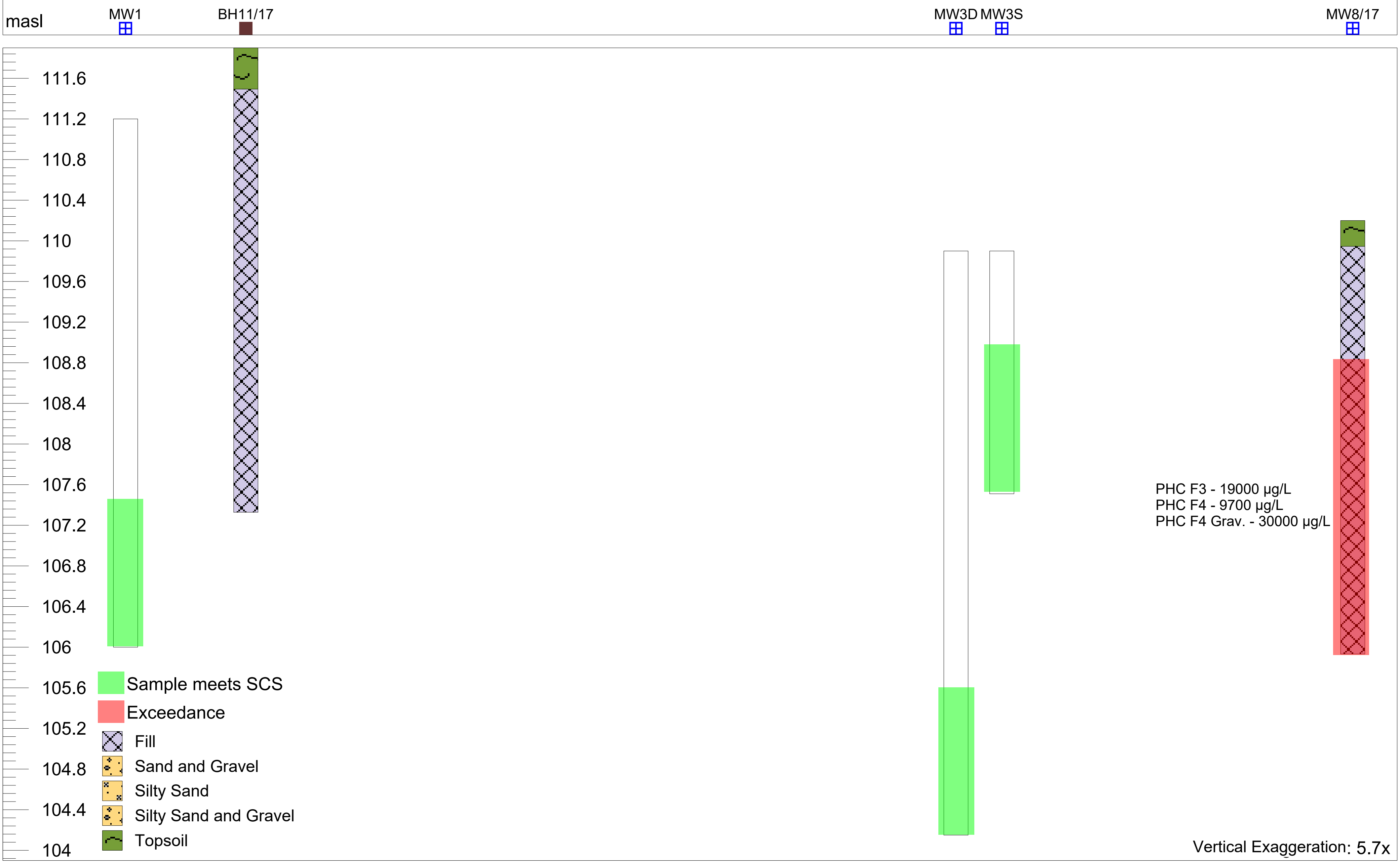
Figure 9n
Cross Section AA'
BTEX/PHC Exceedances - GW

Project: Old Sly Lockstation

Project No.: 10888

Date: October 2017

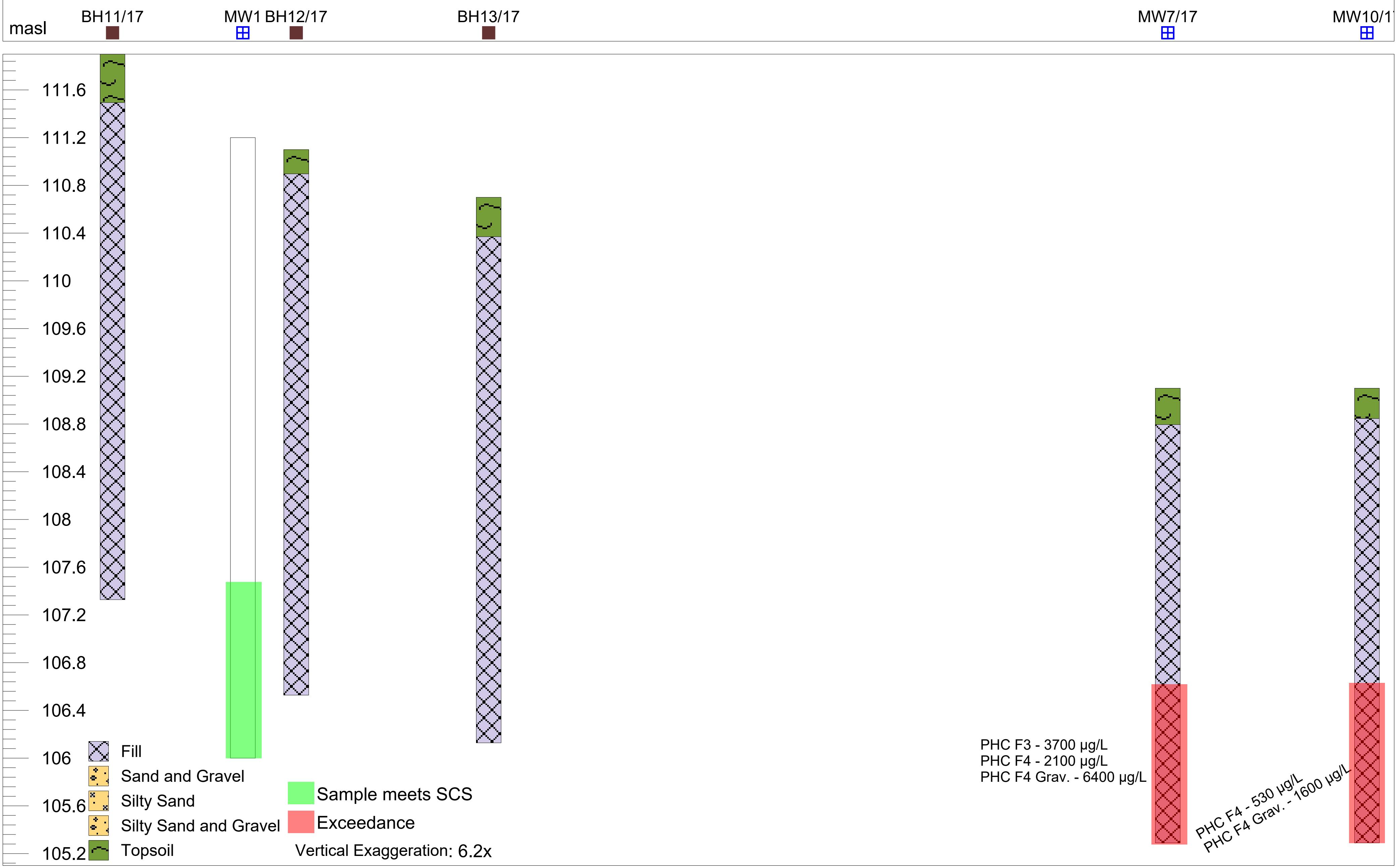
Location: Smiths Falls, ON



AEL environment
1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

Figure 9o
Cross Section BB'
BTEX/PHC Exceedances - GW

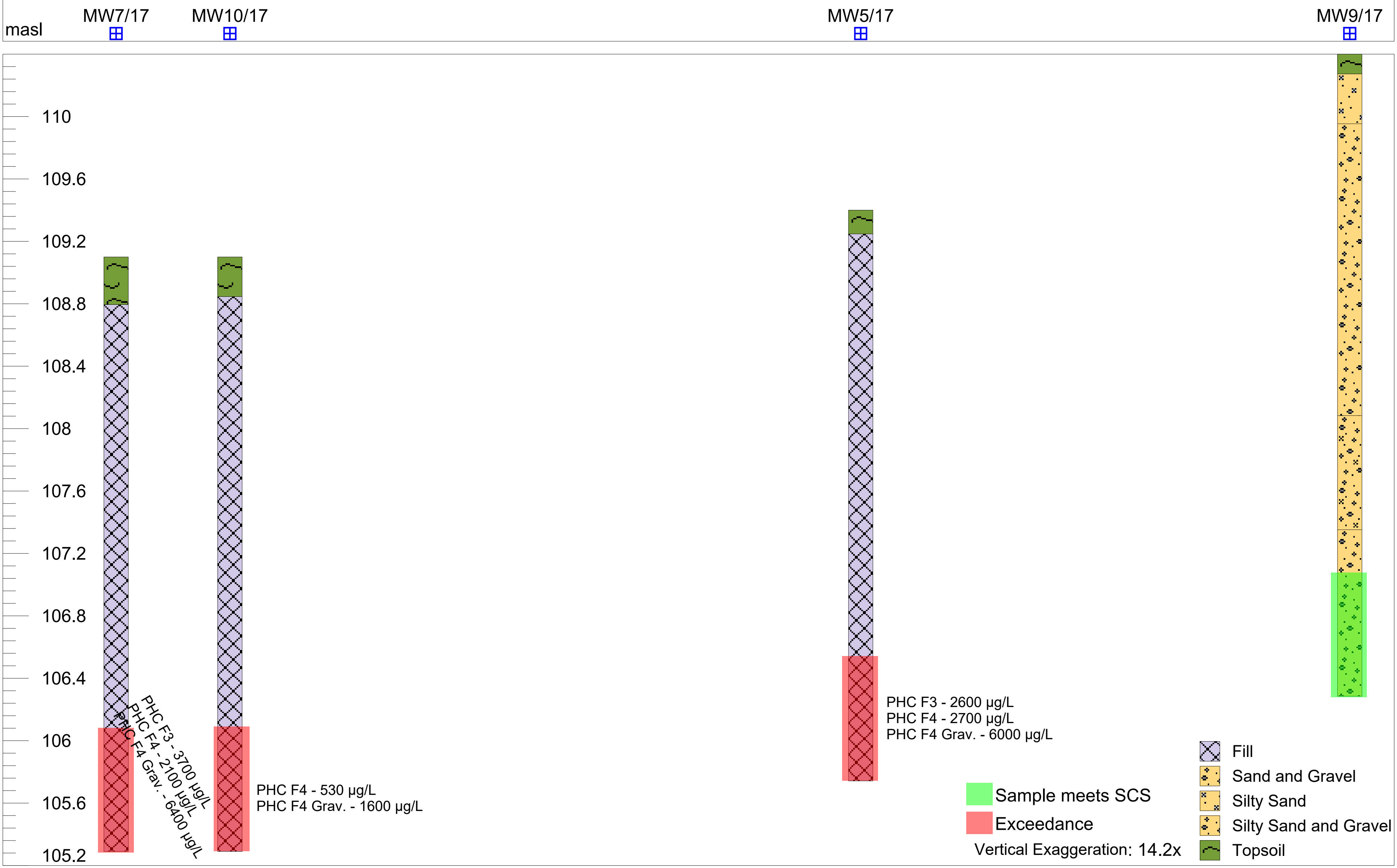
Project: Old Sly Lockstation
Project No.: 10888
Date: October 2017
Location: Smiths Falls, ON



1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

Figure 9p
Cross Section CC'
BTEX/PHC Exceedances - GW

Project: Old Sly Lockstation
Project No.: 10888
Date: October 2017
Location: Smiths Falls, ON



1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

Figure 9q

Cross Section AA'

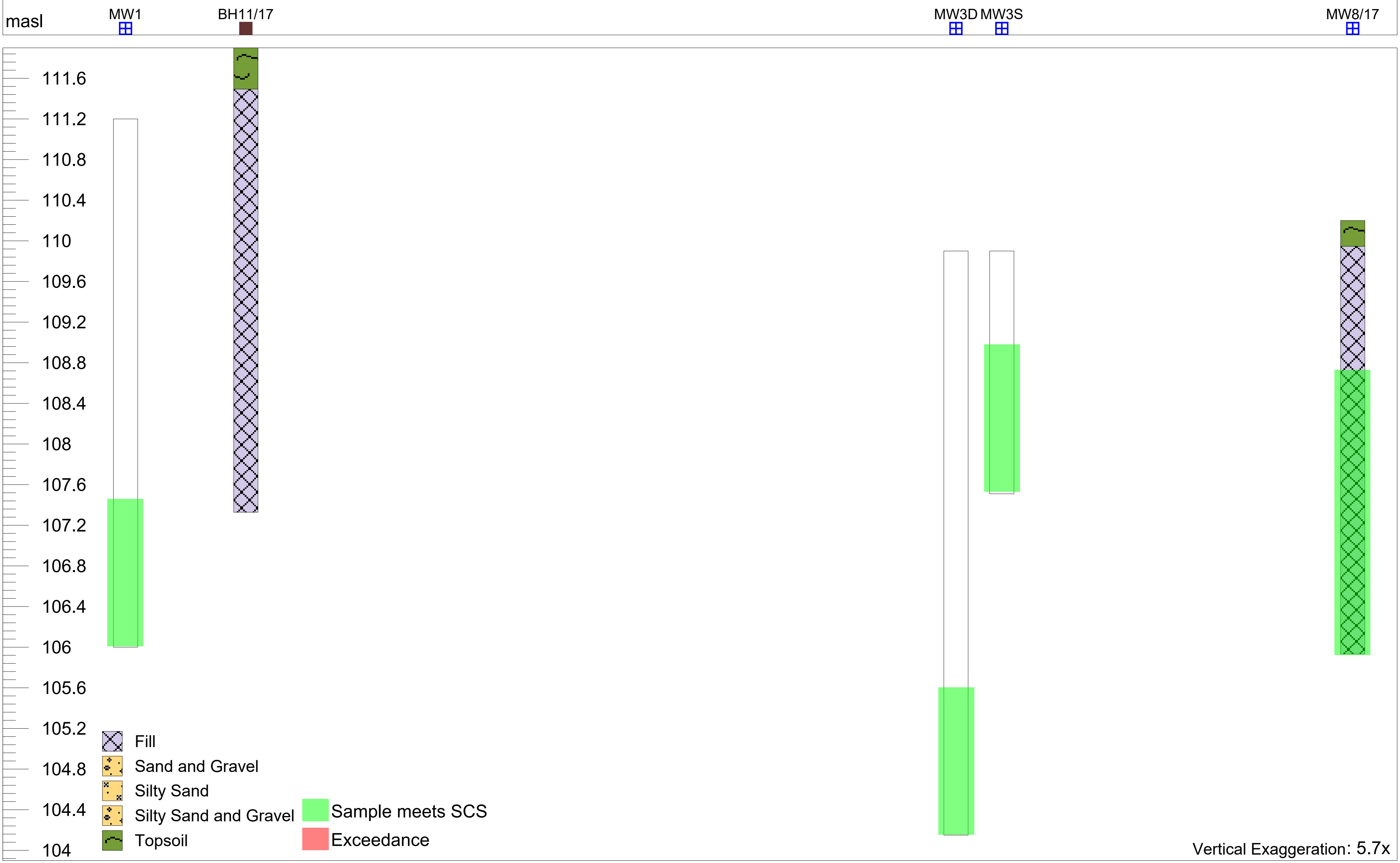
VOC Exceedances - GW

Project: Old Sly Lockstation

Project No.: 10888

Date: October 2017

Location: Smiths Falls, ON



1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

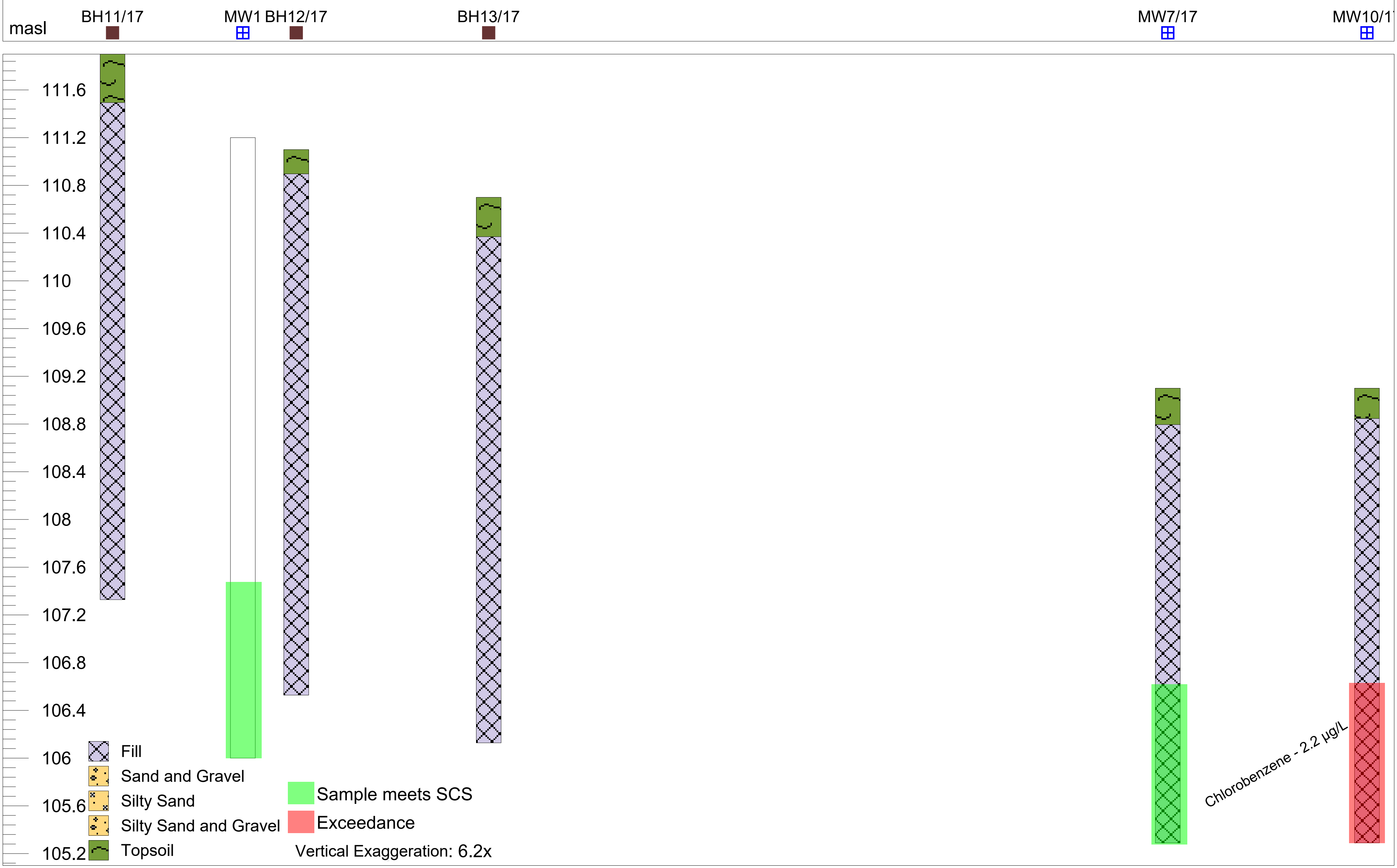
Figure 9r
Cross Section BB'
VOC Exceedances - GW

Project: Old Sly Lockstation

Project No.: 10888

Date: October 2017

Location: Smiths Falls, ON



1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

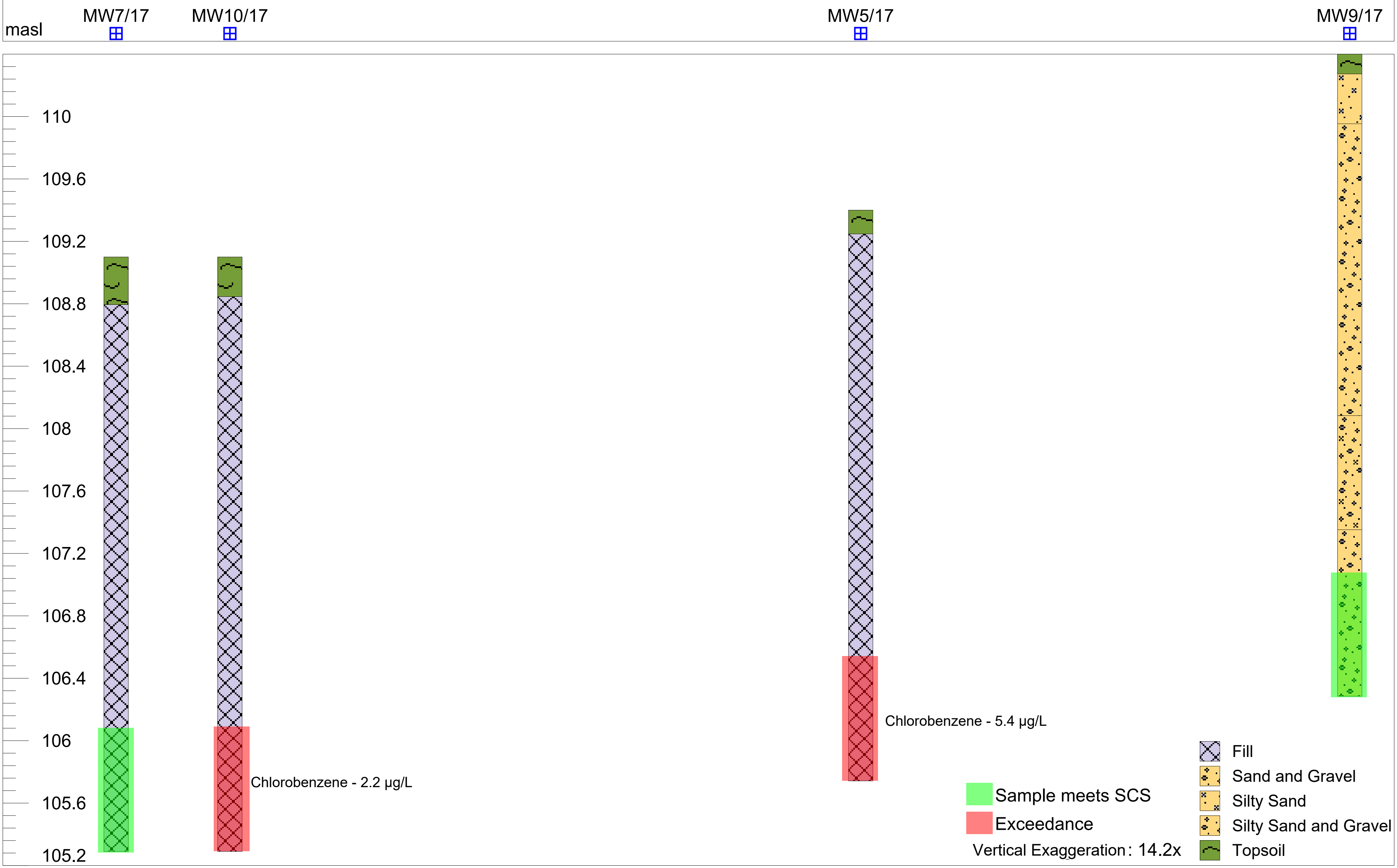
Figure 9s
Cross Section CC'
VOC Exceedances - GW

Project: Old Sly Lockstation

Project No.: 10888

Date: October 2017

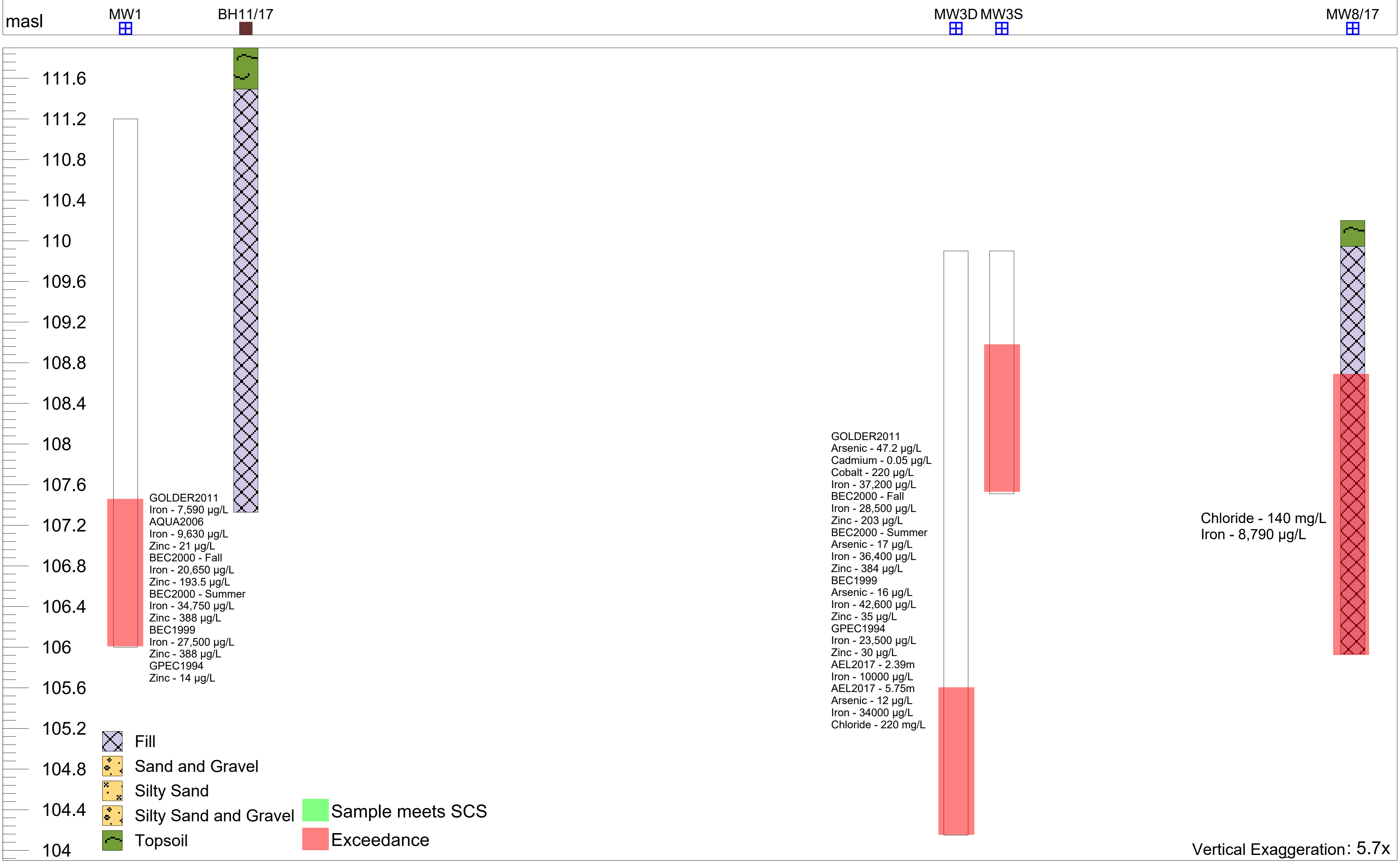
Location: Smiths Falls, ON



1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

Figure 9t
Cross Section AA'
Metals Exceedances - GW

Project: Old Sly Lockstation
Project No.: 10888
Date: October 2017
Location: Smiths Falls, ON



1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

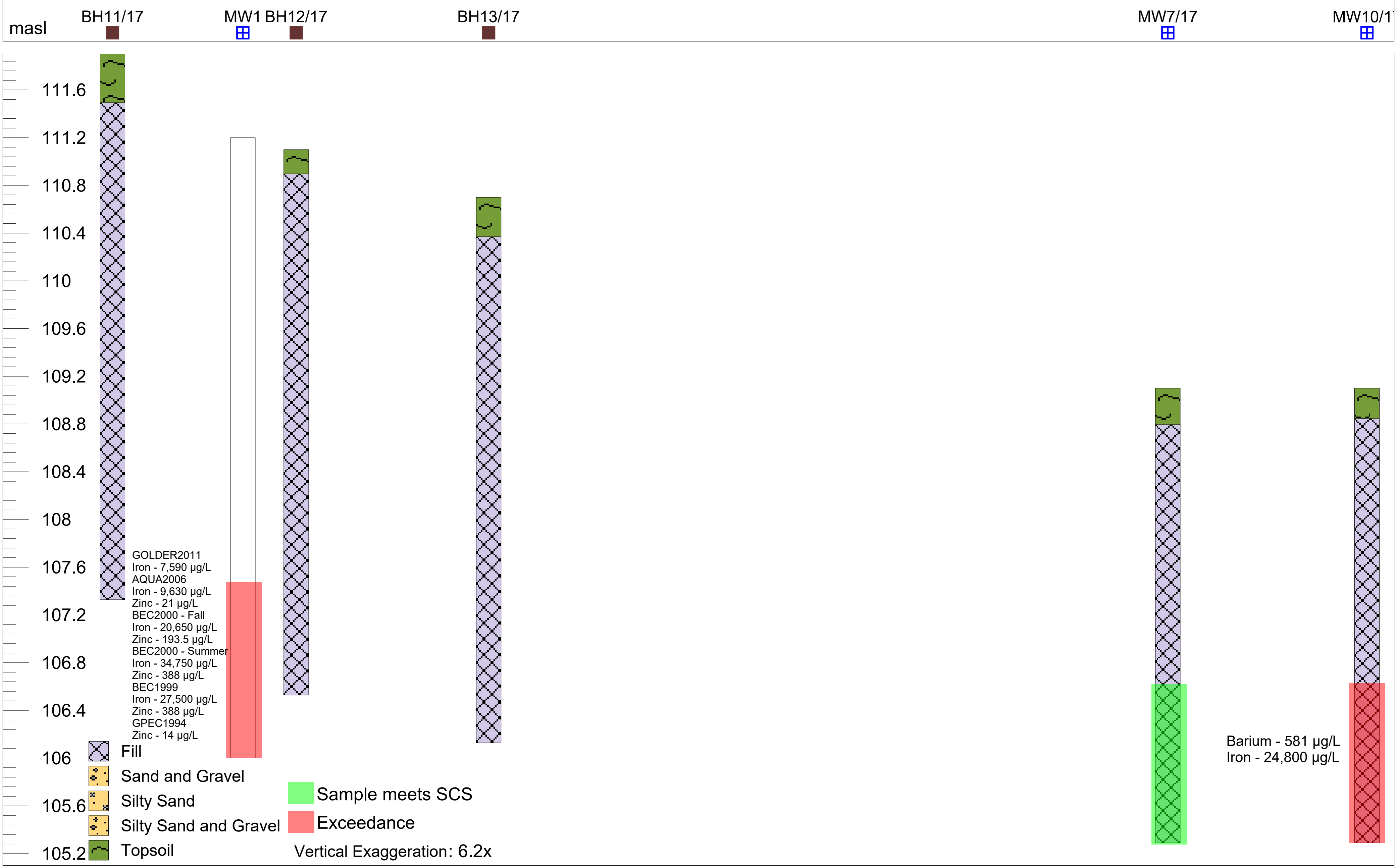
Figure 9u
Cross Section BB'
Metals Exceedances - GW

Project: Old Sly Lockstation

Project No.: 10888

Date: October 2017

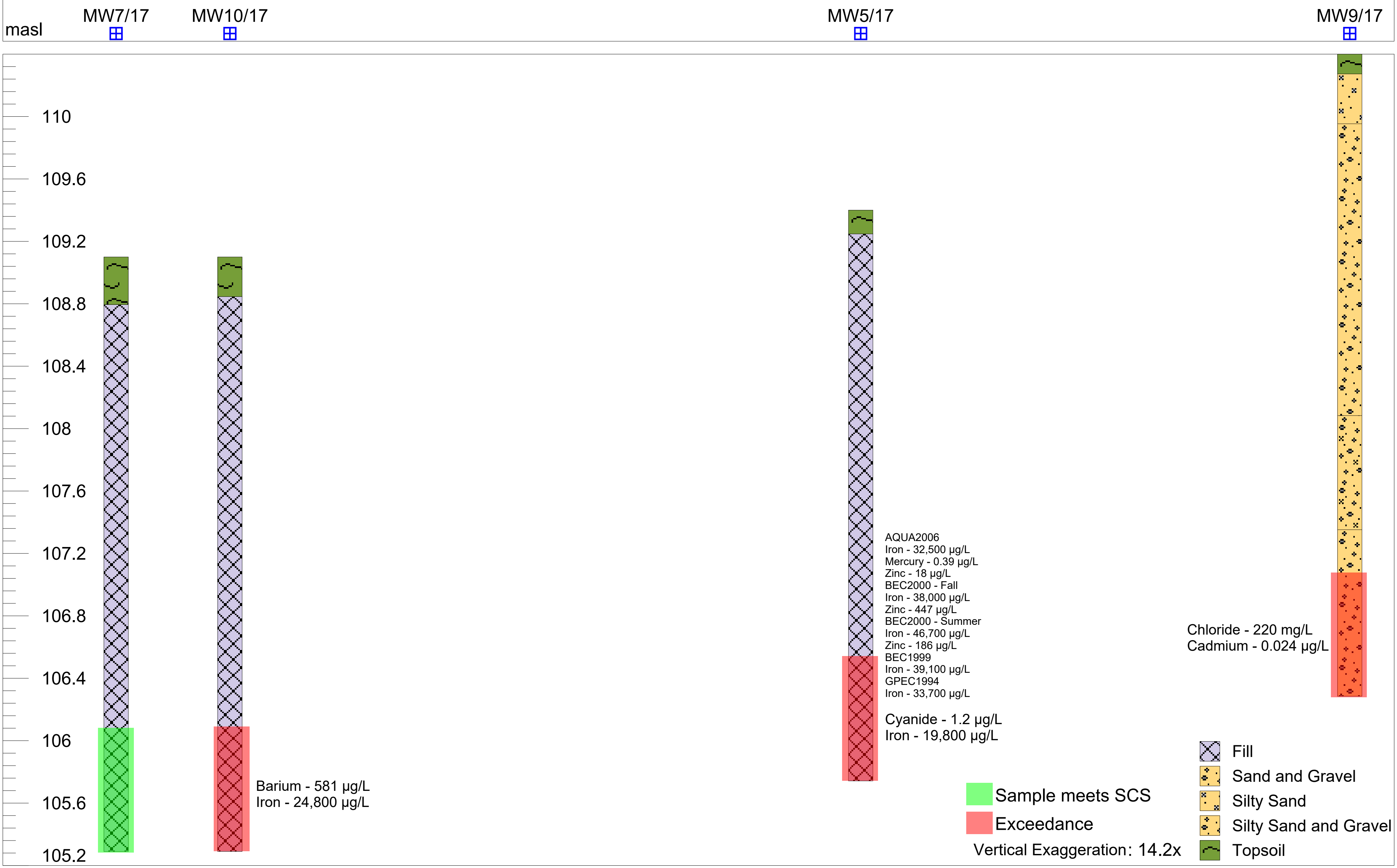
Location: Smiths Falls, ON



AEL environment
1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

Figure 9v
Cross Section CC'
Metals Exceedances - GW

Project: Old Sly Lockstation
Project No.: 10888
Date: October 2017
Location: Smiths Falls, ON



1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

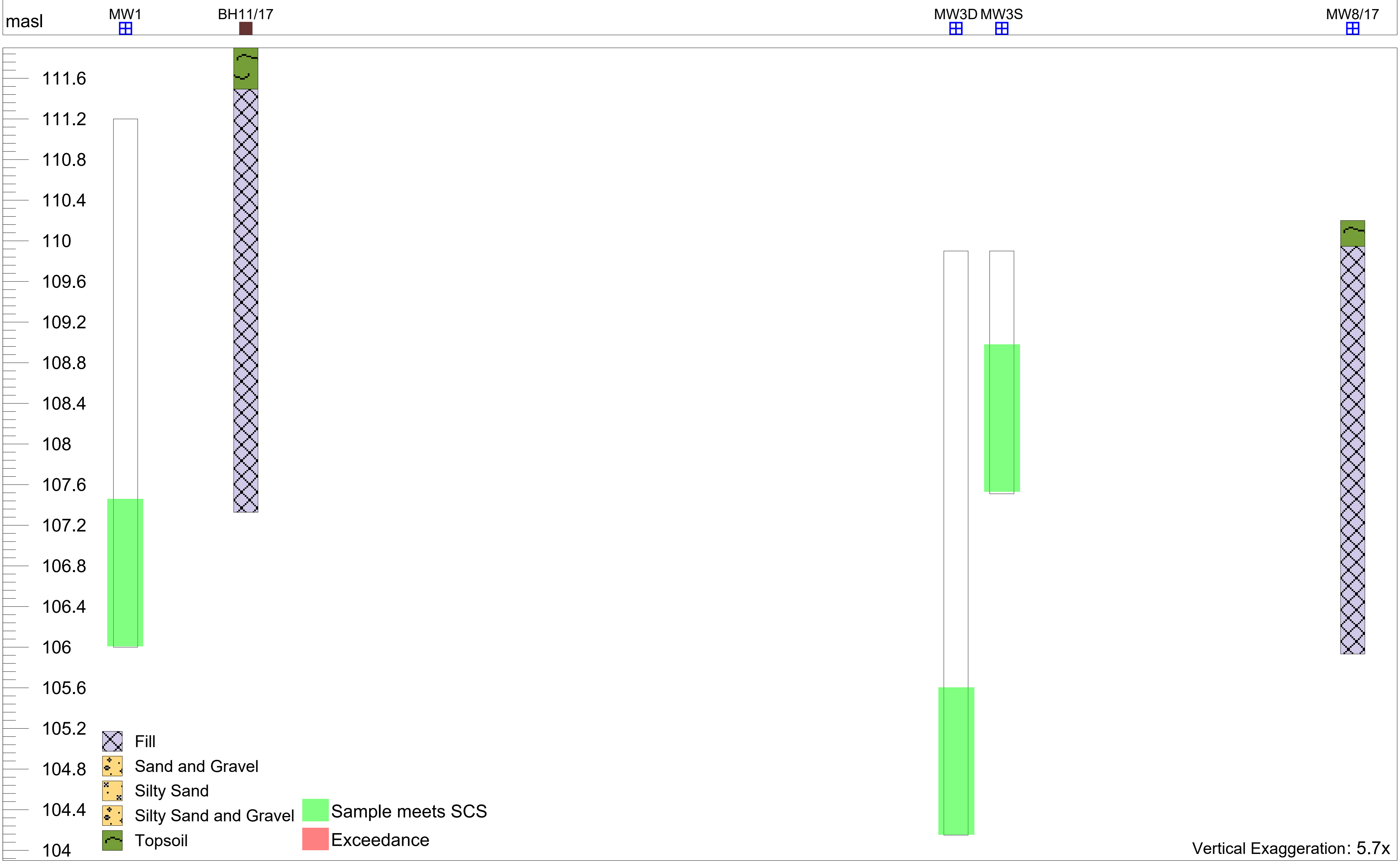
Figure 9w
Cross Section AA'
PAH Exceedances - GW

Project: Old Sly Lockstation

Project No.: 10888

Date: October 2017

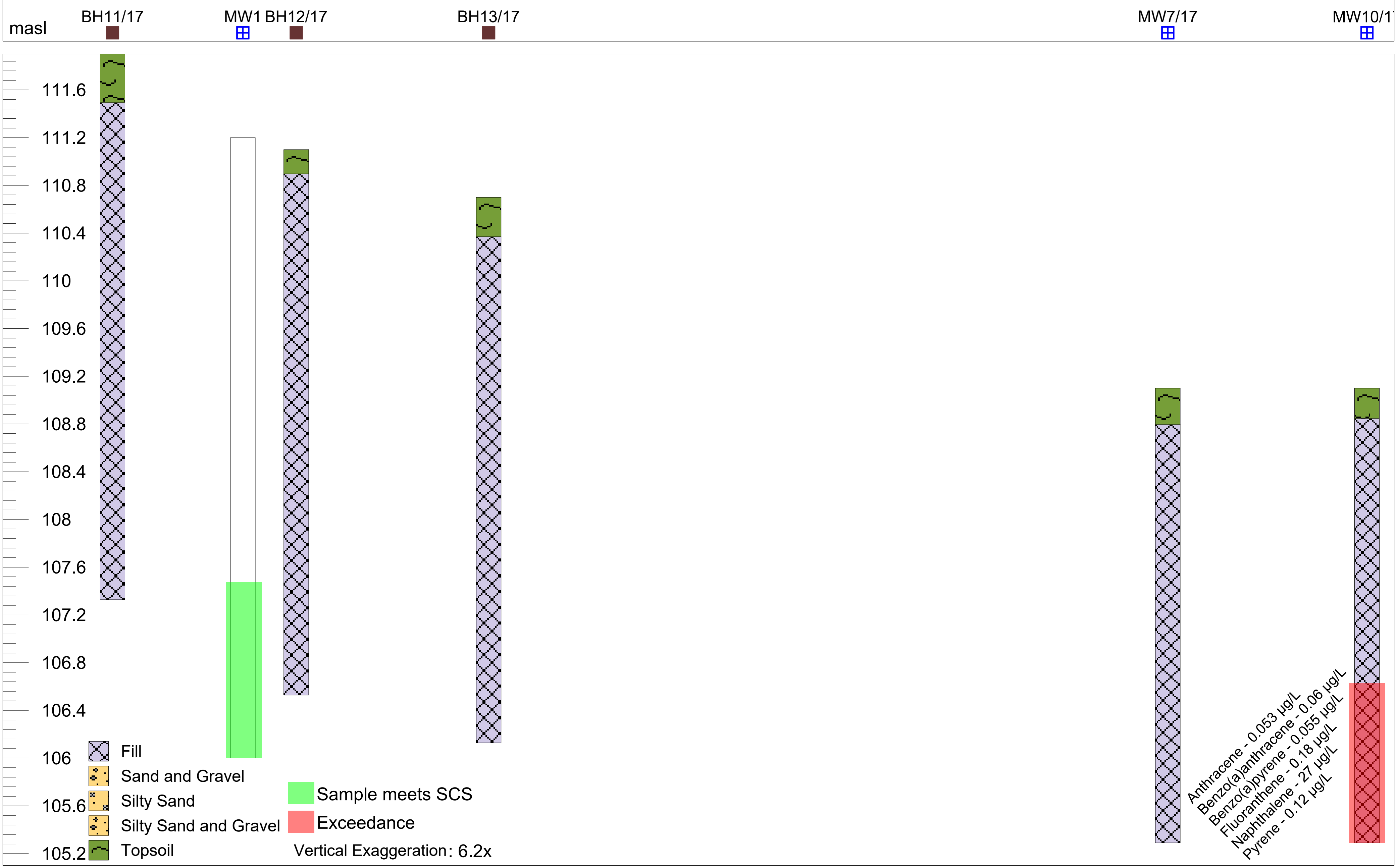
Location: Smiths Falls, ON



1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

Figure 9x
Cross Section BB'
PAH Exceedances - GW

Project:	Old Sly Lockstation
Project No.:	10888
Date:	October 2017
Location:	Smiths Falls, ON



1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

Figure 9y
Cross Section CC'
PAH Exceedances - GW

Project: Old Sly Lockstation
Project No.: 10888
Date: October 2017
Location: Smiths Falls, ON

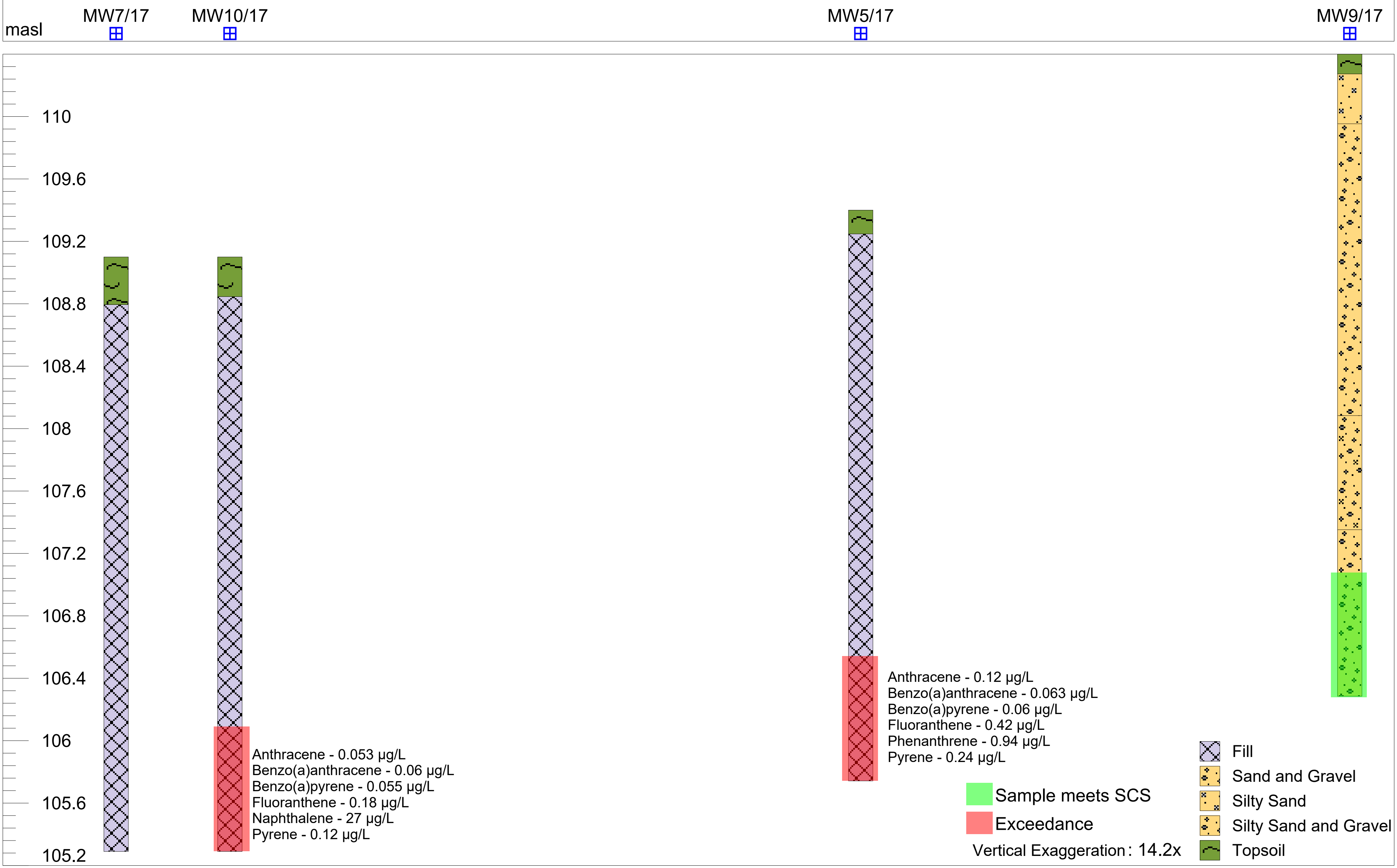
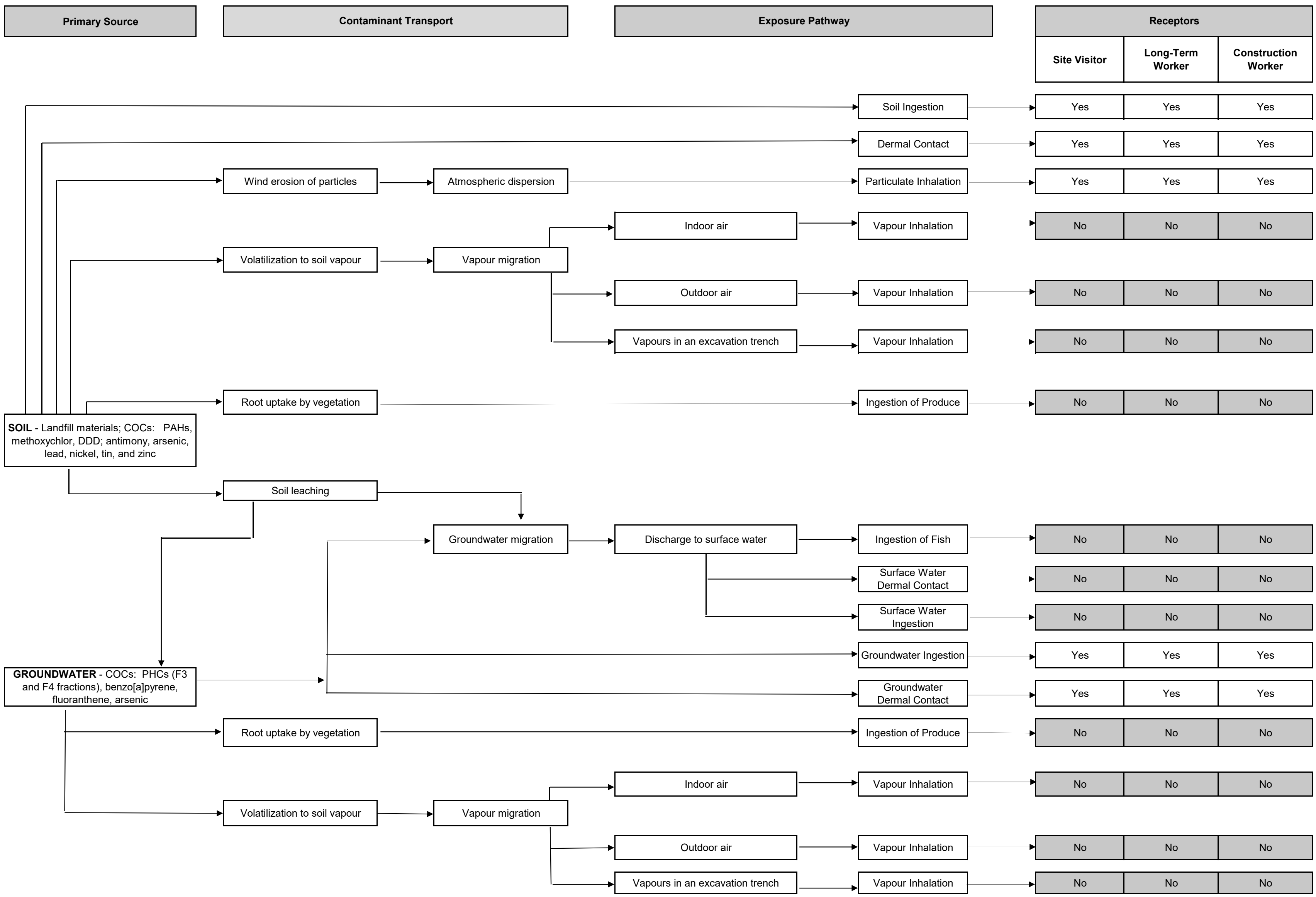
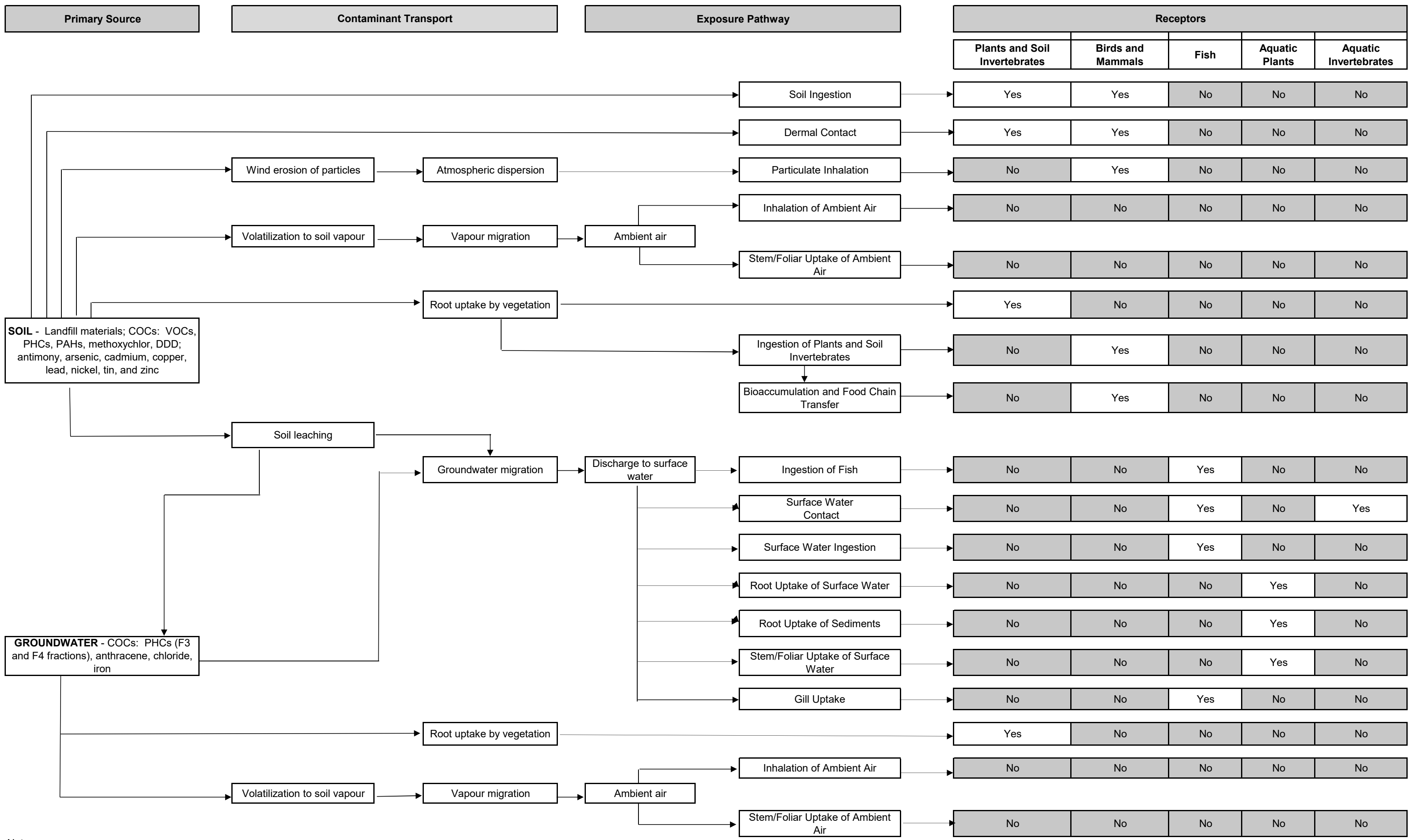


Figure 10a: Human Health Conceptual Site Model



Note:
"No" - exposure pathway incomplete
"Yes" - exposure pathway evaluated in RA

Figure 10b: Ecological Conceptual Site Model



Note:
"No" - exposure pathway incomplete
"Yes" - exposure pathway evaluated in RA

1705 Argentia Road, Unit 3 | Mississauga, Ontario, L5N 3A9
Tel/Fax: 416-657-2367| Toll free: 1-800-267-4797
info@aelenv.com | www.aelenv.com

APPENDIX 1

Sampling and Analysis Plan

AELenvironment

A division of Aeon Egmond Ltd.

Old Sly Locks

Site Investigation

Soil Sampling Plan - Borehole

#10888

Legend

- ● Historical Sampling Location
- ● New Borehole Location
- Estimated Landfill Extents

Smiths Falls, ON

Source:

Soil		
Sampling Location	**Location Description**	**Rationale**
MW-3	West central portion of Site, beside current MW-3; Replacement well to be installed if inspection determines MW-3B or MW-3C are deficient	Confirmation sampling to determine if location has exceedances of Lead, Zinc, Dichlorobenzene, Chlorobenzene and Xylenes
MW-5	South central portion of Site, in the area of current MW-5; Replacement well to be installed if inspection determines MW-5A or MW-5B are deficient	Confirmation sampling to determine if location has exceedances of PAHs
MW7/17	North central portion of Site	New monitoring well location for vertical delineation; down gradient of MW-1, which has historically had exceedances of Zinc
MW8/17	East central portion of Site	New monitoring well location for vertical delineation; up gradient of MW-3, which has historically had exceedances of Lead, Zinc, Xylenes and PAHs
MW9/17	South central portion of Site	New monitoring well location for vertical delineation; trans gradient to all known exceedances, and located outside of landfill extents
SS1 to SS20	North side of Site, in 10 x 10 m grid sections	New surface sampling locations; Area could be a potential staging area for work to be completed on locks. Sampling needs and locations will be confirmed by the client, and will only be completed if confirmed.

AELenvironment

A division of Aeon Egmond Ltd.

Old Sly Locks

Site Investigation

Groundwater Sampling Plan

#10888

Legend

- Resample
- Historical Sampling Location
- New Monitoring Well Location
- Estimated Landfill Extents

Smiths Falls, ON

Source:

Groundwater		
Sampling Location	**Location Description**	**Rationale**
SP3	Central portion of Site	Existing monitoring location; confirmation sampling to determine if location still has exceedances of Metals and PCBs
MW-1	Northwest side of Site	Existing monitoring location; confirmation sampling to determine if location still has exceedances of Metals
MW-2	Northeast side of Site	Existing monitoring location; confirmation sampling to determine if location still has exceedances of Metals
MW-3A	West central portion of Site	Existing monitoring location; confirmation sampling to determine if location still has exceedances of Metals and PCBs
MW-3B	West central portion of Site; AEL to confirm if well is still viable before sampling	Existing monitoring location; confirmation sampling to determine if location still has exceedances of Metals and PCBs
MW-3C	West central portion of Site; AEL to confirm if well is still viable before sampling	Existing monitoring location; confirmation sampling to determine if location still has exceedances of Metals and PCBs
MW-4	East central portion of Site	Existing monitoring location; confirmation sampling to determine if location still has exceedances of Metals
MW-5A	South central portion of Site; AEL to confirm if well is still viable before sampling	Existing monitoring location; confirmation sampling to determine if location still has exceedances of Metals
MW-5B	South central portion of Site; AEL to confirm if well is still viable before sampling	Existing monitoring location; confirmation sampling to determine if location still has exceedances of Metals
MW-6	Southeast corner of Site	Existing monitoring location; confirmation sampling to determine if location still has exceedances of Metals
MW7/17	North central portion of Site	New monitoring well location for vertical delineation; down gradient of MW-1, which has historically had exceedances of Metals
MW8/17	East central portion of Site	New monitoring well location for vertical delineation; up gradient of MW-3, which has historically had exceedances of Metals and PCBs
MW9/17	South central portion of Site	New monitoring well location for horizontal and vertical delineation; trans gradient to all known exceedances, and located outside of landfill extents

AELenvironment

A division of Aeon Egmond Ltd.

Old Sly Locks

Site Investigation

Sediment Sampling Plan

#10888

Legend

- Resample
- New Sampling Location
- Estimated Landfill Extents

Smiths Falls, ON

New locations dependant on conditions at time of sampling

Source:

Sediment		
Sampling Location	**Location Description**	**Rationale**
SED1	Southeast side of Site, east of rail tracks	Previous sampling location; confirmation sampling to determine if location still has exceedances of Lead, Mercury and Zinc
SED2	Southwest side of Site, west of Old Sly Rd.	Previous sampling location; confirmation sampling to determine if location still has exceedances of Cadmium, Chromium, Lead, Mercury and Zinc
SED3	Northeast side of Site, east of rail tracks	Previous sampling location; confirmation sampling to determine if location still has exceedances of Cadmium and Lead
SED4	Northwest side of Site, west of Old Sly Rd.	Previous sampling location; confirmation sampling to determine if location still has exceedances of Cadmium, Chromium, Lead, Mercury and Zinc
SED5	Northeast side of Site, east of rail tracks	New sampling location for delineation; downstream of SED3, which has historically had exceedances of Cadmium and Lead
SED6	East side of Site, central, east of rail tracks	New sampling location for delineation; downstream of SED1, which has historically had exceedances of Lead, Mercury and Zinc
SED7	Southeast side of Site, east of rail tracks	New sampling location for delineation; downstream of SED1, which has historically had exceedances of Lead, Mercury and Zinc

AELenvironment

A division of Aeon Egmond Ltd.

Old Sly Locks

Site Investigation

Surface Water Sampling Plan

#10888

Legend

- Resample
- Historical Sampling Location
- New Sampling Location
- Site Investigation Area

Smiths Falls, ON

New locations dependant on conditions at time of sampling

Source:

Sampling Locations and Rationale

Surface Water/Seepage		
Sampling Location	**Location Description**	**Rationale**
RR3	North side of Site, west of rail tracks	Previous sampling location; confirmation that location still has no exceedances, as downstream location (SEDW3) had exceedances of Iron and Toluene
OW-1	Historical seep at north side of Site by rail tracks	Previous sampling location; AEL to confirm if seep is still present during Site walk over, and re-sample if still present
SEDW3	North side of Site, east of rail tracks	Previous sampling location; confirmation sampling to determine if location still has exceedances of Iron and Toluene
SW5/RR5	East side of Site, central	Previous sampling location; confirmation that location still has no exceedances, as locations to the north (SEDW3) and south (RR1) had exceedances of Iron and Toluene or Mercury
RR1	East side of Site, east of rail tracks	Previous sampling location; confirmation sampling to determine if location still has exceedances of Iron and Mercury
SW6	Southeast corner of Site	Previous sampling location; confirmation that location still has no exceedances to confirm delineation
SW7	Northeast corner of Site, downstream of SEDW3	New sampling location for delineation; downstream of SEDW3, which has historically had exceedances for Iron and Toluene
SW8	East side of Site, central, downstream of RR1	New sampling location for delineation; downstream of RR1, which has historically had exceedances for Iron and Mercury

AEL environment
A division of Aeon Egmond Ltd.
1705 Argentia Road, Unit 3 | Mississauga, Ontario, L5N 3A9
Tel/Fax: 416-657-2367| Toll free: 1-800-267-4797
info@aelenv.com | www.aelenv.com

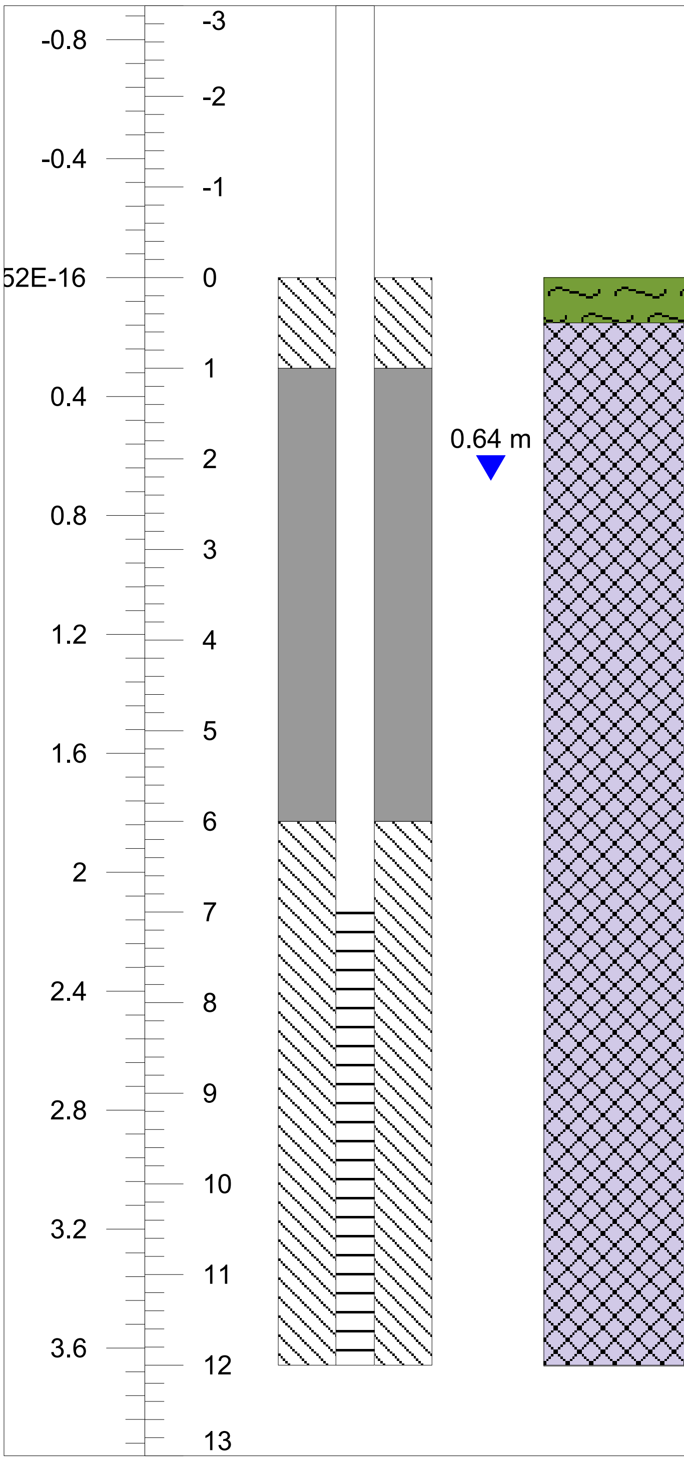
APPENDIX 2

Finalized Field Logs

AEL environment

1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

Project No.:	10888	Log of Test Hole:	MW5/17
Project:	Old Slys Lockstation	Project Manager:	Paul Wilson
Client:	Parks Canada	Easting:	
Location:	Old Slys Road Smiths Falls, Ontario	Northing:	
		Elevation:	



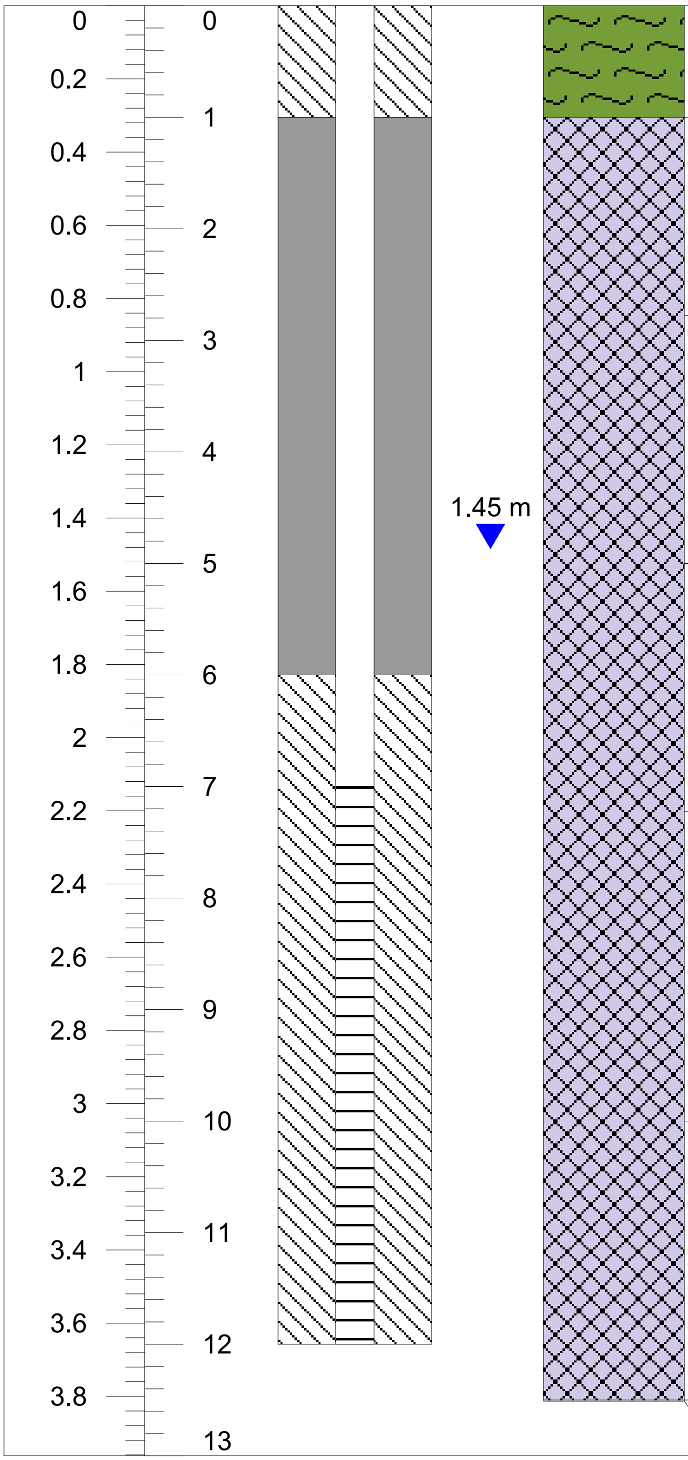
Description		Sample ID
Topsoil	Grass	
Fill	Coarse sand with gravel	A0241
Fill	Brown to black, silty sand with plastic, moist, slight hydrocarbon odour	A0242
Fill	Cbrown, coarse sand, large wood chunks, saturated	A0243
Fill	Black, medium to coarse sand with gravel, slight hydrocarbon odour, wet	A0244
Fill	Grey, coarse sand, wet	A0245
Refusal		

Drill Method:	Direct Push / Auger	Hole Depth (m):	3.66 m
Drill Date:	30-Aug-17	Technician:	EH
Hole Diameter:	3.8cm	Drilled By:	Strata

AEL environment
1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

Project No.:	10888	**Log of Test Hole:**	MW7/17
Project:	Old Slys Lockstation	Project Manager:	Paul Wilson
		Easting:	
Client:	Parks Canada	Northing:	
Location:	Old Slys Road Smiths Falls, Ontario	Elevation:	

Depth (m/ft)	Well Construction	Lithology	Description		Sample ID



Material	Description	Sample ID
Topsoil	Brown, moist	A0214
Fill	White/grey, gravel	A0214
Fill	Brown, sandy, dry	A0215
Fill	Dark brown/black, silty sand, wet, slight hydrocarbon odour	A0216
Fill	Brown, silty sand, wet	A0216
Fill	Brown, coarse sand with gravel, saturated, slight hydrocarbon odour	A0217
Refusal		

Drill Method:	Direct Push / Auger	Hole Depth (m):	3.81 m
Drill Date:	30-Aug-17	Technician:	EH
Hole Diameter:	3.8cm	Drilled By:	Strata

1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

Project No.: 10888

Project: Old Slys Lockstation

Client: Parks Canada

Location: Old Slys Road Smiths Falls, Ontario

Log of Test Hole: MW8/17

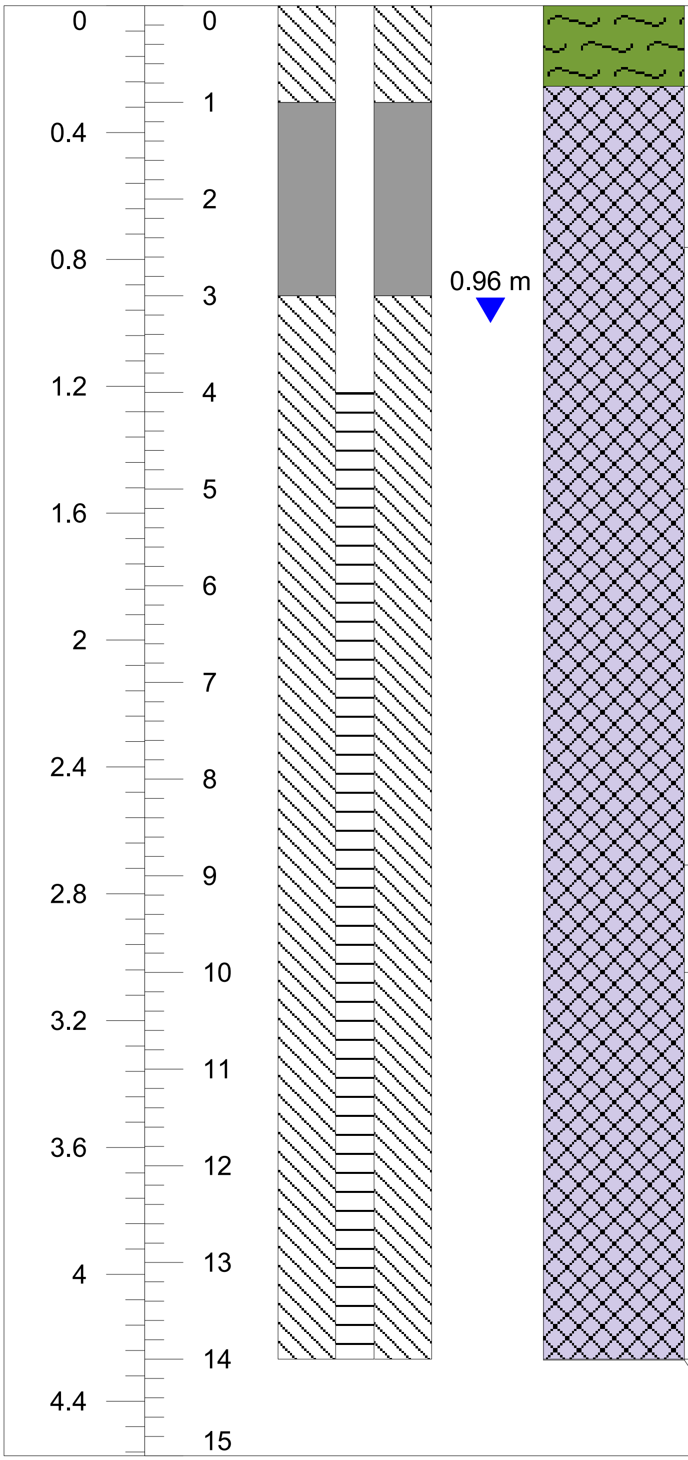
Project Manager: Paul Wilson

Easting:

Northing:

Elevation:

Depth (m/ft)	Well Construction	Lithology	Description		Sample ID



Topsoil	Grass	A0234
Fill	Coarse sand with gravel	A0234
Fill	Coarse sand, plastic and glass	A0234
Fill	Brown, coarse sand with glass and plastic, wet	A0235
Fill	Brown, coarse sand, wet	A0235
Fill	Coarse sand, glass, saturated	A0236

Drill Method: Direct Push / Auger

Drill Date: 30-Aug-17

Hole Diameter: 3.8cm

Hole Depth (m): 4.27 m

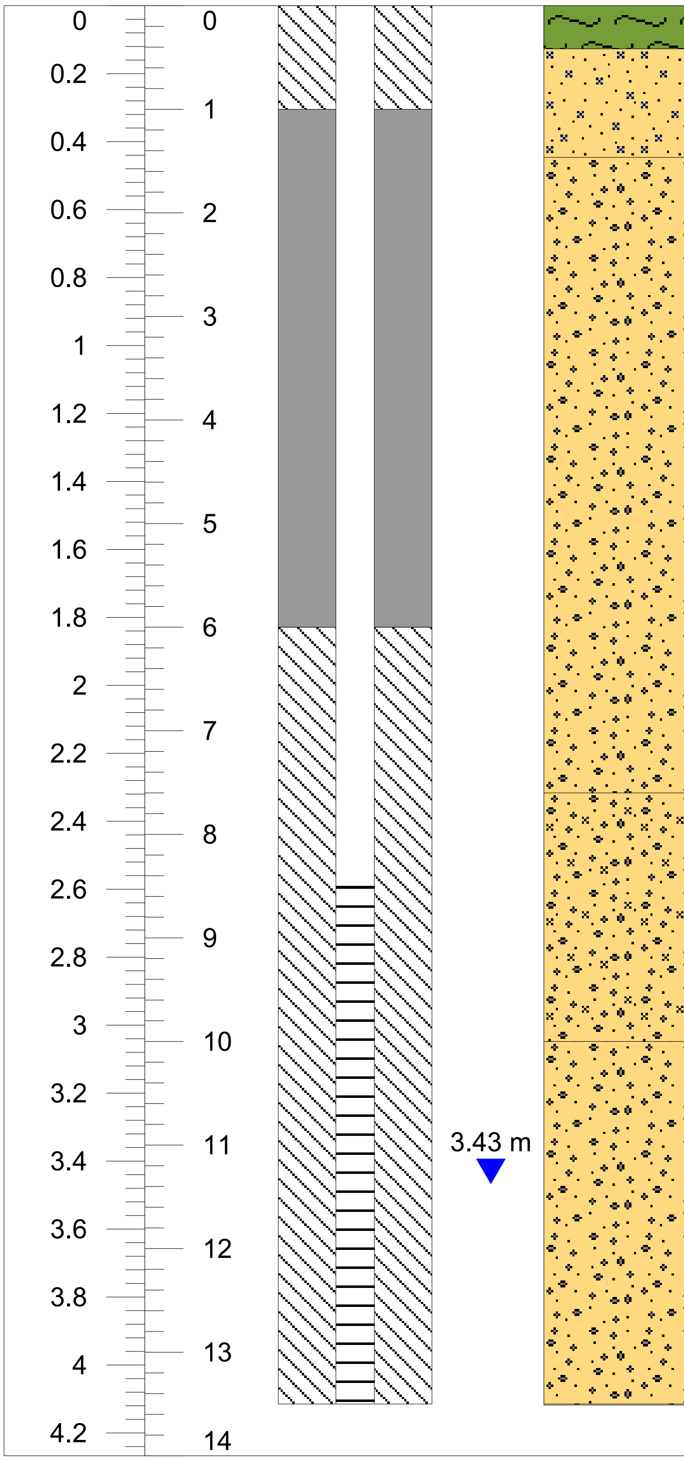
Technician: EH

Drilled By: Strata

1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

Project No.:	10888	**Log of Test Hole:**	MW9/17
Project:	Old Slys Lockstation	Project Manager:	Paul Wilson
Client:	Parks Canada	Easting:	
Location:	Old Slys Road Smiths Falls, Ontario	Northing:	
		Elevation:	

Depth (m/ft)	Well Construction	Lithology	Description		Sample ID



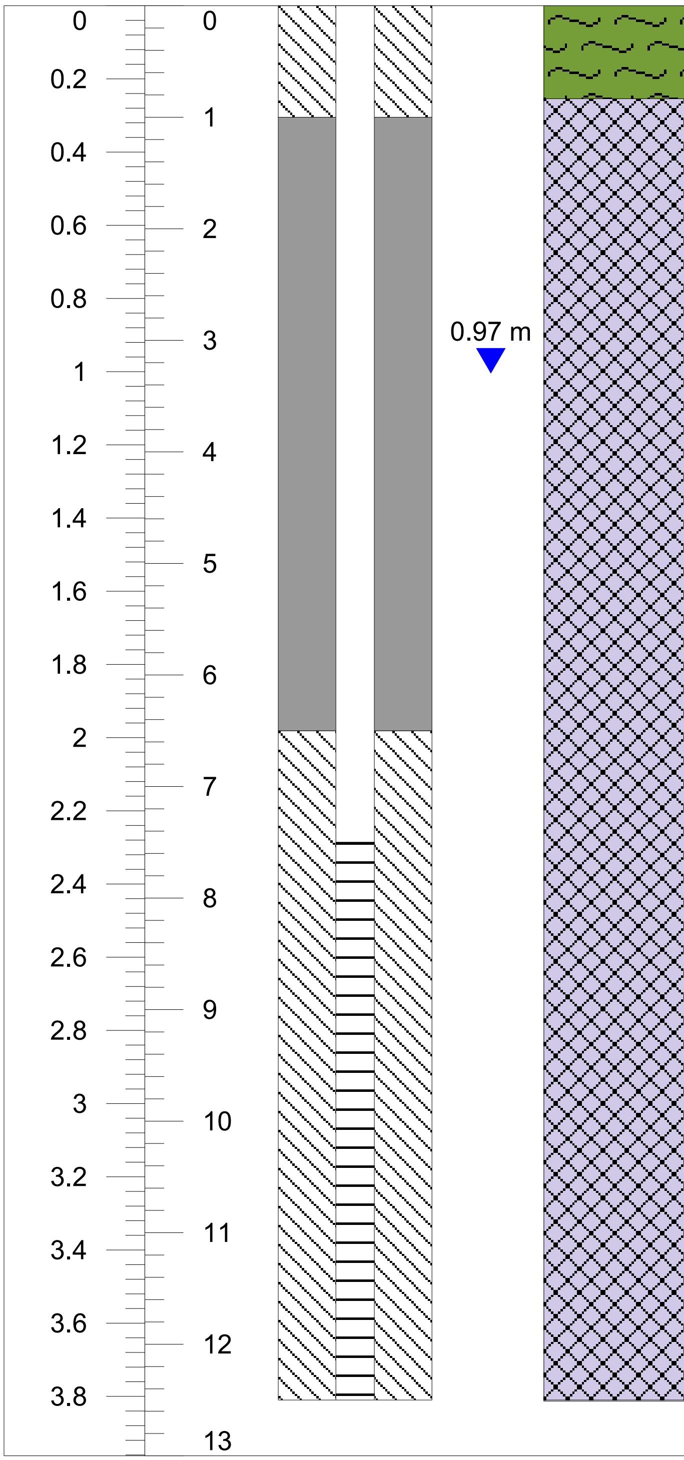
Topsoil	Grass	A0251
Silty Sand	Brown	
Sand and Gravel	Grey to brown, coarse	A0252
Sand and Gravel	Brown, coarse	A0253
Sand and Gravel	Orange/brown, coarse	
Silty Sand and Gravel	Brown, damp	A0254
Sand and Gravel	Fine sand, wet	A0255
Refusal		

Drill Method:	Direct Push / Auger	Hole Depth (m):	4.11 m
Drill Date:	30-Aug-17	Technician:	EH
Hole Diameter:	3.8cm	Drilled By:	Strata

1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

Project No.:	10888	**Log of Test Hole:**	MW10/17
Project:	Old Slys Lockstation	Project Manager:	Paul Wilson
Client:	Parks Canada	Easting:	
Location:	Old Slys Road Smiths Falls, Ontario	Northing:	
		Elevation:	

Depth (m/ft)	Well Construction	Lithology	Description	Sample ID



Lithology	Description	Sample ID
Topsoil	Brown, grass, moist	A0218
Fill	Brown, sandy silt, moist	A0218 / A0219
Fill	Brown, sandy silt, wood and plastic	A0219
Fill	Black, coarse sand, wood and metal, saturated	A0220
Fill	Black, coarse sand, wood, saturated	A0221
Fill	Grey, medium to fine sand, saturated, slight hydrocarbon odour	A0221
Refusal		

Drill Method:	Direct Push / Auger	Hole Depth (m):	3.81 m
Drill Date:	30-Aug-17	Technician:	EH
Hole Diameter:	3.8cm	Drilled By:	Strata

Project No.:	10888
Project:	Old Slys Lockstation
Client:	Parks Canada
Location:	Old Slys Road Smiths Falls, Ontario

1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

Log of Test Hole:	BH11/17
Project Manager:	Paul Wilson
Easting:	
Northing:	
Elevation:	

Depth (m/ft)	Lithology	Description		Sample ID
0 m / 0 ft		Topsoil	Grass and gravel	A0226
		Fill	Brown, silty sand, plastic, moist	A0227
		Fill	Brown, coarse silty sand, saturated	A0228
		Fill	Brown/black, coarse sand, strong hydrocarbon odour	
		Fill	Grey, coarse sand and gravel	
4.4 m / 15 ft		Fill	Brown, coarse sand and gravel, wet, slight hydrocarbon odour	A0229

Depth scale (m): 0, 0.4, 0.8, 1.2, 1.6, 2, 2.4, 2.8, 3.2, 3.6, 4, 4.4
Depth scale (ft): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

Drill Method:	Direct Push	Hole Depth (m):	4.57 m
Drill Date:	30-Aug-17	Technician:	EH
Hole Diameter:	3.8cm	Drilled By:	Strata

1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

Project No.:	10888	**Log of Test Hole:**	BH12/17
Project:	Old Slys Lockstation	**Project Manager:**	Paul Wilson
Client:	Parks Canada	**Easting:**	
Location:	Old Slys Road Smiths Falls, Ontario	**Northing:**	
		Elevation:	

Depth (m/ft): m: 0, 0.4, 0.8, 1.2, 1.6, 2, 2.4, 2.8, 3.2, 3.6, 4, 4.4; ft: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

Lithology	Description		Sample ID
Topsoil	Topsoil	Grass	A0222
Fill	Fill	Grey, gravel	A0222
Fill	Fill	Brown, silty sand, wood debris	A0223
Fill	Fill	Brown, coarse sand and gravel, saturated	A0224
Fill	Fill	Brown to black, silty sand, fine, slight hydrocarbon odour, saturated	A0224
Fill	Fill	Grey to black, coarse sand and gravel, saturated, slight hydrocarbon odour	A0225
Fill	Fill	Brown, coarse sand, wood debris, saturated	A0225

Drill Method:	Direct Push	**Hole Depth (m):**	4.57 m
Drill Date:	30-Aug-17	**Technician:**	EH
Hole Diameter:	3.8cm	**Drilled By:**	Strata

1705 Argentia Road, Unit 3
Mississauga, ON, L5N 3A9
1-800-267-4797

Project No.:	10888	**Log of Test Hole:**	BH13/17
Project:	Old Slys Lockstation	Project Manager:	Paul Wilson
Client:	Parks Canada	Easting:	
Location:	Old Slys Road Smiths Falls, Ontario	Northing:	
		Elevation:	

Depth (m/ft)	Lithology	Description		Sample ID
0 / 0	Topsoil	Topsoil	Grass, wet	A0230
	Fill	Fill	Brown, silty sand, wood, saturated	
	Fill	Fill	Brown, coarse sand and wood, saturated	A0231
	Fill	Fill	Black, coarse sand and wood, wet, slight hydrocarbon odour	
	Fill	Fill	Grey, silty sand, wet	
	Fill	Fill	Black, coarse sand and gravel, metal, saturated, slight hydrocarbon odour	A0232
	Fill	Fill	Grey, coarse sand and gravel	

Depth scale (m): 0, 0.4, 0.8, 1.2, 1.6, 2, 2.4, 2.8, 3.2, 3.6, 4, 4.4, 4.8
Depth scale (ft): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16

Drill Method:	Direct Push	Hole Depth (m):	4.57 m
Drill Date:	30-Aug-17	Technician:	EH
Hole Diameter:	3.8cm	Drilled By:	Strata

AELenvironment
A division of Aeon Egmond Ltd.
1705 Argentia Road, Unit 3 | Mississauga, Ontario, L5N 3A9
Tel/Fax: 416-657-2367| Toll free: 1-800-267-4797
info@aelenv.com | www.aelenv.com

APPENDIX 3
Certificates of Analysis

Maxxam
A Bureau Veritas Group Company

Your Project #: 10888

Attention:Reporting Group

AEL Environment
1705 Argentia Rd
Unit 3
Mississauga, ON
CANADA L5N 3A9

Your C.O.C. #: 625115-01-01, 625115-02-01, 625115-03-01

Report Date: 2017/09/12
Report #: R4695121
Version: 2 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7J1295
Received: 2017/09/01, 14:36

Sample Matrix: Soil
Samples Received: 28

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Methylnaphthalene Sum	2	N/A	2017/09/08	CAM SOP-00301	EPA 8270D m
Methylnaphthalene Sum	7	N/A	2017/09/11	CAM SOP-00301	EPA 8270D m
Semivolatile Organic Compounds (TCLP)	1	2017/09/08	2017/09/09	CAM SOP-00301	EPA 8270D m
Hot Water Extractable Boron	10	2017/09/07	2017/09/07	CAM SOP-00408	R153 Ana. Prot. 2011
Hot Water Extractable Boron	7	2017/09/07	2017/09/08	CAM SOP-00408	R153 Ana. Prot. 2011
Free (WAD) Cyanide	17	2017/09/07	2017/09/08	CAM SOP-00457	OMOE E3015 m
Cyanide (WAD) in Leachates	1	N/A	2017/09/08	CAM SOP-00457	OMOE 3015 m
Conductivity	17	2017/09/08	2017/09/08	CAM SOP-00414	OMOE E3530 v1 m
Hexavalent Chromium in Soil by IC (1)	17	2017/09/06	2017/09/08	CAM SOP-00436	EPA 3060/7199 m
Petroleum Hydrocarbons F2-F4 in Soil (2)	17	2017/09/07	2017/09/08	CAM SOP-00316	CCME CWS m
F4G (CCME Hydrocarbons Gravimetric)	11	2017/09/09	2017/09/09	CAM SOP-00316	CCME PHC-CWS m
Fluoride by ISE in Leachates	1	2017/09/08	2017/09/09	CAM SOP-00449	SM 22 4500-F- C m
Soluble Fluoride analysis in Soil	17	2017/09/07	2017/09/08	CAM SOP-00449	SM 22 4500 F C m
Mercury (TCLP Leachable) (mg/L)	1	N/A	2017/09/08	CAM SOP-00453	EPA 7470A m
Strong Acid Leachable Metals by ICPMS	17	2017/09/07	2017/09/11	CAM SOP-00447	EPA 6020B m
Total Metals in TCLP Leachate by ICPMS	1	2017/09/08	2017/09/11	CAM SOP-00447	EPA 6020B m
Acid Extractable Metals Analysis by ICP	17	2017/09/07	2017/09/08	CAM SOP-00408	EPA 6010D m
Moisture	8	N/A	2017/09/06	CAM SOP-00445	Carter 2nd ed 51.2 m
Moisture	19	N/A	2017/09/07	CAM SOP-00445	Carter 2nd ed 51.2 m
Nitrate(NO3) + Nitrite(NO2) in Leachate	1	N/A	2017/09/08	CAM SOP-00440	SM 22 4500-NO3I/NO2B
PAH Compounds in Soil by GC/MS (SIM)	9	2017/09/07	2017/09/08	CAM SOP-00318	EPA 8270D m
Polychlorinated Biphenyl in Soil	5	2017/09/07	2017/09/07	CAM SOP-00309	EPA 8082A m
Polychlorinated Biphenyl in Soil	4	2017/09/07	2017/09/08	CAM SOP-00309	EPA 8082A m
Polychlorinated Biphenyl in Leachate	1	2017/09/08	2017/09/09	CAM SOP-00309	EPA 8082A m
pH CaCl2 EXTRACT	17	2017/09/07	2017/09/07	CAM SOP-00413	EPA 9045 D m
Sodium Adsorption Ratio (SAR)	17	N/A	2017/09/11	CAM SOP-00102	EPA 6010C
TCLP - % Solids	1	2017/09/07	2017/09/08	CAM SOP-00401	EPA 1311 Update I m

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Your Project #: 10888

Attention:Reporting Group

AEL Environment
1705 Argentia Rd
Unit 3
Mississauga, ON
CANADA L5N 3A9

Your C.O.C. #: 625115-01-01, 625115-02-01, 625115-03-01

Report Date: 2017/09/12
Report #: R4695121
Version: 2 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7J1295
Received: 2017/09/01, 14:36

Sample Matrix: Soil
Samples Received: 28

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
TCLP - Extraction Fluid	1	N/A	2017/09/08	CAM SOP-00401	EPA 1311 Update I m
TCLP - Initial and final pH	1	N/A	2017/09/08	CAM SOP-00401	EPA 1311 Update I m
TCLP Zero Headspace Extraction	1	2017/09/07	2017/09/08	CAM SOP-00430	EPA 1311 m
Volatile Organic Compounds and F1 PHCs	17	N/A	2017/09/08	CAM SOP-00230	EPA 8260 m
VOCs in ZHE Leachates	1	2017/09/08	2017/09/08	CAM SOP-00228	EPA 8260C m

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam’s profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Your Project #: 10888

Attention:Reporting Group

AEL Environment
1705 Argentia Rd
Unit 3
Mississauga, ON
CANADA L5N 3A9

Your C.O.C. #: 625115-01-01, 625115-02-01, 625115-03-01

Report Date: 2017/09/12
Report #: R4695121
Version: 2 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7J1295
Received: 2017/09/01, 14:36

(1) Soils are reported on a dry weight basis unless otherwise specified.
(2) All CCME PHC results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Maxxam conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following “Alberta Environment’s Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Validation of Performance-Based Alternative Methods September 2003”. Documentation is available upon request. Modifications from Reference Method for the Canada-wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method: F2/F3/F4 data reported using validated cold solvent extraction instead of Soxhlet extraction.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Antonella Brasil, Senior Project Manager
Email: ABrasil@maxxam.ca
Phone# (905)817-5817
==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

CCME SOIL INORGANICS PACKAGE (SOIL)

Maxxam ID		FBE228	FBE229		FBE230			
Sampling Date		2017/08/30 09:40	2017/08/30 09:54		2017/08/30 14:30			
COC Number		625115-01-01	625115-01-01		625115-01-01			
	UNITS	A0215 MW7/17	A0217 MW7/17	QC Batch	A0234 MW8/17	RDL	MDL	QC Batch
Calculated Parameters								
Sodium Adsorption Ratio	N/A	0.21	0.29	5150107	0.15			5150107
Inorganics								
Conductivity	mS/cm	0.19	0.33	5153325	0.47	0.002	0.0005	5153325
Fluoride (F-)	ug/g	ND	ND	5153414	ND	5	N/A	5153414
Available (CaCl2) pH	pH	6.80	7.37	5153106	7.55			5153106
WAD Cyanide (Free)	ug/g	0.18	0.05	5153321	0.06	0.01	0.005	5153321
Chromium (VI)	ug/g	ND	ND	5152238	ND	0.2	0.05	5152238
Metals								
Hot Water Ext. Boron (B)	ug/g	0.17	0.12	5153124	0.38	0.050	0.030	5153309
Acid Extractable Antimony (Sb)	ug/g	0.58	0.42	5153043	1.3	0.20	0.10	5153043
Acid Extractable Arsenic (As)	ug/g	3.5	7.7	5153043	3.2	1.0	0.10	5153043
Acid Extractable Barium (Ba)	ug/g	130	37	5153043	210	0.50	0.30	5153043
Acid Extractable Beryllium (Be)	ug/g	0.53	ND	5153043	0.37	0.20	0.020	5153043
Acid Extractable Cadmium (Cd)	ug/g	0.40	0.21	5153043	1.9	0.10	0.030	5153043
Acid Extractable Chromium (Cr)	ug/g	24	9.8	5153043	39	1.0	0.20	5153043
Acid Extractable Cobalt (Co)	ug/g	7.9	2.6	5153043	6.8	0.10	0.020	5153043
Acid Extractable Copper (Cu)	ug/g	66	320	5153043	47	0.50	0.20	5153043
Acid Extractable Lead (Pb)	ug/g	35	27	5153043	210	1.0	0.10	5153043
Acid Extractable Sulphur (S)	ug/g	320	1900	5153040	910	50	N/A	5153040
Acid Extractable Molybdenum (Mo)	ug/g	1.5	2.6	5153043	3.4	0.50	0.10	5153043
Acid Extractable Nickel (Ni)	ug/g	17	13	5153043	21	0.50	0.20	5153043
Acid Extractable Selenium (Se)	ug/g	ND	ND	5153043	ND	0.50	0.10	5153043
Acid Extractable Silver (Ag)	ug/g	ND	ND	5153043	0.38	0.20	0.040	5153043
Acid Extractable Thallium (Tl)	ug/g	0.14	0.11	5153043	0.14	0.050	0.010	5153043
Acid Extractable Tin (Sn)	ug/g	15	8.6	5153043	77	1.0	0.20	5153043
Acid Extractable Uranium (U)	ug/g	0.66	0.19	5153043	0.52	0.050	0.030	5153043
Acid Extractable Vanadium (V)	ug/g	35	6.9	5153043	46	5.0	0.50	5153043
Acid Extractable Zinc (Zn)	ug/g	82	53	5153043	310	5.0	0.50	5153043
Acid Extractable Mercury (Hg)	ug/g	0.12	ND	5153043	0.40	0.050	0.030	5153043

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected
N/A = Not Applicable

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

CCME SOIL INORGANICS PACKAGE (SOIL)

Maxxam ID		FBE232	FBE235		FBE270			
Sampling Date		2017/08/30 11:04	2017/08/30 13:36		2017/08/30 13:19			
COC Number		625115-01-01	625115-01-01		625115-02-01			
	UNITS	A0219 MW10/17	A0228 BH11/17	QC Batch	A0224 BH12/17	RDL	MDL	QC Batch
Calculated Parameters								
Sodium Adsorption Ratio	N/A	0.15	0.10	5150107	0.18			5150107
Inorganics								
Conductivity	mS/cm	0.47	0.84	5153325	0.34	0.002	0.0005	5153325
Fluoride (F-)	ug/g	ND	ND	5153414	ND	5	N/A	5153414
Available (CaCl2) pH	pH	7.19	11.6	5153106	7.48			5153106
WAD Cyanide (Free)	ug/g	0.13	0.03	5153321	0.10	0.01	0.005	5153321
Chromium (VI)	ug/g	ND	ND	5152238	ND	0.2	0.05	5152238
Metals								
Hot Water Ext. Boron (B)	ug/g	0.24	0.30	5153309	0.11	0.050	0.030	5153124
Acid Extractable Antimony (Sb)	ug/g	1.4	4.7	5153043	0.42	0.20	0.10	5153043
Acid Extractable Arsenic (As)	ug/g	3.4	7.6	5153043	2.3	1.0	0.10	5153043
Acid Extractable Barium (Ba)	ug/g	130	160	5153043	69	0.50	0.30	5153043
Acid Extractable Beryllium (Be)	ug/g	0.39	0.47	5153043	0.21	0.20	0.020	5153043
Acid Extractable Cadmium (Cd)	ug/g	1.7	13	5153043	0.38	0.10	0.030	5153043
Acid Extractable Chromium (Cr)	ug/g	38	39	5153043	14	1.0	0.20	5153043
Acid Extractable Cobalt (Co)	ug/g	7.1	7.0	5153043	2.9	0.10	0.020	5153043
Acid Extractable Copper (Cu)	ug/g	62	62	5153043	23	0.50	0.20	5153043
Acid Extractable Lead (Pb)	ug/g	190	200	5153043	73	1.0	0.10	5153043
Acid Extractable Sulphur (S)	ug/g	1400	1700	5153040	570	50	N/A	5153040
Acid Extractable Molybdenum (Mo)	ug/g	3.4	2.3	5153043	1.4	0.50	0.10	5153043
Acid Extractable Nickel (Ni)	ug/g	17	20	5153043	9.5	0.50	0.20	5153043
Acid Extractable Selenium (Se)	ug/g	ND	ND	5153043	ND	0.50	0.10	5153043
Acid Extractable Silver (Ag)	ug/g	0.38	0.30	5153043	ND	0.20	0.040	5153043
Acid Extractable Thallium (Tl)	ug/g	0.18	0.24	5153043	0.097	0.050	0.010	5153043
Acid Extractable Tin (Sn)	ug/g	16	130	5153043	50	1.0	0.20	5153043
Acid Extractable Uranium (U)	ug/g	0.44	0.63	5153043	0.64	0.050	0.030	5153043
Acid Extractable Vanadium (V)	ug/g	29	31	5153043	19	5.0	0.50	5153043
Acid Extractable Zinc (Zn)	ug/g	310	150	5153043	180	5.0	0.50	5153043
Acid Extractable Mercury (Hg)	ug/g	0.23	0.21	5153043	0.087	0.050	0.030	5153043

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected
N/A = Not Applicable

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

CCME SOIL INORGANICS PACKAGE (SOIL)

Maxxam ID		FBE271				FBE273	FBE275			
Sampling Date		2017/08/30 13:22				2017/08/30 14:25	2017/08/31 08:00			
COC Number		625115-02-01				625115-02-01	625115-02-01			
	UNITS	**A0225 BH12/17**	**RDL**	**MDL**	**QC Batch**	**A0232 BH13/17**	**A0256 POND**	**RDL**	**MDL**	**QC Batch**
Calculated Parameters										
Sodium Adsorption Ratio	N/A	0.14			5150107	0.14	0.25			5150107
Inorganics										
Conductivity	mS/cm	0.51	0.002	0.0005	5153325	0.49	0.20	0.002	0.0005	5153325
Fluoride (F-)	ug/g	ND	5	N/A	5153414	ND	ND	5	N/A	5153414
Moisture	%	26	1.0	0.50	5151294			1.0	0.50	5151294
Available (CaCl2) pH	pH	7.32			5153106	8.90	5.78			5153106
WAD Cyanide (Free)	ug/g	0.06	0.01	0.005	5153321	0.10	0.09	0.01	0.005	5153321
Chromium (VI)	ug/g	ND	0.2	0.05	5152238	ND	ND	0.2	0.05	5152238
Metals										
Hot Water Ext. Boron (B)	ug/g	0.21	0.050	0.030	5153309	0.36	1.2	0.050	0.030	5153124
Acid Extractable Antimony (Sb)	ug/g	1.4	0.20	0.10	5153043	3.5	0.46	0.20	0.10	5153043
Acid Extractable Arsenic (As)	ug/g	4.0	1.0	0.10	5153043	4.4	2.4	1.0	0.10	5153043
Acid Extractable Barium (Ba)	ug/g	140	0.50	0.30	5153043	87	120	0.50	0.30	5153043
Acid Extractable Beryllium (Be)	ug/g	ND	0.20	0.020	5153043	0.30	0.31	0.20	0.020	5153043
Acid Extractable Cadmium (Cd)	ug/g	4.3	0.10	0.030	5153043	0.86	0.29	0.10	0.030	5153043
Acid Extractable Chromium (Cr)	ug/g	20	1.0	0.20	5153043	23	15	1.0	0.20	5153043
Acid Extractable Cobalt (Co)	ug/g	4.1	0.10	0.020	5153043	4.9	5.2	0.10	0.020	5153043
Acid Extractable Copper (Cu)	ug/g	51	0.50	0.20	5153043	710	17	0.50	0.20	5153043
Acid Extractable Lead (Pb)	ug/g	330	1.0	0.10	5153043	90	47	1.0	0.10	5153043
Acid Extractable Sulphur (S)	ug/g	1800	50	N/A	5153040	4100	530	50	N/A	5153040
Acid Extractable Molybdenum (Mo)	ug/g	3.2	0.50	0.10	5153043	3.1	1.2	0.50	0.10	5153043
Acid Extractable Nickel (Ni)	ug/g	18	0.50	0.20	5153043	13	13	0.50	0.20	5153043
Acid Extractable Selenium (Se)	ug/g	ND	0.50	0.10	5153043	ND	ND	0.50	0.10	5153043
Acid Extractable Silver (Ag)	ug/g	ND	0.20	0.040	5153043	0.84	0.24	0.20	0.040	5153043
Acid Extractable Thallium (Tl)	ug/g	0.16	0.050	0.010	5153043	0.19	0.20	0.050	0.010	5153043
Acid Extractable Tin (Sn)	ug/g	150	1.0	0.20	5153043	15	11	1.0	0.20	5153043
Acid Extractable Uranium (U)	ug/g	0.35	0.050	0.030	5153043	0.71	0.33	0.050	0.030	5153043
Acid Extractable Vanadium (V)	ug/g	13	5.0	0.50	5153043	21	19	5.0	0.50	5153043
Acid Extractable Zinc (Zn)	ug/g	4500	25	2.5	5153043	340	61	5.0	0.50	5153043
Acid Extractable Mercury (Hg)	ug/g	0.16	0.050	0.030	5153043	0.12	0.071	0.050	0.030	5153043

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected
N/A = Not Applicable

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

CCME SOIL INORGANICS PACKAGE (SOIL)

Maxxam ID		FBE275	FBE276				FBE277			
Sampling Date		2017/08/31 08:00	2017/08/31 08:02				2017/08/30 09:48			
COC Number		625115-02-01	625115-02-01				625115-02-01			
	UNITS	**A0256 POND Lab-Dup**	**A0257 POND**	**RDL**	**MDL**	**QC Batch**	**A0216 MW7/17**	**RDL**	**MDL**	**QC Batch**
Calculated Parameters										
Sodium Adsorption Ratio	N/A		0.26			5150107	0.12			5150107
Inorganics										
Conductivity	mS/cm		0.17	0.002	0.0005	5153325	0.68	0.002	0.0005	5153325
Fluoride (F-)	ug/g		ND	5	N/A	5153414	ND	5	N/A	5153414
Moisture	%		42	1.0	0.50	5151294	31	1.0	0.50	5151294
Available (CaCl2) pH	pH	5.81	5.99			5153106	7.27			5153106
WAD Cyanide (Free)	ug/g	0.07	0.09	0.01	0.005	5153321	0.26	0.01	0.005	5153321
Chromium (VI)	ug/g	ND	ND	0.2	0.05	5152238	ND	0.2	0.05	5152238
Metals										
Hot Water Ext. Boron (B)	ug/g		1.1	0.050	0.030	5153124	0.32	0.050	0.030	5153309
Acid Extractable Antimony (Sb)	ug/g		0.30	0.20	0.10	5153043	5.9	0.20	0.10	5153043
Acid Extractable Arsenic (As)	ug/g		2.1	1.0	0.10	5153043	17	1.0	0.10	5153043
Acid Extractable Barium (Ba)	ug/g		100	0.50	0.30	5153043	100	0.50	0.30	5153043
Acid Extractable Beryllium (Be)	ug/g		0.25	0.20	0.020	5153043	0.37	0.20	0.020	5153043
Acid Extractable Cadmium (Cd)	ug/g		0.25	0.10	0.030	5153043	3.4	0.10	0.030	5153043
Acid Extractable Chromium (Cr)	ug/g		13	1.0	0.20	5153043	42	1.0	0.20	5153043
Acid Extractable Cobalt (Co)	ug/g		4.7	0.10	0.020	5153043	8.6	0.10	0.020	5153043
Acid Extractable Copper (Cu)	ug/g		14	0.50	0.20	5153043	110	0.50	0.20	5153043
Acid Extractable Lead (Pb)	ug/g		40	1.0	0.10	5153043	350	1.0	0.10	5153043
Acid Extractable Sulphur (S)	ug/g		470	50	N/A	5153040	1700	50	N/A	5153040
Acid Extractable Molybdenum (Mo)	ug/g		1.0	0.50	0.10	5153043	4.1	0.50	0.10	5153043
Acid Extractable Nickel (Ni)	ug/g		11	0.50	0.20	5153043	550	2.5	1.0	5153043
Acid Extractable Selenium (Se)	ug/g		ND	0.50	0.10	5153043	ND	0.50	0.10	5153043
Acid Extractable Silver (Ag)	ug/g		0.23	0.20	0.040	5153043	0.36	0.20	0.040	5153043
Acid Extractable Thallium (Tl)	ug/g		0.18	0.050	0.010	5153043	0.19	0.050	0.010	5153043
Acid Extractable Tin (Sn)	ug/g		1.4	1.0	0.20	5153043	230	1.0	0.20	5153043
Acid Extractable Uranium (U)	ug/g		0.33	0.050	0.030	5153043	0.65	0.050	0.030	5153043
Acid Extractable Vanadium (V)	ug/g		19	5.0	0.50	5153043	27	5.0	0.50	5153043
Acid Extractable Zinc (Zn)	ug/g		50	5.0	0.50	5153043	590	5.0	0.50	5153043
Acid Extractable Mercury (Hg)	ug/g		0.052	0.050	0.030	5153043	0.64	0.050	0.030	5153043

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected
N/A = Not Applicable

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

CCME SOIL INORGANICS PACKAGE (SOIL)

Maxxam ID		FBE278		FBE279	FBE297			
Sampling Date		2017/08/30 11:09		2017/08/30 14:18	2017/08/31 08:26			
COC Number		625115-02-01		625115-02-01	625115-03-01			
	UNITS	A0220 MW10/17	QC Batch	A0231 BH13/17	A0241 MW5	RDL	MDL	QC Batch
Calculated Parameters								
Sodium Adsorption Ratio	N/A	0.17	5150107	0.19	0.19			5150107
Inorganics								
Conductivity	mS/cm	0.38	5153325	0.31	0.28	0.002	0.0005	5153325
Fluoride (F-)	ug/g	ND	5153414	ND	ND	5	N/A	5153414
Moisture	%	38	5151294	36		1.0	0.50	5151294
Available (CaCl2) pH	pH	6.82	5153106	7.29	7.52			5153106
WAD Cyanide (Free)	ug/g	0.20	5153321	0.13	0.04	0.01	0.005	5153321
Chromium (VI)	ug/g	ND	5152238	ND	ND	0.2	0.05	5152238
Metals								
Hot Water Ext. Boron (B)	ug/g	0.61	5153124	0.30	0.30	0.050	0.030	5153309
Acid Extractable Antimony (Sb)	ug/g	9.8	5153043	0.73	0.29	0.20	0.10	5153043
Acid Extractable Arsenic (As)	ug/g	12	5153043	3.0	2.6	1.0	0.10	5153043
Acid Extractable Barium (Ba)	ug/g	280	5153043	120	67	0.50	0.30	5153043
Acid Extractable Beryllium (Be)	ug/g	0.38	5153043	0.39	0.26	0.20	0.020	5153043
Acid Extractable Cadmium (Cd)	ug/g	1.7	5153043	0.49	0.18	0.10	0.030	5153043
Acid Extractable Chromium (Cr)	ug/g	51	5153043	25	13	1.0	0.20	5153043
Acid Extractable Cobalt (Co)	ug/g	9.5	5153043	5.8	4.2	0.10	0.020	5153043
Acid Extractable Copper (Cu)	ug/g	210	5153043	30	16	0.50	0.20	5153043
Acid Extractable Lead (Pb)	ug/g	530	5153043	110	20	1.0	0.10	5153043
Acid Extractable Sulphur (S)	ug/g	1800	5153040	890	720	50	N/A	5153040
Acid Extractable Molybdenum (Mo)	ug/g	6.7	5153043	1.9	1.7	0.50	0.10	5153043
Acid Extractable Nickel (Ni)	ug/g	43	5153043	14	8.6	0.50	0.20	5153043
Acid Extractable Selenium (Se)	ug/g	0.91	5153043	ND	ND	0.50	0.10	5153043
Acid Extractable Silver (Ag)	ug/g	0.99	5153043	ND	ND	0.20	0.040	5153043
Acid Extractable Thallium (Tl)	ug/g	0.21	5153043	0.13	0.14	0.050	0.010	5153043
Acid Extractable Tin (Sn)	ug/g	210	5153043	57	5.8	1.0	0.20	5153043
Acid Extractable Uranium (U)	ug/g	0.66	5153043	0.53	0.53	0.050	0.030	5153043
Acid Extractable Vanadium (V)	ug/g	23	5153043	32	18	5.0	0.50	5153043
Acid Extractable Zinc (Zn)	ug/g	880	5153043	230	32	5.0	0.50	5153043
Acid Extractable Mercury (Hg)	ug/g	0.27	5153043	0.15	ND	0.050	0.030	5153043

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected
N/A = Not Applicable

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

CCME SOIL INORGANICS PACKAGE (SOIL)

Maxxam ID		FBE299		FBE301	FBE301			
Sampling Date		2017/08/31 08:34		2017/08/31 10:10	2017/08/31 10:10			
COC Number		625115-03-01		625115-03-01	625115-03-01			
	UNITS	**A0245 MW5**	**RDL**	**A0254 MW9/17**	**A0254 MW9/17 Lab-Dup**	**RDL**	**MDL**	**QC Batch**
Calculated Parameters								
Sodium Adsorption Ratio	N/A	0.31		0.27				5150107
Inorganics								
Conductivity	mS/cm	0.24	0.002	0.13	0.13	0.002	0.0005	5153325
Fluoride (F-)	ug/g	ND	5	ND		5	N/A	5153414
Moisture	%	11	1.0	13		1.0	0.50	5151294
Available (CaCl2) pH	pH	7.61		7.83				5153106
WAD Cyanide (Free)	ug/g	ND	0.01	ND		0.01	0.005	5153321
Chromium (VI)	ug/g	ND	0.2	ND		0.2	0.05	5152238
Metals								
Hot Water Ext. Boron (B)	ug/g	0.12	0.050	0.17		0.050	0.030	5153124
Acid Extractable Antimony (Sb)	ug/g	ND	0.20	ND		0.20	0.10	5153043
Acid Extractable Arsenic (As)	ug/g	13	1.0	3.2		1.0	0.10	5153043
Acid Extractable Barium (Ba)	ug/g	35	0.50	96		0.50	0.30	5153043
Acid Extractable Beryllium (Be)	ug/g	ND	0.20	0.31		0.20	0.020	5153043
Acid Extractable Cadmium (Cd)	ug/g	ND	0.10	0.11		0.10	0.030	5153043
Acid Extractable Chromium (Cr)	ug/g	9.9	1.0	11		1.0	0.20	5153043
Acid Extractable Cobalt (Co)	ug/g	4.5	0.10	4.9		0.10	0.020	5153043
Acid Extractable Copper (Cu)	ug/g	18	0.50	7.4		0.50	0.20	5153043
Acid Extractable Lead (Pb)	ug/g	33	1.0	8.7		1.0	0.10	5153043
Acid Extractable Sulphur (S)	ug/g	4800	50	110		100	N/A	5153040
Acid Extractable Molybdenum (Mo)	ug/g	3.4	0.50	1.4		0.50	0.10	5153043
Acid Extractable Nickel (Ni)	ug/g	18	0.50	7.8		0.50	0.20	5153043
Acid Extractable Selenium (Se)	ug/g	ND	0.50	ND		0.50	0.10	5153043
Acid Extractable Silver (Ag)	ug/g	ND	0.20	ND		0.20	0.040	5153043
Acid Extractable Thallium (Tl)	ug/g	0.13	0.050	0.14		0.050	0.010	5153043
Acid Extractable Tin (Sn)	ug/g	16	1.0	ND		1.0	0.20	5153043
Acid Extractable Uranium (U)	ug/g	0.69	0.050	0.32		0.050	0.030	5153043
Acid Extractable Vanadium (V)	ug/g	8.0	5.0	21		5.0	0.50	5153043
Acid Extractable Zinc (Zn)	ug/g	37	5.0	13		5.0	0.50	5153043
Acid Extractable Mercury (Hg)	ug/g	ND	0.050	ND		0.050	0.030	5153043

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

CCME SOIL INORGANICS PACKAGE (SOIL)

Maxxam ID		FBE304	FBE304			
Sampling Date		2017/08/31 10:00	2017/08/31 10:00			
COC Number		625115-03-01	625115-03-01			
	UNITS	**A0251 MW9/17**	**A0251 MW9/17 Lab-Dup**	**RDL**	**MDL**	**QC Batch**
Calculated Parameters						
Sodium Adsorption Ratio	N/A	0.23				5150107
Inorganics						
Conductivity	mS/cm	0.15		0.002	0.0005	5153325
Fluoride (F-)	ug/g	ND		5	N/A	5153414
Moisture	%	12		1.0	0.50	5151294
Available (CaCl2) pH	pH	7.50				5153106
WAD Cyanide (Free)	ug/g	ND		0.01	0.005	5153321
Chromium (VI)	ug/g	ND		0.2	0.05	5152238
Metals						
Hot Water Ext. Boron (B)	ug/g	0.22		0.050	0.030	5153124
Acid Extractable Antimony (Sb)	ug/g	0.36	0.30	0.20	0.10	5153043
Acid Extractable Arsenic (As)	ug/g	4.5	3.9	1.0	0.10	5153043
Acid Extractable Barium (Ba)	ug/g	110	100	0.50	0.30	5153043
Acid Extractable Beryllium (Be)	ug/g	0.44	0.42	0.20	0.020	5153043
Acid Extractable Cadmium (Cd)	ug/g	0.15	0.24	0.10	0.030	5153043
Acid Extractable Chromium (Cr)	ug/g	17	17	1.0	0.20	5153043
Acid Extractable Cobalt (Co)	ug/g	6.2	5.8	0.10	0.020	5153043
Acid Extractable Copper (Cu)	ug/g	22	22	0.50	0.20	5153043
Acid Extractable Lead (Pb)	ug/g	32	31	1.0	0.10	5153043
Acid Extractable Sulphur (S)	ug/g	270	270	50	N/A	5153040
Acid Extractable Molybdenum (Mo)	ug/g	1.4	1.7	0.50	0.10	5153043
Acid Extractable Nickel (Ni)	ug/g	13	11	0.50	0.20	5153043
Acid Extractable Selenium (Se)	ug/g	ND	ND	0.50	0.10	5153043
Acid Extractable Silver (Ag)	ug/g	0.40	0.39	0.20	0.040	5153043
Acid Extractable Thallium (Tl)	ug/g	0.24	0.22	0.050	0.010	5153043
Acid Extractable Tin (Sn)	ug/g	1.9	2.3	1.0	0.20	5153043
Acid Extractable Uranium (U)	ug/g	0.46	0.47	0.050	0.030	5153043
Acid Extractable Vanadium (V)	ug/g	25	25	5.0	0.50	5153043
Acid Extractable Zinc (Zn)	ug/g	54	52	5.0	0.50	5153043
Acid Extractable Mercury (Hg)	ug/g	0.085	0.096	0.050	0.030	5153043

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected
N/A = Not Applicable

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

CCME VOC F1-F4 (SOIL)

Maxxam ID		FBE228		FBE229		FBE231			
Sampling Date		2017/08/30 09:40		2017/08/30 09:54		2017/08/30 14:38			
COC Number		625115-01-01		625115-01-01		625115-01-01			
	UNITS	A0215 MW7/17	QC Batch	A0217 MW7/17	QC Batch	A0235 MW8/17	RDL	MDL	QC Batch
Inorganics									
Moisture	%	21	5152888	17	5152888	32	1.0	0.50	5152888
Volatile Organics									
Acetone (2-Propanone)	ug/g	ND	5152114	ND	5152114	ND	0.50	0.50	5152114
Benzene	ug/g	ND	5152114	ND	5152114	ND	0.0060	0.0060	5152114
Bromodichloromethane	ug/g	ND	5152114	ND	5152114	ND	0.050	0.050	5152114
Bromoform	ug/g	ND	5152114	ND	5152114	ND	0.050	0.050	5152114
Bromomethane	ug/g	ND	5152114	ND	5152114	ND	0.050	0.050	5152114
Carbon Tetrachloride	ug/g	ND	5152114	ND	5152114	ND	0.050	0.050	5152114
Chlorobenzene	ug/g	ND	5152114	ND	5152114	ND	0.050	0.050	5152114
Chloroform	ug/g	ND	5152114	ND	5152114	ND	0.050	0.050	5152114
Dibromochloromethane	ug/g	ND	5152114	ND	5152114	ND	0.050	0.050	5152114
1,2-Dichlorobenzene	ug/g	ND	5152114	ND	5152114	ND	0.050	0.050	5152114
1,3-Dichlorobenzene	ug/g	ND	5152114	ND	5152114	ND	0.050	0.050	5152114
1,4-Dichlorobenzene	ug/g	ND	5152114	ND	5152114	ND	0.050	0.050	5152114
Dichlorodifluoromethane (FREON 12)	ug/g	ND	5152114	ND	5152114	ND	0.050	0.050	5152114
1,1-Dichloroethane	ug/g	ND	5152114	ND	5152114	ND	0.050	0.050	5152114
1,2-Dichloroethane	ug/g	ND	5152114	ND	5152114	ND	0.050	0.050	5152114
1,1-Dichloroethylene	ug/g	ND	5152114	ND	5152114	ND	0.050	0.050	5152114
cis-1,2-Dichloroethylene	ug/g	ND	5152114	ND	5152114	ND	0.050	0.050	5152114
trans-1,2-Dichloroethylene	ug/g	ND	5152114	ND	5152114	ND	0.050	0.050	5152114
1,2-Dichloropropane	ug/g	ND	5152114	ND	5152114	ND	0.050	0.050	5152114
cis-1,3-Dichloropropene	ug/g	ND	5152114	ND	5152114	ND	0.030	0.030	5152114
trans-1,3-Dichloropropene	ug/g	ND	5152114	ND	5152114	ND	0.040	0.040	5152114
Ethylbenzene	ug/g	ND	5152114	ND	5152114	0.048	0.010	0.010	5152114
Ethylene Dibromide	ug/g	ND	5152114	ND	5152114	ND	0.050	0.050	5152114
Hexane	ug/g	ND	5152114	ND	5152114	ND	0.050	0.050	5152114
Methylene Chloride(Dichloromethane)	ug/g	ND	5152114	ND	5152114	ND	0.050	0.050	5152114
Methyl Isobutyl Ketone	ug/g	ND	5152114	ND	5152114	ND	0.50	0.50	5152114
Methyl Ethyl Ketone (2-Butanone)	ug/g	ND	5152114	ND	5152114	ND	0.50	0.50	5152114
Methyl t-butyl ether (MTBE)	ug/g	ND	5152114	ND	5152114	ND	0.050	0.050	5152114
Styrene	ug/g	ND	5152114	ND	5152114	ND	0.050	0.050	5152114
1,1,1,2-Tetrachloroethane	ug/g	ND	5152114	ND	5152114	ND	0.050	0.050	5152114

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

CCME VOC F1-F4 (SOIL)

Maxxam ID		FBE228		FBE229		FBE231			
Sampling Date		2017/08/30 09:40		2017/08/30 09:54		2017/08/30 14:38			
COC Number		625115-01-01		625115-01-01		625115-01-01			
	UNITS	A0215 MW7/17	QC Batch	A0217 MW7/17	QC Batch	A0235 MW8/17	RDL	MDL	QC Batch
1,1,2,2-Tetrachloroethane	ug/g	ND	5152114	ND	5152114	ND	0.050	0.050	5152114
Tetrachloroethylene	ug/g	ND	5152114	ND	5152114	ND	0.050	0.050	5152114
Toluene	ug/g	ND	5152114	ND	5152114	0.72	0.020	0.020	5152114
1,1,1-Trichloroethane	ug/g	ND	5152114	ND	5152114	ND	0.050	0.050	5152114
1,1,2-Trichloroethane	ug/g	ND	5152114	ND	5152114	ND	0.050	0.050	5152114
Trichloroethylene	ug/g	ND	5152114	ND	5152114	0.011	0.010	0.010	5152114
Vinyl Chloride	ug/g	ND	5152114	ND	5152114	ND	0.020	0.020	5152114
p+m-Xylene	ug/g	ND	5152114	ND	5152114	0.48	0.020	0.020	5152114
o-Xylene	ug/g	ND	5152114	ND	5152114	0.053	0.020	0.020	5152114
Total Xylenes	ug/g	ND	5152114	ND	5152114	0.53	0.020	0.020	5152114
Trichlorofluoromethane (FREON 11)	ug/g	ND	5152114	ND	5152114	ND	0.050	0.050	5152114
F1 (C6-C10)	ug/g	ND	5152114	ND	5152114	ND	10	N/A	5152114
F1 (C6-C10) - BTEX	ug/g	ND	5152114	ND	5152114	ND	10	N/A	5152114
F2-F4 Hydrocarbons									
F2 (C10-C16 Hydrocarbons)	ug/g	ND	5154622	ND	5153651	110	10	5.0	5154622
F3 (C16-C34 Hydrocarbons)	ug/g	140	5154622	130	5153651	1400	50	5.0	5154622
F4 (C34-C50 Hydrocarbons)	ug/g	95	5154622	190	5153651	530	50	10	5154622
Reached Baseline at C50	ug/g	No	5154622	No	5153651	No			5154622
Surrogate Recovery (%)									
o-Terphenyl	%	87	5154622	94	5153651	90			5154622
4-Bromofluorobenzene	%	92	5152114	92	5152114	95			5152114
D10-o-Xylene	%	78	5152114	75	5152114	81			5152114
D4-1,2-Dichloroethane	%	109	5152114	109	5152114	109			5152114
D8-Toluene	%	94	5152114	94	5152114	93			5152114

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected
N/A = Not Applicable

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

CCME VOC F1-F4 (SOIL)

Maxxam ID		FBE232	FBE233	FBE235	FBE236			
Sampling Date		2017/08/30 11:04	2017/08/30 11:12	2017/08/30 13:36	2017/08/30 13:48			
COC Number		625115-01-01	625115-01-01	625115-01-01	625115-01-01			
	UNITS	A0219 MW10/17	A0221 MW10/17	A0228 BH11/17	A0229 BH11/17	RDL	MDL	QC Batch
Inorganics								
Moisture	%	27	25	24	25	1.0	0.50	5152888
Volatile Organics								
Acetone (2-Propanone)	ug/g	ND	ND	ND	ND	0.50	0.50	5152114
Benzene	ug/g	ND	ND	ND	ND	0.0060	0.0060	5152114
Bromodichloromethane	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
Bromoform	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
Bromomethane	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
Carbon Tetrachloride	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
Chlorobenzene	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
Chloroform	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
Dibromochloromethane	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
1,2-Dichlorobenzene	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
1,3-Dichlorobenzene	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
1,4-Dichlorobenzene	ug/g	ND	ND	0.060	ND	0.050	0.050	5152114
Dichlorodifluoromethane (FREON 12)	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
1,1-Dichloroethane	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
1,2-Dichloroethane	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
1,1-Dichloroethylene	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
cis-1,2-Dichloroethylene	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
trans-1,2-Dichloroethylene	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
1,2-Dichloropropane	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
cis-1,3-Dichloropropene	ug/g	ND	ND	ND	ND	0.030	0.030	5152114
trans-1,3-Dichloropropene	ug/g	ND	ND	ND	ND	0.040	0.040	5152114
Ethylbenzene	ug/g	0.44	0.24	0.010	0.011	0.010	0.010	5152114
Ethylene Dibromide	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
Hexane	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
Methylene Chloride(Dichloromethane)	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
Methyl Isobutyl Ketone	ug/g	ND	ND	ND	ND	0.50	0.50	5152114
Methyl Ethyl Ketone (2-Butanone)	ug/g	ND	ND	ND	ND	0.50	0.50	5152114
Methyl t-butyl ether (MTBE)	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
Styrene	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
1,1,1,2-Tetrachloroethane	ug/g	ND	ND	ND	ND	0.050	0.050	5152114

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

CCME VOC F1-F4 (SOIL)

Maxxam ID		FBE232	FBE233	FBE235	FBE236			
Sampling Date		2017/08/30 11:04	2017/08/30 11:12	2017/08/30 13:36	2017/08/30 13:48			
COC Number		625115-01-01	625115-01-01	625115-01-01	625115-01-01			
	UNITS	**A0219 MW10/17**	**A0221 MW10/17**	**A0228 BH11/17**	**A0229 BH11/17**	**RDL**	**MDL**	**QC Batch**
1,1,2,2-Tetrachloroethane	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
Tetrachloroethylene	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
Toluene	ug/g	0.024	ND	0.030	0.024	0.020	0.020	5152114
1,1,1-Trichloroethane	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
1,1,2-Trichloroethane	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
Trichloroethylene	ug/g	ND	ND	ND	0.48	0.010	0.010	5152114
Vinyl Chloride	ug/g	ND	ND	ND	ND	0.020	0.020	5152114
p+m-Xylene	ug/g	2.7	1.6	0.080	0.070	0.020	0.020	5152114
o-Xylene	ug/g	2.3	1.2	ND	ND	0.020	0.020	5152114
Total Xylenes	ug/g	5.0	2.8	0.080	0.070	0.020	0.020	5152114
Trichlorofluoromethane (FREON 11)	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
F1 (C6-C10)	ug/g	20	12	ND	ND	10	N/A	5152114
F1 (C6-C10) - BTEX	ug/g	15	ND	ND	ND	10	N/A	5152114
F2-F4 Hydrocarbons								
F2 (C10-C16 Hydrocarbons)	ug/g	130	74	ND	32	10	5.0	5154622
F3 (C16-C34 Hydrocarbons)	ug/g	520	170	100	620	50	5.0	5154622
F4 (C34-C50 Hydrocarbons)	ug/g	190	110	65	370	50	10	5154622
Reached Baseline at C50	ug/g	No	No	No	No			5154622
Surrogate Recovery (%)								
o-Terphenyl	%	86	87	85	90			5154622
4-Bromofluorobenzene	%	103	100	97	97			5152114
D10-o-Xylene	%	83	84	77	77			5152114
D4-1,2-Dichloroethane	%	110	108	107	108			5152114
D8-Toluene	%	93	94	94	94			5152114

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected
N/A = Not Applicable

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

CCME VOC F1-F4 (SOIL)

Maxxam ID		FBE237	FBE270	FBE272	FBE272			
Sampling Date		2017/08/30 13:08	2017/08/30 13:19	2017/08/30 14:10	2017/08/30 14:10			
COC Number		625115-01-01	625115-02-01	625115-02-01	625115-02-01			
	UNITS	**A0223 BH12/17**	**A0224 BH12/17**	**A0230 BH13/17**	**A0230 BH13/17 Lab-Dup**	**RDL**	**MDL**	**QC Batch**
Inorganics								
Moisture	%	18	20	19		1.0	0.50	5152888
Volatile Organics								
Acetone (2-Propanone)	ug/g	ND	ND	ND		0.50	0.50	5152114
Benzene	ug/g	ND	ND	ND		0.0060	0.0060	5152114
Bromodichloromethane	ug/g	ND	ND	ND		0.050	0.050	5152114
Bromoform	ug/g	ND	ND	ND		0.050	0.050	5152114
Bromomethane	ug/g	ND	ND	ND		0.050	0.050	5152114
Carbon Tetrachloride	ug/g	ND	ND	ND		0.050	0.050	5152114
Chlorobenzene	ug/g	ND	ND	ND		0.050	0.050	5152114
Chloroform	ug/g	ND	ND	ND		0.050	0.050	5152114
Dibromochloromethane	ug/g	ND	ND	ND		0.050	0.050	5152114
1,2-Dichlorobenzene	ug/g	ND	ND	ND		0.050	0.050	5152114
1,3-Dichlorobenzene	ug/g	ND	ND	ND		0.050	0.050	5152114
1,4-Dichlorobenzene	ug/g	ND	ND	ND		0.050	0.050	5152114
Dichlorodifluoromethane (FREON 12)	ug/g	ND	ND	ND		0.050	0.050	5152114
1,1-Dichloroethane	ug/g	ND	ND	ND		0.050	0.050	5152114
1,2-Dichloroethane	ug/g	ND	ND	ND		0.050	0.050	5152114
1,1-Dichloroethylene	ug/g	ND	ND	ND		0.050	0.050	5152114
cis-1,2-Dichloroethylene	ug/g	ND	ND	ND		0.050	0.050	5152114
trans-1,2-Dichloroethylene	ug/g	ND	ND	ND		0.050	0.050	5152114
1,2-Dichloropropane	ug/g	ND	ND	ND		0.050	0.050	5152114
cis-1,3-Dichloropropene	ug/g	ND	ND	ND		0.030	0.030	5152114
trans-1,3-Dichloropropene	ug/g	ND	ND	ND		0.040	0.040	5152114
Ethylbenzene	ug/g	ND	ND	ND		0.010	0.010	5152114
Ethylene Dibromide	ug/g	ND	ND	ND		0.050	0.050	5152114
Hexane	ug/g	ND	ND	ND		0.050	0.050	5152114
Methylene Chloride(Dichloromethane)	ug/g	ND	ND	ND		0.050	0.050	5152114
Methyl Isobutyl Ketone	ug/g	ND	ND	ND		0.50	0.50	5152114
Methyl Ethyl Ketone (2-Butanone)	ug/g	ND	ND	ND		0.50	0.50	5152114
Methyl t-butyl ether (MTBE)	ug/g	ND	ND	ND		0.050	0.050	5152114
Styrene	ug/g	ND	ND	ND		0.050	0.050	5152114

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

CCME VOC F1-F4 (SOIL)

Maxxam ID		FBE237	FBE270	FBE272	FBE272			
Sampling Date		2017/08/30 13:08	2017/08/30 13:19	2017/08/30 14:10	2017/08/30 14:10			
COC Number		625115-01-01	625115-02-01	625115-02-01	625115-02-01			
	UNITS	**A0223 BH12/17**	**A0224 BH12/17**	**A0230 BH13/17**	**A0230 BH13/17 Lab-Dup**	**RDL**	**MDL**	**QC Batch**
1,1,1,2-Tetrachloroethane	ug/g	ND	ND	ND		0.050	0.050	5152114
1,1,2,2-Tetrachloroethane	ug/g	ND	ND	ND		0.050	0.050	5152114
Tetrachloroethylene	ug/g	ND	ND	ND		0.050	0.050	5152114
Toluene	ug/g	ND	ND	ND		0.020	0.020	5152114
1,1,1-Trichloroethane	ug/g	ND	ND	ND		0.050	0.050	5152114
1,1,2-Trichloroethane	ug/g	ND	ND	ND		0.050	0.050	5152114
Trichloroethylene	ug/g	ND	ND	ND		0.010	0.010	5152114
Vinyl Chloride	ug/g	ND	ND	ND		0.020	0.020	5152114
p+m-Xylene	ug/g	0.026	0.11	ND		0.020	0.020	5152114
o-Xylene	ug/g	ND	ND	ND		0.020	0.020	5152114
Total Xylenes	ug/g	0.026	0.11	ND		0.020	0.020	5152114
Trichlorofluoromethane (FREON 11)	ug/g	ND	ND	ND		0.050	0.050	5152114
F1 (C6-C10)	ug/g	ND	ND	ND		10	N/A	5152114
F1 (C6-C10) - BTEX	ug/g	ND	ND	ND		10	N/A	5152114
F2-F4 Hydrocarbons								
F2 (C10-C16 Hydrocarbons)	ug/g	ND	ND	ND	ND	10	5.0	5154622
F3 (C16-C34 Hydrocarbons)	ug/g	150	210	ND	ND	50	5.0	5154622
F4 (C34-C50 Hydrocarbons)	ug/g	68	68	ND	ND	50	10	5154622
Reached Baseline at C50	ug/g	No	No	Yes	Yes			5154622
Surrogate Recovery (%)								
o-Terphenyl	%	91	84	85	86			5154622
4-Bromofluorobenzene	%	95	95	94				5152114
D10-o-Xylene	%	77	74	72				5152114
D4-1,2-Dichloroethane	%	109	109	109				5152114
D8-Toluene	%	92	93	92				5152114

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

CCME VOC F1-F4 (SOIL)

Maxxam ID		FBE273	FBE274		FBE275			
Sampling Date		2017/08/30 14:25	2017/08/30 14:12		2017/08/31 08:00			
COC Number		625115-02-01	625115-02-01		625115-02-01			
	UNITS	A0232 BH13/17	A0233 BH13/17	QC Batch	A0256 POND	RDL	MDL	QC Batch
Inorganics								
Moisture	%	24	27	5152888	41	1.0	0.50	5152888
Volatile Organics								
Acetone (2-Propanone)	ug/g	ND	ND	5152114	0.57	0.50	0.50	5152114
Benzene	ug/g	ND	ND	5152114	ND	0.0060	0.0060	5152114
Bromodichloromethane	ug/g	ND	ND	5152114	ND	0.050	0.050	5152114
Bromoform	ug/g	ND	ND	5152114	ND	0.050	0.050	5152114
Bromomethane	ug/g	ND	ND	5152114	ND	0.050	0.050	5152114
Carbon Tetrachloride	ug/g	ND	ND	5152114	ND	0.050	0.050	5152114
Chlorobenzene	ug/g	ND	ND	5152114	ND	0.050	0.050	5152114
Chloroform	ug/g	ND	ND	5152114	ND	0.050	0.050	5152114
Dibromochloromethane	ug/g	ND	ND	5152114	ND	0.050	0.050	5152114
1,2-Dichlorobenzene	ug/g	ND	ND	5152114	ND	0.050	0.050	5152114
1,3-Dichlorobenzene	ug/g	ND	ND	5152114	ND	0.050	0.050	5152114
1,4-Dichlorobenzene	ug/g	ND	ND	5152114	ND	0.050	0.050	5152114
Dichlorodifluoromethane (FREON 12)	ug/g	ND	ND	5152114	ND	0.050	0.050	5152114
1,1-Dichloroethane	ug/g	ND	ND	5152114	ND	0.050	0.050	5152114
1,2-Dichloroethane	ug/g	ND	ND	5152114	ND	0.050	0.050	5152114
1,1-Dichloroethylene	ug/g	ND	ND	5152114	ND	0.050	0.050	5152114
cis-1,2-Dichloroethylene	ug/g	ND	ND	5152114	ND	0.050	0.050	5152114
trans-1,2-Dichloroethylene	ug/g	ND	ND	5152114	ND	0.050	0.050	5152114
1,2-Dichloropropane	ug/g	ND	ND	5152114	ND	0.050	0.050	5152114
cis-1,3-Dichloropropene	ug/g	ND	ND	5152114	ND	0.030	0.030	5152114
trans-1,3-Dichloropropene	ug/g	ND	ND	5152114	ND	0.040	0.040	5152114
Ethylbenzene	ug/g	0.015	ND	5152114	ND	0.010	0.010	5152114
Ethylene Dibromide	ug/g	ND	ND	5152114	ND	0.050	0.050	5152114
Hexane	ug/g	ND	ND	5152114	ND	0.050	0.050	5152114
Methylene Chloride(Dichloromethane)	ug/g	ND	ND	5152114	ND	0.050	0.050	5152114
Methyl Isobutyl Ketone	ug/g	ND	ND	5152114	ND	0.50	0.50	5152114
Methyl Ethyl Ketone (2-Butanone)	ug/g	ND	ND	5152114	ND	0.50	0.50	5152114
Methyl t-butyl ether (MTBE)	ug/g	ND	ND	5152114	ND	0.050	0.050	5152114
Styrene	ug/g	ND	ND	5152114	ND	0.050	0.050	5152114
1,1,1,2-Tetrachloroethane	ug/g	ND	ND	5152114	ND	0.050	0.050	5152114

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

CCME VOC F1-F4 (SOIL)

Maxxam ID		FBE273	FBE274		FBE275			
Sampling Date		2017/08/30 14:25	2017/08/30 14:12		2017/08/31 08:00			
COC Number		625115-02-01	625115-02-01		625115-02-01			
	UNITS	**A0232 BH13/17**	**A0233 BH13/17**	**QC Batch**	**A0256 POND**	**RDL**	**MDL**	**QC Batch**
1,1,2,2-Tetrachloroethane	ug/g	ND	ND	5152114	ND	0.050	0.050	5152114
Tetrachloroethylene	ug/g	ND	ND	5152114	ND	0.050	0.050	5152114
Toluene	ug/g	0.020	ND	5152114	ND	0.020	0.020	5152114
1,1,1-Trichloroethane	ug/g	ND	ND	5152114	ND	0.050	0.050	5152114
1,1,2-Trichloroethane	ug/g	ND	ND	5152114	ND	0.050	0.050	5152114
Trichloroethylene	ug/g	ND	ND	5152114	ND	0.010	0.010	5152114
Vinyl Chloride	ug/g	ND	ND	5152114	ND	0.020	0.020	5152114
p+m-Xylene	ug/g	0.048	ND	5152114	ND	0.020	0.020	5152114
o-Xylene	ug/g	ND	ND	5152114	ND	0.020	0.020	5152114
Total Xylenes	ug/g	0.048	ND	5152114	ND	0.020	0.020	5152114
Trichlorofluoromethane (FREON 11)	ug/g	ND	ND	5152114	ND	0.050	0.050	5152114
F1 (C6-C10)	ug/g	ND	ND	5152114	ND	10	N/A	5152114
F1 (C6-C10) - BTEX	ug/g	ND	ND	5152114	ND	10	N/A	5152114
F2-F4 Hydrocarbons								
F2 (C10-C16 Hydrocarbons)	ug/g	11	ND	5154622	13	10	5.0	5153651
F3 (C16-C34 Hydrocarbons)	ug/g	410	ND	5154622	76	50	5.0	5153651
F4 (C34-C50 Hydrocarbons)	ug/g	78	ND	5154622	ND	50	10	5153651
Reached Baseline at C50	ug/g	No	Yes	5154622	Yes			5153651
Surrogate Recovery (%)								
o-Terphenyl	%	90	86	5154622	97			5153651
4-Bromofluorobenzene	%	95	93	5152114	92			5152114
D10-o-Xylene	%	70	79	5152114	74			5152114
D4-1,2-Dichloroethane	%	108	108	5152114	109			5152114
D8-Toluene	%	92	93	5152114	94			5152114

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected
N/A = Not Applicable

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

CCME VOC F1-F4 (SOIL)

Maxxam ID		FBE297	FBE298	FBE300	FBE300			
Sampling Date		2017/08/31 08:26	2017/08/31 08:34	2017/08/31 10:00	2017/08/31 10:00			
COC Number		625115-03-01	625115-03-01	625115-03-01	625115-03-01			
	UNITS	**A0241 MW5**	**A0244 MW5**	**A0252 MW9/17**	**A0252 MW9/17 Lab-Dup**	**RDL**	**MDL**	**QC Batch**
Inorganics								
Moisture	%	15	29	6.0		1.0	0.50	5152888
Volatile Organics								
Acetone (2-Propanone)	ug/g	ND	0.54	ND	ND	0.50	0.50	5152114
Benzene	ug/g	ND	0.014	ND	ND	0.0060	0.0060	5152114
Bromodichloromethane	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
Bromoform	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
Bromomethane	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
Carbon Tetrachloride	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
Chlorobenzene	ug/g	ND	0.35	ND	ND	0.050	0.050	5152114
Chloroform	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
Dibromochloromethane	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
1,2-Dichlorobenzene	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
1,3-Dichlorobenzene	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
1,4-Dichlorobenzene	ug/g	ND	0.12	ND	ND	0.050	0.050	5152114
Dichlorodifluoromethane (FREON 12)	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
1,1-Dichloroethane	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
1,2-Dichloroethane	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
1,1-Dichloroethylene	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
cis-1,2-Dichloroethylene	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
trans-1,2-Dichloroethylene	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
1,2-Dichloropropane	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
cis-1,3-Dichloropropene	ug/g	ND	ND	ND	ND	0.030	0.030	5152114
trans-1,3-Dichloropropene	ug/g	ND	ND	ND	ND	0.040	0.040	5152114
Ethylbenzene	ug/g	ND	0.034	ND	ND	0.010	0.010	5152114
Ethylene Dibromide	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
Hexane	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
Methylene Chloride(Dichloromethane)	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
Methyl Isobutyl Ketone	ug/g	ND	ND	ND	ND	0.50	0.50	5152114
Methyl Ethyl Ketone (2-Butanone)	ug/g	ND	ND	ND	ND	0.50	0.50	5152114
Methyl t-butyl ether (MTBE)	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
Styrene	ug/g	ND	ND	ND	ND	0.050	0.050	5152114

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

CCME VOC F1-F4 (SOIL)

Maxxam ID		FBE297	FBE298	FBE300	FBE300			
Sampling Date		2017/08/31 08:26	2017/08/31 08:34	2017/08/31 10:00	2017/08/31 10:00			
COC Number		625115-03-01	625115-03-01	625115-03-01	625115-03-01			
	UNITS	**A0241 MW5**	**A0244 MW5**	**A0252 MW9/17**	**A0252 MW9/17 Lab-Dup**	**RDL**	**MDL**	**QC Batch**
1,1,1,2-Tetrachloroethane	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
1,1,2,2-Tetrachloroethane	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
Tetrachloroethylene	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
Toluene	ug/g	ND	0.045	ND	ND	0.020	0.020	5152114
1,1,1-Trichloroethane	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
1,1,2-Trichloroethane	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
Trichloroethylene	ug/g	ND	0.047	ND	ND	0.010	0.010	5152114
Vinyl Chloride	ug/g	ND	ND	ND	ND	0.020	0.020	5152114
p+m-Xylene	ug/g	0.022	1.2	ND	ND	0.020	0.020	5152114
o-Xylene	ug/g	ND	0.058	ND	ND	0.020	0.020	5152114
Total Xylenes	ug/g	0.022	1.3	ND	ND	0.020	0.020	5152114
Trichlorofluoromethane (FREON 11)	ug/g	ND	ND	ND	ND	0.050	0.050	5152114
F1 (C6-C10)	ug/g	ND	ND	ND	ND	10	N/A	5152114
F1 (C6-C10) - BTEX	ug/g	ND	ND	ND	ND	10	N/A	5152114
F2-F4 Hydrocarbons								
F2 (C10-C16 Hydrocarbons)	ug/g	ND	79	ND		10	5.0	5154622
F3 (C16-C34 Hydrocarbons)	ug/g	ND	1400	ND		50	5.0	5154622
F4 (C34-C50 Hydrocarbons)	ug/g	ND	1700	ND		50	10	5154622
Reached Baseline at C50	ug/g	Yes	No	Yes				5154622
Surrogate Recovery (%)								
o-Terphenyl	%	83	86	88				5154622
4-Bromofluorobenzene	%	94	99	93	92			5152114
D10-o-Xylene	%	72	77	76	75			5152114
D4-1,2-Dichloroethane	%	109	109	106	106			5152114
D8-Toluene	%	92	92	94	94			5152114

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected
N/A = Not Applicable

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

CCME VOC F1-F4 (SOIL)

Maxxam ID		FBE302			
Sampling Date		2017/08/31 10:15			
COC Number		625115-03-01			
	UNITS	**A0255 MW9/17**	**RDL**	**MDL**	**QC Batch**
Inorganics					
Moisture	%	17	1.0	0.50	5152888
Volatile Organics					
Acetone (2-Propanone)	ug/g	ND	0.50	0.50	5152114
Benzene	ug/g	ND	0.0060	0.0060	5152114
Bromodichloromethane	ug/g	ND	0.050	0.050	5152114
Bromoform	ug/g	ND	0.050	0.050	5152114
Bromomethane	ug/g	ND	0.050	0.050	5152114
Carbon Tetrachloride	ug/g	ND	0.050	0.050	5152114
Chlorobenzene	ug/g	ND	0.050	0.050	5152114
Chloroform	ug/g	ND	0.050	0.050	5152114
Dibromochloromethane	ug/g	ND	0.050	0.050	5152114
1,2-Dichlorobenzene	ug/g	ND	0.050	0.050	5152114
1,3-Dichlorobenzene	ug/g	ND	0.050	0.050	5152114
1,4-Dichlorobenzene	ug/g	ND	0.050	0.050	5152114
Dichlorodifluoromethane (FREON 12)	ug/g	ND	0.050	0.050	5152114
1,1-Dichloroethane	ug/g	ND	0.050	0.050	5152114
1,2-Dichloroethane	ug/g	ND	0.050	0.050	5152114
1,1-Dichloroethylene	ug/g	ND	0.050	0.050	5152114
cis-1,2-Dichloroethylene	ug/g	ND	0.050	0.050	5152114
trans-1,2-Dichloroethylene	ug/g	ND	0.050	0.050	5152114
1,2-Dichloropropane	ug/g	ND	0.050	0.050	5152114
cis-1,3-Dichloropropene	ug/g	ND	0.030	0.030	5152114
trans-1,3-Dichloropropene	ug/g	ND	0.040	0.040	5152114
Ethylbenzene	ug/g	ND	0.010	0.010	5152114
Ethylene Dibromide	ug/g	ND	0.050	0.050	5152114
Hexane	ug/g	ND	0.050	0.050	5152114
Methylene Chloride(Dichloromethane)	ug/g	ND	0.050	0.050	5152114
Methyl Isobutyl Ketone	ug/g	ND	0.50	0.50	5152114
Methyl Ethyl Ketone (2-Butanone)	ug/g	ND	0.50	0.50	5152114
Methyl t-butyl ether (MTBE)	ug/g	ND	0.050	0.050	5152114
Styrene	ug/g	ND	0.050	0.050	5152114
1,1,1,2-Tetrachloroethane	ug/g	ND	0.050	0.050	5152114

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

CCME VOC F1-F4 (SOIL)

Maxxam ID		FBE302			
Sampling Date		2017/08/31 10:15			
COC Number		625115-03-01			
	UNITS	**A0255 MW9/17**	**RDL**	**MDL**	**QC Batch**
1,1,2,2-Tetrachloroethane	ug/g	ND	0.050	0.050	5152114
Tetrachloroethylene	ug/g	ND	0.050	0.050	5152114
Toluene	ug/g	ND	0.020	0.020	5152114
1,1,1-Trichloroethane	ug/g	ND	0.050	0.050	5152114
1,1,2-Trichloroethane	ug/g	ND	0.050	0.050	5152114
Trichloroethylene	ug/g	ND	0.010	0.010	5152114
Vinyl Chloride	ug/g	ND	0.020	0.020	5152114
p+m-Xylene	ug/g	ND	0.020	0.020	5152114
o-Xylene	ug/g	ND	0.020	0.020	5152114
Total Xylenes	ug/g	ND	0.020	0.020	5152114
Trichlorofluoromethane (FREON 11)	ug/g	ND	0.050	0.050	5152114
F1 (C6-C10)	ug/g	ND	10	N/A	5152114
F1 (C6-C10) - BTEX	ug/g	ND	10	N/A	5152114
F2-F4 Hydrocarbons					
F2 (C10-C16 Hydrocarbons)	ug/g	ND	10	5.0	5154622
F3 (C16-C34 Hydrocarbons)	ug/g	ND	50	5.0	5154622
F4 (C34-C50 Hydrocarbons)	ug/g	ND	50	10	5154622
Reached Baseline at C50	ug/g	Yes			5154622
Surrogate Recovery (%)					
o-Terphenyl	%	87			5154622
4-Bromofluorobenzene	%	93			5152114
D10-o-Xylene	%	76			5152114
D4-1,2-Dichloroethane	%	107			5152114
D8-Toluene	%	94			5152114

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected
N/A = Not Applicable

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

O.REG 153 PAHS (SOIL)

Maxxam ID		FBE229				FBE230	FBE232			
Sampling Date		2017/08/30 09:54				2017/08/30 14:30	2017/08/30 11:04			
COC Number		625115-01-01				625115-01-01	625115-01-01			
	UNITS	**A0217 MW7/17**	**RDL**	**MDL**	**QC Batch**	**A0234 MW8/17**	**A0219 MW10/17**	**RDL**	**MDL**	**QC Batch**
Inorganics										
Moisture	%		1.0	0.50	5154063	20		1.0	0.50	5154063
Calculated Parameters										
Methylnaphthalene, 2-(1-)	ug/g	ND	0.0071	N/A	5150108	0.057	5.3	0.0071	N/A	5150108
Polyaromatic Hydrocarbons										
Acenaphthene	ug/g	ND	0.0050	0.0020	5153622	0.013	0.099	0.0050	0.0020	5153892
Acenaphthylene	ug/g	ND	0.0050	0.0010	5153622	ND	0.018	0.0050	0.0010	5153892
Anthracene	ug/g	ND (1)	0.010	0.0020	5153622	0.023	0.015	0.0050	0.0010	5153892
Benzo(a)anthracene	ug/g	ND	0.0050	0.0020	5153622	0.062	0.032	0.0050	0.0020	5153892
Benzo(a)pyrene	ug/g	0.029	0.0050	0.0010	5153622	0.053	0.029	0.0050	0.0010	5153892
Benzo(b/j)fluoranthene	ug/g	0.017	0.0050	0.0020	5153622	0.078	0.044	0.0050	0.0020	5153892
Benzo(g,h,i)perylene	ug/g	0.043	0.0050	0.0040	5153622	0.033	0.020	0.0050	0.0040	5153892
Benzo(k)fluoranthene	ug/g	ND	0.0050	0.0020	5153622	0.024	0.016	0.0050	0.0020	5153892
Chrysene	ug/g	ND (1)	0.010	0.0040	5153622	0.052	0.036	0.0050	0.0020	5153892
Dibenz(a,h)anthracene	ug/g	ND	0.0050	0.0040	5153622	0.0077	ND	0.0050	0.0040	5153892
Fluoranthene	ug/g	0.0054	0.0050	0.0010	5153622	0.14	0.073	0.0050	0.0010	5153892
Fluorene	ug/g	ND	0.0050	0.0010	5153622	0.014	0.21	0.0050	0.0010	5153892
Indeno(1,2,3-cd)pyrene	ug/g	0.014	0.0050	0.0040	5153622	0.034	0.020	0.0050	0.0040	5153892
1-Methylnaphthalene	ug/g	ND	0.0050	0.0010	5153622	0.021	2.3	0.0050	0.0010	5153892
2-Methylnaphthalene	ug/g	ND	0.0050	0.0010	5153622	0.036	2.9	0.0050	0.0010	5153892
Naphthalene	ug/g	ND	0.0050	0.0010	5153622	0.054	3.7	0.0050	0.0010	5153892
Phenanthrene	ug/g	0.0085	0.0050	0.0010	5153622	0.088	0.055	0.0050	0.0010	5153892
Pyrene	ug/g	0.021	0.0050	0.0010	5153622	0.12	0.076	0.0050	0.0010	5153892
Surrogate Recovery (%)										
D10-Anthracene	%	83			5153622	95	95			5153892
D14-Terphenyl (FS)	%	84			5153622	88	85			5153892
D8-Acenaphthylene	%	86			5153622	91	94			5153892

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected
N/A = Not Applicable
(1) DL was raised due to matrix interference.

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

O.REG 153 PAHS (SOIL)

Maxxam ID		FBE234			FBE271			FBE272			
Sampling Date		2017/08/30 13:30			2017/08/30 13:22			2017/08/30 14:10			
COC Number		625115-01-01			625115-02-01			625115-02-01			
	UNITS	**A0227 BH11/17**	**RDL**	**MDL**	**A0225 BH12/17**	**RDL**	**MDL**	**A0230 BH13/17**	**RDL**	**MDL**	**QC Batch**
Inorganics											
Moisture	%	16	1.0	0.50		1.0	0.50		1.0	0.50	5154063
Calculated Parameters											
Methylnaphthalene, 2-(1-)	ug/g	ND	0.0071	N/A	ND	0.21	N/A	0.013	0.0071	N/A	5150108
Polyaromatic Hydrocarbons											
Acenaphthene	ug/g	ND	0.0050	0.0020	ND	0.050	0.020	ND	0.0050	0.0020	5153892
Acenaphthylene	ug/g	ND	0.0050	0.0010	ND	0.050	0.010	ND	0.0050	0.0010	5153892
Anthracene	ug/g	0.011	0.0050	0.0010	ND	0.050	0.010	0.010	0.0050	0.0010	5153892
Benzo(a)anthracene	ug/g	0.043	0.0050	0.0020	ND	0.050	0.020	0.039	0.0050	0.0020	5153892
Benzo(a)pyrene	ug/g	0.043	0.0050	0.0010	ND	0.050	0.010	0.039	0.0050	0.0010	5153892
Benzo(b/j)fluoranthene	ug/g	0.061	0.0050	0.0020	ND	0.050	0.020	0.053	0.0050	0.0020	5153892
Benzo(g,h,i)perylene	ug/g	0.024	0.0050	0.0040	ND	0.050	0.040	0.021	0.0050	0.0040	5153892
Benzo(k)fluoranthene	ug/g	0.019	0.0050	0.0020	ND	0.050	0.020	0.017	0.0050	0.0020	5153892
Chrysene	ug/g	0.044	0.0050	0.0020	ND	0.050	0.020	0.035	0.0050	0.0020	5153892
Dibenz(a,h)anthracene	ug/g	0.0062	0.0050	0.0040	ND	0.050	0.040	0.0062	0.0050	0.0040	5153892
Fluoranthene	ug/g	0.076	0.0050	0.0010	0.10	0.050	0.010	0.069	0.0050	0.0010	5153892
Fluorene	ug/g	ND	0.0050	0.0010	ND	0.050	0.010	ND	0.0050	0.0010	5153892
Indeno(1,2,3-cd)pyrene	ug/g	0.028	0.0050	0.0040	ND	0.050	0.040	0.023	0.0050	0.0040	5153892
1-Methylnaphthalene	ug/g	ND	0.0050	0.0010	ND	0.050	0.010	0.0051	0.0050	0.0010	5153892
2-Methylnaphthalene	ug/g	ND	0.0050	0.0010	ND (1)	0.20	0.040	0.0081	0.0050	0.0010	5153892
Naphthalene	ug/g	ND	0.0050	0.0010	ND	0.050	0.010	ND	0.0050	0.0010	5153892
Phenanthrene	ug/g	0.042	0.0050	0.0010	0.073	0.050	0.010	0.041	0.0050	0.0010	5153892
Pyrene	ug/g	0.065	0.0050	0.0010	0.10	0.050	0.010	0.058	0.0050	0.0010	5153892
Surrogate Recovery (%)											
D10-Anthracene	%	98			98			97			5153892
D14-Terphenyl (FS)	%	86			85			87			5153892
D8-Acenaphthylene	%	92			94			95			5153892

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected
N/A = Not Applicable
(1) Detection Limit was raised due to matrix interferences.

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

O.REG 153 PAHS (SOIL)

Maxxam ID		FBE275				FBE299			
Sampling Date		2017/08/31 08:00				2017/08/31 08:34			
COC Number		625115-02-01				625115-03-01			
	UNITS	A0256 POND	RDL	MDL	QC Batch	A0245 MW5	RDL	MDL	QC Batch
Calculated Parameters									
Methylnaphthalene, 2-(1-)	ug/g	ND	0.014	N/A	5150108	ND	0.021	N/A	5150108
Polyaromatic Hydrocarbons									
Acenaphthene	ug/g	ND	0.010	0.0040	5153622	0.0058	0.0050	0.0020	5153892
Acenaphthylene	ug/g	ND	0.010	0.0020	5153622	ND	0.0050	0.0010	5153892
Anthracene	ug/g	ND (1)	0.020	0.0040	5153622	ND	0.0050	0.0010	5153892
Benzo(a)anthracene	ug/g	0.035	0.010	0.0040	5153622	ND	0.0050	0.0020	5153892
Benzo(a)pyrene	ug/g	0.041	0.010	0.0020	5153622	ND	0.0050	0.0010	5153892
Benzo(b/j)fluoranthene	ug/g	0.059	0.010	0.0040	5153622	ND	0.0050	0.0020	5153892
Benzo(g,h,i)perylene	ug/g	0.031	0.010	0.0080	5153622	ND	0.0050	0.0040	5153892
Benzo(k)fluoranthene	ug/g	0.020	0.010	0.0040	5153622	ND	0.0050	0.0020	5153892
Chrysene	ug/g	0.036	0.010	0.0040	5153622	ND	0.0050	0.0020	5153892
Dibenz(a,h)anthracene	ug/g	ND	0.010	0.0080	5153622	ND	0.0050	0.0040	5153892
Fluoranthene	ug/g	0.077	0.010	0.0020	5153622	0.012	0.0050	0.0010	5153892
Fluorene	ug/g	ND	0.010	0.0020	5153622	0.0063	0.0050	0.0010	5153892
Indeno(1,2,3-cd)pyrene	ug/g	0.029	0.010	0.0080	5153622	ND	0.0050	0.0040	5153892
1-Methylnaphthalene	ug/g	ND	0.010	0.0020	5153622	0.012	0.0050	0.0010	5153892
2-Methylnaphthalene	ug/g	ND	0.010	0.0020	5153622	ND (2)	0.020	0.0040	5153892
Naphthalene	ug/g	ND	0.010	0.0020	5153622	ND	0.0050	0.0010	5153892
Phenanthrene	ug/g	0.037	0.010	0.0020	5153622	0.018	0.0050	0.0010	5153892
Pyrene	ug/g	0.062	0.010	0.0020	5153622	0.011	0.0050	0.0010	5153892
Surrogate Recovery (%)									
D10-Anthracene	%	93			5153622	97			5153892
D14-Terphenyl (FS)	%	94			5153622	85			5153892
D8-Acenaphthylene	%	100			5153622	93			5153892

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected
N/A = Not Applicable
(1) DL was raised due to matrix interference.
(2) Detection Limit was raised due to matrix interferences.

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

O.REG 153 PAHS (SOIL)

Maxxam ID		FBE301	FBE301			
Sampling Date		2017/08/31 10:10	2017/08/31 10:10			
COC Number		625115-03-01	625115-03-01			
	UNITS	**A0254 MW9/17**	**A0254 MW9/17 Lab-Dup**	**RDL**	**MDL**	**QC Batch**
Calculated Parameters						
Methylnaphthalene, 2-(1-)	ug/g	ND		0.0071	N/A	5150108
Polyaromatic Hydrocarbons						
Acenaphthene	ug/g	ND	ND	0.0050	0.0020	5153892
Acenaphthylene	ug/g	ND	ND	0.0050	0.0010	5153892
Anthracene	ug/g	ND	ND	0.0050	0.0010	5153892
Benzo(a)anthracene	ug/g	ND	ND	0.0050	0.0020	5153892
Benzo(a)pyrene	ug/g	ND	ND	0.0050	0.0010	5153892
Benzo(b/j)fluoranthene	ug/g	ND	ND	0.0050	0.0020	5153892
Benzo(g,h,i)perylene	ug/g	ND	ND	0.0050	0.0040	5153892
Benzo(k)fluoranthene	ug/g	ND	ND	0.0050	0.0020	5153892
Chrysene	ug/g	ND	ND	0.0050	0.0020	5153892
Dibenz(a,h)anthracene	ug/g	ND	ND	0.0050	0.0040	5153892
Fluoranthene	ug/g	ND	ND	0.0050	0.0010	5153892
Fluorene	ug/g	ND	ND	0.0050	0.0010	5153892
Indeno(1,2,3-cd)pyrene	ug/g	ND	ND	0.0050	0.0040	5153892
1-Methylnaphthalene	ug/g	ND	ND	0.0050	0.0010	5153892
2-Methylnaphthalene	ug/g	ND	ND	0.0050	0.0010	5153892
Naphthalene	ug/g	ND	ND	0.0050	0.0010	5153892
Phenanthrene	ug/g	ND	ND	0.0050	0.0010	5153892
Pyrene	ug/g	ND	ND	0.0050	0.0010	5153892
Surrogate Recovery (%)						
D10-Anthracene	%	93	92			5153892
D14-Terphenyl (FS)	%	87	89			5153892
D8-Acenaphthylene	%	85	84			5153892

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

O.REG 153 PCBS (SOIL)

Maxxam ID		FBE229	FBE230	FBE232	FBE234	FBE271			
Sampling Date		2017/08/30 09:54	2017/08/30 14:30	2017/08/30 11:04	2017/08/30 13:30	2017/08/30 13:22			
COC Number		625115-01-01	625115-01-01	625115-01-01	625115-01-01	625115-02-01			
	UNITS	**A0217 MW7/17**	**A0234 MW8/17**	**A0219 MW10/17**	**A0227 BH11/17**	**A0225 BH12/17**	**RDL**	**MDL**	**QC Batch**
PCBs									
Aroclor 1242	ug/g	ND	0.012	0.073	ND	0.070	0.010	0.0070	5153229
Aroclor 1248	ug/g	ND	ND	ND	ND	ND	0.010	0.0070	5153229
Aroclor 1254	ug/g	ND	ND	0.025	ND	0.011	0.010	0.0070	5153229
Aroclor 1260	ug/g	ND	0.015	0.090	ND	0.018	0.010	0.0070	5153229
Total PCB	ug/g	ND	0.027	0.19	ND	0.099	0.010	0.0070	5153229
Surrogate Recovery (%)									
Decachlorobiphenyl	%	88	82	117	63	72			5153229

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam ID		FBE272			FBE275			FBE299			
Sampling Date		2017/08/30 14:10			2017/08/31 08:00			2017/08/31 08:34			
COC Number		625115-02-01			625115-02-01			625115-03-01			
	UNITS	**A0230 BH13/17**	**RDL**	**MDL**	**A0256 POND**	**RDL**	**MDL**	**A0245 MW5**	**RDL**	**MDL**	**QC Batch**
PCBs											
Aroclor 1242	ug/g	ND	0.010	0.0070	ND	0.020	0.014	ND	0.010	0.0070	5153229
Aroclor 1248	ug/g	ND	0.010	0.0070	ND	0.020	0.014	ND	0.010	0.0070	5153229
Aroclor 1254	ug/g	ND	0.010	0.0070	ND	0.020	0.014	ND	0.010	0.0070	5153229
Aroclor 1260	ug/g	ND	0.010	0.0070	ND	0.020	0.014	ND	0.010	0.0070	5153229
Total PCB	ug/g	ND	0.010	0.0070	ND	0.020	0.014	ND	0.010	0.0070	5153229
Surrogate Recovery (%)											
Decachlorobiphenyl	%	69			88			72			5153229

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

O.REG 153 PCBS (SOIL)

Maxxam ID		FBE301			
Sampling Date		2017/08/31 10:10			
COC Number		625115-03-01			
	UNITS	**A0254 MW9/17**	**RDL**	**MDL**	**QC Batch**
PCBs					
Aroclor 1242	ug/g	ND	0.010	0.0070	5153229
Aroclor 1248	ug/g	ND	0.010	0.0070	5153229
Aroclor 1254	ug/g	ND	0.010	0.0070	5153229
Aroclor 1260	ug/g	ND	0.010	0.0070	5153229
Total PCB	ug/g	ND	0.010	0.0070	5153229
Surrogate Recovery (%)					
Decachlorobiphenyl	%	86			5153229

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

O.REG 558 TCLP INORGANICS PACKAGE (SOIL)

Maxxam ID		FBE303			
Sampling Date		2017/08/31 13:45			
COC Number		625115-03-01			
	UNITS	**A0250 COMP**	**RDL**	**MDL**	**QC Batch**
Inorganics					
Leachable Fluoride (F-)	mg/L	0.14	0.10	0.020	5155747
Leachable WAD Cyanide (Free)	mg/L	ND	0.010	0.0050	5155728
Leachable Nitrite (N)	mg/L	ND	0.10	0.050	5155737
Leachable Nitrate (N)	mg/L	ND	1.0	0.20	5155737
Leachable Nitrate + Nitrite (N)	mg/L	ND	1.0	0.20	5155737
Metals					
Leachable Mercury (Hg)	mg/L	ND	0.0010	0.00010	5155278
Leachable Arsenic (As)	mg/L	ND	0.2	0.01	5155389
Leachable Barium (Ba)	mg/L	1.0	0.2	0.01	5155389
Leachable Boron (B)	mg/L	ND	0.1	0.02	5155389
Leachable Cadmium (Cd)	mg/L	ND	0.05	0.0007	5155389
Leachable Chromium (Cr)	mg/L	ND	0.1	0.01	5155389
Leachable Lead (Pb)	mg/L	ND	0.1	0.001	5155389
Leachable Selenium (Se)	mg/L	ND	0.1	0.01	5155389
Leachable Silver (Ag)	mg/L	ND	0.01	0.001	5155389
Leachable Uranium (U)	mg/L	ND	0.01	0.001	5155389

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

O.REG 558 TCLP LEACHATE PREPARATION (SOIL)

Maxxam ID		FBE303			
Sampling Date		2017/08/31 13:45			
COC Number		625115-03-01			
	UNITS	A0250 COMP	RDL	MDL	QC Batch
Inorganics					
Final pH	pH	5.48			5155273
Initial pH	pH	8.62			5155273
TCLP - % Solids	%	100	0.2	N/A	5155269
TCLP Extraction Fluid	N/A	FLUID 1			5155271

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

O.REG 558 TCLP PCBS (SOIL)

Maxxam ID		FBE303			
Sampling Date		2017/08/31 13:45			
COC Number		625115-03-01			
	UNITS	A0250 COMP	RDL	MDL	QC Batch
PCBs					
Leachable Total PCB	ug/L	ND	3.0	0.20	5155494
Surrogate Recovery (%)					
Leachable Decachlorobiphenyl	%	86			5155494

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

O.REG 558 TCLP SEMI-VOLATILE ORGANICS (SOIL)

Maxxam ID		FBE303			
Sampling Date		2017/08/31 13:45			
COC Number		625115-03-01			
	UNITS	A0250 COMP	RDL	MDL	QC Batch
Semivolatile Organics					
Leachable Benzo(a)pyrene	ug/L	ND	0.10	0.010	5155829
Leachable m/p-Cresol	ug/L	ND	2.5	0.10	5155829
Leachable o-Cresol	ug/L	ND	2.5	0.10	5155829
Leachable Cresol Total	ug/L	ND	2.5	0.10	5155829
Leachable 2,4-Dichlorophenol	ug/L	ND	2.5	0.10	5155829
Leachable 2,4-Dinitrotoluene	ug/L	ND	10	0.50	5155829
Leachable Hexachlorobenzene	ug/L	ND	10	0.50	5155829
Leachable Hexachlorobutadiene	ug/L	ND	10	0.50	5155829
Leachable Hexachloroethane	ug/L	ND	10	0.50	5155829
Leachable Nitrobenzene	ug/L	ND	10	0.50	5155829
Leachable Pentachlorophenol	ug/L	ND	2.5	0.10	5155829
Leachable Pyridine	ug/L	ND	10	1.0	5155829
Leachable 2,3,4,6-Tetrachlorophenol	ug/L	ND	2.5	0.10	5155829
Leachable 2,4,5-Trichlorophenol	ug/L	ND	0.50	0.10	5155829
Leachable 2,4,6-Trichlorophenol	ug/L	ND	2.5	0.10	5155829
Surrogate Recovery (%)					
Leachable 2,4,6-Tribromophenol	%	85			5155829
Leachable 2-Fluorobiphenyl	%	72			5155829
Leachable 2-Fluorophenol	%	29			5155829
Leachable D14-Terphenyl (FS)	%	91			5155829
Leachable D5-Nitrobenzene	%	89			5155829
Leachable D5-Phenol	%	29			5155829

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

O.REG 558 TCLP VOLATILE ORGANICS HS (SOIL)

Maxxam ID		FBE303			
Sampling Date		2017/08/31 13:45			
COC Number		625115-03-01			
	UNITS	A0250 COMP	RDL	MDL	QC Batch
Charge/Prep Analysis					
Amount Extracted (Wet Weight) (g)	N/A	23	N/A	N/A	5153174
Volatile Organics					
Leachable Benzene	mg/L	ND	0.020	0.0020	5154951
Leachable Carbon Tetrachloride	mg/L	ND	0.020	0.0020	5154951
Leachable Chlorobenzene	mg/L	ND	0.020	0.0020	5154951
Leachable Chloroform	mg/L	ND	0.020	0.0020	5154951
Leachable 1,2-Dichlorobenzene	mg/L	ND	0.050	0.0040	5154951
Leachable 1,4-Dichlorobenzene	mg/L	ND	0.050	0.0040	5154951
Leachable 1,2-Dichloroethane	mg/L	ND	0.050	0.0040	5154951
Leachable 1,1-Dichloroethylene	mg/L	ND	0.020	0.0020	5154951
Leachable Methylene Chloride(Dichloromethane)	mg/L	ND	0.20	0.010	5154951
Leachable Methyl Ethyl Ketone (2-Butanone)	mg/L	ND	1.0	1.0	5154951
Leachable Tetrachloroethylene	mg/L	ND	0.020	0.0020	5154951
Leachable Trichloroethylene	mg/L	ND	0.020	0.0020	5154951
Leachable Vinyl Chloride	mg/L	ND	0.020	0.0040	5154951
Surrogate Recovery (%)					
Leachable 4-Bromofluorobenzene	%	97			5154951
Leachable D4-1,2-Dichloroethane	%	96			5154951
Leachable D8-Toluene	%	98			5154951

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

PETROLEUM HYDROCARBONS (CCME)

Maxxam ID		FBE228	FBE229	FBE231	FBE232			
Sampling Date		2017/08/30 09:40	2017/08/30 09:54	2017/08/30 14:38	2017/08/30 11:04			
COC Number		625115-01-01	625115-01-01	625115-01-01	625115-01-01			
	UNITS	**A0215 MW7/17**	**A0217 MW7/17**	**A0235 MW8/17**	**A0219 MW10/17**	**RDL**	**MDL**	**QC Batch**
F2-F4 Hydrocarbons								
F4G-sg (Grav. Heavy Hydrocarbons)	ug/g	390	560	1500	440	100	100	5156924

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam ID		FBE233	FBE235	FBE236	FBE237			
Sampling Date		2017/08/30 11:12	2017/08/30 13:36	2017/08/30 13:48	2017/08/30 13:08			
COC Number		625115-01-01	625115-01-01	625115-01-01	625115-01-01			
	UNITS	**A0221 MW10/17**	**A0228 BH11/17**	**A0229 BH11/17**	**A0223 BH12/17**	**RDL**	**MDL**	**QC Batch**
F2-F4 Hydrocarbons								
F4G-sg (Grav. Heavy Hydrocarbons)	ug/g	240	340	1000	ND	100	100	5156924

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam ID		FBE270	FBE273	FBE298			
Sampling Date		2017/08/30 13:19	2017/08/30 14:25	2017/08/31 08:34			
COC Number		625115-02-01	625115-02-01	625115-03-01			
	UNITS	**A0224 BH12/17**	**A0232 BH13/17**	**A0244 MW5**	**RDL**	**MDL**	**QC Batch**
F2-F4 Hydrocarbons							
F4G-sg (Grav. Heavy Hydrocarbons)	ug/g	170	ND	7300	100	100	5156924

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

TEST SUMMARY

Maxxam ID: FBE228
Sample ID: A0215 MW7/17
Matrix: Soil

Collected: 2017/08/30
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hot Water Extractable Boron	ICP	5153124	2017/09/07	2017/09/07	Jolly John
Free (WAD) Cyanide	TECH	5153321	2017/09/07	2017/09/08	Louise Harding
Conductivity	AT	5153325	2017/09/08	2017/09/08	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	5152238	2017/09/06	2017/09/08	Sally Coughlin
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	5154622	2017/09/07	2017/09/08	Zhiyue (Frank) Zhu
F4G (CCME Hydrocarbons Gravimetric)	BAL	5156924	2017/09/09	2017/09/09	Sandeep Kaur
Soluble Fluoride analysis in Soil	ISE	5153414	2017/09/07	2017/09/08	Surinder Rai
Strong Acid Leachable Metals by ICPMS	ICP/MS	5153043	2017/09/07	2017/09/11	Daniel Teclu
Acid Extractable Metals Analysis by ICP	ICP	5153040	2017/09/07	2017/09/08	Azita Fazaeli
Moisture	BAL	5152888	N/A	2017/09/07	Min Yang
pH CaCl2 EXTRACT	AT	5153106	2017/09/07	2017/09/07	Tahir Anwar
Sodium Adsorption Ratio (SAR)	CALC/MET	5150107	N/A	2017/09/11	Automated Statchk
Volatile Organic Compounds and F1 PHCs	GC/MS	5152114	N/A	2017/09/08	Xueming Jiang

Maxxam ID: FBE229
Sample ID: A0217 MW7/17
Matrix: Soil

Collected: 2017/08/30
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	5150108	N/A	2017/09/08	Automated Statchk
Hot Water Extractable Boron	ICP	5153124	2017/09/07	2017/09/07	Jolly John
Free (WAD) Cyanide	TECH	5153321	2017/09/07	2017/09/08	Louise Harding
Conductivity	AT	5153325	2017/09/08	2017/09/08	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	5152238	2017/09/06	2017/09/08	Sally Coughlin
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	5153651	2017/09/07	2017/09/08	Zhiyue (Frank) Zhu
F4G (CCME Hydrocarbons Gravimetric)	BAL	5156924	2017/09/09	2017/09/09	Sandeep Kaur
Soluble Fluoride analysis in Soil	ISE	5153414	2017/09/07	2017/09/08	Surinder Rai
Strong Acid Leachable Metals by ICPMS	ICP/MS	5153043	2017/09/07	2017/09/11	Daniel Teclu
Acid Extractable Metals Analysis by ICP	ICP	5153040	2017/09/07	2017/09/08	Azita Fazaeli
Moisture	BAL	5152888	N/A	2017/09/07	Min Yang
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	5153622	2017/09/07	2017/09/08	Mitesh Raj
Polychlorinated Biphenyl in Soil	GC/ECD	5153229	2017/09/07	2017/09/07	Dawn Alarie
pH CaCl2 EXTRACT	AT	5153106	2017/09/07	2017/09/07	Tahir Anwar
Sodium Adsorption Ratio (SAR)	CALC/MET	5150107	N/A	2017/09/11	Automated Statchk
Volatile Organic Compounds and F1 PHCs	GC/MS	5152114	N/A	2017/09/08	Xueming Jiang

Maxxam ID: FBE230
Sample ID: A0234 MW8/17
Matrix: Soil

Collected: 2017/08/30
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	5150108	N/A	2017/09/11	Automated Statchk
Hot Water Extractable Boron	ICP	5153309	2017/09/07	2017/09/08	Jolly John
Free (WAD) Cyanide	TECH	5153321	2017/09/07	2017/09/08	Louise Harding
Conductivity	AT	5153325	2017/09/08	2017/09/08	Neil Dassanayake

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

TEST SUMMARY

Maxxam ID: FBE230
Sample ID: A0234 MW8/17
Matrix: Soil

Collected: 2017/08/30
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hexavalent Chromium in Soil by IC	IC/SPEC	5152238	2017/09/06	2017/09/08	Sally Coughlin
Soluble Fluoride analysis in Soil	ISE	5153414	2017/09/07	2017/09/08	Surinder Rai
Strong Acid Leachable Metals by ICPMS	ICP/MS	5153043	2017/09/07	2017/09/11	Daniel Teclu
Acid Extractable Metals Analysis by ICP	ICP	5153040	2017/09/07	2017/09/08	Azita Fazaeli
Moisture	BAL	5154063	N/A	2017/09/07	Chun Yan
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	5153892	2017/09/07	2017/09/08	Mitesh Raj
Polychlorinated Biphenyl in Soil	GC/ECD	5153229	2017/09/07	2017/09/07	Dawn Alarie
pH CaCl2 EXTRACT	AT	5153106	2017/09/07	2017/09/07	Tahir Anwar
Sodium Adsorption Ratio (SAR)	CALC/MET	5150107	N/A	2017/09/11	Automated Statchk

Maxxam ID: FBE231
Sample ID: A0235 MW8/17
Matrix: Soil

Collected: 2017/08/30
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	5154622	2017/09/07	2017/09/08	Zhiyue (Frank) Zhu
F4G (CCME Hydrocarbons Gravimetric)	BAL	5156924	2017/09/09	2017/09/09	Sandeep Kaur
Moisture	BAL	5152888	N/A	2017/09/07	Min Yang
Volatile Organic Compounds and F1 PHCs	GC/MS	5152114	N/A	2017/09/08	Xueming Jiang

Maxxam ID: FBE232
Sample ID: A0219 MW10/17
Matrix: Soil

Collected: 2017/08/30
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	5150108	N/A	2017/09/11	Automated Statchk
Hot Water Extractable Boron	ICP	5153309	2017/09/07	2017/09/08	Jolly John
Free (WAD) Cyanide	TECH	5153321	2017/09/07	2017/09/08	Louise Harding
Conductivity	AT	5153325	2017/09/08	2017/09/08	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	5152238	2017/09/06	2017/09/08	Sally Coughlin
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	5154622	2017/09/07	2017/09/08	Zhiyue (Frank) Zhu
F4G (CCME Hydrocarbons Gravimetric)	BAL	5156924	2017/09/09	2017/09/09	Sandeep Kaur
Soluble Fluoride analysis in Soil	ISE	5153414	2017/09/07	2017/09/08	Surinder Rai
Strong Acid Leachable Metals by ICPMS	ICP/MS	5153043	2017/09/07	2017/09/11	Daniel Teclu
Acid Extractable Metals Analysis by ICP	ICP	5153040	2017/09/07	2017/09/08	Azita Fazaeli
Moisture	BAL	5152888	N/A	2017/09/07	Min Yang
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	5153892	2017/09/07	2017/09/08	Mitesh Raj
Polychlorinated Biphenyl in Soil	GC/ECD	5153229	2017/09/07	2017/09/07	Dawn Alarie
pH CaCl2 EXTRACT	AT	5153106	2017/09/07	2017/09/07	Tahir Anwar
Sodium Adsorption Ratio (SAR)	CALC/MET	5150107	N/A	2017/09/11	Automated Statchk
Volatile Organic Compounds and F1 PHCs	GC/MS	5152114	N/A	2017/09/08	Xueming Jiang

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

TEST SUMMARY

Maxxam ID: FBE233
Sample ID: A0221 MW10/17
Matrix: Soil

Collected: 2017/08/30
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	5154622	2017/09/07	2017/09/08	Zhiyue (Frank) Zhu
F4G (CCME Hydrocarbons Gravimetric)	BAL	5156924	2017/09/09	2017/09/09	Sandeep Kaur
Moisture	BAL	5152888	N/A	2017/09/07	Min Yang
Volatile Organic Compounds and F1 PHCs	GC/MS	5152114	N/A	2017/09/08	Xueming Jiang

Maxxam ID: FBE234
Sample ID: A0227 BH11/17
Matrix: Soil

Collected: 2017/08/30
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	5150108	N/A	2017/09/11	Automated Statchk
Moisture	BAL	5154063	N/A	2017/09/07	Chun Yan
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	5153892	2017/09/07	2017/09/08	Mitesh Raj
Polychlorinated Biphenyl in Soil	GC/ECD	5153229	2017/09/07	2017/09/08	Dawn Alarie

Maxxam ID: FBE235
Sample ID: A0228 BH11/17
Matrix: Soil

Collected: 2017/08/30
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hot Water Extractable Boron	ICP	5153309	2017/09/07	2017/09/08	Jolly John
Free (WAD) Cyanide	TECH	5153321	2017/09/07	2017/09/08	Louise Harding
Conductivity	AT	5153325	2017/09/08	2017/09/08	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	5152238	2017/09/06	2017/09/08	Sally Coughlin
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	5154622	2017/09/07	2017/09/08	Zhiyue (Frank) Zhu
F4G (CCME Hydrocarbons Gravimetric)	BAL	5156924	2017/09/09	2017/09/09	Sandeep Kaur
Soluble Fluoride analysis in Soil	ISE	5153414	2017/09/07	2017/09/08	Surinder Rai
Strong Acid Leachable Metals by ICPMS	ICP/MS	5153043	2017/09/07	2017/09/11	Daniel Teclu
Acid Extractable Metals Analysis by ICP	ICP	5153040	2017/09/07	2017/09/08	Azita Fazaeli
Moisture	BAL	5152888	N/A	2017/09/07	Min Yang
pH CaCl2 EXTRACT	AT	5153106	2017/09/07	2017/09/07	Tahir Anwar
Sodium Adsorption Ratio (SAR)	CALC/MET	5150107	N/A	2017/09/11	Automated Statchk
Volatile Organic Compounds and F1 PHCs	GC/MS	5152114	N/A	2017/09/08	Xueming Jiang

Maxxam ID: FBE236
Sample ID: A0229 BH11/17
Matrix: Soil

Collected: 2017/08/30
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	5154622	2017/09/07	2017/09/08	Zhiyue (Frank) Zhu
F4G (CCME Hydrocarbons Gravimetric)	BAL	5156924	2017/09/09	2017/09/09	Sandeep Kaur
Moisture	BAL	5152888	N/A	2017/09/07	Min Yang
Volatile Organic Compounds and F1 PHCs	GC/MS	5152114	N/A	2017/09/08	Xueming Jiang

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

TEST SUMMARY

Maxxam ID: FBE237
Sample ID: A0223 BH12/17
Matrix: Soil

Collected: 2017/08/30
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	5154622	2017/09/07	2017/09/08	Zhiyue (Frank) Zhu
F4G (CCME Hydrocarbons Gravimetric)	BAL	5156924	2017/09/09	2017/09/09	Sandeep Kaur
Moisture	BAL	5152888	N/A	2017/09/07	Min Yang
Volatile Organic Compounds and F1 PHCs	GC/MS	5152114	N/A	2017/09/08	Xueming Jiang

Maxxam ID: FBE270
Sample ID: A0224 BH12/17
Matrix: Soil

Collected: 2017/08/30
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hot Water Extractable Boron	ICP	5153124	2017/09/07	2017/09/07	Jolly John
Free (WAD) Cyanide	TECH	5153321	2017/09/07	2017/09/08	Louise Harding
Conductivity	AT	5153325	2017/09/08	2017/09/08	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	5152238	2017/09/06	2017/09/08	Sally Coughlin
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	5154622	2017/09/07	2017/09/08	Zhiyue (Frank) Zhu
F4G (CCME Hydrocarbons Gravimetric)	BAL	5156924	2017/09/09	2017/09/09	Sandeep Kaur
Soluble Fluoride analysis in Soil	ISE	5153414	2017/09/07	2017/09/08	Surinder Rai
Strong Acid Leachable Metals by ICPMS	ICP/MS	5153043	2017/09/07	2017/09/11	Daniel Teclu
Acid Extractable Metals Analysis by ICP	ICP	5153040	2017/09/07	2017/09/08	Azita Fazaeli
Moisture	BAL	5152888	N/A	2017/09/07	Min Yang
pH CaCl2 EXTRACT	AT	5153106	2017/09/07	2017/09/07	Tahir Anwar
Sodium Adsorption Ratio (SAR)	CALC/MET	5150107	N/A	2017/09/11	Automated Statchk
Volatile Organic Compounds and F1 PHCs	GC/MS	5152114	N/A	2017/09/08	Xueming Jiang

Maxxam ID: FBE271
Sample ID: A0225 BH12/17
Matrix: Soil

Collected: 2017/08/30
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	5150108	N/A	2017/09/11	Automated Statchk
Hot Water Extractable Boron	ICP	5153309	2017/09/07	2017/09/08	Jolly John
Free (WAD) Cyanide	TECH	5153321	2017/09/07	2017/09/08	Louise Harding
Conductivity	AT	5153325	2017/09/08	2017/09/08	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	5152238	2017/09/06	2017/09/08	Sally Coughlin
Soluble Fluoride analysis in Soil	ISE	5153414	2017/09/07	2017/09/08	Surinder Rai
Strong Acid Leachable Metals by ICPMS	ICP/MS	5153043	2017/09/07	2017/09/11	Daniel Teclu
Acid Extractable Metals Analysis by ICP	ICP	5153040	2017/09/07	2017/09/08	Azita Fazaeli
Moisture	BAL	5151294	N/A	2017/09/06	Chun Yan
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	5153892	2017/09/07	2017/09/08	Mitesh Raj
Polychlorinated Biphenyl in Soil	GC/ECD	5153229	2017/09/07	2017/09/08	Dawn Alarie
pH CaCl2 EXTRACT	AT	5153106	2017/09/07	2017/09/07	Tahir Anwar
Sodium Adsorption Ratio (SAR)	CALC/MET	5150107	N/A	2017/09/11	Automated Statchk

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

TEST SUMMARY

Maxxam ID: FBE272
Sample ID: A0230 BH13/17
Matrix: Soil

Collected: 2017/08/30
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	5150108	N/A	2017/09/11	Automated Statchk
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	5154622	2017/09/07	2017/09/08	Zhiyue (Frank) Zhu
Moisture	BAL	5152888	N/A	2017/09/07	Min Yang
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	5153892	2017/09/07	2017/09/08	Mitesh Raj
Polychlorinated Biphenyl in Soil	GC/ECD	5153229	2017/09/07	2017/09/08	Dawn Alarie
Volatile Organic Compounds and F1 PHCs	GC/MS	5152114	N/A	2017/09/08	Xueming Jiang

Maxxam ID: FBE272 Dup
Sample ID: A0230 BH13/17
Matrix: Soil

Collected: 2017/08/30
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	5154622	2017/09/07	2017/09/08	Zhiyue (Frank) Zhu

Maxxam ID: FBE273
Sample ID: A0232 BH13/17
Matrix: Soil

Collected: 2017/08/30
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hot Water Extractable Boron	ICP	5153124	2017/09/07	2017/09/07	Jolly John
Free (WAD) Cyanide	TECH	5153321	2017/09/07	2017/09/08	Louise Harding
Conductivity	AT	5153325	2017/09/08	2017/09/08	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	5152238	2017/09/06	2017/09/08	Sally Coughlin
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	5154622	2017/09/07	2017/09/08	Zhiyue (Frank) Zhu
F4G (CCME Hydrocarbons Gravimetric)	BAL	5156924	2017/09/09	2017/09/09	Sandeep Kaur
Soluble Fluoride analysis in Soil	ISE	5153414	2017/09/07	2017/09/08	Surinder Rai
Strong Acid Leachable Metals by ICPMS	ICP/MS	5153043	2017/09/07	2017/09/11	Daniel Teclu
Acid Extractable Metals Analysis by ICP	ICP	5153040	2017/09/07	2017/09/08	Azita Fazaeli
Moisture	BAL	5152888	N/A	2017/09/07	Min Yang
pH CaCl2 EXTRACT	AT	5153106	2017/09/07	2017/09/07	Tahir Anwar
Sodium Adsorption Ratio (SAR)	CALC/MET	5150107	N/A	2017/09/11	Automated Statchk
Volatile Organic Compounds and F1 PHCs	GC/MS	5152114	N/A	2017/09/08	Xueming Jiang

Maxxam ID: FBE274
Sample ID: A0233 BH13/17
Matrix: Soil

Collected: 2017/08/30
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	5154622	2017/09/07	2017/09/08	Zhiyue (Frank) Zhu
Moisture	BAL	5152888	N/A	2017/09/07	Min Yang
Volatile Organic Compounds and F1 PHCs	GC/MS	5152114	N/A	2017/09/08	Xueming Jiang

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

TEST SUMMARY

Maxxam ID: FBE275
Sample ID: A0256 POND
Matrix: Soil

Collected: 2017/08/31
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	5150108	N/A	2017/09/08	Automated Statchk
Hot Water Extractable Boron	ICP	5153124	2017/09/07	2017/09/07	Jolly John
Free (WAD) Cyanide	TECH	5153321	2017/09/07	2017/09/08	Louise Harding
Conductivity	AT	5153325	2017/09/08	2017/09/08	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	5152238	2017/09/06	2017/09/08	Sally Coughlin
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	5153651	2017/09/07	2017/09/08	Zhiyue (Frank) Zhu
Soluble Fluoride analysis in Soil	ISE	5153414	2017/09/07	2017/09/08	Surinder Rai
Strong Acid Leachable Metals by ICPMS	ICP/MS	5153043	2017/09/07	2017/09/11	Daniel Teclu
Acid Extractable Metals Analysis by ICP	ICP	5153040	2017/09/07	2017/09/08	Azita Fazaeli
Moisture	BAL	5152888	N/A	2017/09/07	Min Yang
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	5153622	2017/09/07	2017/09/08	Mitesh Raj
Polychlorinated Biphenyl in Soil	GC/ECD	5153229	2017/09/07	2017/09/07	Dawn Alarie
pH CaCl2 EXTRACT	AT	5153106	2017/09/07	2017/09/07	Tahir Anwar
Sodium Adsorption Ratio (SAR)	CALC/MET	5150107	N/A	2017/09/11	Automated Statchk
Volatile Organic Compounds and F1 PHCs	GC/MS	5152114	N/A	2017/09/08	Xueming Jiang

Maxxam ID: FBE275 Dup
Sample ID: A0256 POND
Matrix: Soil

Collected: 2017/08/31
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Free (WAD) Cyanide	TECH	5153321	2017/09/07	2017/09/08	Louise Harding
Hexavalent Chromium in Soil by IC	IC/SPEC	5152238	2017/09/06	2017/09/08	Sally Coughlin
pH CaCl2 EXTRACT	AT	5153106	2017/09/07	2017/09/07	Tahir Anwar

Maxxam ID: FBE276
Sample ID: A0257 POND
Matrix: Soil

Collected: 2017/08/31
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hot Water Extractable Boron	ICP	5153124	2017/09/07	2017/09/07	Jolly John
Free (WAD) Cyanide	TECH	5153321	2017/09/07	2017/09/08	Louise Harding
Conductivity	AT	5153325	2017/09/08	2017/09/08	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	5152238	2017/09/06	2017/09/08	Sally Coughlin
Soluble Fluoride analysis in Soil	ISE	5153414	2017/09/07	2017/09/08	Surinder Rai
Strong Acid Leachable Metals by ICPMS	ICP/MS	5153043	2017/09/07	2017/09/11	Daniel Teclu
Acid Extractable Metals Analysis by ICP	ICP	5153040	2017/09/07	2017/09/08	Azita Fazaeli
Moisture	BAL	5151294	N/A	2017/09/06	Chun Yan
pH CaCl2 EXTRACT	AT	5153106	2017/09/07	2017/09/07	Tahir Anwar
Sodium Adsorption Ratio (SAR)	CALC/MET	5150107	N/A	2017/09/11	Automated Statchk

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

TEST SUMMARY

Maxxam ID: FBE277
Sample ID: A0216 MW7/17
Matrix: Soil

Collected: 2017/08/30
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hot Water Extractable Boron	ICP	5153309	2017/09/07	2017/09/08	Jolly John
Free (WAD) Cyanide	TECH	5153321	2017/09/07	2017/09/08	Louise Harding
Conductivity	AT	5153325	2017/09/08	2017/09/08	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	5152238	2017/09/06	2017/09/08	Sally Coughlin
Soluble Fluoride analysis in Soil	ISE	5153414	2017/09/07	2017/09/08	Surinder Rai
Strong Acid Leachable Metals by ICPMS	ICP/MS	5153043	2017/09/07	2017/09/11	Daniel Teclu
Acid Extractable Metals Analysis by ICP	ICP	5153040	2017/09/07	2017/09/08	Azita Fazaeli
Moisture	BAL	5151294	N/A	2017/09/06	Chun Yan
pH CaCl2 EXTRACT	AT	5153106	2017/09/07	2017/09/07	Tahir Anwar
Sodium Adsorption Ratio (SAR)	CALC/MET	5150107	N/A	2017/09/11	Automated Statchk

Maxxam ID: FBE278
Sample ID: A0220 MW10/17
Matrix: Soil

Collected: 2017/08/30
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hot Water Extractable Boron	ICP	5153124	2017/09/07	2017/09/07	Jolly John
Free (WAD) Cyanide	TECH	5153321	2017/09/07	2017/09/08	Louise Harding
Conductivity	AT	5153325	2017/09/08	2017/09/08	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	5152238	2017/09/06	2017/09/08	Sally Coughlin
Soluble Fluoride analysis in Soil	ISE	5153414	2017/09/07	2017/09/08	Surinder Rai
Strong Acid Leachable Metals by ICPMS	ICP/MS	5153043	2017/09/07	2017/09/11	Daniel Teclu
Acid Extractable Metals Analysis by ICP	ICP	5153040	2017/09/07	2017/09/08	Azita Fazaeli
Moisture	BAL	5151294	N/A	2017/09/06	Chun Yan
pH CaCl2 EXTRACT	AT	5153106	2017/09/07	2017/09/07	Tahir Anwar
Sodium Adsorption Ratio (SAR)	CALC/MET	5150107	N/A	2017/09/11	Automated Statchk

Maxxam ID: FBE279
Sample ID: A0231 BH13/17
Matrix: Soil

Collected: 2017/08/30
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hot Water Extractable Boron	ICP	5153309	2017/09/07	2017/09/08	Jolly John
Free (WAD) Cyanide	TECH	5153321	2017/09/07	2017/09/08	Louise Harding
Conductivity	AT	5153325	2017/09/08	2017/09/08	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	5152238	2017/09/06	2017/09/08	Sally Coughlin
Soluble Fluoride analysis in Soil	ISE	5153414	2017/09/07	2017/09/08	Surinder Rai
Strong Acid Leachable Metals by ICPMS	ICP/MS	5153043	2017/09/07	2017/09/11	Daniel Teclu
Acid Extractable Metals Analysis by ICP	ICP	5153040	2017/09/07	2017/09/08	Azita Fazaeli
Moisture	BAL	5151294	N/A	2017/09/06	Chun Yan
pH CaCl2 EXTRACT	AT	5153106	2017/09/07	2017/09/07	Tahir Anwar
Sodium Adsorption Ratio (SAR)	CALC/MET	5150107	N/A	2017/09/11	Automated Statchk

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

TEST SUMMARY

Maxxam ID: FBE297
Sample ID: A0241 MW5
Matrix: Soil

Collected: 2017/08/31
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hot Water Extractable Boron	ICP	5153309	2017/09/07	2017/09/08	Jolly John
Free (WAD) Cyanide	TECH	5153321	2017/09/07	2017/09/08	Louise Harding
Conductivity	AT	5153325	2017/09/08	2017/09/08	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	5152238	2017/09/06	2017/09/08	Sally Coughlin
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	5154622	2017/09/07	2017/09/08	Zhiyue (Frank) Zhu
Soluble Fluoride analysis in Soil	ISE	5153414	2017/09/07	2017/09/08	Surinder Rai
Strong Acid Leachable Metals by ICPMS	ICP/MS	5153043	2017/09/07	2017/09/11	Daniel Teclu
Acid Extractable Metals Analysis by ICP	ICP	5153040	2017/09/07	2017/09/08	Azita Fazaeli
Moisture	BAL	5152888	N/A	2017/09/07	Min Yang
pH CaCl2 EXTRACT	AT	5153106	2017/09/07	2017/09/07	Tahir Anwar
Sodium Adsorption Ratio (SAR)	CALC/MET	5150107	N/A	2017/09/11	Automated Statchk
Volatile Organic Compounds and F1 PHCs	GC/MS	5152114	N/A	2017/09/08	Xueming Jiang

Maxxam ID: FBE298
Sample ID: A0244 MW5
Matrix: Soil

Collected: 2017/08/31
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	5154622	2017/09/07	2017/09/08	Zhiyue (Frank) Zhu
F4G (CCME Hydrocarbons Gravimetric)	BAL	5156924	2017/09/09	2017/09/09	Sandeep Kaur
Moisture	BAL	5152888	N/A	2017/09/07	Min Yang
Volatile Organic Compounds and F1 PHCs	GC/MS	5152114	N/A	2017/09/08	Xueming Jiang

Maxxam ID: FBE299
Sample ID: A0245 MW5
Matrix: Soil

Collected: 2017/08/31
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	5150108	N/A	2017/09/11	Automated Statchk
Hot Water Extractable Boron	ICP	5153124	2017/09/07	2017/09/07	Jolly John
Free (WAD) Cyanide	TECH	5153321	2017/09/07	2017/09/08	Louise Harding
Conductivity	AT	5153325	2017/09/08	2017/09/08	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	5152238	2017/09/06	2017/09/08	Sally Coughlin
Soluble Fluoride analysis in Soil	ISE	5153414	2017/09/07	2017/09/08	Surinder Rai
Strong Acid Leachable Metals by ICPMS	ICP/MS	5153043	2017/09/07	2017/09/11	Daniel Teclu
Acid Extractable Metals Analysis by ICP	ICP	5153040	2017/09/07	2017/09/08	Azita Fazaeli
Moisture	BAL	5151294	N/A	2017/09/06	Chun Yan
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	5153892	2017/09/07	2017/09/08	Mitesh Raj
Polychlorinated Biphenyl in Soil	GC/ECD	5153229	2017/09/07	2017/09/08	Dawn Alarie
pH CaCl2 EXTRACT	AT	5153106	2017/09/07	2017/09/07	Tahir Anwar
Sodium Adsorption Ratio (SAR)	CALC/MET	5150107	N/A	2017/09/11	Automated Statchk

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

TEST SUMMARY

Maxxam ID: FBE300
Sample ID: A0252 MW9/17
Matrix: Soil

Collected: 2017/08/31
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	5154622	2017/09/07	2017/09/08	Zhiyue (Frank) Zhu
Moisture	BAL	5152888	N/A	2017/09/07	Min Yang
Volatile Organic Compounds and F1 PHCs	GC/MS	5152114	N/A	2017/09/08	Xueming Jiang

Maxxam ID: FBE300 Dup
Sample ID: A0252 MW9/17
Matrix: Soil

Collected: 2017/08/31
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Volatile Organic Compounds and F1 PHCs	GC/MS	5152114	N/A	2017/09/08	Xueming Jiang

Maxxam ID: FBE301
Sample ID: A0254 MW9/17
Matrix: Soil

Collected: 2017/08/31
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	5150108	N/A	2017/09/11	Automated Statchk
Hot Water Extractable Boron	ICP	5153124	2017/09/07	2017/09/07	Jolly John
Free (WAD) Cyanide	TECH	5153321	2017/09/07	2017/09/08	Louise Harding
Conductivity	AT	5153325	2017/09/08	2017/09/08	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	5152238	2017/09/06	2017/09/08	Sally Coughlin
Soluble Fluoride analysis in Soil	ISE	5153414	2017/09/07	2017/09/08	Surinder Rai
Strong Acid Leachable Metals by ICPMS	ICP/MS	5153043	2017/09/07	2017/09/11	Daniel Teclu
Acid Extractable Metals Analysis by ICP	ICP	5153040	2017/09/07	2017/09/08	Azita Fazaeli
Moisture	BAL	5151294	N/A	2017/09/06	Chun Yan
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	5153892	2017/09/07	2017/09/08	Mitesh Raj
Polychlorinated Biphenyl in Soil	GC/ECD	5153229	2017/09/07	2017/09/07	Dawn Alarie
pH CaCl2 EXTRACT	AT	5153106	2017/09/07	2017/09/07	Tahir Anwar
Sodium Adsorption Ratio (SAR)	CALC/MET	5150107	N/A	2017/09/11	Automated Statchk

Maxxam ID: FBE301 Dup
Sample ID: A0254 MW9/17
Matrix: Soil

Collected: 2017/08/31
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	5153325	2017/09/08	2017/09/08	Neil Dassanayake
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	5153892	2017/09/07	2017/09/08	Mitesh Raj

Maxxam ID: FBE302
Sample ID: A0255 MW9/17
Matrix: Soil

Collected: 2017/08/31
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	5154622	2017/09/07	2017/09/08	Zhiyue (Frank) Zhu
Moisture	BAL	5152888	N/A	2017/09/07	Min Yang
Volatile Organic Compounds and F1 PHCs	GC/MS	5152114	N/A	2017/09/08	Xueming Jiang

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

TEST SUMMARY

Maxxam ID: FBE303
Sample ID: A0250 COMP
Matrix: Soil

Collected: 2017/08/31
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Semivolatile Organic Compounds (TCLP)	GC/MS	5155829	2017/09/08	2017/09/09	Wendy Zhao
Cyanide (WAD) in Leachates	SKAL/CN	5155728	N/A	2017/09/08	Louise Harding
Fluoride by ISE in Leachates	ISE	5155747	2017/09/08	2017/09/09	Surinder Rai
Mercury (TCLP Leachable) (mg/L)	CV/AA	5155278	N/A	2017/09/08	Ron Morrison
Total Metals in TCLP Leachate by ICPMS	ICP1/MS	5155389	2017/09/08	2017/09/11	Arefa Dabhad
Nitrate(NO3) + Nitrite(NO2) in Leachate	LACH	5155737	N/A	2017/09/08	Chandra Nandlal
Polychlorinated Biphenyl in Leachate	GC/ECD	5155494	2017/09/08	2017/09/09	Sarah Huang
TCLP - % Solids	BAL	5155269	2017/09/07	2017/09/08	Jian (Ken) Wang
TCLP - Extraction Fluid		5155271	N/A	2017/09/08	Jian (Ken) Wang
TCLP - Initial and final pH	PH	5155273	N/A	2017/09/08	Jian (Ken) Wang
TCLP Zero Headspace Extraction		5153174	2017/09/07	2017/09/08	Walt Wang
VOCs in ZHE Leachates	GC/MS	5154951	2017/09/08	2017/09/08	Rebecca Schultz

Maxxam ID: FBE304
Sample ID: A0251 MW9/17
Matrix: Soil

Collected: 2017/08/31
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hot Water Extractable Boron	ICP	5153124	2017/09/07	2017/09/07	Jolly John
Free (WAD) Cyanide	TECH	5153321	2017/09/07	2017/09/08	Louise Harding
Conductivity	AT	5153325	2017/09/08	2017/09/08	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	5152238	2017/09/06	2017/09/08	Sally Coughlin
Soluble Fluoride analysis in Soil	ISE	5153414	2017/09/07	2017/09/08	Surinder Rai
Strong Acid Leachable Metals by ICPMS	ICP/MS	5153043	2017/09/07	2017/09/11	Daniel Teclu
Acid Extractable Metals Analysis by ICP	ICP	5153040	2017/09/07	2017/09/08	Azita Fazaeli
Moisture	BAL	5151294	N/A	2017/09/06	Chun Yan
pH CaCl2 EXTRACT	AT	5153106	2017/09/07	2017/09/07	Tahir Anwar
Sodium Adsorption Ratio (SAR)	CALC/MET	5150107	N/A	2017/09/11	Automated Statchk

Maxxam ID: FBE304 Dup
Sample ID: A0251 MW9/17
Matrix: Soil

Collected: 2017/08/31
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Strong Acid Leachable Metals by ICPMS	ICP/MS	5153043	2017/09/07	2017/09/11	Daniel Teclu
Acid Extractable Metals Analysis by ICP	ICP	5153040	2017/09/07	2017/09/08	Azita Fazaeli

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	2.7°C
Package 2	2.3°C

Custody Seal Present/Intact

Sample FBE228 [A0215 MW7/17] : SAR Analysis: Sodium was not detected. To report SAR the sodium detection limit was used in the calculation. This value represents a maximum ratio.

Sample FBE232 [A0219 MW10/17] : SAR Analysis: Sodium was not detected. To report SAR the sodium detection limit was used in the calculation. This value represents a maximum ratio.

Sample FBE235 [A0228 BH11/17] : SAR Analysis: Sodium was not detected. To report SAR the sodium detection limit was used in the calculation. This value represents a maximum ratio.

Sample FBE270 [A0224 BH12/17] : SAR Analysis: Sodium was not detected. To report SAR the sodium detection limit was used in the calculation. This value represents a maximum ratio.

Sample FBE271 [A0225 BH12/17] : PAH Analysis: Due to the sample matrix, sample required dilution. Detection limits were adjusted accordingly. SAR Analysis: Sodium was not detected. To report SAR the sodium detection limit was used in the calculation. This value represents a maximum ratio.

Sample FBE273 [A0232 BH13/17] : SAR Analysis: Sodium was not detected. To report SAR the sodium detection limit was used in the calculation. This value represents a maximum ratio.

Sample FBE275 [A0256 POND] : PCB & PAH Analysis: Detection limits were adjusted for high moisture content.
SAR Analysis: Sodium was not detected. To report SAR the sodium detection limit was used in the calculation. This value represents a maximum ratio.

Sample FBE276 [A0257 POND] : SAR Analysis: Sodium was not detected. To report SAR the sodium detection limit was used in the calculation. This value represents a maximum ratio.

Sample FBE277 [A0216 MW7/17] : SAR Analysis: Sodium was not detected. To report SAR the sodium detection limit was used in the calculation. This value represents a maximum ratio.

Sample FBE278 [A0220 MW10/17] : SAR Analysis: Sodium was not detected. To report SAR the sodium detection limit was used in the calculation. This value represents a maximum ratio.

Sample FBE279 [A0231 BH13/17] : SAR Analysis: Sodium was not detected. To report SAR the sodium detection limit was used in the calculation. This value represents a maximum ratio.

Sample FBE297 [A0241 MW5] : SAR Analysis: Sodium was not detected. To report SAR the sodium detection limit was used in the calculation. This value represents a maximum ratio.

Sample FBE301 [A0254 MW9/17] : Metals: Due to the sample matrix, sample required dilution. Detection limits were adjusted accordingly.
SAR Analysis: Sodium was not detected. To report SAR the sodium detection limit was used in the calculation. This value represents a maximum ratio.

Sample FBE304 [A0251 MW9/17] : SAR Analysis: Sodium was not detected. To report SAR the sodium detection limit was used in the calculation. This value represents a maximum ratio.

Results relate only to the items tested.

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
5151294	CYN	RPD	Moisture	2017/09/06	8.4		%	20
5152114	XJI	Matrix Spike [FBE300-02]	4-Bromofluorobenzene	2017/09/08		101	%	60 - 140
			D10-o-Xylene	2017/09/08		84	%	60 - 130
			D4-1,2-Dichloroethane	2017/09/08		102	%	60 - 140
			D8-Toluene	2017/09/08		103	%	60 - 140
			Acetone (2-Propanone)	2017/09/08		99	%	60 - 140
			Benzene	2017/09/08		107	%	60 - 140
			Bromodichloromethane	2017/09/08		98	%	60 - 140
			Bromoform	2017/09/08		108	%	60 - 140
			Bromomethane	2017/09/08		108	%	60 - 140
			Carbon Tetrachloride	2017/09/08		100	%	60 - 140
			Chlorobenzene	2017/09/08		98	%	60 - 140
			Chloroform	2017/09/08		104	%	60 - 140
			Dibromochloromethane	2017/09/08		104	%	60 - 140
			1,2-Dichlorobenzene	2017/09/08		97	%	60 - 140
			1,3-Dichlorobenzene	2017/09/08		95	%	60 - 140
			1,4-Dichlorobenzene	2017/09/08		95	%	60 - 140
			Dichlorodifluoromethane (FREON 12)	2017/09/08		113	%	60 - 140
			1,1-Dichloroethane	2017/09/08		108	%	60 - 140
			1,2-Dichloroethane	2017/09/08		102	%	60 - 140
			1,1-Dichloroethylene	2017/09/08		112	%	60 - 140
			cis-1,2-Dichloroethylene	2017/09/08		102	%	60 - 140
			trans-1,2-Dichloroethylene	2017/09/08		109	%	60 - 140
			1,2-Dichloropropane	2017/09/08		92	%	60 - 140
			cis-1,3-Dichloropropene	2017/09/08		84	%	60 - 140
			trans-1,3-Dichloropropene	2017/09/08		91	%	60 - 140
			Ethylbenzene	2017/09/08		91	%	60 - 140
			Ethylene Dibromide	2017/09/08		104	%	60 - 140
			Hexane	2017/09/08		109	%	60 - 140
			Methylene Chloride(Dichloromethane)	2017/09/08		109	%	60 - 140
			Methyl Isobutyl Ketone	2017/09/08		88	%	60 - 140
			Methyl Ethyl Ketone (2-Butanone)	2017/09/08		97	%	60 - 140
			Methyl t-butyl ether (MTBE)	2017/09/08		89	%	60 - 140
			Styrene	2017/09/08		88	%	60 - 140
			1,1,1,2-Tetrachloroethane	2017/09/08		110	%	60 - 140
			1,1,2,2-Tetrachloroethane	2017/09/08		107	%	60 - 140
			Tetrachloroethylene	2017/09/08		104	%	60 - 140
			Toluene	2017/09/08		98	%	60 - 140
			1,1,1-Trichloroethane	2017/09/08		100	%	60 - 140
			1,1,2-Trichloroethane	2017/09/08		108	%	60 - 140
			Trichloroethylene	2017/09/08		98	%	60 - 140
			Vinyl Chloride	2017/09/08		100	%	60 - 140
			p+m-Xylene	2017/09/08		91	%	60 - 140
			o-Xylene	2017/09/08		90	%	60 - 140
			Trichlorofluoromethane (FREON 11)	2017/09/08		111	%	60 - 140
			F1 (C6-C10)	2017/09/08		104	%	60 - 140
5152114	XJI	Spiked Blank	4-Bromofluorobenzene	2017/09/07		102	%	60 - 140
			D10-o-Xylene	2017/09/07		91	%	60 - 130
			D4-1,2-Dichloroethane	2017/09/07		104	%	60 - 140
			D8-Toluene	2017/09/07		102	%	60 - 140
			Acetone (2-Propanone)	2017/09/07		97	%	60 - 140
			Benzene	2017/09/07		107	%	60 - 130
			Bromodichloromethane	2017/09/07		99	%	60 - 130
			Bromoform	2017/09/07		106	%	60 - 130

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Bromomethane	2017/09/07		103	%	60 - 140
			Carbon Tetrachloride	2017/09/07		101	%	60 - 130
			Chlorobenzene	2017/09/07		98	%	60 - 130
			Chloroform	2017/09/07		104	%	60 - 130
			Dibromochloromethane	2017/09/07		103	%	60 - 130
			1,2-Dichlorobenzene	2017/09/07		96	%	60 - 130
			1,3-Dichlorobenzene	2017/09/07		96	%	60 - 130
			1,4-Dichlorobenzene	2017/09/07		95	%	60 - 130
			Dichlorodifluoromethane (FREON 12)	2017/09/07		119	%	60 - 140
			1,1-Dichloroethane	2017/09/07		108	%	60 - 130
			1,2-Dichloroethane	2017/09/07		103	%	60 - 130
			1,1-Dichloroethylene	2017/09/07		113	%	60 - 130
			cis-1,2-Dichloroethylene	2017/09/07		103	%	60 - 130
			trans-1,2-Dichloroethylene	2017/09/07		110	%	60 - 130
			1,2-Dichloropropane	2017/09/07		93	%	60 - 130
			cis-1,3-Dichloropropene	2017/09/07		76	%	60 - 130
			trans-1,3-Dichloropropene	2017/09/07		78	%	60 - 130
			Ethylbenzene	2017/09/07		91	%	60 - 130
			Ethylene Dibromide	2017/09/07		103	%	60 - 130
			Hexane	2017/09/07		109	%	60 - 130
			Methylene Chloride(Dichloromethane)	2017/09/07		110	%	60 - 130
			Methyl Isobutyl Ketone	2017/09/07		87	%	60 - 130
			Methyl Ethyl Ketone (2-Butanone)	2017/09/07		95	%	60 - 140
			Methyl t-butyl ether (MTBE)	2017/09/07		88	%	60 - 130
			Styrene	2017/09/07		88	%	60 - 130
			1,1,1,2-Tetrachloroethane	2017/09/07		109	%	60 - 130
			1,1,2,2-Tetrachloroethane	2017/09/07		105	%	60 - 130
			Tetrachloroethylene	2017/09/07		105	%	60 - 130
			Toluene	2017/09/07		98	%	60 - 130
			1,1,1-Trichloroethane	2017/09/07		100	%	60 - 130
			1,1,2-Trichloroethane	2017/09/07		106	%	60 - 130
			Trichloroethylene	2017/09/07		100	%	60 - 130
			Vinyl Chloride	2017/09/07		102	%	60 - 130
			p+m-Xylene	2017/09/07		91	%	60 - 130
			o-Xylene	2017/09/07		90	%	60 - 130
			Trichlorofluoromethane (FREON 11)	2017/09/07		112	%	60 - 130
			F1 (C6-C10)	2017/09/07		96	%	80 - 120
5152114	XJI	Method Blank	4-Bromofluorobenzene	2017/09/07		94	%	60 - 140
			D10-o-Xylene	2017/09/07		74	%	60 - 130
			D4-1,2-Dichloroethane	2017/09/07		108	%	60 - 140
			D8-Toluene	2017/09/07		95	%	60 - 140
			Acetone (2-Propanone)	2017/09/07	ND, RDL=0.50		ug/g	
			Benzene	2017/09/07	ND, RDL=0.0060		ug/g	
			Bromodichloromethane	2017/09/07	ND, RDL=0.050		ug/g	
			Bromoform	2017/09/07	ND, RDL=0.050		ug/g	
			Bromomethane	2017/09/07	ND, RDL=0.050		ug/g	
			Carbon Tetrachloride	2017/09/07	ND, RDL=0.050		ug/g	

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Chlorobenzene	2017/09/07	ND, RDL=0.050		ug/g	
			Chloroform	2017/09/07	ND, RDL=0.050		ug/g	
			Dibromochloromethane	2017/09/07	ND, RDL=0.050		ug/g	
			1,2-Dichlorobenzene	2017/09/07	ND, RDL=0.050		ug/g	
			1,3-Dichlorobenzene	2017/09/07	ND, RDL=0.050		ug/g	
			1,4-Dichlorobenzene	2017/09/07	ND, RDL=0.050		ug/g	
			Dichlorodifluoromethane (FREON 12)	2017/09/07	ND, RDL=0.050		ug/g	
			1,1-Dichloroethane	2017/09/07	ND, RDL=0.050		ug/g	
			1,2-Dichloroethane	2017/09/07	ND, RDL=0.050		ug/g	
			1,1-Dichloroethylene	2017/09/07	ND, RDL=0.050		ug/g	
			cis-1,2-Dichloroethylene	2017/09/07	ND, RDL=0.050		ug/g	
			trans-1,2-Dichloroethylene	2017/09/07	ND, RDL=0.050		ug/g	
			1,2-Dichloropropane	2017/09/07	ND, RDL=0.050		ug/g	
			cis-1,3-Dichloropropene	2017/09/07	ND, RDL=0.030		ug/g	
			trans-1,3-Dichloropropene	2017/09/07	ND, RDL=0.040		ug/g	
			Ethylbenzene	2017/09/07	ND, RDL=0.010		ug/g	
			Ethylene Dibromide	2017/09/07	ND, RDL=0.050		ug/g	
			Hexane	2017/09/07	ND, RDL=0.050		ug/g	
			Methylene Chloride(Dichloromethane)	2017/09/07	ND, RDL=0.050		ug/g	
			Methyl Isobutyl Ketone	2017/09/07	ND, RDL=0.50		ug/g	
			Methyl Ethyl Ketone (2-Butanone)	2017/09/07	ND, RDL=0.50		ug/g	
			Methyl t-butyl ether (MTBE)	2017/09/07	ND, RDL=0.050		ug/g	
			Styrene	2017/09/07	ND, RDL=0.050		ug/g	
			1,1,1,2-Tetrachloroethane	2017/09/07	ND, RDL=0.050		ug/g	
			1,1,2,2-Tetrachloroethane	2017/09/07	ND, RDL=0.050		ug/g	
			Tetrachloroethylene	2017/09/07	ND, RDL=0.050		ug/g	
			Toluene	2017/09/07	ND, RDL=0.020		ug/g	

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			1,1,1-Trichloroethane	2017/09/07	ND, RDL=0.050		ug/g	
			1,1,2-Trichloroethane	2017/09/07	ND, RDL=0.050		ug/g	
			Trichloroethylene	2017/09/07	ND, RDL=0.010		ug/g	
			Vinyl Chloride	2017/09/07	ND, RDL=0.020		ug/g	
			p+m-Xylene	2017/09/07	ND, RDL=0.020		ug/g	
			o-Xylene	2017/09/07	ND, RDL=0.020		ug/g	
			Total Xylenes	2017/09/07	ND, RDL=0.020		ug/g	
			Trichlorofluoromethane (FREON 11)	2017/09/07	ND, RDL=0.050		ug/g	
			F1 (C6-C10)	2017/09/07	ND, RDL=10		ug/g	
			F1 (C6-C10) - BTEX	2017/09/07	ND, RDL=10		ug/g	
5152114	XJI	RPD [FBE300-02]	Acetone (2-Propanone)	2017/09/08	NC		%	50
			Benzene	2017/09/08	NC		%	50
			Bromodichloromethane	2017/09/08	NC		%	50
			Bromoform	2017/09/08	NC		%	50
			Bromomethane	2017/09/08	NC		%	50
			Carbon Tetrachloride	2017/09/08	NC		%	50
			Chlorobenzene	2017/09/08	NC		%	50
			Chloroform	2017/09/08	NC		%	50
			Dibromochloromethane	2017/09/08	NC		%	50
			1,2-Dichlorobenzene	2017/09/08	NC		%	50
			1,3-Dichlorobenzene	2017/09/08	NC		%	50
			1,4-Dichlorobenzene	2017/09/08	NC		%	50
			Dichlorodifluoromethane (FREON 12)	2017/09/08	NC		%	50
			1,1-Dichloroethane	2017/09/08	NC		%	50
			1,2-Dichloroethane	2017/09/08	NC		%	50
			1,1-Dichloroethylene	2017/09/08	NC		%	50
			cis-1,2-Dichloroethylene	2017/09/08	NC		%	50
			trans-1,2-Dichloroethylene	2017/09/08	NC		%	50
			1,2-Dichloropropane	2017/09/08	NC		%	50
			cis-1,3-Dichloropropene	2017/09/08	NC		%	50
			trans-1,3-Dichloropropene	2017/09/08	NC		%	50
			Ethylbenzene	2017/09/08	NC		%	50
			Ethylene Dibromide	2017/09/08	NC		%	50
			Hexane	2017/09/08	NC		%	50
			Methylene Chloride(Dichloromethane)	2017/09/08	NC		%	50
			Methyl Isobutyl Ketone	2017/09/08	NC		%	50
			Methyl Ethyl Ketone (2-Butanone)	2017/09/08	NC		%	50
			Methyl t-butyl ether (MTBE)	2017/09/08	NC		%	50
			Styrene	2017/09/08	NC		%	50
			1,1,1,2-Tetrachloroethane	2017/09/08	NC		%	50
			1,1,2,2-Tetrachloroethane	2017/09/08	NC		%	50
			Tetrachloroethylene	2017/09/08	NC		%	50
			Toluene	2017/09/08	NC		%	50
			1,1,1-Trichloroethane	2017/09/08	NC		%	50

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			1,1,2-Trichloroethane	2017/09/08	NC		%	50
			Trichloroethylene	2017/09/08	NC		%	50
			Vinyl Chloride	2017/09/08	NC		%	50
			p+m-Xylene	2017/09/08	NC		%	50
			o-Xylene	2017/09/08	NC		%	50
			Total Xylenes	2017/09/08	NC		%	50
			Trichlorofluoromethane (FREON 11)	2017/09/08	NC		%	50
			F1 (C6-C10)	2017/09/08	NC		%	30
			F1 (C6-C10) - BTEX	2017/09/08	NC		%	30
5152238	SAC	Matrix Spike [FBE275-01]	Chromium (VI)	2017/09/08		0.065 (1)	%	75 - 125
5152238	SAC	Spiked Blank	Chromium (VI)	2017/09/08		87	%	80 - 120
5152238	SAC	Method Blank	Chromium (VI)	2017/09/08	ND, RDL=0.2		ug/g	
5152238	SAC	RPD [FBE275-01]	Chromium (VI)	2017/09/08	NC		%	35
5152888	AV3	RPD	Moisture	2017/09/07	4.1		%	20
5153040	AFZ	Matrix Spike [FBE304-01]	Acid Extractable Sulphur (S)	2017/09/08		NC	%	75 - 125
5153040	AFZ	Spiked Blank	Acid Extractable Sulphur (S)	2017/09/08		100	%	80 - 120
5153040	AFZ	Method Blank	Acid Extractable Sulphur (S)	2017/09/08	ND, RDL=500		ug/g	
5153040	AFZ	RPD [FBE304-01]	Acid Extractable Sulphur (S)	2017/09/08	0.51		%	30
5153043	DT1	Matrix Spike [FBE304-01]	Acid Extractable Antimony (Sb)	2017/09/11		92	%	75 - 125
			Acid Extractable Arsenic (As)	2017/09/11		101	%	75 - 125
			Acid Extractable Barium (Ba)	2017/09/11		NC	%	75 - 125
			Acid Extractable Beryllium (Be)	2017/09/11		101	%	75 - 125
			Acid Extractable Cadmium (Cd)	2017/09/11		97	%	75 - 125
			Acid Extractable Chromium (Cr)	2017/09/11		100	%	75 - 125
			Acid Extractable Cobalt (Co)	2017/09/11		99	%	75 - 125
			Acid Extractable Copper (Cu)	2017/09/11		97	%	75 - 125
			Acid Extractable Lead (Pb)	2017/09/11		NC	%	75 - 125
			Acid Extractable Molybdenum (Mo)	2017/09/11		96	%	75 - 125
			Acid Extractable Nickel (Ni)	2017/09/11		99	%	75 - 125
			Acid Extractable Selenium (Se)	2017/09/11		103	%	75 - 125
			Acid Extractable Silver (Ag)	2017/09/11		98	%	75 - 125
			Acid Extractable Thallium (Tl)	2017/09/11		100	%	75 - 125
			Acid Extractable Tin (Sn)	2017/09/11		98	%	75 - 125
			Acid Extractable Uranium (U)	2017/09/11		99	%	75 - 125
			Acid Extractable Vanadium (V)	2017/09/11		NC	%	75 - 125
			Acid Extractable Zinc (Zn)	2017/09/11		NC	%	75 - 125
			Acid Extractable Mercury (Hg)	2017/09/11		110	%	75 - 125
5153043	DT1	Spiked Blank	Acid Extractable Antimony (Sb)	2017/09/11		100	%	80 - 120
			Acid Extractable Arsenic (As)	2017/09/11		103	%	80 - 120
			Acid Extractable Barium (Ba)	2017/09/11		102	%	80 - 120
			Acid Extractable Beryllium (Be)	2017/09/11		102	%	80 - 120
			Acid Extractable Cadmium (Cd)	2017/09/11		98	%	80 - 120
			Acid Extractable Chromium (Cr)	2017/09/11		103	%	80 - 120
			Acid Extractable Cobalt (Co)	2017/09/11		104	%	80 - 120
			Acid Extractable Copper (Cu)	2017/09/11		100	%	80 - 120
			Acid Extractable Lead (Pb)	2017/09/11		104	%	80 - 120
			Acid Extractable Molybdenum (Mo)	2017/09/11		99	%	80 - 120
			Acid Extractable Nickel (Ni)	2017/09/11		101	%	80 - 120
			Acid Extractable Selenium (Se)	2017/09/11		106	%	80 - 120
			Acid Extractable Silver (Ag)	2017/09/11		101	%	80 - 120
			Acid Extractable Thallium (Tl)	2017/09/11		103	%	80 - 120
			Acid Extractable Tin (Sn)	2017/09/11		102	%	80 - 120

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Acid Extractable Uranium (U)	2017/09/11		100	%	80 - 120
			Acid Extractable Vanadium (V)	2017/09/11		103	%	80 - 120
			Acid Extractable Zinc (Zn)	2017/09/11		103	%	80 - 120
			Acid Extractable Mercury (Hg)	2017/09/11		109	%	80 - 120
5153043	DT1	Method Blank	Acid Extractable Antimony (Sb)	2017/09/11	ND, RDL=0.20		ug/g	
			Acid Extractable Arsenic (As)	2017/09/11	ND, RDL=1.0		ug/g	
			Acid Extractable Barium (Ba)	2017/09/11	ND, RDL=0.50		ug/g	
			Acid Extractable Beryllium (Be)	2017/09/11	ND, RDL=0.20		ug/g	
			Acid Extractable Cadmium (Cd)	2017/09/11	ND, RDL=0.10		ug/g	
			Acid Extractable Chromium (Cr)	2017/09/11	ND, RDL=1.0		ug/g	
			Acid Extractable Cobalt (Co)	2017/09/11	ND, RDL=0.10		ug/g	
			Acid Extractable Copper (Cu)	2017/09/11	ND, RDL=0.50		ug/g	
			Acid Extractable Lead (Pb)	2017/09/11	ND, RDL=1.0		ug/g	
			Acid Extractable Molybdenum (Mo)	2017/09/11	ND, RDL=0.50		ug/g	
			Acid Extractable Nickel (Ni)	2017/09/11	ND, RDL=0.50		ug/g	
			Acid Extractable Selenium (Se)	2017/09/11	ND, RDL=0.50		ug/g	
			Acid Extractable Silver (Ag)	2017/09/11	ND, RDL=0.20		ug/g	
			Acid Extractable Thallium (Tl)	2017/09/11	ND, RDL=0.050		ug/g	
			Acid Extractable Tin (Sn)	2017/09/11	ND, RDL=1.0		ug/g	
			Acid Extractable Uranium (U)	2017/09/11	ND, RDL=0.050		ug/g	
			Acid Extractable Vanadium (V)	2017/09/11	ND, RDL=5.0		ug/g	
			Acid Extractable Zinc (Zn)	2017/09/11	ND, RDL=5.0		ug/g	
			Acid Extractable Mercury (Hg)	2017/09/11	ND, RDL=0.050		ug/g	
5153043	DT1	RPD [FBE304-01]	Acid Extractable Antimony (Sb)	2017/09/11	20		%	30
			Acid Extractable Arsenic (As)	2017/09/11	14		%	30
			Acid Extractable Barium (Ba)	2017/09/11	5.4		%	30
			Acid Extractable Beryllium (Be)	2017/09/11	3.1		%	30
			Acid Extractable Cadmium (Cd)	2017/09/11	NC		%	30
			Acid Extractable Chromium (Cr)	2017/09/11	2.2		%	30
			Acid Extractable Cobalt (Co)	2017/09/11	5.7		%	30
			Acid Extractable Copper (Cu)	2017/09/11	1.4		%	30
			Acid Extractable Lead (Pb)	2017/09/11	2.6		%	30
			Acid Extractable Molybdenum (Mo)	2017/09/11	23		%	30
			Acid Extractable Nickel (Ni)	2017/09/11	10		%	30
			Acid Extractable Selenium (Se)	2017/09/11	NC		%	30

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Acid Extractable Silver (Ag)	2017/09/11	2.6		%	30
			Acid Extractable Thallium (Tl)	2017/09/11	5.7		%	30
			Acid Extractable Tin (Sn)	2017/09/11	20		%	30
			Acid Extractable Uranium (U)	2017/09/11	1.8		%	30
			Acid Extractable Vanadium (V)	2017/09/11	2.0		%	30
			Acid Extractable Zinc (Zn)	2017/09/11	3.3		%	30
			Acid Extractable Mercury (Hg)	2017/09/11	12		%	30
5153106	TA1	Spiked Blank	Available (CaCl2) pH	2017/09/07		100	%	97 - 103
5153106	TA1	RPD [FBE275-01]	Available (CaCl2) pH	2017/09/07	0.57		%	N/A
5153124	JOH	Matrix Spike	Hot Water Ext. Boron (B)	2017/09/07		101	%	75 - 125
5153124	JOH	Spiked Blank	Hot Water Ext. Boron (B)	2017/09/07		97	%	75 - 125
5153124	JOH	Method Blank	Hot Water Ext. Boron (B)	2017/09/07	ND, RDL=0.050		ug/g	
5153124	JOH	RPD	Hot Water Ext. Boron (B)	2017/09/07	4.4		%	40
5153229	DH	Matrix Spike	Decachlorobiphenyl	2017/09/07		85	%	60 - 130
			Aroclor 1260	2017/09/07		91	%	60 - 130
			Total PCB	2017/09/07		91	%	60 - 130
5153229	DH	Spiked Blank	Decachlorobiphenyl	2017/09/07		96	%	60 - 130
			Aroclor 1260	2017/09/07		96	%	60 - 130
			Total PCB	2017/09/07		96	%	60 - 130
5153229	DH	Method Blank	Decachlorobiphenyl	2017/09/07		87	%	60 - 130
			Aroclor 1242	2017/09/07	ND, RDL=0.010		ug/g	
			Aroclor 1248	2017/09/07	ND, RDL=0.010		ug/g	
			Aroclor 1254	2017/09/07	ND, RDL=0.010		ug/g	
			Aroclor 1260	2017/09/07	ND, RDL=0.010		ug/g	
			Total PCB	2017/09/07	ND, RDL=0.010		ug/g	
5153229	DH	RPD	Aroclor 1242	2017/09/07	NC		%	50
			Aroclor 1248	2017/09/07	NC		%	50
			Aroclor 1254	2017/09/07	NC		%	50
			Aroclor 1260	2017/09/07	NC		%	50
			Total PCB	2017/09/07	NC		%	50
5153309	JOH	Matrix Spike	Hot Water Ext. Boron (B)	2017/09/08		97	%	75 - 125
5153309	JOH	Spiked Blank	Hot Water Ext. Boron (B)	2017/09/07		92	%	75 - 125
5153309	JOH	Method Blank	Hot Water Ext. Boron (B)	2017/09/07	ND, RDL=0.050		ug/g	
5153309	JOH	RPD	Hot Water Ext. Boron (B)	2017/09/07	NC		%	40
5153321	LHA	Matrix Spike [FBE275-01]	WAD Cyanide (Free)	2017/09/08		88	%	75 - 125
5153321	LHA	Spiked Blank	WAD Cyanide (Free)	2017/09/08		97	%	80 - 120
5153321	LHA	Method Blank	WAD Cyanide (Free)	2017/09/08	ND, RDL=0.01		ug/g	
5153321	LHA	RPD [FBE275-01]	WAD Cyanide (Free)	2017/09/08	32		%	35
5153325	NYS	Spiked Blank	Conductivity	2017/09/08		102	%	90 - 110
5153325	NYS	Method Blank	Conductivity	2017/09/08	ND, RDL=0.002		mS/cm	
5153325	NYS	RPD [FBE301-01]	Conductivity	2017/09/08	0.079		%	10
5153414	SAU	Matrix Spike	Fluoride (F-)	2017/09/08		92	%	80 - 120
5153414	SAU	Spiked Blank	Fluoride (F-)	2017/09/08		103	%	80 - 120
5153414	SAU	Method Blank	Fluoride (F-)	2017/09/08	ND,RDL=5		ug/g	
5153414	SAU	RPD	Fluoride (F-)	2017/09/08	NC		%	25

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
5153622	RAJ	Matrix Spike	D10-Anthracene	2017/09/07		97	%	50 - 130
			D14-Terphenyl (FS)	2017/09/07		94	%	50 - 130
			D8-Acenaphthylene	2017/09/07		90	%	50 - 130
			Acenaphthene	2017/09/07		88	%	50 - 130
			Acenaphthylene	2017/09/07		84	%	50 - 130
			Anthracene	2017/09/07		86	%	50 - 130
			Benzo(a)anthracene	2017/09/07		93	%	50 - 130
			Benzo(a)pyrene	2017/09/07		93	%	50 - 130
			Benzo(b/j)fluoranthene	2017/09/07		94	%	50 - 130
			Benzo(g,h,i)perylene	2017/09/07		85	%	50 - 130
			Benzo(k)fluoranthene	2017/09/07		83	%	50 - 130
			Chrysene	2017/09/07		92	%	50 - 130
			Dibenz(a,h)anthracene	2017/09/07		90	%	50 - 130
			Fluoranthene	2017/09/07		99	%	50 - 130
			Fluorene	2017/09/07		86	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2017/09/07		91	%	50 - 130
			1-Methylnaphthalene	2017/09/07		85	%	50 - 130
			2-Methylnaphthalene	2017/09/07		77	%	50 - 130
			Naphthalene	2017/09/07		72	%	50 - 130
			Phenanthrene	2017/09/07		94	%	50 - 130
			Pyrene	2017/09/07		100	%	50 - 130
5153622	RAJ	Spiked Blank	D10-Anthracene	2017/09/07		97	%	50 - 130
			D14-Terphenyl (FS)	2017/09/07		93	%	50 - 130
			D8-Acenaphthylene	2017/09/07		91	%	50 - 130
			Acenaphthene	2017/09/07		89	%	50 - 130
			Acenaphthylene	2017/09/07		85	%	50 - 130
			Anthracene	2017/09/07		86	%	50 - 130
			Benzo(a)anthracene	2017/09/07		93	%	50 - 130
			Benzo(a)pyrene	2017/09/07		94	%	50 - 130
			Benzo(b/j)fluoranthene	2017/09/07		93	%	50 - 130
			Benzo(g,h,i)perylene	2017/09/07		87	%	50 - 130
			Benzo(k)fluoranthene	2017/09/07		90	%	50 - 130
			Chrysene	2017/09/07		93	%	50 - 130
			Dibenz(a,h)anthracene	2017/09/07		92	%	50 - 130
			Fluoranthene	2017/09/07		99	%	50 - 130
			Fluorene	2017/09/07		87	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2017/09/07		93	%	50 - 130
			1-Methylnaphthalene	2017/09/07		85	%	50 - 130
			2-Methylnaphthalene	2017/09/07		77	%	50 - 130
			Naphthalene	2017/09/07		72	%	50 - 130
			Phenanthrene	2017/09/07		94	%	50 - 130
			Pyrene	2017/09/07		100	%	50 - 130
5153622	RAJ	Method Blank	D10-Anthracene	2017/09/07		96	%	50 - 130
			D14-Terphenyl (FS)	2017/09/07		91	%	50 - 130
			D8-Acenaphthylene	2017/09/07		86	%	50 - 130
			Acenaphthene	2017/09/07	ND, RDL=0.0050		ug/g	
			Acenaphthylene	2017/09/07	ND, RDL=0.0050		ug/g	
			Anthracene	2017/09/07	ND, RDL=0.0050		ug/g	
			Benzo(a)anthracene	2017/09/07	ND, RDL=0.0050		ug/g	

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Benzo(a)pyrene	2017/09/07	ND, RDL=0.0050		ug/g	
			Benzo(b/j)fluoranthene	2017/09/07	ND, RDL=0.0050		ug/g	
			Benzo(g,h,i)perylene	2017/09/07	ND, RDL=0.0050		ug/g	
			Benzo(k)fluoranthene	2017/09/07	ND, RDL=0.0050		ug/g	
			Chrysene	2017/09/07	ND, RDL=0.0050		ug/g	
			Dibenz(a,h)anthracene	2017/09/07	ND, RDL=0.0050		ug/g	
			Fluoranthene	2017/09/07	ND, RDL=0.0050		ug/g	
			Fluorene	2017/09/07	ND, RDL=0.0050		ug/g	
			Indeno(1,2,3-cd)pyrene	2017/09/07	ND, RDL=0.0050		ug/g	
			1-Methylnaphthalene	2017/09/07	ND, RDL=0.0050		ug/g	
			2-Methylnaphthalene	2017/09/07	ND, RDL=0.0050		ug/g	
			Naphthalene	2017/09/07	ND, RDL=0.0050		ug/g	
			Phenanthrene	2017/09/07	ND, RDL=0.0050		ug/g	
			Pyrene	2017/09/07	ND, RDL=0.0050		ug/g	
5153622	RAJ	RPD	Acenaphthene	2017/09/07	NC		%	40
			Acenaphthylene	2017/09/07	NC		%	40
			Anthracene	2017/09/07	NC		%	40
			Benzo(a)anthracene	2017/09/07	NC		%	40
			Benzo(a)pyrene	2017/09/07	NC		%	40
			Benzo(b/j)fluoranthene	2017/09/07	NC		%	40
			Benzo(g,h,i)perylene	2017/09/07	NC		%	40
			Benzo(k)fluoranthene	2017/09/07	NC		%	40
			Chrysene	2017/09/07	NC		%	40
			Dibenz(a,h)anthracene	2017/09/07	NC		%	40
			Fluoranthene	2017/09/07	NC		%	40
			Fluorene	2017/09/07	NC		%	40
			Indeno(1,2,3-cd)pyrene	2017/09/07	NC		%	40
			1-Methylnaphthalene	2017/09/07	NC		%	40
			2-Methylnaphthalene	2017/09/07	NC		%	40
			Naphthalene	2017/09/07	NC		%	40
			Phenanthrene	2017/09/07	NC		%	40
			Pyrene	2017/09/07	NC		%	40
5153651	ZZ	Matrix Spike	o-Terphenyl	2017/09/08		89	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2017/09/08		91	%	50 - 130
			F3 (C16-C34 Hydrocarbons)	2017/09/08		89	%	50 - 130
			F4 (C34-C50 Hydrocarbons)	2017/09/08		85	%	50 - 130
5153651	ZZ	Spiked Blank	o-Terphenyl	2017/09/08		89	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2017/09/08		91	%	80 - 120
			F3 (C16-C34 Hydrocarbons)	2017/09/08		91	%	80 - 120
			F4 (C34-C50 Hydrocarbons)	2017/09/08		85	%	80 - 120

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
5153651	ZZ	Method Blank	o-Terphenyl	2017/09/08		96	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2017/09/08	ND, RDL=10		ug/g	
			F3 (C16-C34 Hydrocarbons)	2017/09/08	ND, RDL=50		ug/g	
			F4 (C34-C50 Hydrocarbons)	2017/09/08	ND, RDL=50		ug/g	
5153651	ZZ	RPD	F2 (C10-C16 Hydrocarbons)	2017/09/08	NC		%	30
			F3 (C16-C34 Hydrocarbons)	2017/09/08	NC		%	30
			F4 (C34-C50 Hydrocarbons)	2017/09/08	NC		%	30
5153892	RAJ	Matrix Spike [FBE301-02]	D10-Anthracene	2017/09/08		96	%	50 - 130
			D14-Terphenyl (FS)	2017/09/08		92	%	50 - 130
			D8-Acenaphthylene	2017/09/08		91	%	50 - 130
			Acenaphthene	2017/09/08		90	%	50 - 130
			Acenaphthylene	2017/09/08		83	%	50 - 130
			Anthracene	2017/09/08		84	%	50 - 130
			Benzo(a)anthracene	2017/09/08		89	%	50 - 130
			Benzo(a)pyrene	2017/09/08		89	%	50 - 130
			Benzo(b/j)fluoranthene	2017/09/08		86	%	50 - 130
			Benzo(g,h,i)perylene	2017/09/08		82	%	50 - 130
			Benzo(k)fluoranthene	2017/09/08		77	%	50 - 130
			Chrysene	2017/09/08		89	%	50 - 130
			Dibenz(a,h)anthracene	2017/09/08		90	%	50 - 130
			Fluoranthene	2017/09/08		87	%	50 - 130
			Fluorene	2017/09/08		91	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2017/09/08		81	%	50 - 130
			1-Methylnaphthalene	2017/09/08		111	%	50 - 130
			2-Methylnaphthalene	2017/09/08		98	%	50 - 130
			Naphthalene	2017/09/08		84	%	50 - 130
			Phenanthrene	2017/09/08		89	%	50 - 130
			Pyrene	2017/09/08		91	%	50 - 130
5153892	RAJ	Spiked Blank	D10-Anthracene	2017/09/08		91	%	50 - 130
			D14-Terphenyl (FS)	2017/09/08		88	%	50 - 130
			D8-Acenaphthylene	2017/09/08		86	%	50 - 130
			Acenaphthene	2017/09/08		90	%	50 - 130
			Acenaphthylene	2017/09/08		82	%	50 - 130
			Anthracene	2017/09/08		85	%	50 - 130
			Benzo(a)anthracene	2017/09/08		87	%	50 - 130
			Benzo(a)pyrene	2017/09/08		89	%	50 - 130
			Benzo(b/j)fluoranthene	2017/09/08		94	%	50 - 130
			Benzo(g,h,i)perylene	2017/09/08		89	%	50 - 130
			Benzo(k)fluoranthene	2017/09/08		98	%	50 - 130
			Chrysene	2017/09/08		89	%	50 - 130
			Dibenz(a,h)anthracene	2017/09/08		99	%	50 - 130
			Fluoranthene	2017/09/08		85	%	50 - 130
			Fluorene	2017/09/08		91	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2017/09/08		90	%	50 - 130
			1-Methylnaphthalene	2017/09/08		113	%	50 - 130
			2-Methylnaphthalene	2017/09/08		102	%	50 - 130
			Naphthalene	2017/09/08		85	%	50 - 130
			Phenanthrene	2017/09/08		87	%	50 - 130
			Pyrene	2017/09/08		89	%	50 - 130
5153892	RAJ	Method Blank	D10-Anthracene	2017/09/08		92	%	50 - 130
			D14-Terphenyl (FS)	2017/09/08		90	%	50 - 130

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			D8-Acenaphthylene	2017/09/08		86	%	50 - 130
			Acenaphthene	2017/09/08	ND, RDL=0.0050		ug/g	
			Acenaphthylene	2017/09/08	ND, RDL=0.0050		ug/g	
			Anthracene	2017/09/08	ND, RDL=0.0050		ug/g	
			Benzo(a)anthracene	2017/09/08	ND, RDL=0.0050		ug/g	
			Benzo(a)pyrene	2017/09/08	ND, RDL=0.0050		ug/g	
			Benzo(b/j)fluoranthene	2017/09/08	ND, RDL=0.0050		ug/g	
			Benzo(g,h,i)perylene	2017/09/08	ND, RDL=0.0050		ug/g	
			Benzo(k)fluoranthene	2017/09/08	ND, RDL=0.0050		ug/g	
			Chrysene	2017/09/08	ND, RDL=0.0050		ug/g	
			Dibenz(a,h)anthracene	2017/09/08	ND, RDL=0.0050		ug/g	
			Fluoranthene	2017/09/08	ND, RDL=0.0050		ug/g	
			Fluorene	2017/09/08	ND, RDL=0.0050		ug/g	
			Indeno(1,2,3-cd)pyrene	2017/09/08	ND, RDL=0.0050		ug/g	
			1-Methylnaphthalene	2017/09/08	ND, RDL=0.0050		ug/g	
			2-Methylnaphthalene	2017/09/08	ND, RDL=0.0050		ug/g	
			Naphthalene	2017/09/08	ND, RDL=0.0050		ug/g	
			Phenanthrene	2017/09/08	ND, RDL=0.0050		ug/g	
			Pyrene	2017/09/08	ND, RDL=0.0050		ug/g	
5153892	RAJ	RPD [FBE301-02]	Acenaphthene	2017/09/08	NC		%	40
			Acenaphthylene	2017/09/08	NC		%	40
			Anthracene	2017/09/08	NC		%	40
			Benzo(a)anthracene	2017/09/08	NC		%	40
			Benzo(a)pyrene	2017/09/08	NC		%	40
			Benzo(b/j)fluoranthene	2017/09/08	NC		%	40
			Benzo(g,h,i)perylene	2017/09/08	NC		%	40
			Benzo(k)fluoranthene	2017/09/08	NC		%	40
			Chrysene	2017/09/08	NC		%	40
			Dibenz(a,h)anthracene	2017/09/08	NC		%	40
			Fluoranthene	2017/09/08	NC		%	40
			Fluorene	2017/09/08	NC		%	40
			Indeno(1,2,3-cd)pyrene	2017/09/08	NC		%	40
			1-Methylnaphthalene	2017/09/08	NC		%	40
			2-Methylnaphthalene	2017/09/08	NC		%	40
			Naphthalene	2017/09/08	NC		%	40
			Phenanthrene	2017/09/08	NC		%	40

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Pyrene	2017/09/08	NC		%	40
5154063	NS3	RPD	Moisture	2017/09/07	0.72		%	20
5154622	ZZ	Matrix Spike [FBE272-02]	o-Terphenyl	2017/09/08		88	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2017/09/08		92	%	50 - 130
			F3 (C16-C34 Hydrocarbons)	2017/09/08		95	%	50 - 130
			F4 (C34-C50 Hydrocarbons)	2017/09/08		98	%	50 - 130
5154622	ZZ	Spiked Blank	o-Terphenyl	2017/09/08		87	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2017/09/08		89	%	80 - 120
			F3 (C16-C34 Hydrocarbons)	2017/09/08		91	%	80 - 120
			F4 (C34-C50 Hydrocarbons)	2017/09/08		91	%	80 - 120
5154622	ZZ	Method Blank	o-Terphenyl	2017/09/08		88	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2017/09/08	ND, RDL=10		ug/g	
			F3 (C16-C34 Hydrocarbons)	2017/09/08	ND, RDL=50		ug/g	
			F4 (C34-C50 Hydrocarbons)	2017/09/08	ND, RDL=50		ug/g	
5154622	ZZ	RPD [FBE272-02]	F2 (C10-C16 Hydrocarbons)	2017/09/08	NC		%	30
			F3 (C16-C34 Hydrocarbons)	2017/09/08	NC		%	30
			F4 (C34-C50 Hydrocarbons)	2017/09/08	NC		%	30
5154951	RSC	Matrix Spike	Leachable 4-Bromofluorobenzene	2017/09/08		99	%	70 - 130
			Leachable D4-1,2-Dichloroethane	2017/09/08		95	%	70 - 130
			Leachable D8-Toluene	2017/09/08		101	%	70 - 130
			Leachable Benzene	2017/09/08		105	%	70 - 130
			Leachable Carbon Tetrachloride	2017/09/08		102	%	70 - 130
			Leachable Chlorobenzene	2017/09/08		97	%	70 - 130
			Leachable Chloroform	2017/09/08		97	%	70 - 130
			Leachable 1,2-Dichlorobenzene	2017/09/08		97	%	70 - 130
			Leachable 1,4-Dichlorobenzene	2017/09/08		101	%	70 - 130
			Leachable 1,2-Dichloroethane	2017/09/08		90	%	70 - 130
			Leachable 1,1-Dichloroethylene	2017/09/08		107	%	70 - 130
			Leachable Methylene Chloride(Dichloromethan	2017/09/08		95	%	70 - 130
			Leachable Methyl Ethyl Ketone (2-Butanone)	2017/09/08		86	%	60 - 140
			Leachable Tetrachloroethylene	2017/09/08		99	%	70 - 130
			Leachable Trichloroethylene	2017/09/08		98	%	70 - 130
			Leachable Vinyl Chloride	2017/09/08		99	%	70 - 130
5154951	RSC	Spiked Blank	Leachable 4-Bromofluorobenzene	2017/09/08		99	%	70 - 130
			Leachable D4-1,2-Dichloroethane	2017/09/08		96	%	70 - 130
			Leachable D8-Toluene	2017/09/08		101	%	70 - 130
			Leachable Benzene	2017/09/08		106	%	70 - 130
			Leachable Carbon Tetrachloride	2017/09/08		103	%	70 - 130
			Leachable Chlorobenzene	2017/09/08		98	%	70 - 130
			Leachable Chloroform	2017/09/08		98	%	70 - 130
			Leachable 1,2-Dichlorobenzene	2017/09/08		98	%	70 - 130
			Leachable 1,4-Dichlorobenzene	2017/09/08		101	%	70 - 130
			Leachable 1,2-Dichloroethane	2017/09/08		92	%	70 - 130
			Leachable 1,1-Dichloroethylene	2017/09/08		108	%	70 - 130
			Leachable Methylene Chloride(Dichloromethan	2017/09/08		95	%	70 - 130
			Leachable Methyl Ethyl Ketone (2-Butanone)	2017/09/08		94	%	60 - 140
			Leachable Tetrachloroethylene	2017/09/08		98	%	70 - 130
			Leachable Trichloroethylene	2017/09/08		99	%	70 - 130
			Leachable Vinyl Chloride	2017/09/08		100	%	70 - 130
5154951	RSC	Method Blank	Leachable 4-Bromofluorobenzene	2017/09/08		97	%	70 - 130
			Leachable D4-1,2-Dichloroethane	2017/09/08		94	%	70 - 130

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Leachable D8-Toluene	2017/09/08		96	%	70 - 130
			Leachable Benzene	2017/09/08	ND, RDL=0.020		mg/L	
			Leachable Carbon Tetrachloride	2017/09/08	ND, RDL=0.020		mg/L	
			Leachable Chlorobenzene	2017/09/08	ND, RDL=0.020		mg/L	
			Leachable Chloroform	2017/09/08	ND, RDL=0.020		mg/L	
			Leachable 1,2-Dichlorobenzene	2017/09/08	ND, RDL=0.050		mg/L	
			Leachable 1,4-Dichlorobenzene	2017/09/08	ND, RDL=0.050		mg/L	
			Leachable 1,2-Dichloroethane	2017/09/08	ND, RDL=0.050		mg/L	
			Leachable 1,1-Dichloroethylene	2017/09/08	ND, RDL=0.020		mg/L	
			Leachable Methylene Chloride(Dichloromethane)	2017/09/08	ND, RDL=0.20		mg/L	
			Leachable Methyl Ethyl Ketone (2-Butanone)	2017/09/08	ND, RDL=1.0		mg/L	
			Leachable Tetrachloroethylene	2017/09/08	ND, RDL=0.020		mg/L	
			Leachable Trichloroethylene	2017/09/08	ND, RDL=0.020		mg/L	
			Leachable Vinyl Chloride	2017/09/08	ND, RDL=0.020		mg/L	
5154951	RSC	RPD	Leachable Benzene	2017/09/09	NC		%	30
			Leachable Carbon Tetrachloride	2017/09/09	NC		%	30
			Leachable Chlorobenzene	2017/09/09	NC		%	30
			Leachable Chloroform	2017/09/09	NC		%	30
			Leachable 1,2-Dichlorobenzene	2017/09/09	NC		%	30
			Leachable 1,4-Dichlorobenzene	2017/09/09	NC		%	30
			Leachable 1,2-Dichloroethane	2017/09/09	NC		%	30
			Leachable 1,1-Dichloroethylene	2017/09/09	NC		%	30
			Leachable Methylene Chloride(Dichloromethan	2017/09/09	NC		%	30
			Leachable Methyl Ethyl Ketone (2-Butanone)	2017/09/09	NC		%	30
			Leachable Tetrachloroethylene	2017/09/09	NC		%	30
			Leachable Trichloroethylene	2017/09/09	NC		%	30
			Leachable Vinyl Chloride	2017/09/09	NC		%	30
5155278	RON	Matrix Spike	Leachable Mercury (Hg)	2017/09/08		93	%	75 - 125
5155278	RON	Leachate Blank	Leachable Mercury (Hg)	2017/09/08	ND, RDL=0.0010		mg/L	
5155278	RON	Spiked Blank	Leachable Mercury (Hg)	2017/09/08		94	%	80 - 120
5155278	RON	Method Blank	Leachable Mercury (Hg)	2017/09/08	ND, RDL=0.0010		mg/L	
5155278	RON	RPD	Leachable Mercury (Hg)	2017/09/08	NC		%	25
5155389	ADA	Matrix Spike	Leachable Arsenic (As)	2017/09/11		101	%	80 - 120
			Leachable Barium (Ba)	2017/09/11		99	%	80 - 120
			Leachable Boron (B)	2017/09/11		101	%	80 - 120
			Leachable Cadmium (Cd)	2017/09/11		99	%	80 - 120
			Leachable Chromium (Cr)	2017/09/11		98	%	80 - 120
			Leachable Lead (Pb)	2017/09/11		95	%	80 - 120
			Leachable Selenium (Se)	2017/09/11		101	%	80 - 120

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Leachable Silver (Ag)	2017/09/11		95	%	80 - 120
			Leachable Uranium (U)	2017/09/11		99	%	80 - 120
5155389	ADA	Leachate Blank	Leachable Arsenic (As)	2017/09/11	ND, RDL=0.2		mg/L	
			Leachable Barium (Ba)	2017/09/11	ND, RDL=0.2		mg/L	
			Leachable Boron (B)	2017/09/11	ND, RDL=0.1		mg/L	
			Leachable Cadmium (Cd)	2017/09/11	ND, RDL=0.05		mg/L	
			Leachable Chromium (Cr)	2017/09/11	ND, RDL=0.1		mg/L	
			Leachable Lead (Pb)	2017/09/11	ND, RDL=0.1		mg/L	
			Leachable Selenium (Se)	2017/09/11	ND, RDL=0.1		mg/L	
			Leachable Silver (Ag)	2017/09/11	ND, RDL=0.01		mg/L	
			Leachable Uranium (U)	2017/09/11	ND, RDL=0.01		mg/L	
5155389	ADA	Spiked Blank	Leachable Arsenic (As)	2017/09/11		97	%	80 - 120
			Leachable Barium (Ba)	2017/09/11		97	%	80 - 120
			Leachable Boron (B)	2017/09/11		95	%	80 - 120
			Leachable Cadmium (Cd)	2017/09/11		92	%	80 - 120
			Leachable Chromium (Cr)	2017/09/11		93	%	80 - 120
			Leachable Lead (Pb)	2017/09/11		94	%	80 - 120
			Leachable Selenium (Se)	2017/09/11		96	%	80 - 120
			Leachable Silver (Ag)	2017/09/11		90	%	80 - 120
			Leachable Uranium (U)	2017/09/11		97	%	80 - 120
5155389	ADA	RPD	Leachable Arsenic (As)	2017/09/11	NC		%	35
			Leachable Barium (Ba)	2017/09/11	3.4		%	35
			Leachable Boron (B)	2017/09/11	7.6		%	35
			Leachable Cadmium (Cd)	2017/09/11	NC		%	35
			Leachable Chromium (Cr)	2017/09/11	NC		%	35
			Leachable Lead (Pb)	2017/09/11	NC		%	35
			Leachable Selenium (Se)	2017/09/11	NC		%	35
			Leachable Silver (Ag)	2017/09/11	NC		%	35
			Leachable Uranium (U)	2017/09/11	NC		%	35
5155494	SHG	Matrix Spike	Leachable Decachlorobiphenyl	2017/09/09		77	%	30 - 130
			Leachable Total PCB	2017/09/09		84	%	30 - 130
5155494	SHG	Spiked Blank	Leachable Decachlorobiphenyl	2017/09/09		74	%	30 - 130
			Leachable Total PCB	2017/09/09		86	%	30 - 130
5155494	SHG	Method Blank	Leachable Decachlorobiphenyl	2017/09/09		74	%	30 - 130
			Leachable Total PCB	2017/09/09	ND, RDL=3.0		ug/L	
5155494	SHG	RPD	Leachable Total PCB	2017/09/09	NC		%	40
5155728	LHA	Matrix Spike	Leachable WAD Cyanide (Free)	2017/09/08		90	%	80 - 120
5155728	LHA	Leachate Blank	Leachable WAD Cyanide (Free)	2017/09/08	ND, RDL=0.010		mg/L	
5155728	LHA	Spiked Blank	Leachable WAD Cyanide (Free)	2017/09/08		100	%	80 - 120
5155728	LHA	Method Blank	Leachable WAD Cyanide (Free)	2017/09/08	ND, RDL=0.0020		mg/L	
5155728	LHA	RPD	Leachable WAD Cyanide (Free)	2017/09/08	NC		%	20
5155737	C_N	Matrix Spike	Leachable Nitrite (N)	2017/09/08		102	%	80 - 120

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Leachable Nitrate (N)	2017/09/08		98	%	80 - 120
			Leachable Nitrate + Nitrite (N)	2017/09/08		99	%	80 - 120
5155737	C_N	Leachate Blank	Leachable Nitrite (N)	2017/09/08	ND, RDL=0.10		mg/L	
			Leachable Nitrate (N)	2017/09/08	ND, RDL=1.0		mg/L	
			Leachable Nitrate + Nitrite (N)	2017/09/08	ND, RDL=1.0		mg/L	
5155737	C_N	Spiked Blank	Leachable Nitrite (N)	2017/09/08		101	%	80 - 120
			Leachable Nitrate (N)	2017/09/08		100	%	80 - 120
			Leachable Nitrate + Nitrite (N)	2017/09/08		100	%	80 - 120
5155737	C_N	Method Blank	Leachable Nitrite (N)	2017/09/08	ND, RDL=0.10		mg/L	
			Leachable Nitrate (N)	2017/09/08	ND, RDL=1.0		mg/L	
			Leachable Nitrate + Nitrite (N)	2017/09/08	ND, RDL=1.0		mg/L	
5155737	C_N	RPD	Leachable Nitrite (N)	2017/09/08	NC		%	25
			Leachable Nitrate (N)	2017/09/08	NC		%	25
			Leachable Nitrate + Nitrite (N)	2017/09/08	NC		%	25
5155747	SAU	Matrix Spike	Leachable Fluoride (F-)	2017/09/09		87	%	80 - 120
5155747	SAU	Leachate Blank	Leachable Fluoride (F-)	2017/09/09	ND, RDL=0.10		mg/L	
5155747	SAU	Spiked Blank	Leachable Fluoride (F-)	2017/09/09		102	%	80 - 120
5155747	SAU	Method Blank	Leachable Fluoride (F-)	2017/09/09	ND, RDL=0.10		mg/L	
5155747	SAU	RPD	Leachable Fluoride (F-)	2017/09/09	NC		%	25
5155829	WZ	Matrix Spike [FBE303-01]	Leachable 2,4,6-Tribromophenol	2017/09/09		80	%	10 - 130
			Leachable 2-Fluorobiphenyl	2017/09/09		56	%	30 - 130
			Leachable 2-Fluorophenol	2017/09/09		30	%	10 - 130
			Leachable D14-Terphenyl (FS)	2017/09/09		93	%	30 - 130
			Leachable D5-Nitrobenzene	2017/09/09		68	%	30 - 130
			Leachable D5-Phenol	2017/09/09		25	%	10 - 130
			Leachable Benzo(a)pyrene	2017/09/09		103	%	30 - 130
			Leachable m/p-Cresol	2017/09/09		39	%	10 - 130
			Leachable o-Cresol	2017/09/09		56	%	10 - 130
			Leachable Cresol Total	2017/09/09		48	%	10 - 130
			Leachable 2,4-Dichlorophenol	2017/09/09		65	%	10 - 130
			Leachable 2,4-Dinitrotoluene	2017/09/09		79	%	30 - 130
			Leachable Hexachlorobenzene	2017/09/09		84	%	30 - 130
			Leachable Hexachlorobutadiene	2017/09/09		60	%	30 - 130
			Leachable Hexachloroethane	2017/09/09		65	%	30 - 130
			Leachable Nitrobenzene	2017/09/09		70	%	30 - 130
			Leachable Pentachlorophenol	2017/09/09		85	%	30 - 130
			Leachable Pyridine	2017/09/09		4.0 (2)	%	10 - 130
			Leachable 2,3,4,6-Tetrachlorophenol	2017/09/09		86	%	10 - 130
			Leachable 2,4,5-Trichlorophenol	2017/09/09		73	%	10 - 130
			Leachable 2,4,6-Trichlorophenol	2017/09/09		68	%	10 - 130
5155829	WZ	Spiked Blank	Leachable 2,4,6-Tribromophenol	2017/09/09		81	%	10 - 130
			Leachable 2-Fluorobiphenyl	2017/09/09		67	%	30 - 130
			Leachable 2-Fluorophenol	2017/09/09		39	%	10 - 130
			Leachable D14-Terphenyl (FS)	2017/09/09		93	%	30 - 130
			Leachable D5-Nitrobenzene	2017/09/09		79	%	30 - 130
			Leachable D5-Phenol	2017/09/09		34	%	10 - 130

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Leachable Benzo(a)pyrene	2017/09/09		102	%	30 - 130
			Leachable m/p-Cresol	2017/09/09		65	%	10 - 130
			Leachable o-Cresol	2017/09/09		80	%	10 - 130
			Leachable Cresol Total	2017/09/09		72	%	10 - 130
			Leachable 2,4-Dichlorophenol	2017/09/09		77	%	10 - 130
			Leachable 2,4-Dinitrotoluene	2017/09/09		78	%	30 - 130
			Leachable Hexachlorobenzene	2017/09/09		86	%	30 - 130
			Leachable Hexachlorobutadiene	2017/09/09		74	%	30 - 130
			Leachable Hexachloroethane	2017/09/09		75	%	30 - 130
			Leachable Nitrobenzene	2017/09/09		80	%	30 - 130
			Leachable Pentachlorophenol	2017/09/09		86	%	30 - 130
			Leachable Pyridine	2017/09/09		11	%	10 - 130
			Leachable 2,3,4,6-Tetrachlorophenol	2017/09/09		89	%	10 - 130
			Leachable 2,4,5-Trichlorophenol	2017/09/09		76	%	10 - 130
			Leachable 2,4,6-Trichlorophenol	2017/09/09		77	%	10 - 130
5155829	WZ	Method Blank	Leachable 2,4,6-Tribromophenol	2017/09/09		75	%	10 - 130
			Leachable 2-Fluorobiphenyl	2017/09/09		69	%	30 - 130
			Leachable 2-Fluorophenol	2017/09/09		36	%	10 - 130
			Leachable D14-Terphenyl (FS)	2017/09/09		91	%	30 - 130
			Leachable D5-Nitrobenzene	2017/09/09		78	%	30 - 130
			Leachable D5-Phenol	2017/09/09		30	%	10 - 130
			Leachable Benzo(a)pyrene	2017/09/09	ND, RDL=0.10		ug/L	
			Leachable m/p-Cresol	2017/09/09	ND, RDL=2.5		ug/L	
			Leachable o-Cresol	2017/09/09	ND, RDL=2.5		ug/L	
			Leachable Cresol Total	2017/09/09	ND, RDL=2.5		ug/L	
			Leachable 2,4-Dichlorophenol	2017/09/09	ND, RDL=2.5		ug/L	
			Leachable 2,4-Dinitrotoluene	2017/09/09	ND, RDL=10		ug/L	
			Leachable Hexachlorobenzene	2017/09/09	ND, RDL=10		ug/L	
			Leachable Hexachlorobutadiene	2017/09/09	ND, RDL=10		ug/L	
			Leachable Hexachloroethane	2017/09/09	ND, RDL=10		ug/L	
			Leachable Nitrobenzene	2017/09/09	ND, RDL=10		ug/L	
			Leachable Pentachlorophenol	2017/09/09	ND, RDL=2.5		ug/L	
			Leachable Pyridine	2017/09/09	ND, RDL=10		ug/L	
			Leachable 2,3,4,6-Tetrachlorophenol	2017/09/09	ND, RDL=2.5		ug/L	
			Leachable 2,4,5-Trichlorophenol	2017/09/09	ND, RDL=0.50		ug/L	
			Leachable 2,4,6-Trichlorophenol	2017/09/09	ND, RDL=2.5		ug/L	
5155829	WZ	RPD	Leachable Benzo(a)pyrene	2017/09/09	NC (3)		%	40
			Leachable m/p-Cresol	2017/09/09	NC		%	40
			Leachable o-Cresol	2017/09/09	NC		%	40

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Leachable Cresol Total	2017/09/09	NC		%	40
			Leachable 2,4-Dichlorophenol	2017/09/09	NC		%	40
			Leachable 2,4-Dinitrotoluene	2017/09/09	NC		%	40
			Leachable Hexachlorobenzene	2017/09/09	NC		%	40
			Leachable Hexachlorobutadiene	2017/09/09	NC		%	40
			Leachable Hexachloroethane	2017/09/09	NC		%	40
			Leachable Nitrobenzene	2017/09/09	NC		%	40
			Leachable Pentachlorophenol	2017/09/09	NC		%	40
			Leachable Pyridine	2017/09/09	NC		%	40
			Leachable 2,3,4,6-Tetrachlorophenol	2017/09/09	NC		%	40
			Leachable 2,4,5-Trichlorophenol	2017/09/09	NC		%	40
			Leachable 2,4,6-Trichlorophenol	2017/09/09	NC		%	40
5156924	SK1	Matrix Spike	F4G-sg (Grav. Heavy Hydrocarbons)	2017/09/09		115	%	65 - 135
5156924	SK1	Spiked Blank	F4G-sg (Grav. Heavy Hydrocarbons)	2017/09/09		101	%	65 - 135
5156924	SK1	Method Blank	F4G-sg (Grav. Heavy Hydrocarbons)	2017/09/09	ND, RDL=100		ug/g	
5156924	SK1	RPD	F4G-sg (Grav. Heavy Hydrocarbons)	2017/09/09	0		%	50

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Leachate Blank: A blank matrix containing all reagents used in the leaching procedure. Used to determine any process contamination.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) The matrix spike recovery was below the lower control limit. This may be due in part to the reducing environment of the sample. The matrix spike was reanalyzed to confirm result.

(2) The recovery was below the lower control limit. This may represent a low bias in some results for this specific analyte.

(3) Detection Limit was raised due to matrix interferences.

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1295
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888
Sampler Initials: EH

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

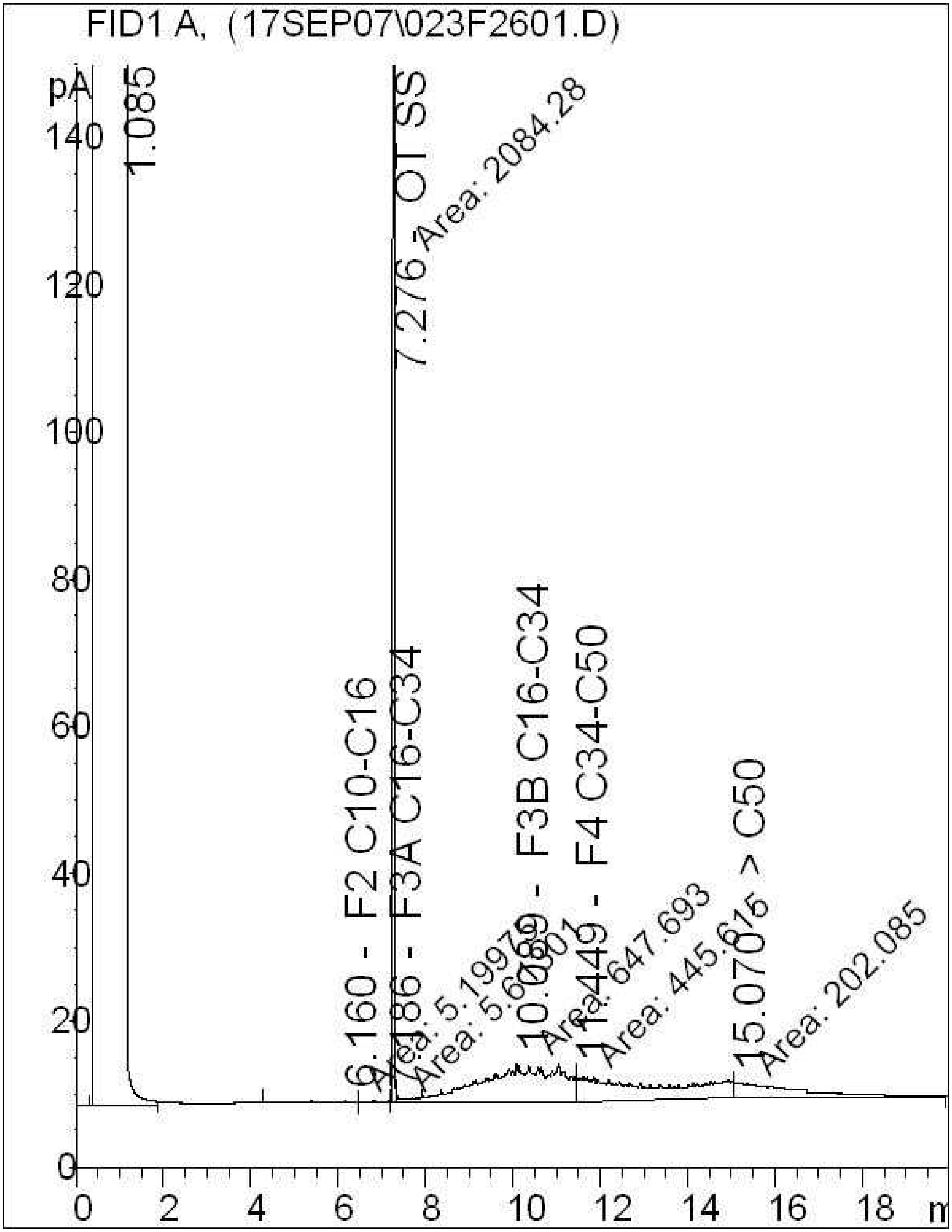
Brad Newman, Scientific Service Specialist

Cristina Carriere, Scientific Service Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

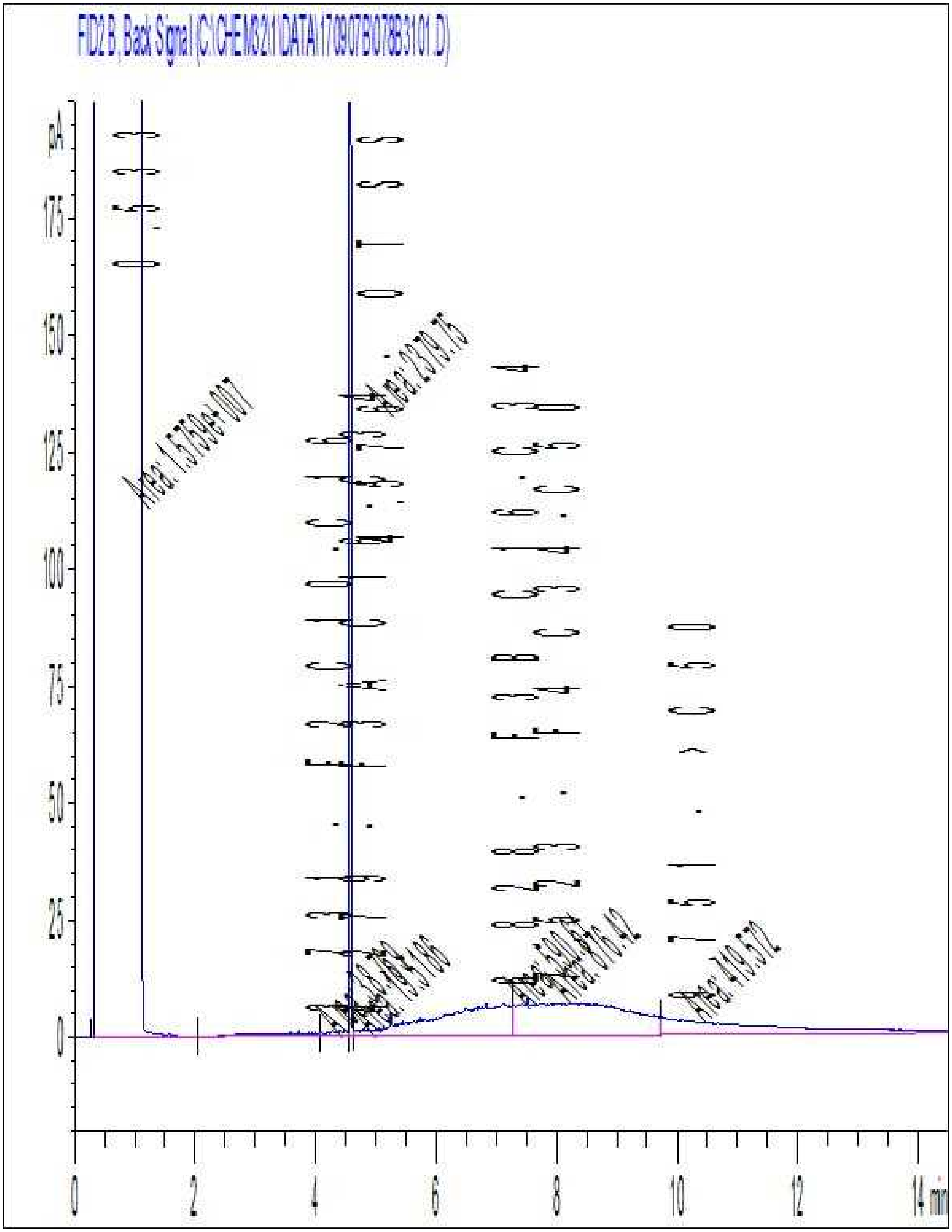


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7J1295
Report Date: 2017/09/12
Maxxam Sample: FBE229

AEL Environment
Client Project #: 10888
Client ID: A0217 MW7/17

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

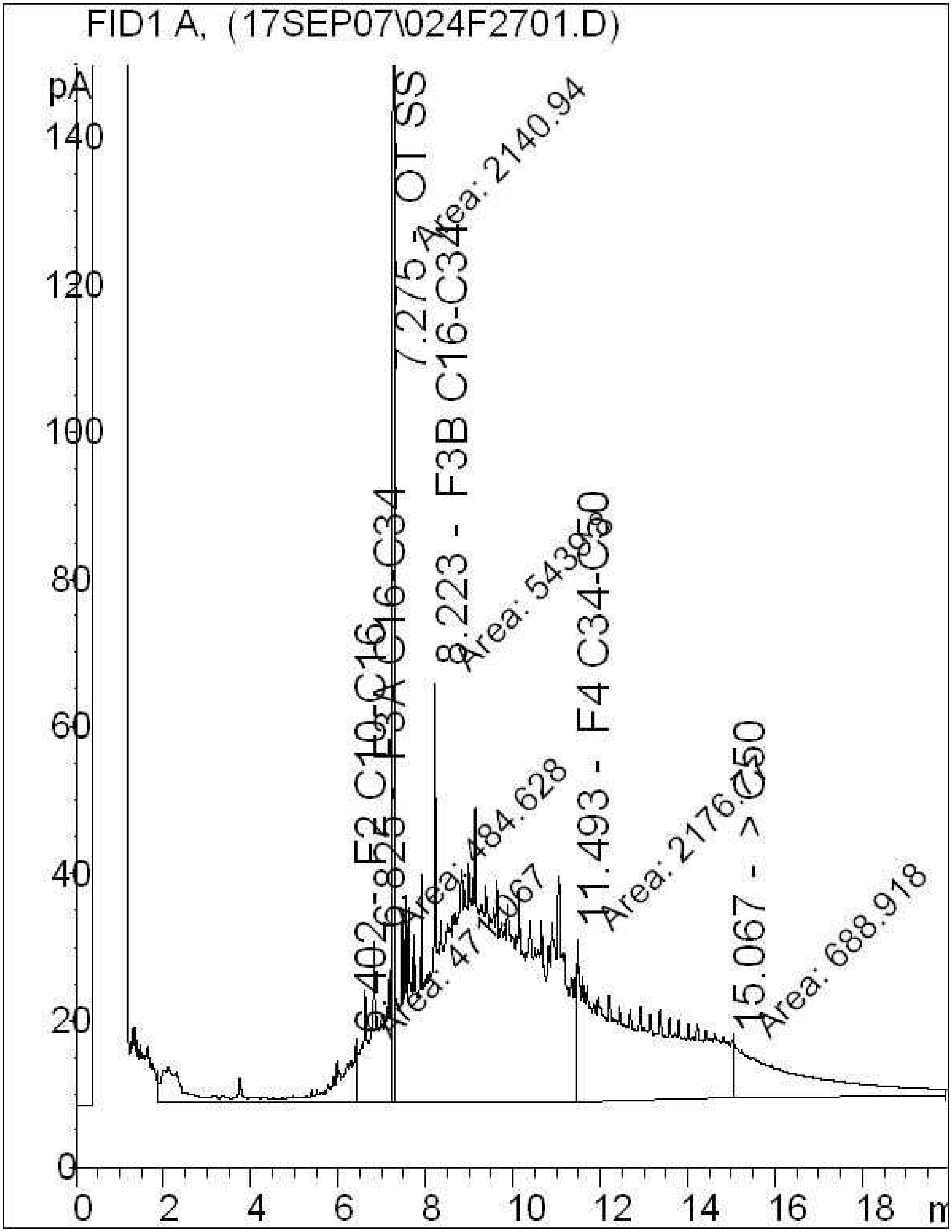


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7J1295
Report Date: 2017/09/12
Maxxam Sample: FBE231

AEL Environment
Client Project #: 10888
Client ID: A0235 MW8/17

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

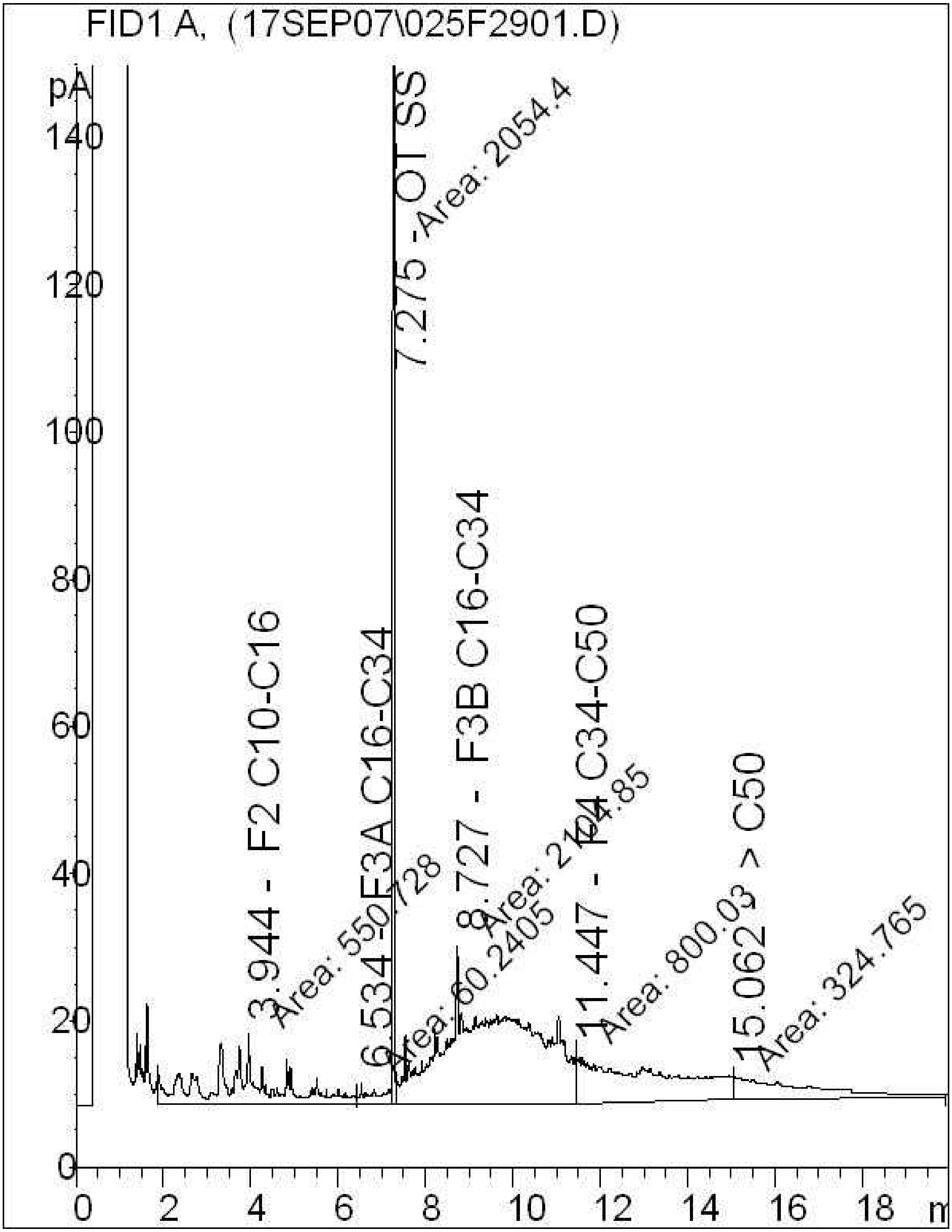


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7J1295
Report Date: 2017/09/12
Maxxam Sample: FBE232

AEL Environment
Client Project #: 10888
Client ID: A0219 MW10/17

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

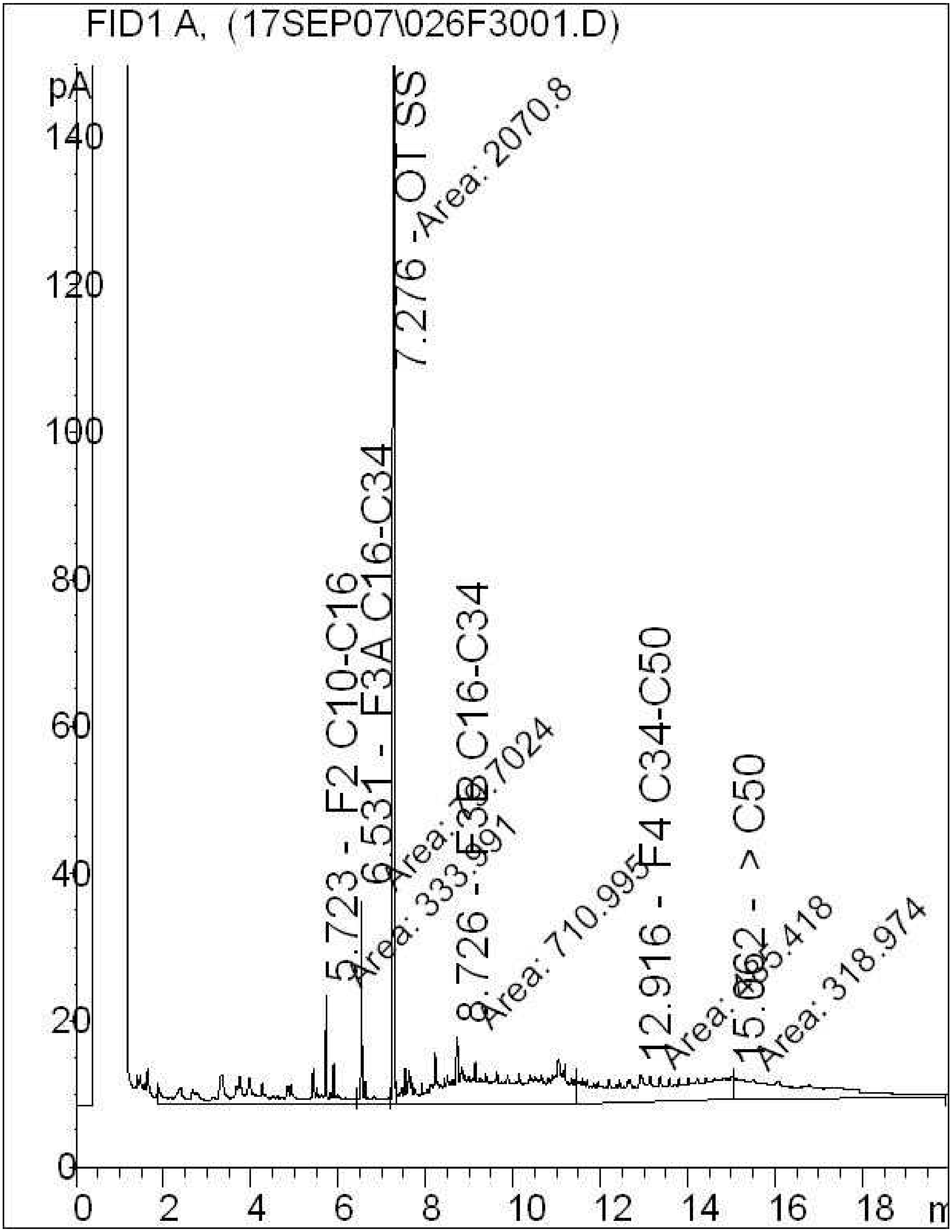


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7J1295
Report Date: 2017/09/12
Maxxam Sample: FBE233

AEL Environment
Client Project #: 10888
Client ID: A0221 MW10/17

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

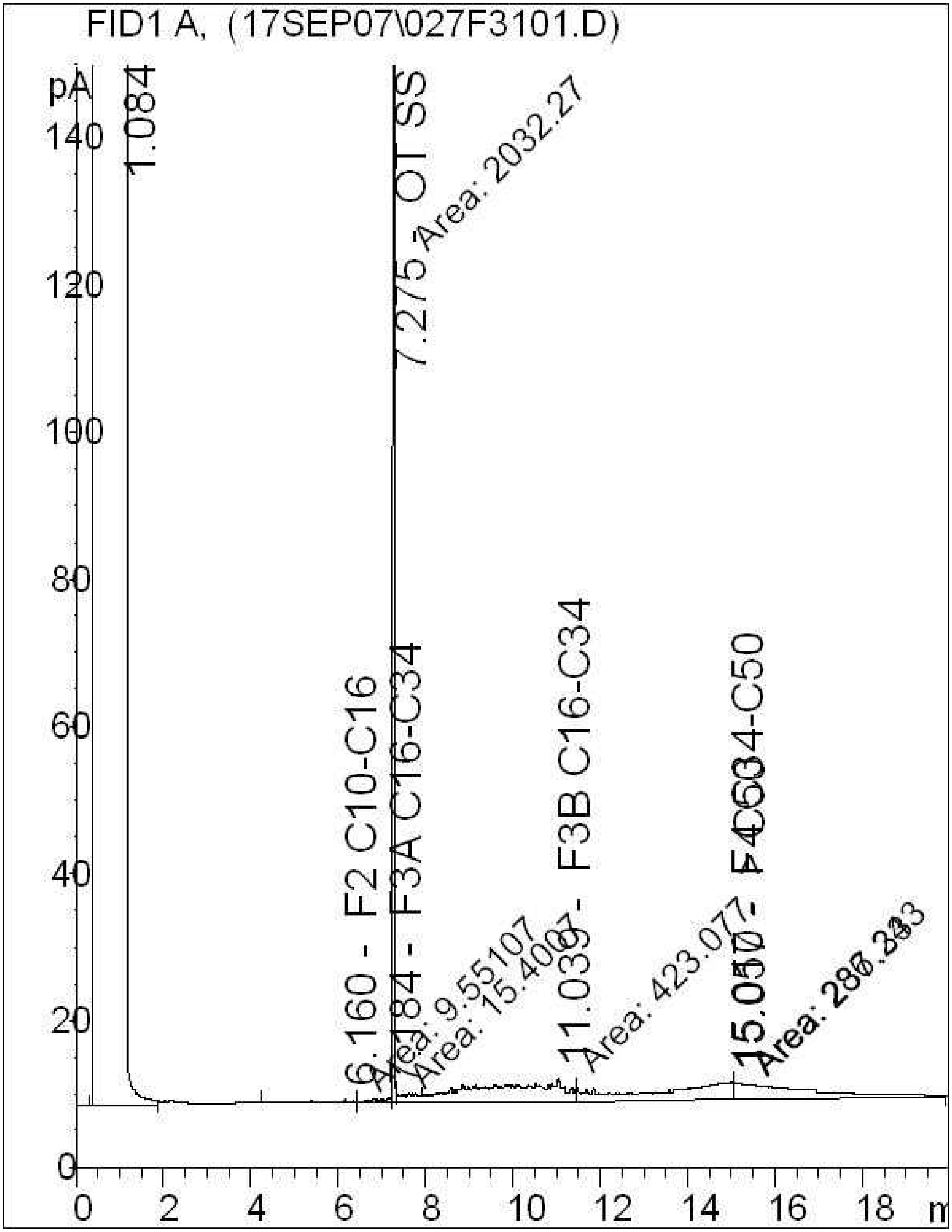


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7J1295
Report Date: 2017/09/12
Maxxam Sample: FBE235

AEL Environment
Client Project #: 10888
Client ID: A0228 BH11/17

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

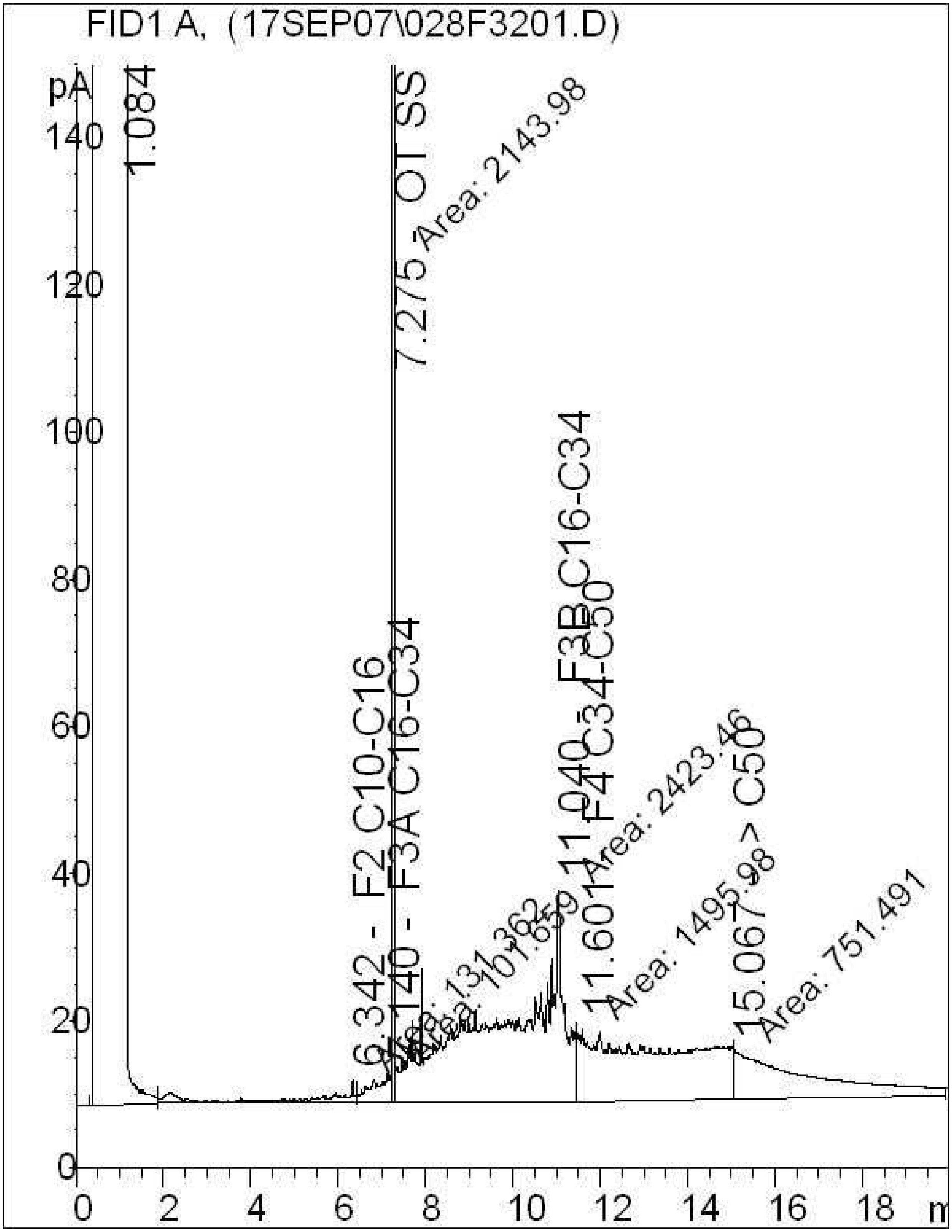


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7J1295
Report Date: 2017/09/12
Maxxam Sample: FBE236

AEL Environment
Client Project #: 10888
Client ID: A0229 BH11/17

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

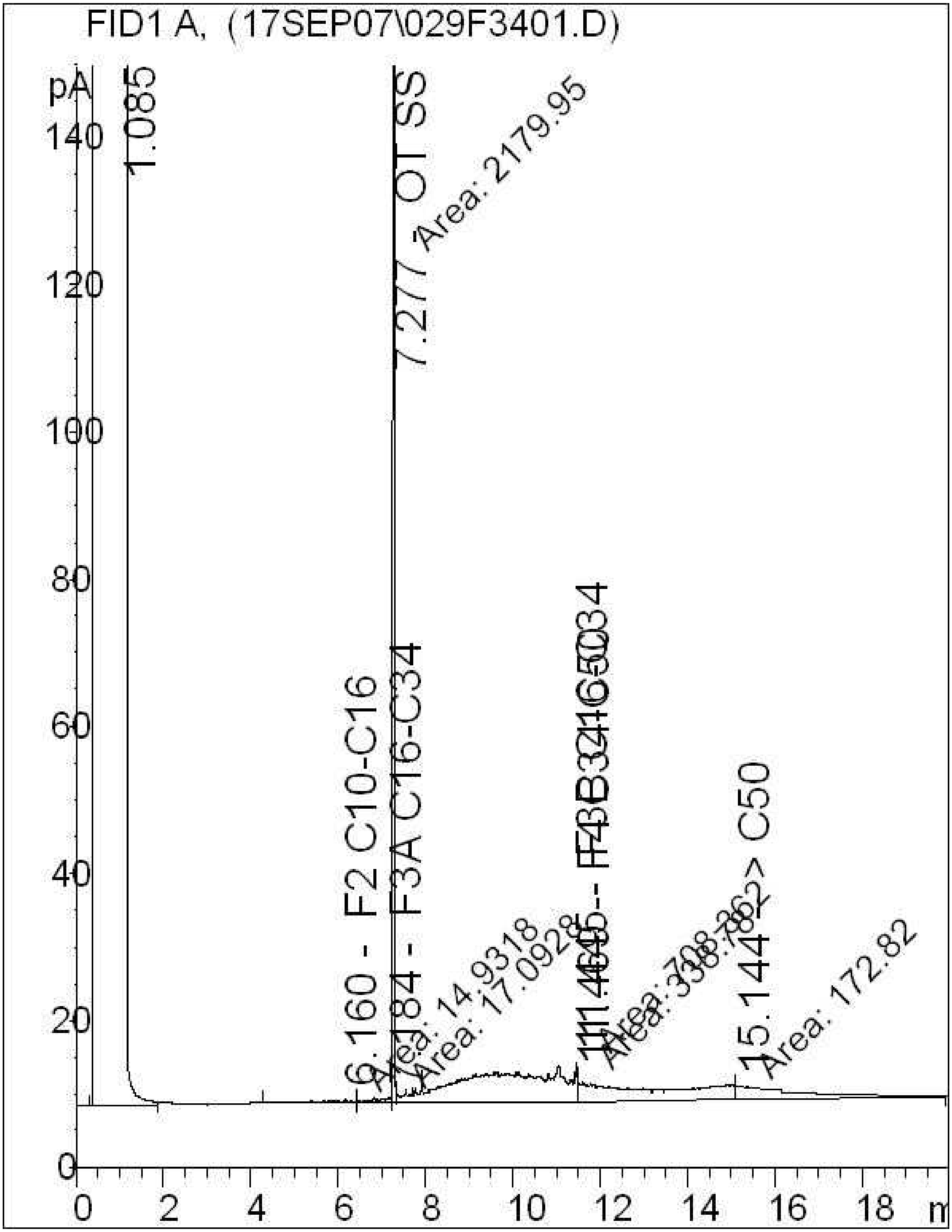


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7J1295
Report Date: 2017/09/12
Maxxam Sample: FBE237

AEL Environment
Client Project #: 10888
Client ID: A0223 BH12/17

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

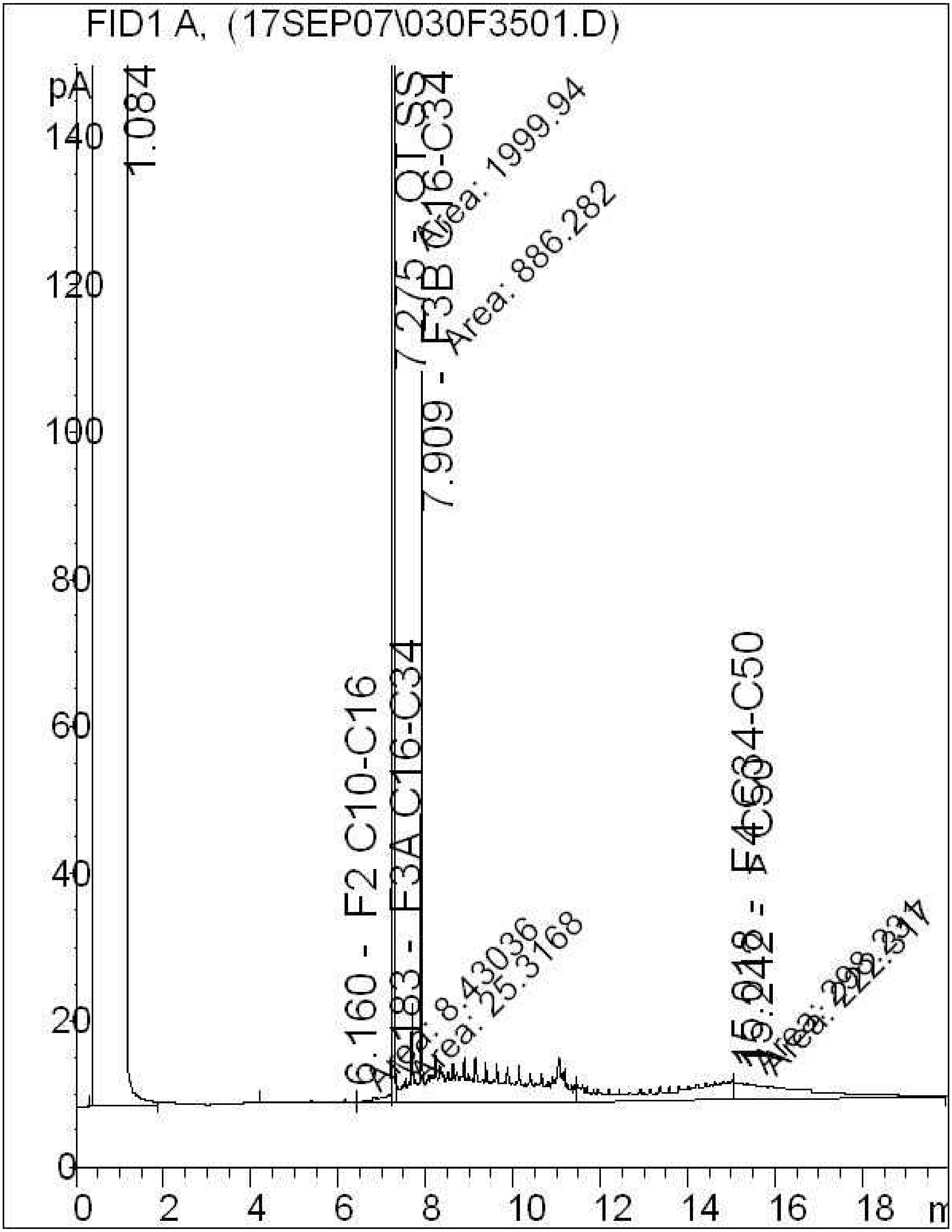


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7J1295
Report Date: 2017/09/12
Maxxam Sample: FBE270

AEL Environment
Client Project #: 10888
Client ID: A0224 BH12/17

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

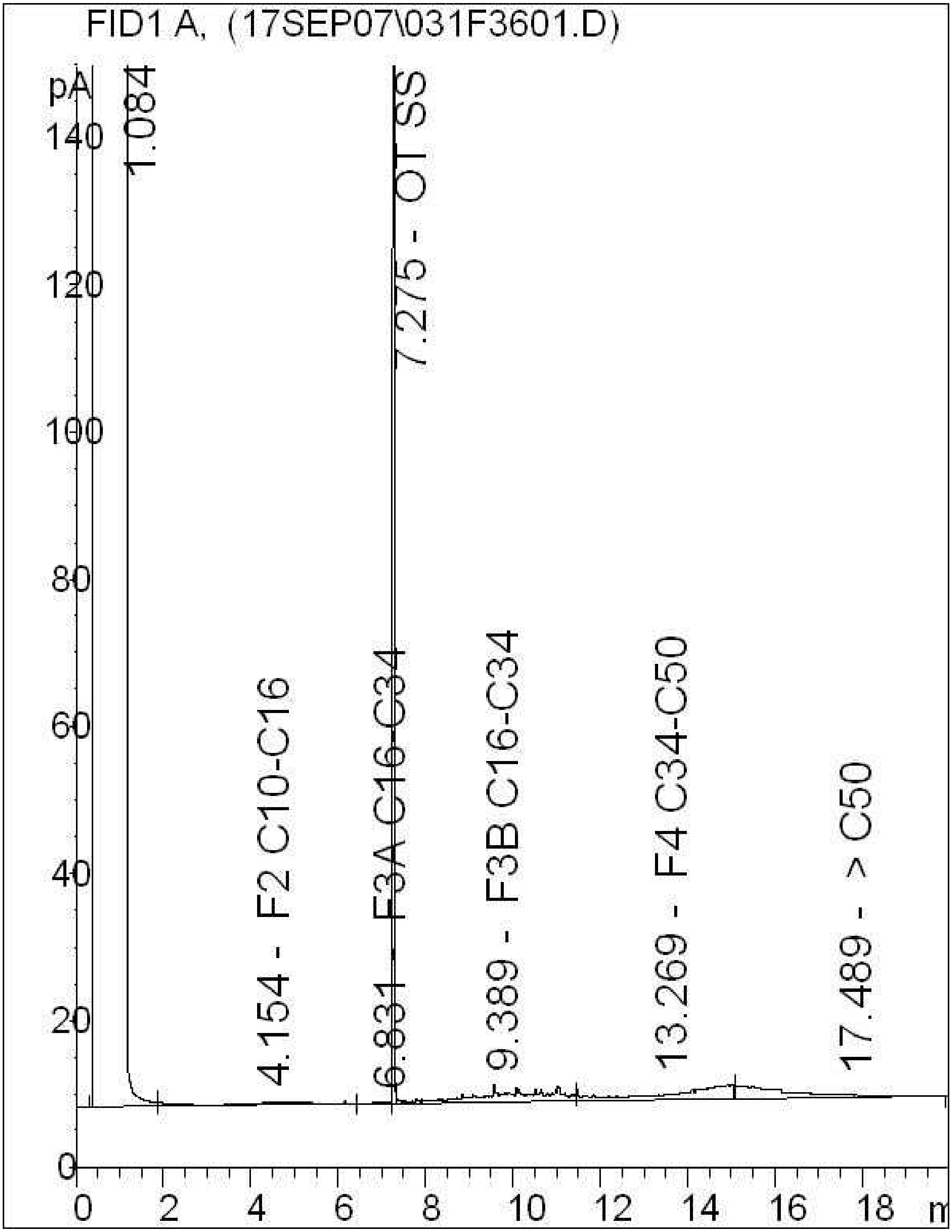


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7J1295
Report Date: 2017/09/12
Maxxam Sample: FBE272

AEL Environment
Client Project #: 10888
Client ID: A0230 BH13/17

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

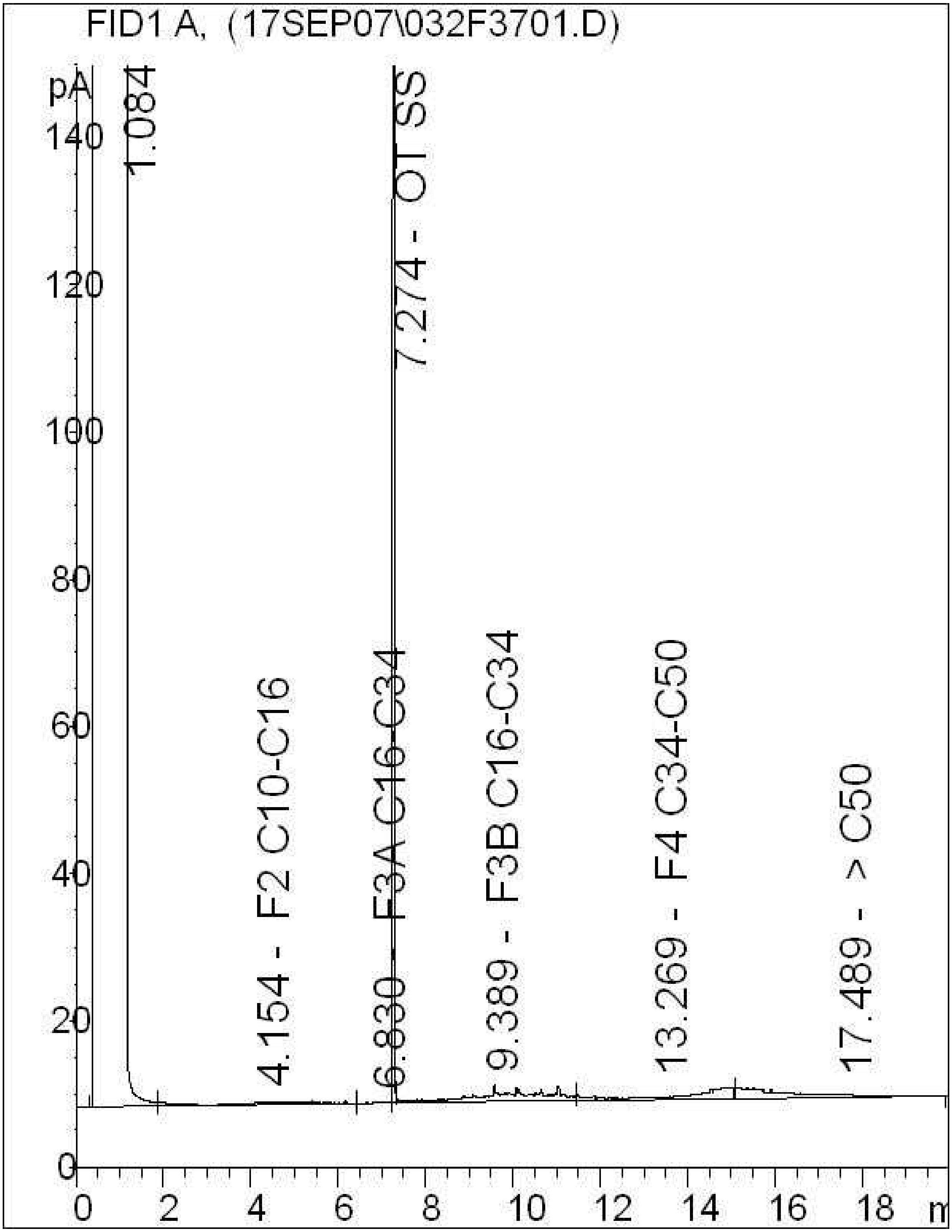


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7J1295
Report Date: 2017/09/12
Maxxam Sample: FBE272 Lab-Dup

AEL Environment
Client Project #: 10888
Client ID: A0230 BH13/17

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

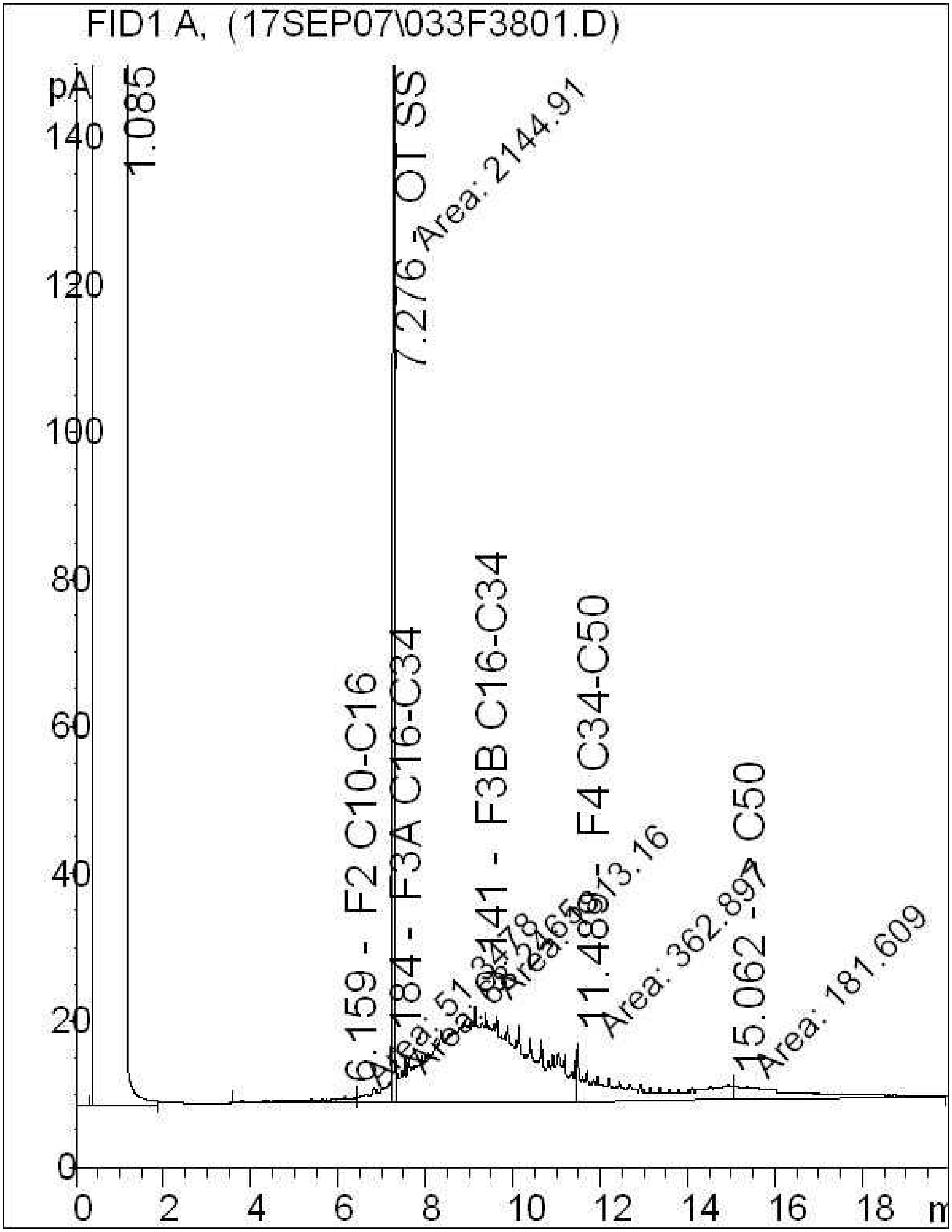


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7J1295
Report Date: 2017/09/12
Maxxam Sample: FBE273

AEL Environment
Client Project #: 10888
Client ID: A0232 BH13/17

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

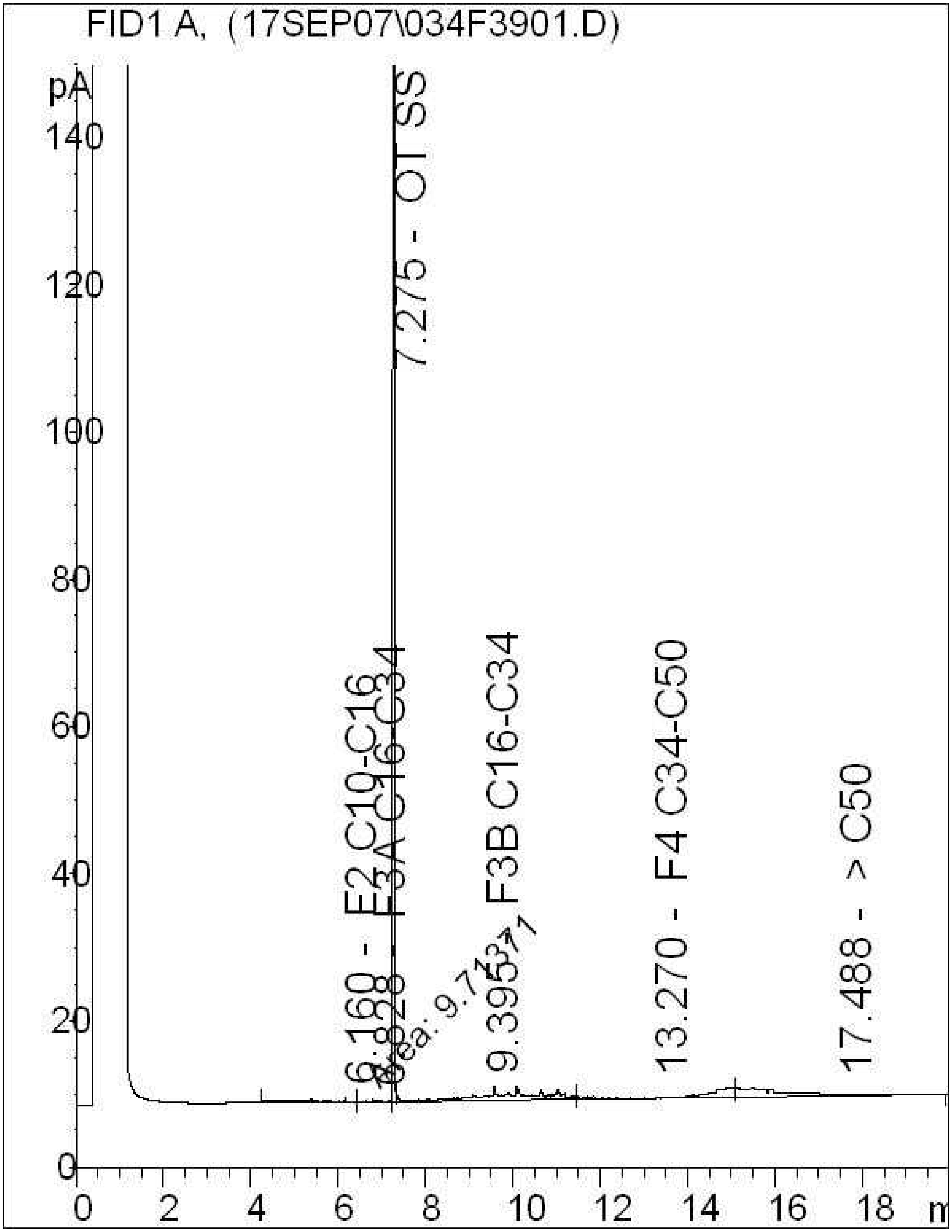


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7J1295
Report Date: 2017/09/12
Maxxam Sample: FBE274

AEL Environment
Client Project #: 10888
Client ID: A0233 BH13/17

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

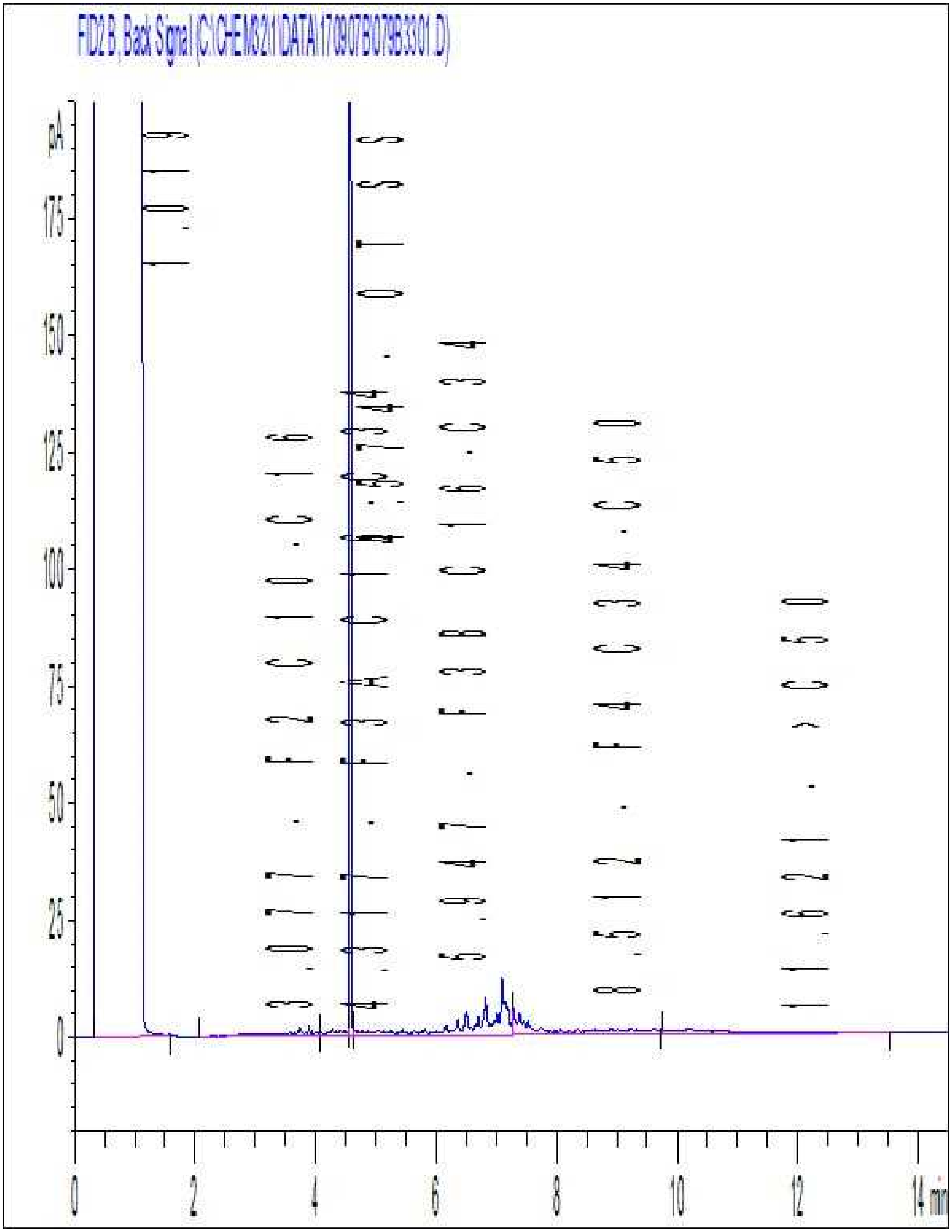


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7J1295
Report Date: 2017/09/12
Maxxam Sample: FBE275

AEL Environment
Client Project #: 10888
Client ID: A0256 POND

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

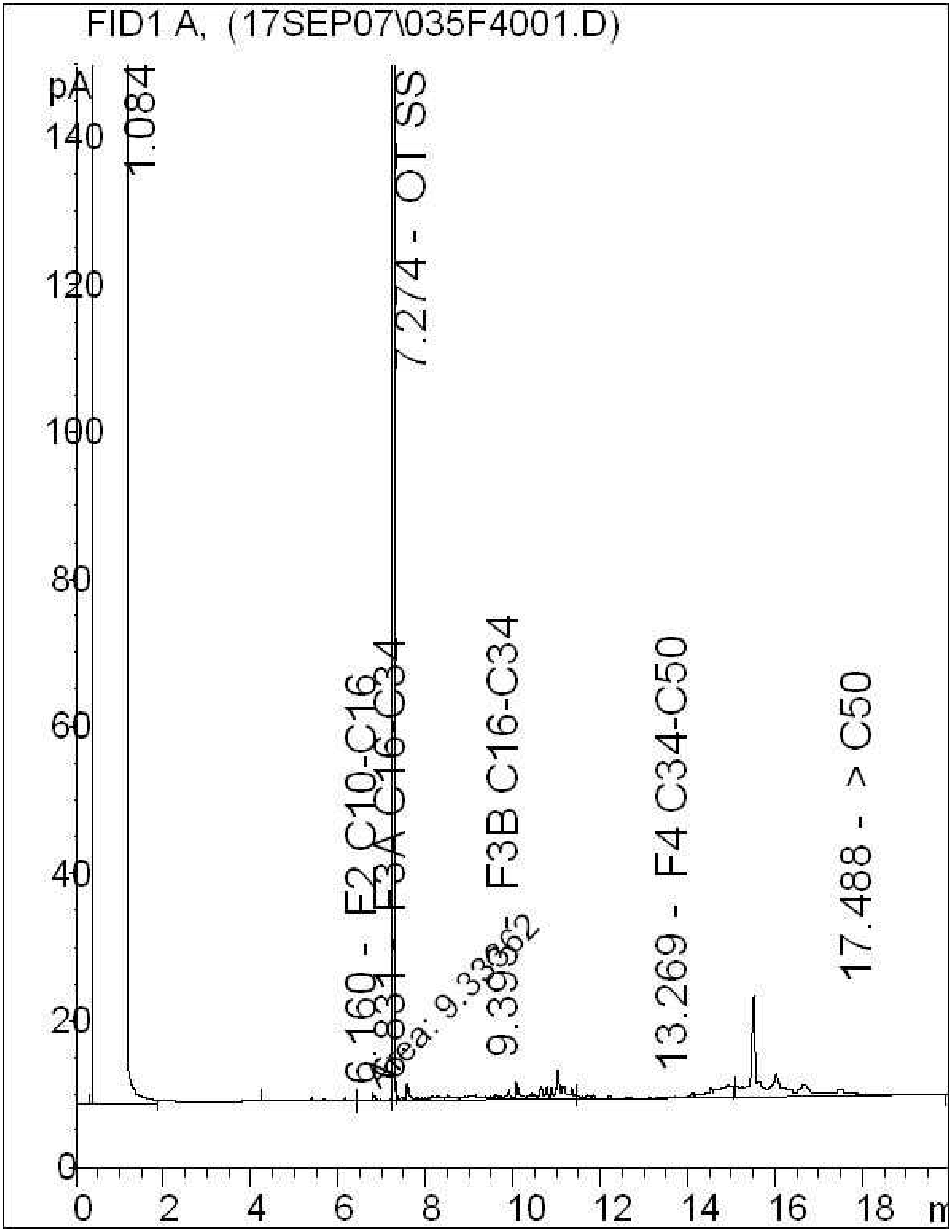


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7J1295
Report Date: 2017/09/12
Maxxam Sample: FBE297

AEL Environment
Client Project #: 10888
Client ID: A0241 MW5

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

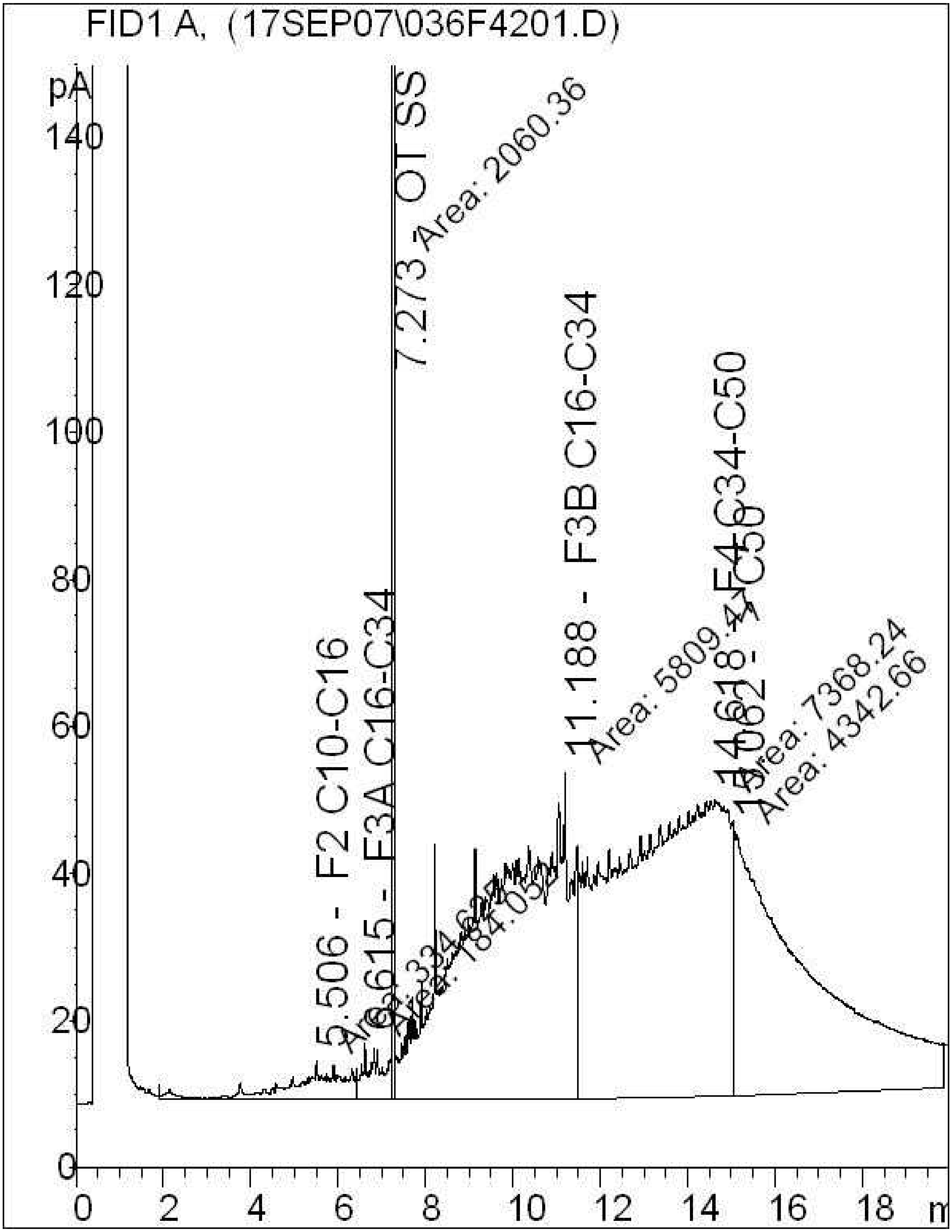


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7J1295
Report Date: 2017/09/12
Maxxam Sample: FBE298

AEL Environment
Client Project #: 10888
Client ID: A0244 MW5

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

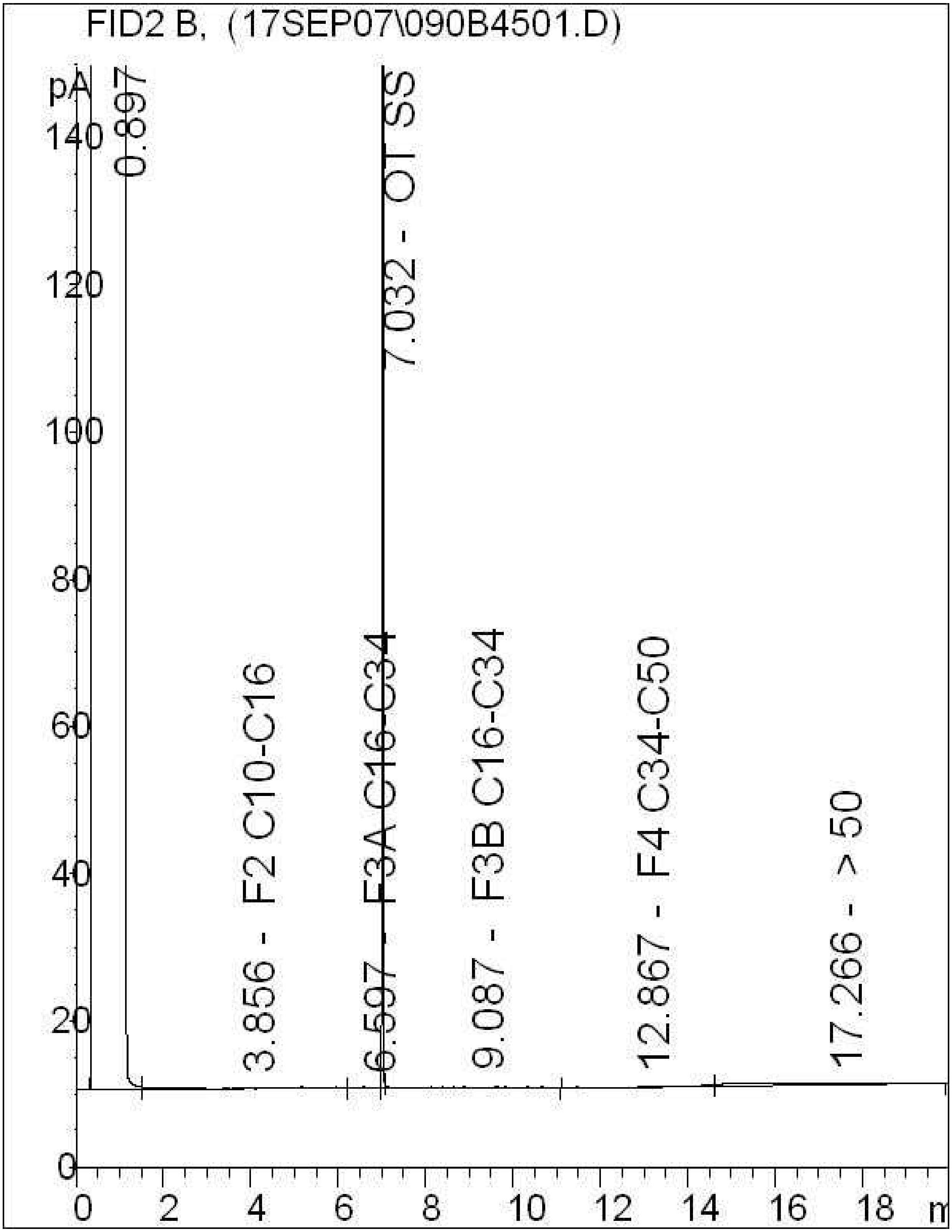


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7J1295
Report Date: 2017/09/12
Maxxam Sample: FBE300

AEL Environment
Client Project #: 10888
Client ID: A0252 MW9/17

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

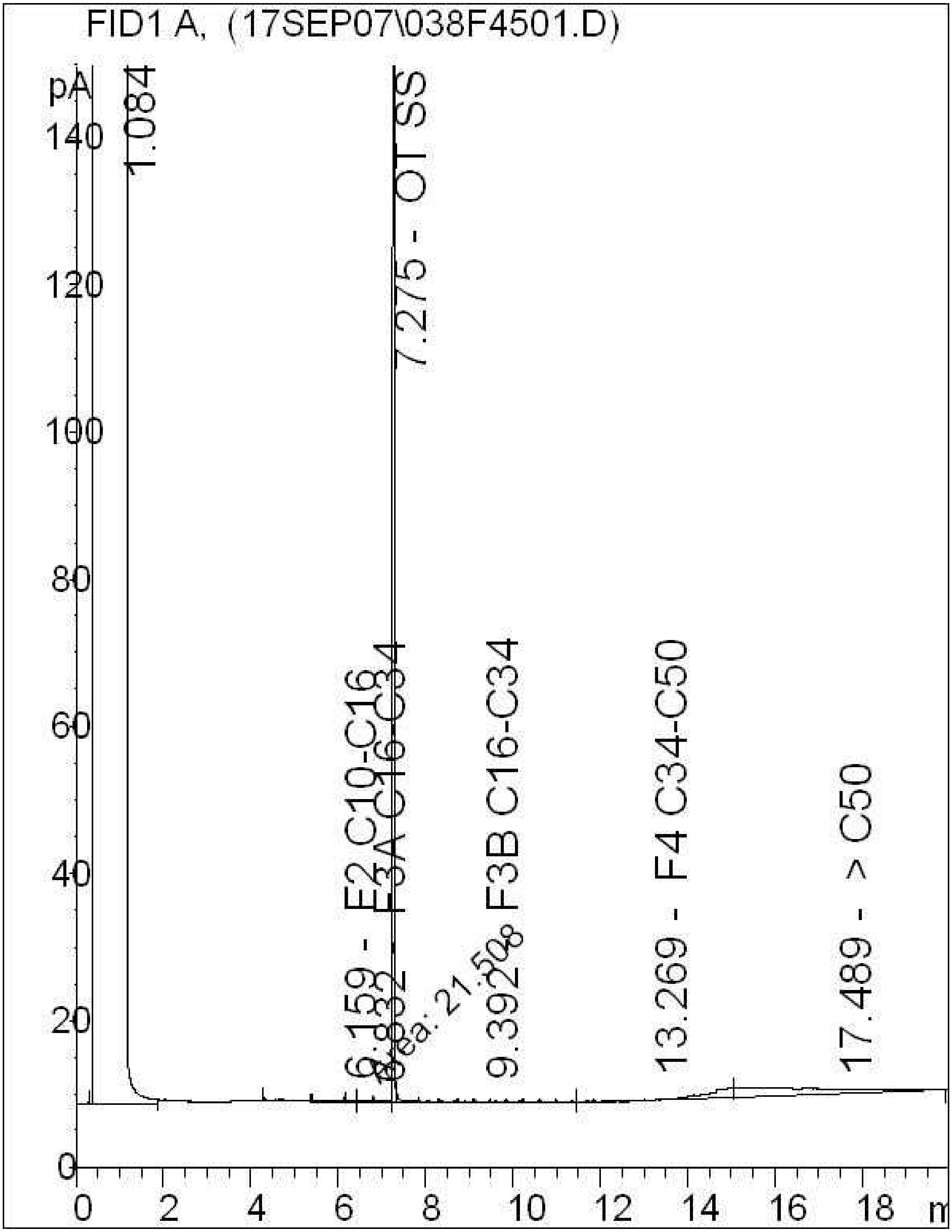


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7J1295
Report Date: 2017/09/12
Maxxam Sample: FBE302

AEL Environment
Client Project #: 10888
Client ID: A0255 MW9/17

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam
A Bureau Veritas Group Company

Your Project #: 10888
Your C.O.C. #: 625116-01-01

Attention:Reporting Group

AEL Environment
1705 Argentia Rd
Unit 3
Mississauga, ON
CANADA L5N 3A9

Report Date: 2017/09/07
Report #: R4689867
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7I8549
Received: 2017/08/29, 17:25

Sample Matrix: Water
Samples Received: 5

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Methylnaphthalene Sum	2	N/A	2017/09/07	CAM SOP-00301	EPA 8270D m
1,3-Dichloropropene Sum	5	N/A	2017/09/06		EPA 8260C m
Chloride by Automated Colourimetry	4	N/A	2017/09/01	CAM SOP-00463	EPA 325.2 m
Chromium (VI) in Water	4	N/A	2017/08/31	CAM SOP-00436	EPA 7199 m
Free (WAD) Cyanide	4	N/A	2017/09/01	CAM SOP-00457	OMOE E3015 m
Petroleum Hydrocarbons F2-F4 in Water (1)	2	2017/09/01	2017/09/03	CAM SOP-00316	CCME PHC-CWS m
Petroleum Hydrocarbons F2-F4 in Water (1)	2	2017/09/01	2017/09/05	CAM SOP-00316	CCME PHC-CWS m
Mercury	4	2017/09/01	2017/09/05	CAM SOP-00453	EPA 7470A m
Dissolved Metals by ICPMS	4	N/A	2017/09/05	CAM SOP-00447	EPA 6020B m
PAH Compounds in Water by GC/MS (SIM)	2	2017/09/01	2017/09/02	CAM SOP-00318	EPA 8270D m
Polychlorinated Biphenyl in Water	2	2017/08/31	2017/09/01	CAM SOP-00309	EPA 8082A m
Volatile Organic Compounds and F1 PHCs	5	N/A	2017/09/02	CAM SOP-00230	EPA 8260C m

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Your Project #: 10888
Your C.O.C. #: 625116-01-01

Attention:Reporting Group

AEL Environment
1705 Argentia Rd
Unit 3
Mississauga, ON
CANADA L5N 3A9

Report Date: 2017/09/07
Report #: R4689867
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7I8549
Received: 2017/08/29, 17:25

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) All CCME PHC results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Maxxam conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following “Alberta Environment’s Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Validation of Performance-Based Alternative Methods September 2003”. Documentation is available upon request. Modifications from Reference Method for the Canada-wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method: F2/F3/F4 data reported using validated cold solvent extraction instead of Soxhlet extraction.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Antonella Brasil, Senior Project Manager
Email: ABrasil@maxxam.ca
Phone# (905)817-5817
==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

VOLATILE ORGANICS BY GC/MS (WATER)

Maxxam ID		FAR103		
Sampling Date				
COC Number		625116-01-01		
	UNITS	TRIP BLANK	RDL	QC Batch
Calculated Parameters				
1,3-Dichloropropene (cis+trans)	ug/L	ND	0.50	5145154
Volatile Organics				
Acetone (2-Propanone)	ug/L	ND	10	5145411
Benzene	ug/L	ND	0.20	5145411
Bromodichloromethane	ug/L	ND	0.50	5145411
Bromoform	ug/L	ND	1.0	5145411
Bromomethane	ug/L	ND	0.50	5145411
Carbon Tetrachloride	ug/L	ND	0.20	5145411
Chlorobenzene	ug/L	ND	0.20	5145411
Chloroform	ug/L	ND	0.20	5145411
Dibromochloromethane	ug/L	ND	0.50	5145411
1,2-Dichlorobenzene	ug/L	ND	0.50	5145411
1,3-Dichlorobenzene	ug/L	ND	0.50	5145411
1,4-Dichlorobenzene	ug/L	ND	0.50	5145411
Dichlorodifluoromethane (FREON 12)	ug/L	ND	1.0	5145411
1,1-Dichloroethane	ug/L	ND	0.20	5145411
1,2-Dichloroethane	ug/L	ND	0.50	5145411
1,1-Dichloroethylene	ug/L	ND	0.20	5145411
cis-1,2-Dichloroethylene	ug/L	ND	0.50	5145411
trans-1,2-Dichloroethylene	ug/L	ND	0.50	5145411
1,2-Dichloropropane	ug/L	ND	0.20	5145411
cis-1,3-Dichloropropene	ug/L	ND	0.30	5145411
trans-1,3-Dichloropropene	ug/L	ND	0.40	5145411
Ethylbenzene	ug/L	ND	0.20	5145411
Ethylene Dibromide	ug/L	ND	0.20	5145411
Hexane	ug/L	ND	1.0	5145411
Methylene Chloride(Dichloromethane)	ug/L	ND	2.0	5145411
Methyl Ethyl Ketone (2-Butanone)	ug/L	ND	10	5145411
Methyl Isobutyl Ketone	ug/L	ND	5.0	5145411
Methyl t-butyl ether (MTBE)	ug/L	ND	0.50	5145411
Styrene	ug/L	ND	0.50	5145411
1,1,1,2-Tetrachloroethane	ug/L	ND	0.50	5145411
1,1,2,2-Tetrachloroethane	ug/L	ND	0.50	5145411
Tetrachloroethylene	ug/L	ND	0.20	5145411
Toluene	ug/L	ND	0.20	5145411

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam Job #: B7I8549
Report Date: 2017/09/07

AEL Environment
Client Project #: 10888

VOLATILE ORGANICS BY GC/MS (WATER)

Maxxam ID		FAR103		
Sampling Date				
COC Number		625116-01-01		
	UNITS	**TRIP BLANK**	**RDL**	**QC Batch**
1,1,1-Trichloroethane	ug/L	ND	0.20	5145411
1,1,2-Trichloroethane	ug/L	ND	0.50	5145411
Trichloroethylene	ug/L	ND	0.20	5145411
Trichlorofluoromethane (FREON 11)	ug/L	ND	0.50	5145411
Vinyl Chloride	ug/L	ND	0.20	5145411
p+m-Xylene	ug/L	ND	0.20	5145411
o-Xylene	ug/L	ND	0.20	5145411
Total Xylenes	ug/L	ND	0.20	5145411
F1 (C6-C10)	ug/L	ND	25	5145411
F1 (C6-C10) - BTEX	ug/L	ND	25	5145411
Surrogate Recovery (%)				
4-Bromofluorobenzene	%	97		5145411
D4-1,2-Dichloroethane	%	105		5145411
D8-Toluene	%	96		5145411

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B7I8549
Report Date: 2017/09/07

AEL Environment
Client Project #: 10888

O.REG 153 METALS & INORGANICS PKG (WTR)

Maxxam ID		FAR099	FAR100		FAR101		FAR102		
Sampling Date		2017/08/28 13:40	2017/08/28 15:00		2017/08/28 17:15		2017/08/28 17:45		
COC Number		625116-01-01	625116-01-01		625116-01-01		625116-01-01		
	UNITS	A0191 MW6	A0192 MW1	RDL	A0193 MW3D	RDL	A0194 MW3S	RDL	QC Batch
Inorganics									
WAD Cyanide (Free)	ug/L	ND	ND	1	ND	1	ND	1	5145235
Dissolved Chloride (Cl)	mg/L	15	11	1.0	220	3.0	11	1.0	5145887
Metals									
Chromium (VI)	ug/L	ND	ND	0.50	ND	0.50	ND	0.50	5144886
Mercury (Hg)	ug/L	ND	ND	0.1	ND	0.1	ND	0.1	5146814
Dissolved Antimony (Sb)	ug/L	ND	ND	0.50	ND	0.50	ND	0.50	5145782
Dissolved Arsenic (As)	ug/L	ND	ND	1.0	12	1.0	ND	1.0	5145782
Dissolved Barium (Ba)	ug/L	110	120	2.0	500	2.0	150	2.0	5145782
Dissolved Beryllium (Be)	ug/L	ND	ND	0.50	ND	0.50	ND	0.50	5145782
Dissolved Boron (B)	ug/L	25	23	10	33	10	24	10	5145782
Dissolved Cadmium (Cd)	ug/L	ND	ND	0.10	ND	0.10	ND	0.10	5145782
Dissolved Chromium (Cr)	ug/L	ND	ND	5.0	ND	5.0	ND	5.0	5145782
Dissolved Cobalt (Co)	ug/L	0.56	ND	0.50	1.9	0.50	0.71	0.50	5145782
Dissolved Copper (Cu)	ug/L	ND	ND	1.0	ND	1.0	ND	1.0	5145782
Dissolved Iron (Fe)	ug/L	1700	9400	100	34000	100	10000	100	5145782
Dissolved Lead (Pb)	ug/L	ND	ND	0.50	ND	0.50	ND	0.50	5145782
Dissolved Molybdenum (Mo)	ug/L	0.86	0.57	0.50	0.81	0.50	ND	0.50	5145782
Dissolved Nickel (Ni)	ug/L	1.2	ND	1.0	ND	1.0	7.9	1.0	5145782
Dissolved Selenium (Se)	ug/L	ND	ND	2.0	ND	2.0	ND	2.0	5145782
Dissolved Silver (Ag)	ug/L	ND	ND	0.10	ND	0.10	ND	0.10	5145782
Dissolved Sodium (Na)	ug/L	15000	6700	100	120000	100	6600	100	5145782
Dissolved Thallium (Tl)	ug/L	ND	ND	0.050	ND	0.050	ND	0.050	5145782
Dissolved Uranium (U)	ug/L	0.31	ND	0.10	ND	0.10	ND	0.10	5145782
Dissolved Vanadium (V)	ug/L	ND	ND	0.50	ND	0.50	ND	0.50	5145782
Dissolved Zinc (Zn)	ug/L	ND	ND	5.0	ND	5.0	ND	5.0	5145782

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B7I8549
Report Date: 2017/09/07

AEL Environment
Client Project #: 10888

O.REG 153 PAHS (WATER)

Maxxam ID		FAR100	FAR101		
Sampling Date		2017/08/28 15:00	2017/08/28 17:15		
COC Number		625116-01-01	625116-01-01		
	UNITS	**A0192 MW1**	**A0193 MW3D**	**RDL**	**QC Batch**
Calculated Parameters					
Methylnaphthalene, 2-(1-)	ug/L	0.26	0.23	0.071	5142569
Polyaromatic Hydrocarbons					
Acenaphthene	ug/L	0.59	0.11	0.050	5146932
Acenaphthylene	ug/L	ND	ND	0.050	5146932
Anthracene	ug/L	0.085	ND	0.050	5146932
Benzo(a)anthracene	ug/L	ND	ND	0.050	5146932
Benzo(a)pyrene	ug/L	ND	ND	0.010	5146932
Benzo(b/j)fluoranthene	ug/L	ND	ND	0.050	5146932
Benzo(g,h,i)perylene	ug/L	ND	ND	0.050	5146932
Benzo(k)fluoranthene	ug/L	ND	ND	0.050	5146932
Chrysene	ug/L	ND	ND	0.050	5146932
Dibenz(a,h)anthracene	ug/L	ND	ND	0.050	5146932
Fluoranthene	ug/L	0.11	ND	0.050	5146932
Fluorene	ug/L	0.53	ND	0.050	5146932
Indeno(1,2,3-cd)pyrene	ug/L	ND	ND	0.050	5146932
1-Methylnaphthalene	ug/L	0.26	0.23	0.050	5146932
2-Methylnaphthalene	ug/L	ND	ND	0.050	5146932
Naphthalene	ug/L	ND	ND	0.050	5146932
Phenanthrene	ug/L	0.56	0.051	0.030	5146932
Pyrene	ug/L	0.072	ND	0.050	5146932
Surrogate Recovery (%)					
D10-Anthracene	%	88	93		5146932
D14-Terphenyl (FS)	%	94	93		5146932
D8-Acenaphthylene	%	111	113		5146932

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B7I8549
Report Date: 2017/09/07

AEL Environment
Client Project #: 10888

O.REG 153 PCBS (WATER)

Maxxam ID		FAR100		FAR101		
Sampling Date		2017/08/28 15:00		2017/08/28 17:15		
COC Number		625116-01-01		625116-01-01		
	UNITS	A0192 MW1	RDL	A0193 MW3D	RDL	QC Batch
PCBs						
Aroclor 1242	ug/L	0.11	0.05	ND	0.5	5145389
Aroclor 1248	ug/L	ND	0.05	ND	0.5	5145389
Aroclor 1254	ug/L	ND	0.05	ND	0.5	5145389
Aroclor 1260	ug/L	0.06	0.05	ND	0.5	5145389
Total PCB	ug/L	0.17	0.05	ND	0.5	5145389
Surrogate Recovery (%)						
Decachlorobiphenyl	%	69		74		5145389

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

O.REG 153 VOCS BY HS & F1-F4 (WATER)

Maxxam ID		FAR099		FAR100	FAR101		FAR102		
Sampling Date		2017/08/28 13:40		2017/08/28 15:00	2017/08/28 17:15		2017/08/28 17:45		
COC Number		625116-01-01		625116-01-01	625116-01-01		625116-01-01		
	UNITS	A0191 MW6	QC Batch	A0192 MW1	A0193 MW3D	QC Batch	A0194 MW3S	RDL	QC Batch
Calculated Parameters									
1,3-Dichloropropene (cis+trans)	ug/L	ND	5143947	ND	ND	5143947	ND	0.50	5143947
Volatile Organics									
Acetone (2-Propanone)	ug/L	ND	5145411	ND	ND	5145411	ND	10	5145411
Benzene	ug/L	ND	5145411	ND	ND	5145411	ND	0.20	5145411
Bromodichloromethane	ug/L	ND	5145411	ND	ND	5145411	ND	0.50	5145411
Bromoform	ug/L	ND	5145411	ND	ND	5145411	ND	1.0	5145411
Bromomethane	ug/L	ND	5145411	ND	ND	5145411	ND	0.50	5145411
Carbon Tetrachloride	ug/L	ND	5145411	ND	ND	5145411	ND	0.20	5145411
Chlorobenzene	ug/L	ND	5145411	3.1	0.73	5145411	ND	0.20	5145411
Chloroform	ug/L	ND	5145411	ND	ND	5145411	ND	0.20	5145411
Dibromochloromethane	ug/L	ND	5145411	ND	ND	5145411	ND	0.50	5145411
1,2-Dichlorobenzene	ug/L	ND	5145411	ND	ND	5145411	ND	0.50	5145411
1,3-Dichlorobenzene	ug/L	ND	5145411	ND	ND	5145411	ND	0.50	5145411
1,4-Dichlorobenzene	ug/L	ND	5145411	ND	ND	5145411	ND	0.50	5145411
Dichlorodifluoromethane (FREON 12)	ug/L	ND	5145411	ND	ND	5145411	ND	1.0	5145411
1,1-Dichloroethane	ug/L	ND	5145411	ND	ND	5145411	ND	0.20	5145411
1,2-Dichloroethane	ug/L	ND	5145411	ND	ND	5145411	ND	0.50	5145411
1,1-Dichloroethylene	ug/L	ND	5145411	ND	ND	5145411	ND	0.20	5145411
cis-1,2-Dichloroethylene	ug/L	ND	5145411	ND	ND	5145411	ND	0.50	5145411
trans-1,2-Dichloroethylene	ug/L	ND	5145411	ND	ND	5145411	ND	0.50	5145411
1,2-Dichloropropane	ug/L	ND	5145411	ND	ND	5145411	ND	0.20	5145411
cis-1,3-Dichloropropene	ug/L	ND	5145411	ND	ND	5145411	ND	0.30	5145411
trans-1,3-Dichloropropene	ug/L	ND	5145411	ND	ND	5145411	ND	0.40	5145411
Ethylbenzene	ug/L	ND	5145411	ND	ND	5145411	ND	0.20	5145411
Ethylene Dibromide	ug/L	ND	5145411	ND	ND	5145411	ND	0.20	5145411
Hexane	ug/L	ND	5145411	ND	ND	5145411	ND	1.0	5145411
Methylene Chloride(Dichloromethane)	ug/L	ND	5145411	ND	ND	5145411	ND	2.0	5145411
Methyl Ethyl Ketone (2-Butanone)	ug/L	ND	5145411	ND	ND	5145411	ND	10	5145411
Methyl Isobutyl Ketone	ug/L	ND	5145411	ND	ND	5145411	ND	5.0	5145411
Methyl t-butyl ether (MTBE)	ug/L	ND	5145411	ND	ND	5145411	ND	0.50	5145411
Styrene	ug/L	ND	5145411	ND	ND	5145411	ND	0.50	5145411
1,1,1,2-Tetrachloroethane	ug/L	ND	5145411	ND	ND	5145411	ND	0.50	5145411
1,1,2,2-Tetrachloroethane	ug/L	ND	5145411	ND	ND	5145411	ND	0.50	5145411
Tetrachloroethylene	ug/L	ND	5145411	ND	ND	5145411	ND	0.20	5145411

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam Job #: B7I8549
Report Date: 2017/09/07

AEL Environment
Client Project #: 10888

O.REG 153 VOCS BY HS & F1-F4 (WATER)

Maxxam ID		FAR099		FAR100	FAR101		FAR102		
Sampling Date		2017/08/28 13:40		2017/08/28 15:00	2017/08/28 17:15		2017/08/28 17:45		
COC Number		625116-01-01		625116-01-01	625116-01-01		625116-01-01		
	UNITS	**A0191 MW6**	**QC Batch**	**A0192 MW1**	**A0193 MW3D**	**QC Batch**	**A0194 MW3S**	**RDL**	**QC Batch**
Toluene	ug/L	ND	5145411	ND	ND	5145411	ND	0.20	5145411
1,1,1-Trichloroethane	ug/L	ND	5145411	ND	ND	5145411	ND	0.20	5145411
1,1,2-Trichloroethane	ug/L	ND	5145411	ND	ND	5145411	ND	0.50	5145411
Trichloroethylene	ug/L	ND	5145411	ND	ND	5145411	ND	0.20	5145411
Trichlorofluoromethane (FREON 11)	ug/L	ND	5145411	ND	ND	5145411	ND	0.50	5145411
Vinyl Chloride	ug/L	ND	5145411	ND	ND	5145411	ND	0.20	5145411
p+m-Xylene	ug/L	ND	5145411	ND	ND	5145411	ND	0.20	5145411
o-Xylene	ug/L	ND	5145411	ND	ND	5145411	ND	0.20	5145411
Total Xylenes	ug/L	ND	5145411	ND	ND	5145411	ND	0.20	5145411
F1 (C6-C10)	ug/L	ND	5145411	ND	ND	5145411	ND	25	5145411
F1 (C6-C10) - BTEX	ug/L	ND	5145411	ND	ND	5145411	ND	25	5145411
F2-F4 Hydrocarbons									
F2 (C10-C16 Hydrocarbons)	ug/L	ND	5146961	ND	ND	5146949	ND	100	5146961
F3 (C16-C34 Hydrocarbons)	ug/L	ND	5146961	260	ND	5146949	310	200	5146961
F4 (C34-C50 Hydrocarbons)	ug/L	ND	5146961	ND	ND	5146949	ND	200	5146961
Reached Baseline at C50	ug/L	Yes	5146961	Yes	Yes	5146949	Yes		5146961
Surrogate Recovery (%)									
o-Terphenyl	%	114	5146961	108	105	5146949	112		5146961
4-Bromofluorobenzene	%	98	5145411	99	97	5145411	97		5145411
D4-1,2-Dichloroethane	%	104	5145411	105	106	5145411	107		5145411
D8-Toluene	%	95	5145411	96	96	5145411	96		5145411

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

TEST SUMMARY

Maxxam ID: FAR099
Sample ID: A0191 MW6
Matrix: Water

Collected: 2017/08/28
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
1,3-Dichloropropene Sum	CALC	5143947	N/A	2017/09/06	Automated Statchk
Chloride by Automated Colourimetry	KONE	5145887	N/A	2017/09/01	Deonarine Ramnarine
Chromium (VI) in Water	IC	5144886	N/A	2017/08/31	Lang Le
Free (WAD) Cyanide	SKAL/CN	5145235	N/A	2017/09/01	Xuanhong Qiu
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	5146961	2017/09/01	2017/09/05	Zhiyue (Frank) Zhu
Mercury	CV/AA	5146814	2017/09/01	2017/09/05	Ron Morrison
Dissolved Metals by ICPMS	ICP/MS	5145782	N/A	2017/09/05	Thao Nguyen
Volatile Organic Compounds and F1 PHCs	GC/MSFD	5145411	N/A	2017/09/02	Blair Gannon

Maxxam ID: FAR100
Sample ID: A0192 MW1
Matrix: Water

Collected: 2017/08/28
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	5142569	N/A	2017/09/07	Automated Statchk
1,3-Dichloropropene Sum	CALC	5143947	N/A	2017/09/06	Automated Statchk
Chloride by Automated Colourimetry	KONE	5145887	N/A	2017/09/01	Deonarine Ramnarine
Chromium (VI) in Water	IC	5144886	N/A	2017/08/31	Lang Le
Free (WAD) Cyanide	SKAL/CN	5145235	N/A	2017/09/01	Xuanhong Qiu
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	5146949	2017/09/01	2017/09/03	Zhiyue (Frank) Zhu
Mercury	CV/AA	5146814	2017/09/01	2017/09/05	Ron Morrison
Dissolved Metals by ICPMS	ICP/MS	5145782	N/A	2017/09/05	Thao Nguyen
PAH Compounds in Water by GC/MS (SIM)	GC/MS	5146932	2017/09/01	2017/09/02	Mitesh Raj
Polychlorinated Biphenyl in Water	GC/ECD	5145389	2017/08/31	2017/09/01	Sarah Huang
Volatile Organic Compounds and F1 PHCs	GC/MSFD	5145411	N/A	2017/09/02	Blair Gannon

Maxxam ID: FAR101
Sample ID: A0193 MW3D
Matrix: Water

Collected: 2017/08/28
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	5142569	N/A	2017/09/07	Automated Statchk
1,3-Dichloropropene Sum	CALC	5143947	N/A	2017/09/06	Automated Statchk
Chloride by Automated Colourimetry	KONE	5145887	N/A	2017/09/01	Deonarine Ramnarine
Chromium (VI) in Water	IC	5144886	N/A	2017/08/31	Lang Le
Free (WAD) Cyanide	SKAL/CN	5145235	N/A	2017/09/01	Xuanhong Qiu
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	5146949	2017/09/01	2017/09/03	Zhiyue (Frank) Zhu
Mercury	CV/AA	5146814	2017/09/01	2017/09/05	Ron Morrison
Dissolved Metals by ICPMS	ICP/MS	5145782	N/A	2017/09/05	Thao Nguyen
PAH Compounds in Water by GC/MS (SIM)	GC/MS	5146932	2017/09/01	2017/09/02	Mitesh Raj
Polychlorinated Biphenyl in Water	GC/ECD	5145389	2017/08/31	2017/09/01	Sarah Huang
Volatile Organic Compounds and F1 PHCs	GC/MSFD	5145411	N/A	2017/09/02	Blair Gannon

TEST SUMMARY

Maxxam ID: FAR102
Sample ID: A0194 MW3S
Matrix: Water

Collected: 2017/08/28
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
1,3-Dichloropropene Sum	CALC	5143947	N/A	2017/09/06	Automated Statchk
Chloride by Automated Colourimetry	KONE	5145887	N/A	2017/09/01	Deonarine Ramnarine
Chromium (VI) in Water	IC	5144886	N/A	2017/08/31	Lang Le
Free (WAD) Cyanide	SKAL/CN	5145235	N/A	2017/09/01	Xuanhong Qiu
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	5146961	2017/09/01	2017/09/05	Zhiyue (Frank) Zhu
Mercury	CV/AA	5146814	2017/09/01	2017/09/05	Ron Morrison
Dissolved Metals by ICPMS	ICP/MS	5145782	N/A	2017/09/05	Thao Nguyen
Volatile Organic Compounds and F1 PHCs	GC/MSFD	5145411	N/A	2017/09/02	Blair Gannon

Maxxam ID: FAR103
Sample ID: TRIP BLANK
Matrix: Water

Collected:
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
1,3-Dichloropropene Sum	CALC	5145154	N/A	2017/09/06	Automated Statchk
Volatile Organic Compounds and F1 PHCs	GC/MSFD	5145411	N/A	2017/09/02	Blair Gannon

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	18.3°C
Package 2	6.0°C
Package 3	19.0°C

All 250mL amber glass bottles for F2-F4 and PAH analyses contained visible sediment, which was included in the extraction.
all 40mL vials for F1BTEX and VOC analyses contained visible sediment except for Trip Blank sample
All 125mL plastic bottles for chromium VI and cyanide analyses contained visible sediment, the 500mL plastic bottle for chloride analysis contained visible sediment

Sample FAR101 [A0193 MW3D] : PCB Analysis: Due to the nature of the sample matrix, a smaller portion of the sample was extracted. DLs were adjusted accordingly

Results relate only to the items tested.

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7I8549
Report Date: 2017/09/07

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
5144886	LLE	Matrix Spike	Chromium (VI)	2017/08/31		101	%	80 - 120
5144886	LLE	Spiked Blank	Chromium (VI)	2017/08/31		102	%	80 - 120
5144886	LLE	Method Blank	Chromium (VI)	2017/08/31	ND, RDL=0.50		ug/L	
5144886	LLE	RPD	Chromium (VI)	2017/08/31	NC		%	20
5145235	XQI	Matrix Spike	WAD Cyanide (Free)	2017/09/01		109	%	80 - 120
5145235	XQI	Spiked Blank	WAD Cyanide (Free)	2017/09/01		101	%	80 - 120
5145235	XQI	Method Blank	WAD Cyanide (Free)	2017/09/01	ND,RDL=1		ug/L	
5145235	XQI	RPD	WAD Cyanide (Free)	2017/09/01	NC		%	20
5145389	SHG	Matrix Spike	Decachlorobiphenyl	2017/09/01		75	%	60 - 130
			Aroclor 1260	2017/09/01		86	%	60 - 130
			Total PCB	2017/09/01		86	%	60 - 130
5145389	SHG	Spiked Blank	Decachlorobiphenyl	2017/09/01		71	%	60 - 130
			Aroclor 1260	2017/09/01		81	%	60 - 130
			Total PCB	2017/09/01		81	%	60 - 130
5145389	SHG	Method Blank	Decachlorobiphenyl	2017/09/01		79	%	60 - 130
			Aroclor 1242	2017/09/01	ND, RDL=0.05		ug/L	
			Aroclor 1248	2017/09/01	ND, RDL=0.05		ug/L	
			Aroclor 1254	2017/09/01	ND, RDL=0.05		ug/L	
			Aroclor 1260	2017/09/01	ND, RDL=0.05		ug/L	
			Total PCB	2017/09/01	ND, RDL=0.05		ug/L	
5145389	SHG	RPD	Aroclor 1242	2017/09/01	NC		%	30
			Aroclor 1248	2017/09/01	NC		%	30
			Aroclor 1254	2017/09/01	NC		%	30
			Aroclor 1260	2017/09/01	NC		%	30
			Total PCB	2017/09/01	NC		%	40
5145411	BG1	Matrix Spike	4-Bromofluorobenzene	2017/09/05		102	%	70 - 130
			D4-1,2-Dichloroethane	2017/09/05		108	%	70 - 130
			D8-Toluene	2017/09/05		102	%	70 - 130
			Acetone (2-Propanone)	2017/09/05		110	%	60 - 140
			Benzene	2017/09/05		115	%	70 - 130
			Bromodichloromethane	2017/09/05		111	%	70 - 130
			Bromoform	2017/09/05		120	%	70 - 130
			Bromomethane	2017/09/05		117	%	60 - 140
			Carbon Tetrachloride	2017/09/05		108	%	70 - 130
			Chlorobenzene	2017/09/05		106	%	70 - 130
			Chloroform	2017/09/05		115	%	70 - 130
			Dibromochloromethane	2017/09/05		116	%	70 - 130
			1,2-Dichlorobenzene	2017/09/05		104	%	70 - 130
			1,3-Dichlorobenzene	2017/09/05		105	%	70 - 130
			1,4-Dichlorobenzene	2017/09/05		106	%	70 - 130
			Dichlorodifluoromethane (FREON 12)	2017/09/05		129	%	60 - 140
			1,1-Dichloroethane	2017/09/05		117	%	70 - 130
			1,2-Dichloroethane	2017/09/05		114	%	70 - 130
			1,1-Dichloroethylene	2017/09/05		118	%	70 - 130
			cis-1,2-Dichloroethylene	2017/09/05		111	%	70 - 130
			trans-1,2-Dichloroethylene	2017/09/05		119	%	70 - 130
			1,2-Dichloropropane	2017/09/05		101	%	70 - 130
			cis-1,3-Dichloropropene	2017/09/05		96	%	70 - 130
			trans-1,3-Dichloropropene	2017/09/05		104	%	70 - 130

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Ethylbenzene	2017/09/05		97	%	70 - 130
			Ethylene Dibromide	2017/09/05		116	%	70 - 130
			Hexane	2017/09/05		113	%	70 - 130
			Methylene Chloride(Dichloromethane)	2017/09/05		120	%	70 - 130
			Methyl Ethyl Ketone (2-Butanone)	2017/09/05		108	%	60 - 140
			Methyl Isobutyl Ketone	2017/09/05		98	%	70 - 130
			Methyl t-butyl ether (MTBE)	2017/09/05		95	%	70 - 130
			Styrene	2017/09/05		96	%	70 - 130
			1,1,1,2-Tetrachloroethane	2017/09/05		120	%	70 - 130
			1,1,2,2-Tetrachloroethane	2017/09/05		118	%	70 - 130
			Tetrachloroethylene	2017/09/05		113	%	70 - 130
			Toluene	2017/09/05		104	%	70 - 130
			1,1,1-Trichloroethane	2017/09/05		107	%	70 - 130
			1,1,2-Trichloroethane	2017/09/05		120	%	70 - 130
			Trichloroethylene	2017/09/05		107	%	70 - 130
			Trichlorofluoromethane (FREON 11)	2017/09/05		118	%	70 - 130
			Vinyl Chloride	2017/09/05		108	%	70 - 130
			p+m-Xylene	2017/09/05		97	%	70 - 130
			o-Xylene	2017/09/05		98	%	70 - 130
			F1 (C6-C10)	2017/09/05		106	%	60 - 140
5145411	BG1	Spiked Blank	4-Bromofluorobenzene	2017/09/02		101	%	70 - 130
			D4-1,2-Dichloroethane	2017/09/02		100	%	70 - 130
			D8-Toluene	2017/09/02		101	%	70 - 130
			Acetone (2-Propanone)	2017/09/02		99	%	60 - 140
			Benzene	2017/09/02		104	%	70 - 130
			Bromodichloromethane	2017/09/02		101	%	70 - 130
			Bromoform	2017/09/02		113	%	70 - 130
			Bromomethane	2017/09/02		103	%	60 - 140
			Carbon Tetrachloride	2017/09/02		103	%	70 - 130
			Chlorobenzene	2017/09/02		101	%	70 - 130
			Chloroform	2017/09/02		100	%	70 - 130
			Dibromochloromethane	2017/09/02		108	%	70 - 130
			1,2-Dichlorobenzene	2017/09/02		101	%	70 - 130
			1,3-Dichlorobenzene	2017/09/02		104	%	70 - 130
			1,4-Dichlorobenzene	2017/09/02		102	%	70 - 130
			Dichlorodifluoromethane (FREON 12)	2017/09/02		103	%	60 - 140
			1,1-Dichloroethane	2017/09/02		105	%	70 - 130
			1,2-Dichloroethane	2017/09/02		100	%	70 - 130
			1,1-Dichloroethylene	2017/09/02		113	%	70 - 130
			cis-1,2-Dichloroethylene	2017/09/02		101	%	70 - 130
			trans-1,2-Dichloroethylene	2017/09/02		106	%	70 - 130
			1,2-Dichloropropane	2017/09/02		97	%	70 - 130
			cis-1,3-Dichloropropene	2017/09/02		95	%	70 - 130
			trans-1,3-Dichloropropene	2017/09/02		98	%	70 - 130
			Ethylbenzene	2017/09/02		98	%	70 - 130
			Ethylene Dibromide	2017/09/02		106	%	70 - 130
			Hexane	2017/09/02		101	%	70 - 130
			Methylene Chloride(Dichloromethane)	2017/09/02		103	%	70 - 130
			Methyl Ethyl Ketone (2-Butanone)	2017/09/02		104	%	60 - 140
			Methyl Isobutyl Ketone	2017/09/02		101	%	70 - 130
			Methyl t-butyl ether (MTBE)	2017/09/02		98	%	70 - 130
			Styrene	2017/09/02		97	%	70 - 130
			1,1,1,2-Tetrachloroethane	2017/09/02		110	%	70 - 130
			1,1,2,2-Tetrachloroethane	2017/09/02		106	%	70 - 130
			Tetrachloroethylene	2017/09/02		100	%	70 - 130

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7I8549
Report Date: 2017/09/07

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Toluene	2017/09/02		98	%	70 - 130
			1,1,1-Trichloroethane	2017/09/02		100	%	70 - 130
			1,1,2-Trichloroethane	2017/09/02		102	%	70 - 130
			Trichloroethylene	2017/09/02		102	%	70 - 130
			Trichlorofluoromethane (FREON 11)	2017/09/02		107	%	70 - 130
			Vinyl Chloride	2017/09/02		103	%	70 - 130
			p+m-Xylene	2017/09/02		101	%	70 - 130
			o-Xylene	2017/09/02		98	%	70 - 130
			F1 (C6-C10)	2017/09/02		99	%	60 - 140
5145411	BG1	Method Blank	4-Bromofluorobenzene	2017/09/02		98	%	70 - 130
			D4-1,2-Dichloroethane	2017/09/02		101	%	70 - 130
			D8-Toluene	2017/09/02		97	%	70 - 130
			Acetone (2-Propanone)	2017/09/02	ND, RDL=10		ug/L	
			Benzene	2017/09/02	ND, RDL=0.20		ug/L	
			Bromodichloromethane	2017/09/02	ND, RDL=0.50		ug/L	
			Bromoform	2017/09/02	ND, RDL=1.0		ug/L	
			Bromomethane	2017/09/02	ND, RDL=0.50		ug/L	
			Carbon Tetrachloride	2017/09/02	ND, RDL=0.20		ug/L	
			Chlorobenzene	2017/09/02	ND, RDL=0.20		ug/L	
			Chloroform	2017/09/02	ND, RDL=0.20		ug/L	
			Dibromochloromethane	2017/09/02	ND, RDL=0.50		ug/L	
			1,2-Dichlorobenzene	2017/09/02	ND, RDL=0.50		ug/L	
			1,3-Dichlorobenzene	2017/09/02	ND, RDL=0.50		ug/L	
			1,4-Dichlorobenzene	2017/09/02	ND, RDL=0.50		ug/L	
			Dichlorodifluoromethane (FREON 12)	2017/09/02	ND, RDL=1.0		ug/L	
			1,1-Dichloroethane	2017/09/02	ND, RDL=0.20		ug/L	
			1,2-Dichloroethane	2017/09/02	ND, RDL=0.50		ug/L	
			1,1-Dichloroethylene	2017/09/02	ND, RDL=0.20		ug/L	
			cis-1,2-Dichloroethylene	2017/09/02	ND, RDL=0.50		ug/L	
			trans-1,2-Dichloroethylene	2017/09/02	ND, RDL=0.50		ug/L	
			1,2-Dichloropropane	2017/09/02	ND, RDL=0.20		ug/L	
			cis-1,3-Dichloropropene	2017/09/02	ND, RDL=0.30		ug/L	
			trans-1,3-Dichloropropene	2017/09/02	ND, RDL=0.40		ug/L	

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Ethylbenzene	2017/09/02	ND, RDL=0.20		ug/L	
			Ethylene Dibromide	2017/09/02	ND, RDL=0.20		ug/L	
			Hexane	2017/09/02	ND, RDL=1.0		ug/L	
			Methylene Chloride(Dichloromethane)	2017/09/02	ND, RDL=2.0		ug/L	
			Methyl Ethyl Ketone (2-Butanone)	2017/09/02	ND, RDL=10		ug/L	
			Methyl Isobutyl Ketone	2017/09/02	ND, RDL=5.0		ug/L	
			Methyl t-butyl ether (MTBE)	2017/09/02	ND, RDL=0.50		ug/L	
			Styrene	2017/09/02	ND, RDL=0.50		ug/L	
			1,1,1,2-Tetrachloroethane	2017/09/02	ND, RDL=0.50		ug/L	
			1,1,2,2-Tetrachloroethane	2017/09/02	ND, RDL=0.50		ug/L	
			Tetrachloroethylene	2017/09/02	ND, RDL=0.20		ug/L	
			Toluene	2017/09/02	ND, RDL=0.20		ug/L	
			1,1,1-Trichloroethane	2017/09/02	ND, RDL=0.20		ug/L	
			1,1,2-Trichloroethane	2017/09/02	ND, RDL=0.50		ug/L	
			Trichloroethylene	2017/09/02	ND, RDL=0.20		ug/L	
			Trichlorofluoromethane (FREON 11)	2017/09/02	ND, RDL=0.50		ug/L	
			Vinyl Chloride	2017/09/02	ND, RDL=0.20		ug/L	
			p+m-Xylene	2017/09/02	ND, RDL=0.20		ug/L	
			o-Xylene	2017/09/02	ND, RDL=0.20		ug/L	
			Total Xylenes	2017/09/02	ND, RDL=0.20		ug/L	
			F1 (C6-C10)	2017/09/02	ND, RDL=25		ug/L	
			F1 (C6-C10) - BTEX	2017/09/02	ND, RDL=25		ug/L	
5145411	BG1	RPD	Acetone (2-Propanone)	2017/09/02	NC		%	30
			Benzene	2017/09/02	NC		%	30
			Bromodichloromethane	2017/09/02	NC		%	30
			Bromoform	2017/09/02	NC		%	30
			Bromomethane	2017/09/02	NC		%	30
			Carbon Tetrachloride	2017/09/02	NC		%	30
			Chlorobenzene	2017/09/02	NC		%	30
			Chloroform	2017/09/02	NC		%	30
			Dibromochloromethane	2017/09/02	NC		%	30
			1,2-Dichlorobenzene	2017/09/02	NC		%	30
			1,3-Dichlorobenzene	2017/09/02	NC		%	30

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7I8549
Report Date: 2017/09/07

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			1,4-Dichlorobenzene	2017/09/02	NC		%	30
			Dichlorodifluoromethane (FREON 12)	2017/09/02	NC		%	30
			1,1-Dichloroethane	2017/09/02	NC		%	30
			1,2-Dichloroethane	2017/09/02	NC		%	30
			1,1-Dichloroethylene	2017/09/02	NC		%	30
			cis-1,2-Dichloroethylene	2017/09/02	NC		%	30
			trans-1,2-Dichloroethylene	2017/09/02	NC		%	30
			1,2-Dichloropropane	2017/09/02	NC		%	30
			cis-1,3-Dichloropropene	2017/09/02	NC		%	30
			trans-1,3-Dichloropropene	2017/09/02	NC		%	30
			Ethylbenzene	2017/09/02	NC		%	30
			Ethylene Dibromide	2017/09/02	NC		%	30
			Hexane	2017/09/02	NC		%	30
			Methylene Chloride(Dichloromethane)	2017/09/02	NC		%	30
			Methyl Ethyl Ketone (2-Butanone)	2017/09/02	NC		%	30
			Methyl Isobutyl Ketone	2017/09/02	NC		%	30
			Methyl t-butyl ether (MTBE)	2017/09/02	NC		%	30
			Styrene	2017/09/02	NC		%	30
			1,1,1,2-Tetrachloroethane	2017/09/02	NC		%	30
			1,1,2,2-Tetrachloroethane	2017/09/02	NC		%	30
			Tetrachloroethylene	2017/09/02	NC		%	30
			Toluene	2017/09/02	NC		%	30
			1,1,1-Trichloroethane	2017/09/02	NC		%	30
			1,1,2-Trichloroethane	2017/09/02	NC		%	30
			Trichloroethylene	2017/09/02	NC		%	30
			Trichlorofluoromethane (FREON 11)	2017/09/02	NC		%	30
			Vinyl Chloride	2017/09/02	NC		%	30
			p+m-Xylene	2017/09/02	NC		%	30
			o-Xylene	2017/09/02	NC		%	30
			Total Xylenes	2017/09/02	NC		%	30
			F1 (C6-C10)	2017/09/02	NC		%	30
			F1 (C6-C10) - BTEX	2017/09/02	NC		%	30
5145782	TNG	Matrix Spike	Dissolved Antimony (Sb)	2017/09/05		101	%	80 - 120
			Dissolved Arsenic (As)	2017/09/05		99	%	80 - 120
			Dissolved Barium (Ba)	2017/09/05		97	%	80 - 120
			Dissolved Beryllium (Be)	2017/09/05		99	%	80 - 120
			Dissolved Boron (B)	2017/09/05		99	%	80 - 120
			Dissolved Cadmium (Cd)	2017/09/05		97	%	80 - 120
			Dissolved Chromium (Cr)	2017/09/05		97	%	80 - 120
			Dissolved Cobalt (Co)	2017/09/05		94	%	80 - 120
			Dissolved Copper (Cu)	2017/09/05		96	%	80 - 120
			Dissolved Iron (Fe)	2017/09/05		98	%	80 - 120
			Dissolved Lead (Pb)	2017/09/05		92	%	80 - 120
			Dissolved Molybdenum (Mo)	2017/09/05		102	%	80 - 120
			Dissolved Nickel (Ni)	2017/09/05		93	%	80 - 120
			Dissolved Selenium (Se)	2017/09/05		98	%	80 - 120
			Dissolved Silver (Ag)	2017/09/05		93	%	80 - 120
			Dissolved Sodium (Na)	2017/09/05		NC	%	80 - 120
			Dissolved Thallium (Tl)	2017/09/05		93	%	80 - 120
			Dissolved Uranium (U)	2017/09/05		99	%	80 - 120
			Dissolved Vanadium (V)	2017/09/05		97	%	80 - 120
			Dissolved Zinc (Zn)	2017/09/05		93	%	80 - 120
5145782	TNG	Spiked Blank	Dissolved Antimony (Sb)	2017/09/05		103	%	80 - 120
			Dissolved Arsenic (As)	2017/09/05		100	%	80 - 120
			Dissolved Barium (Ba)	2017/09/05		100	%	80 - 120

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7I8549
Report Date: 2017/09/07

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Beryllium (Be)	2017/09/05		101	%	80 - 120
			Dissolved Boron (B)	2017/09/05		100	%	80 - 120
			Dissolved Cadmium (Cd)	2017/09/05		100	%	80 - 120
			Dissolved Chromium (Cr)	2017/09/05		98	%	80 - 120
			Dissolved Cobalt (Co)	2017/09/05		97	%	80 - 120
			Dissolved Copper (Cu)	2017/09/05		100	%	80 - 120
			Dissolved Iron (Fe)	2017/09/05		100	%	80 - 120
			Dissolved Lead (Pb)	2017/09/05		96	%	80 - 120
			Dissolved Molybdenum (Mo)	2017/09/05		101	%	80 - 120
			Dissolved Nickel (Ni)	2017/09/05		97	%	80 - 120
			Dissolved Selenium (Se)	2017/09/05		102	%	80 - 120
			Dissolved Silver (Ag)	2017/09/05		98	%	80 - 120
			Dissolved Sodium (Na)	2017/09/05		102	%	80 - 120
			Dissolved Thallium (Tl)	2017/09/05		97	%	80 - 120
			Dissolved Uranium (U)	2017/09/05		101	%	80 - 120
			Dissolved Vanadium (V)	2017/09/05		97	%	80 - 120
			Dissolved Zinc (Zn)	2017/09/05		98	%	80 - 120
5145782	TNG	Method Blank	Dissolved Antimony (Sb)	2017/09/05	ND, RDL=0.50		ug/L	
			Dissolved Arsenic (As)	2017/09/05	ND, RDL=1.0		ug/L	
			Dissolved Barium (Ba)	2017/09/05	ND, RDL=2.0		ug/L	
			Dissolved Beryllium (Be)	2017/09/05	ND, RDL=0.50		ug/L	
			Dissolved Boron (B)	2017/09/05	ND, RDL=10		ug/L	
			Dissolved Cadmium (Cd)	2017/09/05	ND, RDL=0.10		ug/L	
			Dissolved Chromium (Cr)	2017/09/05	ND, RDL=5.0		ug/L	
			Dissolved Cobalt (Co)	2017/09/05	ND, RDL=0.50		ug/L	
			Dissolved Copper (Cu)	2017/09/05	ND, RDL=1.0		ug/L	
			Dissolved Iron (Fe)	2017/09/05	ND, RDL=100		ug/L	
			Dissolved Lead (Pb)	2017/09/05	ND, RDL=0.50		ug/L	
			Dissolved Molybdenum (Mo)	2017/09/05	ND, RDL=0.50		ug/L	
			Dissolved Nickel (Ni)	2017/09/05	ND, RDL=1.0		ug/L	
			Dissolved Selenium (Se)	2017/09/05	ND, RDL=2.0		ug/L	
			Dissolved Silver (Ag)	2017/09/05	ND, RDL=0.10		ug/L	
			Dissolved Sodium (Na)	2017/09/05	ND, RDL=100		ug/L	
			Dissolved Thallium (Tl)	2017/09/05	ND, RDL=0.050		ug/L	
			Dissolved Uranium (U)	2017/09/05	ND, RDL=0.10		ug/L	
			Dissolved Vanadium (V)	2017/09/05	ND, RDL=0.50		ug/L	

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7I8549
Report Date: 2017/09/07

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Zinc (Zn)	2017/09/05	ND, RDL=5.0		ug/L	
5145782	TNG	RPD	Dissolved Antimony (Sb)	2017/09/05	NC		%	20
			Dissolved Arsenic (As)	2017/09/05	2.7		%	20
			Dissolved Barium (Ba)	2017/09/05	1.4		%	20
			Dissolved Beryllium (Be)	2017/09/05	NC		%	20
			Dissolved Boron (B)	2017/09/05	0.076		%	20
			Dissolved Cadmium (Cd)	2017/09/05	NC		%	20
			Dissolved Chromium (Cr)	2017/09/05	NC		%	20
			Dissolved Cobalt (Co)	2017/09/05	3.0		%	20
			Dissolved Copper (Cu)	2017/09/05	NC		%	20
			Dissolved Iron (Fe)	2017/09/05	0.11		%	20
			Dissolved Lead (Pb)	2017/09/05	NC		%	20
			Dissolved Molybdenum (Mo)	2017/09/05	2.3		%	20
			Dissolved Nickel (Ni)	2017/09/05	5.6		%	20
			Dissolved Selenium (Se)	2017/09/05	NC		%	20
			Dissolved Silver (Ag)	2017/09/05	NC		%	20
			Dissolved Sodium (Na)	2017/09/05	0.42		%	20
			Dissolved Thallium (Tl)	2017/09/05	3.8		%	20
			Dissolved Uranium (U)	2017/09/05	0.15		%	20
			Dissolved Vanadium (V)	2017/09/05	NC		%	20
			Dissolved Zinc (Zn)	2017/09/05	NC		%	20
5145887	DRM	Matrix Spike	Dissolved Chloride (Cl)	2017/09/01		102	%	80 - 120
5145887	DRM	Spiked Blank	Dissolved Chloride (Cl)	2017/09/01		103	%	80 - 120
5145887	DRM	Method Blank	Dissolved Chloride (Cl)	2017/09/01	ND, RDL=1.0		mg/L	
5145887	DRM	RPD	Dissolved Chloride (Cl)	2017/09/01	NC		%	20
5146814	RON	Matrix Spike	Mercury (Hg)	2017/09/05		110	%	75 - 125
5146814	RON	Spiked Blank	Mercury (Hg)	2017/09/05		111	%	80 - 120
5146814	RON	Method Blank	Mercury (Hg)	2017/09/05	ND, RDL=0.1		ug/L	
5146814	RON	RPD	Mercury (Hg)	2017/09/05	NC		%	20
5146932	RAJ	Matrix Spike	D10-Anthracene	2017/09/01		103	%	50 - 130
			D14-Terphenyl (FS)	2017/09/01		118	%	50 - 130
			D8-Acenaphthylene	2017/09/01		116	%	50 - 130
			Acenaphthene	2017/09/01		95	%	50 - 130
			Acenaphthylene	2017/09/01		102	%	50 - 130
			Anthracene	2017/09/01		95	%	50 - 130
			Benzo(a)anthracene	2017/09/01		89	%	50 - 130
			Benzo(a)pyrene	2017/09/01		91	%	50 - 130
			Benzo(b/j)fluoranthene	2017/09/01		87	%	50 - 130
			Benzo(g,h,i)perylene	2017/09/01		96	%	50 - 130
			Benzo(k)fluoranthene	2017/09/01		90	%	50 - 130
			Chrysene	2017/09/01		93	%	50 - 130
			Dibenz(a,h)anthracene	2017/09/01		100	%	50 - 130
			Fluoranthene	2017/09/01		100	%	50 - 130
			Fluorene	2017/09/01		89	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2017/09/01		92	%	50 - 130
			1-Methylnaphthalene	2017/09/01		99	%	50 - 130
			2-Methylnaphthalene	2017/09/01		90	%	50 - 130
			Naphthalene	2017/09/01		90	%	50 - 130
			Phenanthrene	2017/09/01		98	%	50 - 130
			Pyrene	2017/09/01		112	%	50 - 130
5146932	RAJ	Spiked Blank	D10-Anthracene	2017/09/01		97	%	50 - 130
			D14-Terphenyl (FS)	2017/09/01		97	%	50 - 130

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			D8-Acenaphthylene	2017/09/01		108	%	50 - 130
			Acenaphthene	2017/09/01		96	%	50 - 130
			Acenaphthylene	2017/09/01		100	%	50 - 130
			Anthracene	2017/09/01		94	%	50 - 130
			Benzo(a)anthracene	2017/09/01		90	%	50 - 130
			Benzo(a)pyrene	2017/09/01		93	%	50 - 130
			Benzo(b/j)fluoranthene	2017/09/01		93	%	50 - 130
			Benzo(g,h,i)perylene	2017/09/01		98	%	50 - 130
			Benzo(k)fluoranthene	2017/09/01		86	%	50 - 130
			Chrysene	2017/09/01		95	%	50 - 130
			Dibenz(a,h)anthracene	2017/09/01		101	%	50 - 130
			Fluoranthene	2017/09/01		94	%	50 - 130
			Fluorene	2017/09/01		96	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2017/09/01		95	%	50 - 130
			1-Methylnaphthalene	2017/09/01		99	%	50 - 130
			2-Methylnaphthalene	2017/09/01		90	%	50 - 130
			Naphthalene	2017/09/01		91	%	50 - 130
			Phenanthrene	2017/09/01		97	%	50 - 130
			Pyrene	2017/09/01		97	%	50 - 130
5146932	RAJ	Method Blank	D10-Anthracene	2017/09/01		95	%	50 - 130
			D14-Terphenyl (FS)	2017/09/01		100	%	50 - 130
			D8-Acenaphthylene	2017/09/01		106	%	50 - 130
			Acenaphthene	2017/09/01	ND, RDL=0.050		ug/L	
			Acenaphthylene	2017/09/01	ND, RDL=0.050		ug/L	
			Anthracene	2017/09/01	ND, RDL=0.050		ug/L	
			Benzo(a)anthracene	2017/09/01	ND, RDL=0.050		ug/L	
			Benzo(a)pyrene	2017/09/01	ND, RDL=0.010		ug/L	
			Benzo(b/j)fluoranthene	2017/09/01	ND, RDL=0.050		ug/L	
			Benzo(g,h,i)perylene	2017/09/01	ND, RDL=0.050		ug/L	
			Benzo(k)fluoranthene	2017/09/01	ND, RDL=0.050		ug/L	
			Chrysene	2017/09/01	ND, RDL=0.050		ug/L	
			Dibenz(a,h)anthracene	2017/09/01	ND, RDL=0.050		ug/L	
			Fluoranthene	2017/09/01	ND, RDL=0.050		ug/L	
			Fluorene	2017/09/01	ND, RDL=0.050		ug/L	
			Indeno(1,2,3-cd)pyrene	2017/09/01	ND, RDL=0.050		ug/L	
			1-Methylnaphthalene	2017/09/01	ND, RDL=0.050		ug/L	
			2-Methylnaphthalene	2017/09/01	ND, RDL=0.050		ug/L	
			Naphthalene	2017/09/01	ND, RDL=0.050		ug/L	

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7I8549
Report Date: 2017/09/07

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Phenanthrene	2017/09/01	ND, RDL=0.030		ug/L	
			Pyrene	2017/09/01	ND, RDL=0.050		ug/L	
5146932	RAJ	RPD	Acenaphthene	2017/09/01	NC		%	30
			Acenaphthylene	2017/09/01	NC		%	30
			Anthracene	2017/09/01	NC		%	30
			Benzo(a)anthracene	2017/09/01	NC		%	30
			Benzo(a)pyrene	2017/09/01	NC		%	30
			Benzo(b/j)fluoranthene	2017/09/01	NC		%	30
			Benzo(g,h,i)perylene	2017/09/01	NC		%	30
			Benzo(k)fluoranthene	2017/09/01	NC		%	30
			Chrysene	2017/09/01	NC		%	30
			Dibenz(a,h)anthracene	2017/09/01	NC		%	30
			Fluoranthene	2017/09/01	NC		%	30
			Fluorene	2017/09/01	NC		%	30
			Indeno(1,2,3-cd)pyrene	2017/09/01	NC		%	30
			1-Methylnaphthalene	2017/09/01	NC		%	30
			2-Methylnaphthalene	2017/09/01	NC		%	30
			Naphthalene	2017/09/01	NC		%	30
			Phenanthrene	2017/09/01	NC		%	30
			Pyrene	2017/09/01	NC		%	30
5146949	ZZ	Matrix Spike	o-Terphenyl	2017/09/03		107	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2017/09/03		95	%	50 - 130
			F3 (C16-C34 Hydrocarbons)	2017/09/03		94	%	50 - 130
			F4 (C34-C50 Hydrocarbons)	2017/09/03		92	%	50 - 130
5146949	ZZ	Spiked Blank	o-Terphenyl	2017/09/03		109	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2017/09/03		97	%	60 - 130
			F3 (C16-C34 Hydrocarbons)	2017/09/03		98	%	60 - 130
			F4 (C34-C50 Hydrocarbons)	2017/09/03		93	%	60 - 130
5146949	ZZ	Method Blank	o-Terphenyl	2017/09/03		106	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2017/09/03	ND, RDL=100		ug/L	
			F3 (C16-C34 Hydrocarbons)	2017/09/03	ND, RDL=200		ug/L	
			F4 (C34-C50 Hydrocarbons)	2017/09/03	ND, RDL=200		ug/L	
5146949	ZZ	RPD	F2 (C10-C16 Hydrocarbons)	2017/09/03	NC		%	30
			F3 (C16-C34 Hydrocarbons)	2017/09/03	NC		%	30
			F4 (C34-C50 Hydrocarbons)	2017/09/03	NC		%	30
5146961	ZZ	Matrix Spike	o-Terphenyl	2017/09/05		120	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2017/09/05		110	%	50 - 130
			F3 (C16-C34 Hydrocarbons)	2017/09/05		111	%	50 - 130
			F4 (C34-C50 Hydrocarbons)	2017/09/05		110	%	50 - 130
5146961	ZZ	Spiked Blank	o-Terphenyl	2017/09/05		118	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2017/09/05		107	%	60 - 130
			F3 (C16-C34 Hydrocarbons)	2017/09/05		113	%	60 - 130
			F4 (C34-C50 Hydrocarbons)	2017/09/05		111	%	60 - 130
5146961	ZZ	Method Blank	o-Terphenyl	2017/09/05		114	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2017/09/05	ND, RDL=100		ug/L	
			F3 (C16-C34 Hydrocarbons)	2017/09/05	ND, RDL=200		ug/L	
			F4 (C34-C50 Hydrocarbons)	2017/09/05	ND, RDL=200		ug/L	

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
5146961	ZZ	RPD	F2 (C10-C16 Hydrocarbons)	2017/09/05	NC		%	30
			F3 (C16-C34 Hydrocarbons)	2017/09/05	NC		%	30
			F4 (C34-C50 Hydrocarbons)	2017/09/05	NC		%	30

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

VALIDATION SIGNATURE PAGE

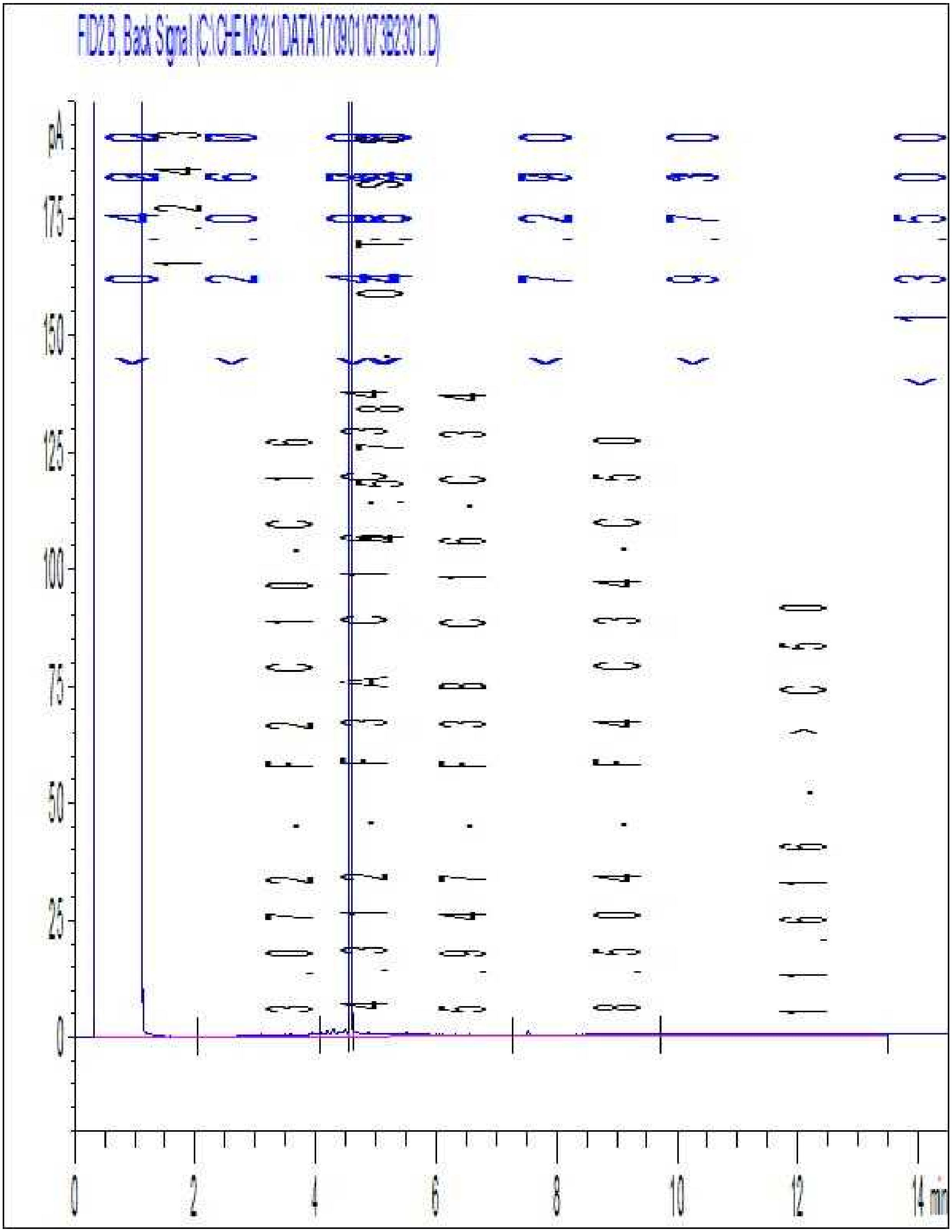
The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

CHARTERED
Eva Pranjic
CHEMIST

Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

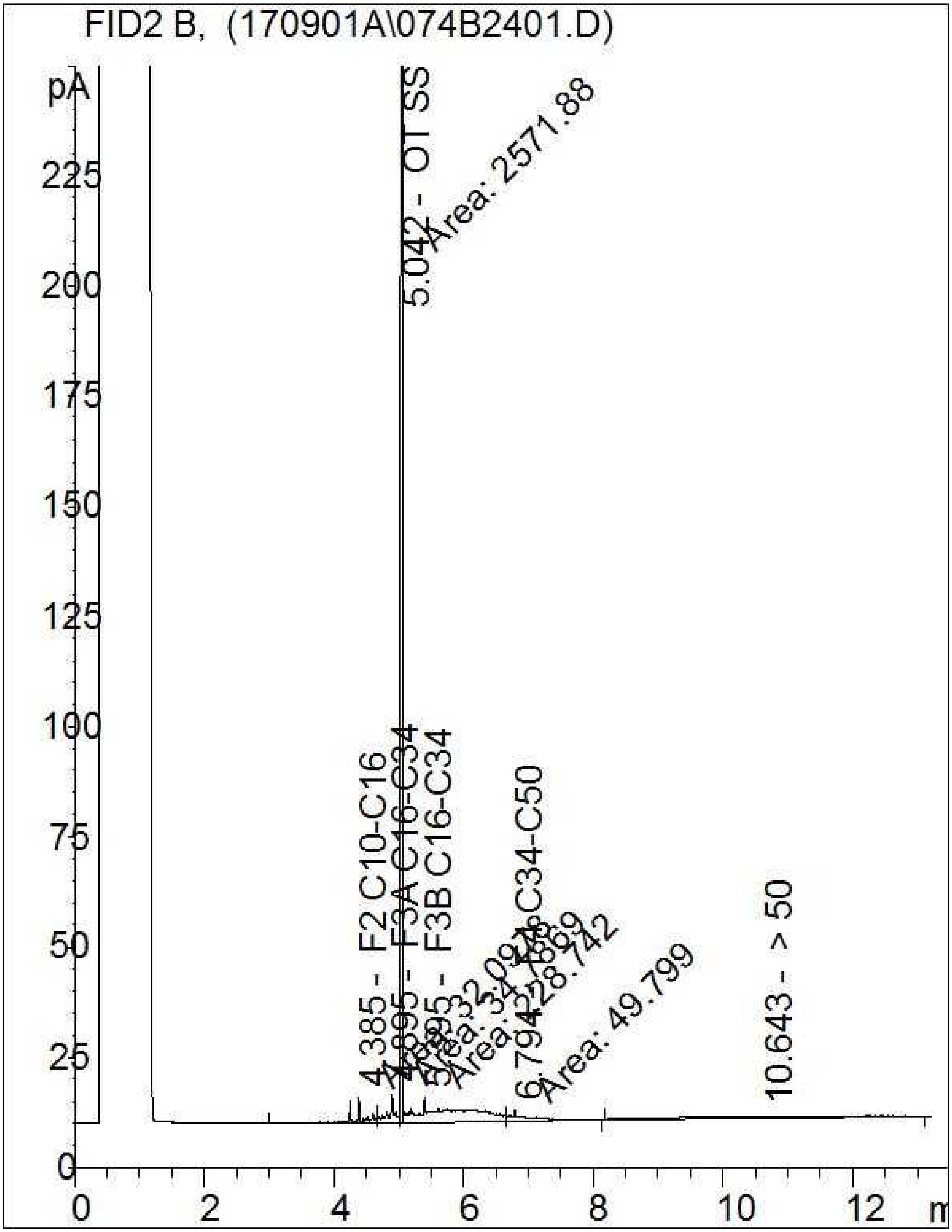


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7I8549
Report Date: 2017/09/07
Maxxam Sample: FAR100

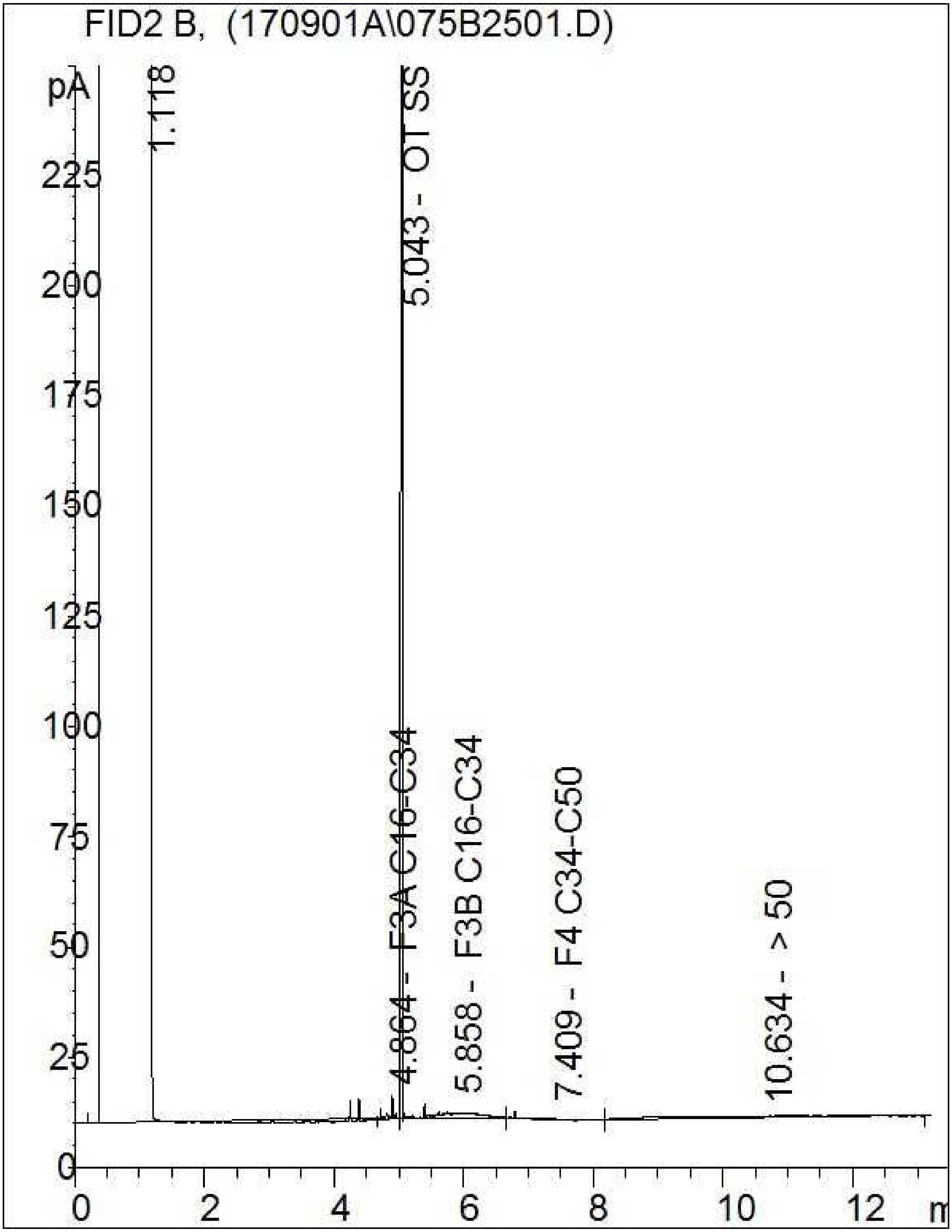
AEL Environment
Client Project #: 10888
Client ID: A0192 MW1

Petroleum Hydrocarbons F2-F4 in Water Chromatogram



Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

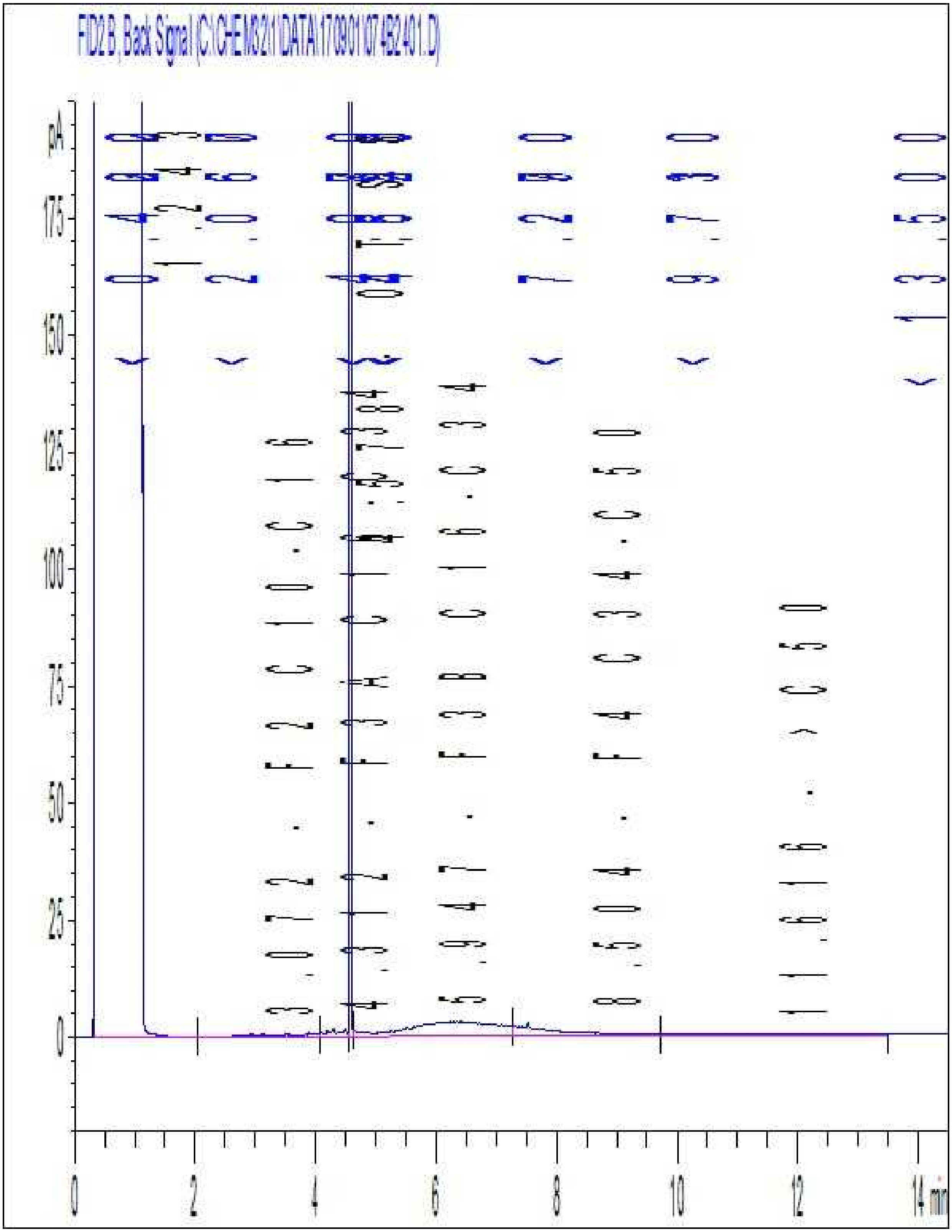


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7I8549
Report Date: 2017/09/07
Maxxam Sample: FAR102

AEL Environment
Client Project #: 10888
Client ID: A0194 MW3S

Petroleum Hydrocarbons F2-F4 in Water Chromatogram



Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam
A Bureau Veritas Group Company

Your Project #: 10888
Your C.O.C. #: 625116-02-01

Attention:Reporting Group

AEL Environment
1705 Argentia Rd
Unit 3
Mississauga, ON
CANADA L5N 3A9

Report Date: 2017/09/12
Report #: R4695926
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7J0380
Received: 2017/08/31, 16:00

Sample Matrix: Water
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
1,3-Dichloropropene Sum (1)	4	N/A	2017/09/07		EPA 8260C m
Chloride by Automated Colourimetry (1)	4	N/A	2017/09/05	CAM SOP-00463	EPA 325.2 m
Chromium (VI) in Water (1)	4	N/A	2017/09/07	CAM SOP-00436	EPA 7199 m
Free (WAD) Cyanide (1)	4	N/A	2017/09/08	CAM SOP-00457	OMOE E3015 m
Petroleum Hydrocarbons F2-F4 in Water (1, 2)	4	2017/09/06	2017/09/07	CAM SOP-00316	CCME PHC-CWS m
F4G (CCME Hydrocarbons Gravimetric) (1)	3	2017/09/08	2017/09/08	CAM SOP-00326	CCME PHC-CWS m
Fluoride (1)	4	2017/09/06	2017/09/07	CAM SOP-00449	SM 22 4500-F C m
Mercury (low level) (1)	4	2017/09/06	2017/09/07	CAM SOP-00453	EPA 7470 m
Nitrate (NO3) and Nitrite (NO2) in Water (1, 3)	4	N/A	2017/09/06	CAM SOP-00440	SM 22 4500-NO3I/NO2B
PAH Compounds in Water by GC/MS (SIM) (1)	1	2017/09/06	2017/09/07	CAM SOP-00318	EPA 8270 m
Polychlorinated Biphenyl (PCB) (1)	1	2017/09/05	2017/09/06	CAM SOP-00309	EPA 8082A m
pH (1)	4	N/A	2017/09/06	CAM SOP-00413	SM 4500H+ B m
Sulphate by Automated Colourimetry (1)	4	N/A	2017/09/06	CAM SOP-00464	EPA 375.4 m
Volatile Organic Compounds and F1 PHCs (1)	4	N/A	2017/09/05	CAM SOP-00230	EPA 8260C m

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested.

Your Project #: 10888
Your C.O.C. #: 625116-02-01

Attention:Reporting Group

AEL Environment
1705 Argentia Rd
Unit 3
Mississauga, ON
CANADA L5N 3A9

Report Date: 2017/09/12
Report #: R4695926
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7J0380

Received: 2017/08/31, 16:00

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) This test was performed by Maxxam Analytics Mississauga
(2) All CCME PHC results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Maxxam conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following “Alberta Environment’s Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Validation of Performance-Based Alternative Methods September 2003”. Documentation is available upon request. Modifications from Reference Method for the Canada-wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method: F2/F3/F4 data reported using validated cold solvent extraction instead of Soxhlet extraction.
(3) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Antonella Brasil, Senior Project Manager
Email: ABrasil@maxxam.ca
Phone# (905)817-5817
==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam Job #: B7J0380
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888

CCME GROUNDWATER INORGANICS PACKAGE (WATER)

Maxxam ID		FAZ634	FAZ635		FAZ636	FAZ636			
Sampling Date		2017/08/31 09:10	2017/08/31 11:20		2017/08/31 11:25	2017/08/31 11:25			
COC Number		625116-02-01	625116-02-01		625116-02-01	625116-02-01			
	UNITS	**A0240- MW7/17**	**A0246- MW8/17**	**QC Batch**	**A0247- MW8/17**	**A0247- MW8/17 Lab-Dup**	**RDL**	**MDL**	**QC Batch**
Inorganics									
Fluoride (F-)	mg/L	0.12	ND	5152347	ND		0.10	0.020	5152347
pH	pH	6.93	6.97	5150362	7.21				5150362
Dissolved Sulphate (SO4)	mg/L	6.3	6.3	5150939	6.2		1.0	0.10	5150021
WAD Cyanide (Free)	mg/L	0.0023	ND	5155526	ND		0.0010	0.00040	5155526
Dissolved Chloride (Cl)	mg/L	9.5	140	5148483	140	140	1.0	0.30	5148654
Nitrite (N)	mg/L	ND	ND	5150274	ND		0.010	0.0020	5150274
Nitrate (N)	mg/L	ND	ND	5150274	ND		0.10	0.010	5150274
Nitrate + Nitrite (N)	mg/L	ND	ND	5150274	ND		0.10	0.010	5150274
Metals									
Mercury (Hg)	ug/L	ND	ND	5150783	ND		0.01	0.004	5150783

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

Maxxam ID		FAZ637			
Sampling Date		2017/08/31 12:35			
COC Number		625116-02-01			
	UNITS	**A0248- MW10/17**	**RDL**	**MDL**	**QC Batch**
Inorganics					
Fluoride (F-)	mg/L	ND	0.10	0.020	5152347
pH	pH	6.81			5150362
Dissolved Sulphate (SO4)	mg/L	5.2	1.0	0.10	5150021
WAD Cyanide (Free)	mg/L	ND	0.0010	0.00040	5155526
Dissolved Chloride (Cl)	mg/L	22	1.0	0.30	5148483
Nitrite (N)	mg/L	ND	0.010	0.0020	5150274
Nitrate (N)	mg/L	ND	0.10	0.010	5150274
Nitrate + Nitrite (N)	mg/L	ND	0.10	0.010	5150274
Metals					
Mercury (Hg)	ug/L	ND	0.01	0.004	5150783

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		FAZ634	FAZ635	FAZ636	FAZ637			
Sampling Date		2017/08/31 09:10	2017/08/31 11:20	2017/08/31 11:25	2017/08/31 12:35			
COC Number		625116-02-01	625116-02-01	625116-02-01	625116-02-01			
	UNITS	**A0240- MW7/17**	**A0246- MW8/17**	**A0247- MW8/17**	**A0248- MW10/17**	**RDL**	**MDL**	**QC Batch**
Metals								
Chromium (VI)	ug/L	ND	ND	ND	ND	0.50	0.30	5152223

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam Job #: B7J0380
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888

SEMI-VOLATILE ORGANICS BY GC-MS (WATER)

Maxxam ID		FAZ637			
Sampling Date		2017/08/31 12:35			
COC Number		625116-02-01			
	UNITS	**A0248- MW10/17**	**RDL**	**MDL**	**QC Batch**
Polyaromatic Hydrocarbons					
Acenaphthene	ug/L	0.46	0.010	0.010	5152033
Acenaphthylene	ug/L	0.013	0.010	0.010	5152033
Anthracene	ug/L	0.053	0.010	0.010	5152033
Benzo(a)anthracene	ug/L	0.060	0.010	0.010	5152033
Benzo(a)pyrene	ug/L	0.055	0.010	0.010	5152033
Benzo(b/j)fluoranthene	ug/L	0.055	0.010	0.010	5152033
Benzo(g,h,i)perylene	ug/L	0.059	0.010	0.010	5152033
Benzo(k)fluoranthene	ug/L	0.022	0.010	0.010	5152033
Chrysene	ug/L	0.062	0.010	0.010	5152033
Dibenz(a,h)anthracene	ug/L	ND	0.010	0.010	5152033
Fluoranthene	ug/L	0.18	0.010	0.010	5152033
Fluorene	ug/L	0.45	0.010	0.010	5152033
Indeno(1,2,3-cd)pyrene	ug/L	0.049	0.010	0.010	5152033
1-Methylnaphthalene	ug/L	6.0	0.010	0.010	5152033
2-Methylnaphthalene	ug/L	7.8	0.010	0.010	5152033
Naphthalene	ug/L	27	0.010	0.010	5152033
Phenanthrene	ug/L	0.33	0.010	0.010	5152033
Pyrene	ug/L	0.12	0.010	0.010	5152033
Surrogate Recovery (%)					
D10-Anthracene	%	58			5152033
D14-Terphenyl (FS)	%	33 (1)			5152033
D8-Acenaphthylene	%	108			5152033

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected
(1) Surrogate recovery was below the lower control limit due to matrix interference. This may represent a low bias in some results.

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

PETROLEUM HYDROCARBONS (CCME)

Maxxam ID		FAZ634	FAZ636	FAZ637			
Sampling Date		2017/08/31 09:10	2017/08/31 11:25	2017/08/31 12:35			
COC Number		625116-02-01	625116-02-01	625116-02-01			
	UNITS	**A0240- MW7/17**	**A0247- MW8/17**	**A0248- MW10/17**	**RDL**	**MDL**	**QC Batch**
F2-F4 Hydrocarbons							
F4G-sg (Grav. Heavy Hydrocarbons)	ug/L	6400	30000	1600	500	N/A	5154922

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

POLYCHLORINATED BIPHENYLS BY GC-ECD (WATER)

Maxxam ID		FAZ637	FAZ637			
Sampling Date		2017/08/31 12:35	2017/08/31 12:35			
COC Number		625116-02-01	625116-02-01			
	UNITS	**A0248- MW10/17**	**A0248- MW10/17 Lab-Dup**	**RDL**	**MDL**	**QC Batch**
PCBs						
Aroclor 1016	ug/L	ND	ND	0.01	N/A	5150530
Aroclor 1221	ug/L	ND	ND	0.01	N/A	5150530
Aroclor 1232	ug/L	ND	ND	0.01	N/A	5150530
Aroclor 1262	ug/L	ND	ND	0.01	N/A	5150530
Aroclor 1268	ug/L	ND	ND	0.01	N/A	5150530
Aroclor 1242	ug/L	0.27	0.29	0.01	N/A	5150530
Aroclor 1248	ug/L	ND	ND	0.01	N/A	5150530
Aroclor 1254	ug/L	0.06	0.06	0.01	N/A	5150530
Aroclor 1260	ug/L	0.18	0.20	0.01	N/A	5150530
Total PCB	ug/L	0.51	0.56	0.01	N/A	5150530
Surrogate Recovery (%)						
Decachlorobiphenyl	%	85	86			5150530

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected
N/A = Not Applicable

Maxxam Job #: B7J0380
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888

O.REG 153 VOCS BY HS & F1-F4 (WATER)

Maxxam ID		FAZ634	FAZ635	FAZ636	FAZ637			
Sampling Date		2017/08/31 09:10	2017/08/31 11:20	2017/08/31 11:25	2017/08/31 12:35			
COC Number		625116-02-01	625116-02-01	625116-02-01	625116-02-01			
	UNITS	A0240- MW7/17	A0246- MW8/17	A0247- MW8/17	A0248- MW10/17	RDL	MDL	QC Batch
Calculated Parameters								
1,3-Dichloropropene (cis+trans)	ug/L	ND	ND	ND	ND	0.50	0.50	5146863
Volatile Organics								
Acetone (2-Propanone)	ug/L	ND	ND	ND	15	10	1.0	5147029
Benzene	ug/L	ND	ND	ND	0.71	0.20	0.020	5147029
Bromodichloromethane	ug/L	ND	ND	ND	ND	0.50	0.050	5147029
Bromoform	ug/L	ND	ND	ND	ND	1.0	0.10	5147029
Bromomethane	ug/L	ND	ND	ND	ND	0.50	0.10	5147029
Carbon Tetrachloride	ug/L	ND	ND	ND	ND	0.20	0.050	5147029
Chlorobenzene	ug/L	0.37	ND	ND	2.2	0.20	0.010	5147029
Chloroform	ug/L	ND	ND	ND	ND	0.20	0.050	5147029
Dibromochloromethane	ug/L	ND	ND	ND	ND	0.50	0.050	5147029
1,2-Dichlorobenzene	ug/L	ND	ND	ND	ND	0.50	0.050	5147029
1,3-Dichlorobenzene	ug/L	ND	ND	ND	ND	0.50	0.050	5147029
1,4-Dichlorobenzene	ug/L	ND	ND	ND	ND	0.50	0.050	5147029
Dichlorodifluoromethane (FREON 12)	ug/L	ND	ND	ND	ND	1.0	0.050	5147029
1,1-Dichloroethane	ug/L	ND	ND	ND	ND	0.20	0.050	5147029
1,2-Dichloroethane	ug/L	ND	ND	ND	ND	0.50	0.020	5147029
1,1-Dichloroethylene	ug/L	ND	ND	ND	ND	0.20	0.050	5147029
cis-1,2-Dichloroethylene	ug/L	ND	ND	ND	ND	0.50	0.050	5147029
trans-1,2-Dichloroethylene	ug/L	ND	ND	ND	ND	0.50	0.050	5147029
1,2-Dichloropropane	ug/L	ND	ND	ND	ND	0.20	0.050	5147029
cis-1,3-Dichloropropene	ug/L	ND	ND	ND	ND	0.30	0.050	5147029
trans-1,3-Dichloropropene	ug/L	ND	ND	ND	ND	0.40	0.050	5147029
Ethylbenzene	ug/L	ND	ND	ND	29	0.20	0.010	5147029
Ethylene Dibromide	ug/L	ND	ND	ND	ND	0.20	0.050	5147029
Hexane	ug/L	ND	ND	ND	ND	1.0	0.10	5147029
Methylene Chloride(Dichloromethane)	ug/L	ND	ND	ND	ND	2.0	0.10	5147029
Methyl Ethyl Ketone (2-Butanone)	ug/L	ND	ND	ND	ND	10	0.50	5147029
Methyl Isobutyl Ketone	ug/L	ND	ND	ND	ND	5.0	0.10	5147029
Methyl t-butyl ether (MTBE)	ug/L	ND	ND	ND	ND	0.50	0.050	5147029
Styrene	ug/L	ND	ND	ND	ND	0.50	0.050	5147029
1,1,1,2-Tetrachloroethane	ug/L	ND	ND	ND	ND	0.50	0.050	5147029

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

O.REG 153 VOCS BY HS & F1-F4 (WATER)

Maxxam ID		FAZ634	FAZ635	FAZ636	FAZ637			
Sampling Date		2017/08/31 09:10	2017/08/31 11:20	2017/08/31 11:25	2017/08/31 12:35			
COC Number		625116-02-01	625116-02-01	625116-02-01	625116-02-01			
	UNITS	**A0240- MW7/17**	**A0246- MW8/17**	**A0247- MW8/17**	**A0248- MW10/17**	**RDL**	**MDL**	**QC Batch**
1,1,2,2-Tetrachloroethane	ug/L	ND	ND	ND	ND	0.50	0.050	5147029
Tetrachloroethylene	ug/L	ND	ND	ND	ND	0.20	0.050	5147029
Toluene	ug/L	ND	0.27	0.30	2.7	0.20	0.010	5147029
1,1,1-Trichloroethane	ug/L	ND	ND	ND	ND	0.20	0.050	5147029
1,1,2-Trichloroethane	ug/L	ND	ND	ND	ND	0.50	0.050	5147029
Trichloroethylene	ug/L	ND	ND	ND	ND	0.20	0.050	5147029
Trichlorofluoromethane (FREON 11)	ug/L	ND	ND	ND	ND	0.50	0.10	5147029
Vinyl Chloride	ug/L	ND	ND	ND	ND	0.20	0.050	5147029
p+m-Xylene	ug/L	0.34	ND	ND	160	0.20	0.010	5147029
o-Xylene	ug/L	ND	ND	ND	170	0.20	0.010	5147029
Total Xylenes	ug/L	0.34	ND	ND	340	0.20	0.010	5147029
F1 (C6-C10)	ug/L	ND	ND	ND	690	25	N/A	5147029
F1 (C6-C10) - BTEX	ug/L	ND	ND	ND	320	25	N/A	5147029
F2-F4 Hydrocarbons								
F2 (C10-C16 Hydrocarbons)	ug/L	ND	270	340	530	100	50	5152340
F3 (C16-C34 Hydrocarbons)	ug/L	3700	4100	19000	350	200	70	5152340
F4 (C34-C50 Hydrocarbons)	ug/L	2100	7300	9700	530	200	50	5152340
Reached Baseline at C50	ug/L	No	No	No	No			5152340
Surrogate Recovery (%)								
o-Terphenyl	%	108	107	109	106			5152340
4-Bromofluorobenzene	%	93	95	93	103			5147029
D4-1,2-Dichloroethane	%	114	116	116	118			5147029
D8-Toluene	%	92	92	92	93			5147029

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected
N/A = Not Applicable

O.REG 153 VOCS BY HS & F1-F4 (WATER)

Maxxam ID		FAZ637			
Sampling Date		2017/08/31 12:35			
COC Number		625116-02-01			
	UNITS	**A0248-MW10/17 Lab-Dup**	**RDL**	**MDL**	**QC Batch**
F2-F4 Hydrocarbons					
F2 (C10-C16 Hydrocarbons)	ug/L	530	100	50	5152340
F3 (C16-C34 Hydrocarbons)	ug/L	520	200	70	5152340
F4 (C34-C50 Hydrocarbons)	ug/L	700	200	50	5152340
Reached Baseline at C50	ug/L	No			5152340
Surrogate Recovery (%)					
o-Terphenyl	%	106			5152340

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

Maxxam Job #: B7J0380
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888

TEST SUMMARY

Maxxam ID: FAZ634
Sample ID: A0240- MW7/17
Matrix: Water

Collected: 2017/08/31
Shipped:
Received: 2017/08/31

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
1,3-Dichloropropene Sum	CALC	5146863	N/A	2017/09/07	Automated Statchk
Chloride by Automated Colourimetry	KONE	5148483	N/A	2017/09/05	Alina Dobreanu
Chromium (VI) in Water	IC	5152223	N/A	2017/09/07	Lang Le
Free (WAD) Cyanide	SKAL/CN	5155526	N/A	2017/09/08	Louise Harding
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	5152340	2017/09/06	2017/09/07	Zhiyue (Frank) Zhu
F4G (CCME Hydrocarbons Gravimetric)	BAL	5154922	2017/09/08	2017/09/08	Francis Afonso
Fluoride	ISE	5152347	2017/09/06	2017/09/07	Surinder Rai
Mercury (low level)	CV/AA	5150783	2017/09/06	2017/09/07	Ron Morrison
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5150274	N/A	2017/09/06	Chandra Nandlal
pH	AT	5150362	N/A	2017/09/06	Tahir Anwar
Sulphate by Automated Colourimetry	KONE	5150939	N/A	2017/09/06	Alina Dobreanu
Volatile Organic Compounds and F1 PHCs	GC/MSFD	5147029	N/A	2017/09/05	Xueming Jiang

Maxxam ID: FAZ635
Sample ID: A0246- MW8/17
Matrix: Water

Collected: 2017/08/31
Shipped:
Received: 2017/08/31

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
1,3-Dichloropropene Sum	CALC	5146863	N/A	2017/09/07	Automated Statchk
Chloride by Automated Colourimetry	KONE	5148483	N/A	2017/09/05	Alina Dobreanu
Chromium (VI) in Water	IC	5152223	N/A	2017/09/07	Lang Le
Free (WAD) Cyanide	SKAL/CN	5155526	N/A	2017/09/08	Louise Harding
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	5152340	2017/09/06	2017/09/07	Zhiyue (Frank) Zhu
Fluoride	ISE	5152347	2017/09/06	2017/09/07	Surinder Rai
Mercury (low level)	CV/AA	5150783	2017/09/06	2017/09/07	Ron Morrison
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5150274	N/A	2017/09/06	Chandra Nandlal
pH	AT	5150362	N/A	2017/09/06	Tahir Anwar
Sulphate by Automated Colourimetry	KONE	5150939	N/A	2017/09/06	Alina Dobreanu
Volatile Organic Compounds and F1 PHCs	GC/MSFD	5147029	N/A	2017/09/05	Xueming Jiang

Maxxam ID: FAZ636
Sample ID: A0247- MW8/17
Matrix: Water

Collected: 2017/08/31
Shipped:
Received: 2017/08/31

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
1,3-Dichloropropene Sum	CALC	5146863	N/A	2017/09/07	Automated Statchk
Chloride by Automated Colourimetry	KONE	5148654	N/A	2017/09/05	Alina Dobreanu
Chromium (VI) in Water	IC	5152223	N/A	2017/09/07	Lang Le
Free (WAD) Cyanide	SKAL/CN	5155526	N/A	2017/09/08	Louise Harding
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	5152340	2017/09/06	2017/09/07	Zhiyue (Frank) Zhu
F4G (CCME Hydrocarbons Gravimetric)	BAL	5154922	2017/09/08	2017/09/08	Francis Afonso
Fluoride	ISE	5152347	2017/09/06	2017/09/07	Surinder Rai
Mercury (low level)	CV/AA	5150783	2017/09/06	2017/09/07	Ron Morrison
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5150274	N/A	2017/09/06	Chandra Nandlal
pH	AT	5150362	N/A	2017/09/06	Tahir Anwar
Sulphate by Automated Colourimetry	KONE	5150021	N/A	2017/09/06	Alina Dobreanu

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J0380
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888

TEST SUMMARY

Maxxam ID: FAZ636
Sample ID: A0247- MW8/17
Matrix: Water

Collected: 2017/08/31
Shipped:
Received: 2017/08/31

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Volatile Organic Compounds and F1 PHCs	GC/MSFD	5147029	N/A	2017/09/05	Xueming Jiang

Maxxam ID: FAZ636 Dup
Sample ID: A0247- MW8/17
Matrix: Water

Collected: 2017/08/31
Shipped:
Received: 2017/08/31

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride by Automated Colourimetry	KONE	5148654	N/A	2017/09/05	Alina Dobreanu

Maxxam ID: FAZ637
Sample ID: A0248- MW10/17
Matrix: Water

Collected: 2017/08/31
Shipped:
Received: 2017/08/31

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
1,3-Dichloropropene Sum	CALC	5146863	N/A	2017/09/07	Automated Statchk
Chloride by Automated Colourimetry	KONE	5148483	N/A	2017/09/05	Alina Dobreanu
Chromium (VI) in Water	IC	5152223	N/A	2017/09/07	Lang Le
Free (WAD) Cyanide	SKAL/CN	5155526	N/A	2017/09/08	Louise Harding
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	5152340	2017/09/06	2017/09/07	Zhiyue (Frank) Zhu
F4G (CCME Hydrocarbons Gravimetric)	BAL	5154922	2017/09/08	2017/09/08	Francis Afonso
Fluoride	ISE	5152347	2017/09/06	2017/09/07	Surinder Rai
Mercury (low level)	CV/AA	5150783	2017/09/06	2017/09/07	Ron Morrison
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5150274	N/A	2017/09/06	Chandra Nandlal
PAH Compounds in Water by GC/MS (SIM)	GC/MS	5152033	2017/09/06	2017/09/07	Mitesh Raj
Polychlorinated Biphenyl (PCB)	GC/ECD	5150530	2017/09/05	2017/09/06	Dawn Alarie
pH	AT	5150362	N/A	2017/09/06	Tahir Anwar
Sulphate by Automated Colourimetry	KONE	5150021	N/A	2017/09/06	Alina Dobreanu
Volatile Organic Compounds and F1 PHCs	GC/MSFD	5147029	N/A	2017/09/05	Xueming Jiang

Maxxam ID: FAZ637 Dup
Sample ID: A0248- MW10/17
Matrix: Water

Collected: 2017/08/31
Shipped:
Received: 2017/08/31

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	5152340	2017/09/06	2017/09/07	Zhiyue (Frank) Zhu
Polychlorinated Biphenyl (PCB)	GC/ECD	5150530	2017/09/05	2017/09/06	Dawn Alarie

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	7.0°C

Cooler custody seal was present and intact.

Results relate only to the items tested.

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
5147029	XJI	Matrix Spike	4-Bromofluorobenzene	2017/09/05		102	%	70 - 130
			D4-1,2-Dichloroethane	2017/09/05		112	%	70 - 130
			D8-Toluene	2017/09/05		100	%	70 - 130
			Acetone (2-Propanone)	2017/09/05		115	%	60 - 140
			Benzene	2017/09/05		111	%	70 - 130
			Bromodichloromethane	2017/09/05		108	%	70 - 130
			Bromoform	2017/09/05		120	%	70 - 130
			Bromomethane	2017/09/05		113	%	60 - 140
			Carbon Tetrachloride	2017/09/05		100	%	70 - 130
			Chlorobenzene	2017/09/05		102	%	70 - 130
			Chloroform	2017/09/05		109	%	70 - 130
			Dibromochloromethane	2017/09/05		114	%	70 - 130
			1,2-Dichlorobenzene	2017/09/05		101	%	70 - 130
			1,3-Dichlorobenzene	2017/09/05		100	%	70 - 130
			1,4-Dichlorobenzene	2017/09/05		100	%	70 - 130
			Dichlorodifluoromethane (FREON 12)	2017/09/05		120	%	60 - 140
			1,1-Dichloroethane	2017/09/05		112	%	70 - 130
			1,2-Dichloroethane	2017/09/05		115	%	70 - 130
			1,1-Dichloroethylene	2017/09/05		112	%	70 - 130
			cis-1,2-Dichloroethylene	2017/09/05		108	%	70 - 130
			trans-1,2-Dichloroethylene	2017/09/05		113	%	70 - 130
			1,2-Dichloropropane	2017/09/05		100	%	70 - 130
			cis-1,3-Dichloropropene	2017/09/05		97	%	70 - 130
			trans-1,3-Dichloropropene	2017/09/05		107	%	70 - 130
			Ethylbenzene	2017/09/05		93	%	70 - 130
			Ethylene Dibromide	2017/09/05		117	%	70 - 130
			Hexane	2017/09/05		106	%	70 - 130
			Methylene Chloride(Dichloromethane)	2017/09/05		118	%	70 - 130
			Methyl Ethyl Ketone (2-Butanone)	2017/09/05		116	%	60 - 140
			Methyl Isobutyl Ketone	2017/09/05		106	%	70 - 130
			Methyl t-butyl ether (MTBE)	2017/09/05		95	%	70 - 130
			Styrene	2017/09/05		91	%	70 - 130
			1,1,1,2-Tetrachloroethane	2017/09/05		114	%	70 - 130
			1,1,2,2-Tetrachloroethane	2017/09/05		106	%	70 - 130
			Tetrachloroethylene	2017/09/05		105	%	70 - 130
			Toluene	2017/09/05		98	%	70 - 130
			1,1,1-Trichloroethane	2017/09/05		101	%	70 - 130
			1,1,2-Trichloroethane	2017/09/05		118	%	70 - 130
			Trichloroethylene	2017/09/05		118	%	70 - 130
			Trichlorofluoromethane (FREON 11)	2017/09/05		109	%	70 - 130
			Vinyl Chloride	2017/09/05		100	%	70 - 130
			p+m-Xylene	2017/09/05		92	%	70 - 130
			o-Xylene	2017/09/05		91	%	70 - 130
			F1 (C6-C10)	2017/09/05		98	%	60 - 140
5147029	XJI	Spiked Blank	4-Bromofluorobenzene	2017/09/05		101	%	70 - 130
			D4-1,2-Dichloroethane	2017/09/05		105	%	70 - 130
			D8-Toluene	2017/09/05		103	%	70 - 130
			Acetone (2-Propanone)	2017/09/05		98	%	60 - 140
			Benzene	2017/09/05		109	%	70 - 130
			Bromodichloromethane	2017/09/05		102	%	70 - 130
			Bromoform	2017/09/05		107	%	70 - 130
			Bromomethane	2017/09/05		109	%	60 - 140
			Carbon Tetrachloride	2017/09/05		104	%	70 - 130
			Chlorobenzene	2017/09/05		99	%	70 - 130
			Chloroform	2017/09/05		106	%	70 - 130

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dibromochloromethane	2017/09/05		105	%	70 - 130
			1,2-Dichlorobenzene	2017/09/05		97	%	70 - 130
			1,3-Dichlorobenzene	2017/09/05		99	%	70 - 130
			1,4-Dichlorobenzene	2017/09/05		99	%	70 - 130
			Dichlorodifluoromethane (FREON 12)	2017/09/05		125	%	60 - 140
			1,1-Dichloroethane	2017/09/05		109	%	70 - 130
			1,2-Dichloroethane	2017/09/05		103	%	70 - 130
			1,1-Dichloroethylene	2017/09/05		113	%	70 - 130
			cis-1,2-Dichloroethylene	2017/09/05		103	%	70 - 130
			trans-1,2-Dichloroethylene	2017/09/05		113	%	70 - 130
			1,2-Dichloropropane	2017/09/05		93	%	70 - 130
			cis-1,3-Dichloropropene	2017/09/05		89	%	70 - 130
			trans-1,3-Dichloropropene	2017/09/05		95	%	70 - 130
			Ethylbenzene	2017/09/05		93	%	70 - 130
			Ethylene Dibromide	2017/09/05		103	%	70 - 130
			Hexane	2017/09/05		108	%	70 - 130
			Methylene Chloride(Dichloromethane)	2017/09/05		110	%	70 - 130
			Methyl Ethyl Ketone (2-Butanone)	2017/09/05		95	%	60 - 140
			Methyl Isobutyl Ketone	2017/09/05		88	%	70 - 130
			Methyl t-butyl ether (MTBE)	2017/09/05		89	%	70 - 130
			Styrene	2017/09/05		91	%	70 - 130
			1,1,1,2-Tetrachloroethane	2017/09/05		111	%	70 - 130
			1,1,2,2-Tetrachloroethane	2017/09/05		106	%	70 - 130
			Tetrachloroethylene	2017/09/05		107	%	70 - 130
			Toluene	2017/09/05		98	%	70 - 130
			1,1,1-Trichloroethane	2017/09/05		103	%	70 - 130
			1,1,2-Trichloroethane	2017/09/05		107	%	70 - 130
			Trichloroethylene	2017/09/05		102	%	70 - 130
			Trichlorofluoromethane (FREON 11)	2017/09/05		113	%	70 - 130
			Vinyl Chloride	2017/09/05		103	%	70 - 130
			p+m-Xylene	2017/09/05		93	%	70 - 130
			o-Xylene	2017/09/05		92	%	70 - 130
			F1 (C6-C10)	2017/09/05		96	%	60 - 140
5147029	XJI	Method Blank	4-Bromofluorobenzene	2017/09/05		94	%	70 - 130
			D4-1,2-Dichloroethane	2017/09/05		113	%	70 - 130
			D8-Toluene	2017/09/05		93	%	70 - 130
			Acetone (2-Propanone)	2017/09/05	ND, RDL=10		ug/L	
			Benzene	2017/09/05	ND, RDL=0.20		ug/L	
			Bromodichloromethane	2017/09/05	ND, RDL=0.50		ug/L	
			Bromoform	2017/09/05	ND, RDL=1.0		ug/L	
			Bromomethane	2017/09/05	ND, RDL=0.50		ug/L	
			Carbon Tetrachloride	2017/09/05	ND, RDL=0.20		ug/L	
			Chlorobenzene	2017/09/05	ND, RDL=0.20		ug/L	
			Chloroform	2017/09/05	ND, RDL=0.20		ug/L	
			Dibromochloromethane	2017/09/05	ND, RDL=0.50		ug/L	

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			1,2-Dichlorobenzene	2017/09/05	ND, RDL=0.50		ug/L	
			1,3-Dichlorobenzene	2017/09/05	ND, RDL=0.50		ug/L	
			1,4-Dichlorobenzene	2017/09/05	ND, RDL=0.50		ug/L	
			Dichlorodifluoromethane (FREON 12)	2017/09/05	ND, RDL=1.0		ug/L	
			1,1-Dichloroethane	2017/09/05	ND, RDL=0.20		ug/L	
			1,2-Dichloroethane	2017/09/05	ND, RDL=0.50		ug/L	
			1,1-Dichloroethylene	2017/09/05	ND, RDL=0.20		ug/L	
			cis-1,2-Dichloroethylene	2017/09/05	ND, RDL=0.50		ug/L	
			trans-1,2-Dichloroethylene	2017/09/05	ND, RDL=0.50		ug/L	
			1,2-Dichloropropane	2017/09/05	ND, RDL=0.20		ug/L	
			cis-1,3-Dichloropropene	2017/09/05	ND, RDL=0.30		ug/L	
			trans-1,3-Dichloropropene	2017/09/05	ND, RDL=0.40		ug/L	
			Ethylbenzene	2017/09/05	ND, RDL=0.20		ug/L	
			Ethylene Dibromide	2017/09/05	ND, RDL=0.20		ug/L	
			Hexane	2017/09/05	ND, RDL=1.0		ug/L	
			Methylene Chloride(Dichloromethane)	2017/09/05	ND, RDL=2.0		ug/L	
			Methyl Ethyl Ketone (2-Butanone)	2017/09/05	ND, RDL=10		ug/L	
			Methyl Isobutyl Ketone	2017/09/05	ND, RDL=5.0		ug/L	
			Methyl t-butyl ether (MTBE)	2017/09/05	ND, RDL=0.50		ug/L	
			Styrene	2017/09/05	ND, RDL=0.50		ug/L	
			1,1,1,2-Tetrachloroethane	2017/09/05	ND, RDL=0.50		ug/L	
			1,1,2,2-Tetrachloroethane	2017/09/05	ND, RDL=0.50		ug/L	
			Tetrachloroethylene	2017/09/05	ND, RDL=0.20		ug/L	
			Toluene	2017/09/05	ND, RDL=0.20		ug/L	
			1,1,1-Trichloroethane	2017/09/05	ND, RDL=0.20		ug/L	
			1,1,2-Trichloroethane	2017/09/05	ND, RDL=0.50		ug/L	
			Trichloroethylene	2017/09/05	ND, RDL=0.20		ug/L	

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J0380
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Trichlorofluoromethane (FREON 11)	2017/09/05	ND, RDL=0.50		ug/L	
			Vinyl Chloride	2017/09/05	ND, RDL=0.20		ug/L	
			p+m-Xylene	2017/09/05	ND, RDL=0.20		ug/L	
			o-Xylene	2017/09/05	ND, RDL=0.20		ug/L	
			Total Xylenes	2017/09/05	ND, RDL=0.20		ug/L	
			F1 (C6-C10)	2017/09/05	ND, RDL=25		ug/L	
			F1 (C6-C10) - BTEX	2017/09/05	ND, RDL=25		ug/L	
5147029	XJI	RPD	Acetone (2-Propanone)	2017/09/05	NC		%	30
			Benzene	2017/09/05	NC		%	30
			Bromodichloromethane	2017/09/05	NC		%	30
			Bromoform	2017/09/05	NC		%	30
			Bromomethane	2017/09/05	NC		%	30
			Carbon Tetrachloride	2017/09/05	NC		%	30
			Chlorobenzene	2017/09/05	NC		%	30
			Chloroform	2017/09/05	NC		%	30
			Dibromochloromethane	2017/09/05	NC		%	30
			1,2-Dichlorobenzene	2017/09/05	NC		%	30
			1,3-Dichlorobenzene	2017/09/05	NC		%	30
			1,4-Dichlorobenzene	2017/09/05	NC		%	30
			Dichlorodifluoromethane (FREON 12)	2017/09/05	NC		%	30
			1,1-Dichloroethane	2017/09/05	NC		%	30
			1,2-Dichloroethane	2017/09/05	NC		%	30
			1,1-Dichloroethylene	2017/09/05	NC		%	30
			cis-1,2-Dichloroethylene	2017/09/05	NC		%	30
			trans-1,2-Dichloroethylene	2017/09/05	NC		%	30
			1,2-Dichloropropane	2017/09/05	NC		%	30
			cis-1,3-Dichloropropene	2017/09/05	NC		%	30
			trans-1,3-Dichloropropene	2017/09/05	NC		%	30
			Ethylbenzene	2017/09/05	NC		%	30
			Ethylene Dibromide	2017/09/05	NC		%	30
			Hexane	2017/09/05	NC		%	30
			Methylene Chloride(Dichloromethane)	2017/09/05	NC		%	30
			Methyl Ethyl Ketone (2-Butanone)	2017/09/05	NC		%	30
			Methyl Isobutyl Ketone	2017/09/05	NC		%	30
			Methyl t-butyl ether (MTBE)	2017/09/05	NC		%	30
			Styrene	2017/09/05	NC		%	30
			1,1,1,2-Tetrachloroethane	2017/09/05	NC		%	30
			1,1,2,2-Tetrachloroethane	2017/09/05	NC		%	30
			Tetrachloroethylene	2017/09/05	NC		%	30
			Toluene	2017/09/05	NC		%	30
			1,1,1-Trichloroethane	2017/09/05	NC		%	30
			1,1,2-Trichloroethane	2017/09/05	NC		%	30
			Trichloroethylene	2017/09/05	NC		%	30
			Trichlorofluoromethane (FREON 11)	2017/09/05	NC		%	30
			Vinyl Chloride	2017/09/05	NC		%	30
			p+m-Xylene	2017/09/05	NC		%	30
			o-Xylene	2017/09/05	NC		%	30
			Total Xylenes	2017/09/05	NC		%	30

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			F1 (C6-C10)	2017/09/05	NC		%	30
			F1 (C6-C10) - BTEX	2017/09/05	NC		%	30
5148483	ADB	Matrix Spike	Dissolved Chloride (Cl)	2017/09/05		NC	%	80 - 120
5148483	ADB	Spiked Blank	Dissolved Chloride (Cl)	2017/09/05		102	%	80 - 120
5148483	ADB	Method Blank	Dissolved Chloride (Cl)	2017/09/05	ND, RDL=1.0		mg/L	
5148483	ADB	RPD	Dissolved Chloride (Cl)	2017/09/05	1.0		%	20
5148654	ADB	Matrix Spike [FAZ636-01]	Dissolved Chloride (Cl)	2017/09/05		NC	%	80 - 120
5148654	ADB	Spiked Blank	Dissolved Chloride (Cl)	2017/09/05		101	%	80 - 120
5148654	ADB	Method Blank	Dissolved Chloride (Cl)	2017/09/05	ND, RDL=1.0		mg/L	
5148654	ADB	RPD [FAZ636-01]	Dissolved Chloride (Cl)	2017/09/05	0.059		%	20
5150021	ADB	Matrix Spike	Dissolved Sulphate (SO4)	2017/09/06		106	%	75 - 125
5150021	ADB	Spiked Blank	Dissolved Sulphate (SO4)	2017/09/06		104	%	80 - 120
5150021	ADB	Method Blank	Dissolved Sulphate (SO4)	2017/09/06	ND, RDL=1.0		mg/L	
5150021	ADB	RPD	Dissolved Sulphate (SO4)	2017/09/06	2.0		%	20
5150274	C_N	Matrix Spike	Nitrite (N)	2017/09/06		105	%	80 - 120
			Nitrate (N)	2017/09/06		104	%	80 - 120
5150274	C_N	Spiked Blank	Nitrite (N)	2017/09/06		103	%	80 - 120
			Nitrate (N)	2017/09/06		99	%	80 - 120
5150274	C_N	Method Blank	Nitrite (N)	2017/09/06	ND, RDL=0.010		mg/L	
			Nitrate (N)	2017/09/06	ND, RDL=0.10		mg/L	
5150274	C_N	RPD	Nitrite (N)	2017/09/06	NC		%	20
			Nitrate (N)	2017/09/06	NC		%	20
5150362	TA1	Spiked Blank	pH	2017/09/06		102	%	98 - 103
5150362	TA1	RPD	pH	2017/09/06	0.26		%	N/A
5150530	DH	Matrix Spike	Decachlorobiphenyl	2017/09/06		92	%	60 - 130
			Aroclor 1260	2017/09/06		104	%	60 - 130
			Total PCB	2017/09/06		104	%	60 - 130
5150530	DH	Spiked Blank	Decachlorobiphenyl	2017/09/06		107	%	60 - 130
			Aroclor 1260	2017/09/06		113	%	60 - 130
			Total PCB	2017/09/06		113	%	60 - 130
5150530	DH	Method Blank	Aroclor 1016	2017/09/06	ND, RDL=0.01		ug/L	
			Aroclor 1221	2017/09/06	ND, RDL=0.01		ug/L	
			Aroclor 1232	2017/09/06	ND, RDL=0.01		ug/L	
			Aroclor 1262	2017/09/06	ND, RDL=0.01		ug/L	
			Aroclor 1268	2017/09/06	ND, RDL=0.01		ug/L	
			Decachlorobiphenyl	2017/09/06		104	%	60 - 130
			Aroclor 1242	2017/09/06	ND, RDL=0.01		ug/L	
			Aroclor 1248	2017/09/06	ND, RDL=0.01		ug/L	
			Aroclor 1254	2017/09/06	ND, RDL=0.01		ug/L	
			Aroclor 1260	2017/09/06	ND, RDL=0.01		ug/L	

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total PCB	2017/09/06	ND, RDL=0.01		ug/L	
5150530	DH	RPD [FAZ637-09]	Aroclor 1016	2017/09/06	NC		%	40
			Aroclor 1221	2017/09/06	NC		%	40
			Aroclor 1232	2017/09/06	NC		%	40
			Aroclor 1262	2017/09/06	NC		%	40
			Aroclor 1268	2017/09/06	NC		%	40
			Aroclor 1242	2017/09/06	7.4		%	40
			Aroclor 1248	2017/09/06	NC		%	40
			Aroclor 1254	2017/09/06	15		%	40
			Aroclor 1260	2017/09/06	9.8		%	40
			Total PCB	2017/09/06	9.1		%	40
5150783	RON	Matrix Spike	Mercury (Hg)	2017/09/07		106	%	75 - 125
5150783	RON	Spiked Blank	Mercury (Hg)	2017/09/07		108	%	80 - 120
5150783	RON	Method Blank	Mercury (Hg)	2017/09/07	ND, RDL=0.01		ug/L	
5150783	RON	RPD	Mercury (Hg)	2017/09/07	NC		%	20
5150939	ADB	Matrix Spike	Dissolved Sulphate (SO4)	2017/09/06		105	%	75 - 125
5150939	ADB	Spiked Blank	Dissolved Sulphate (SO4)	2017/09/06		102	%	80 - 120
5150939	ADB	Method Blank	Dissolved Sulphate (SO4)	2017/09/06	ND, RDL=1.0		mg/L	
5150939	ADB	RPD	Dissolved Sulphate (SO4)	2017/09/06	0.48		%	20
5152033	RAJ	Matrix Spike	D10-Anthracene	2017/09/07		83	%	50 - 130
			D14-Terphenyl (FS)	2017/09/07		92	%	50 - 130
			D8-Acenaphthylene	2017/09/07		100	%	50 - 130
			Acenaphthene	2017/09/07		80	%	50 - 130
			Acenaphthylene	2017/09/07		98	%	50 - 130
			Anthracene	2017/09/07		79	%	50 - 130
			Benzo(a)anthracene	2017/09/07		83	%	50 - 130
			Benzo(a)pyrene	2017/09/07		85	%	50 - 130
			Benzo(b/j)fluoranthene	2017/09/07		72	%	50 - 130
			Benzo(g,h,i)perylene	2017/09/07		82	%	50 - 130
			Benzo(k)fluoranthene	2017/09/07		73	%	50 - 130
			Chrysene	2017/09/07		95	%	50 - 130
			Dibenz(a,h)anthracene	2017/09/07		74	%	50 - 130
			Fluoranthene	2017/09/07		96	%	50 - 130
			Fluorene	2017/09/07		85	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2017/09/07		80	%	50 - 130
			1-Methylnaphthalene	2017/09/07		94	%	50 - 130
			2-Methylnaphthalene	2017/09/07		87	%	50 - 130
			Naphthalene	2017/09/07		76	%	50 - 130
			Phenanthrene	2017/09/07		85	%	50 - 130
			Pyrene	2017/09/07		94	%	50 - 130
5152033	RAJ	Spiked Blank	D10-Anthracene	2017/09/07		98	%	50 - 130
			D14-Terphenyl (FS)	2017/09/07		104	%	50 - 130
			D8-Acenaphthylene	2017/09/07		117	%	50 - 130
			Acenaphthene	2017/09/07		97	%	50 - 130
			Acenaphthylene	2017/09/07		115	%	50 - 130
			Anthracene	2017/09/07		94	%	50 - 130
			Benzo(a)anthracene	2017/09/07		99	%	50 - 130
			Benzo(a)pyrene	2017/09/07		107	%	50 - 130
			Benzo(b/j)fluoranthene	2017/09/07		104	%	50 - 130
			Benzo(g,h,i)perylene	2017/09/07		111	%	50 - 130
			Benzo(k)fluoranthene	2017/09/07		106	%	50 - 130
			Chrysene	2017/09/07		111	%	50 - 130

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J0380
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dibenz(a,h)anthracene	2017/09/07		95	%	50 - 130
			Fluoranthene	2017/09/07		104	%	50 - 130
			Fluorene	2017/09/07		100	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2017/09/07		113	%	50 - 130
			1-Methylnaphthalene	2017/09/07		115	%	50 - 130
			2-Methylnaphthalene	2017/09/07		98	%	50 - 130
			Naphthalene	2017/09/07		92	%	50 - 130
			Phenanthrene	2017/09/07		100	%	50 - 130
			Pyrene	2017/09/07		107	%	50 - 130
5152033	RAJ	Method Blank	D10-Anthracene	2017/09/07		89	%	50 - 130
			D14-Terphenyl (FS)	2017/09/07		93	%	50 - 130
			D8-Acenaphthylene	2017/09/07		106	%	50 - 130
			Acenaphthene	2017/09/07	ND, RDL=0.010		ug/L	
			Acenaphthylene	2017/09/07	ND, RDL=0.010		ug/L	
			Anthracene	2017/09/07	ND, RDL=0.010		ug/L	
			Benzo(a)anthracene	2017/09/07	ND, RDL=0.010		ug/L	
			Benzo(a)pyrene	2017/09/07	ND, RDL=0.010		ug/L	
			Benzo(b/j)fluoranthene	2017/09/07	ND, RDL=0.010		ug/L	
			Benzo(g,h,i)perylene	2017/09/07	ND, RDL=0.010		ug/L	
			Benzo(k)fluoranthene	2017/09/07	ND, RDL=0.010		ug/L	
			Chrysene	2017/09/07	ND, RDL=0.010		ug/L	
			Dibenz(a,h)anthracene	2017/09/07	ND, RDL=0.010		ug/L	
			Fluoranthene	2017/09/07	ND, RDL=0.010		ug/L	
			Fluorene	2017/09/07	ND, RDL=0.010		ug/L	
			Indeno(1,2,3-cd)pyrene	2017/09/07	ND, RDL=0.010		ug/L	
			1-Methylnaphthalene	2017/09/07	ND, RDL=0.010		ug/L	
			2-Methylnaphthalene	2017/09/07	ND, RDL=0.010		ug/L	
			Naphthalene	2017/09/07	ND, RDL=0.010		ug/L	
			Phenanthrene	2017/09/07	ND, RDL=0.010		ug/L	
			Pyrene	2017/09/07	ND, RDL=0.010		ug/L	
5152033	RAJ	RPD	Acenaphthene	2017/09/07	NC		%	30
			Acenaphthylene	2017/09/07	NC		%	30
			Anthracene	2017/09/07	NC		%	30
			Benzo(a)anthracene	2017/09/07	NC		%	30
			Benzo(a)pyrene	2017/09/07	NC		%	30
			Benzo(b/j)fluoranthene	2017/09/07	NC		%	30
			Benzo(g,h,i)perylene	2017/09/07	NC		%	30

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J0380
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Benzo(k)fluoranthene	2017/09/07	NC		%	30
			Chrysene	2017/09/07	NC		%	30
			Dibenz(a,h)anthracene	2017/09/07	NC		%	30
			Fluoranthene	2017/09/07	1.6		%	30
			Fluorene	2017/09/07	NC		%	30
			Indeno(1,2,3-cd)pyrene	2017/09/07	NC		%	30
			1-Methylnaphthalene	2017/09/07	NC		%	30
			2-Methylnaphthalene	2017/09/07	NC		%	30
			Naphthalene	2017/09/07	NC		%	30
			Phenanthrene	2017/09/07	NC		%	30
			Pyrene	2017/09/07	NC		%	30
5152223	LLE	Matrix Spike	Chromium (VI)	2017/09/07		93	%	80 - 120
5152223	LLE	Spiked Blank	Chromium (VI)	2017/09/07		102	%	80 - 120
5152223	LLE	Method Blank	Chromium (VI)	2017/09/07	ND, RDL=0.50		ug/L	
5152223	LLE	RPD	Chromium (VI)	2017/09/07	NC		%	20
5152340	ZZ	Matrix Spike [FAZ635-07]	o-Terphenyl	2017/09/07		110	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2017/09/07		NC	%	50 - 130
			F3 (C16-C34 Hydrocarbons)	2017/09/07		NC	%	50 - 130
			F4 (C34-C50 Hydrocarbons)	2017/09/07		NC	%	50 - 130
5152340	ZZ	Spiked Blank	o-Terphenyl	2017/09/07		108	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2017/09/07		93	%	60 - 130
			F3 (C16-C34 Hydrocarbons)	2017/09/07		107	%	60 - 130
			F4 (C34-C50 Hydrocarbons)	2017/09/07		112	%	60 - 130
5152340	ZZ	Method Blank	o-Terphenyl	2017/09/07		105	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2017/09/07	ND, RDL=100		ug/L	
			F3 (C16-C34 Hydrocarbons)	2017/09/07	ND, RDL=200		ug/L	
			F4 (C34-C50 Hydrocarbons)	2017/09/07	ND, RDL=200		ug/L	
5152340	ZZ	RPD [FAZ637-07]	F2 (C10-C16 Hydrocarbons)	2017/09/07	1.1		%	30
			F3 (C16-C34 Hydrocarbons)	2017/09/07	NC		%	30
			F4 (C34-C50 Hydrocarbons)	2017/09/07	28		%	30
5152347	SAU	Matrix Spike	Fluoride (F-)	2017/09/07		102	%	80 - 120
5152347	SAU	Spiked Blank	Fluoride (F-)	2017/09/07		105	%	80 - 120
5152347	SAU	Method Blank	Fluoride (F-)	2017/09/07	ND, RDL=0.10		mg/L	
5152347	SAU	RPD	Fluoride (F-)	2017/09/07	NC		%	20
5154922	FA	Spiked Blank	F4G-sg (Grav. Heavy Hydrocarbons)	2017/09/08		92	%	65 - 135
5154922	FA	RPD	F4G-sg (Grav. Heavy Hydrocarbons)	2017/09/08	NC		%	20
5154922	FA	Method Blank	F4G-sg (Grav. Heavy Hydrocarbons)	2017/09/08	ND, RDL=500		ug/L	
5155526	LHA	Matrix Spike	WAD Cyanide (Free)	2017/09/08		101	%	80 - 120
5155526	LHA	Spiked Blank	WAD Cyanide (Free)	2017/09/08		103	%	80 - 120
5155526	LHA	Method Blank	WAD Cyanide (Free)	2017/09/08	ND, RDL=0.0010		mg/L	

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
5155526	LHA	RPD	WAD Cyanide (Free)	2017/09/08	0		%	20

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Cristina Carriere

Cristina Carriere, Scientific Service Specialist

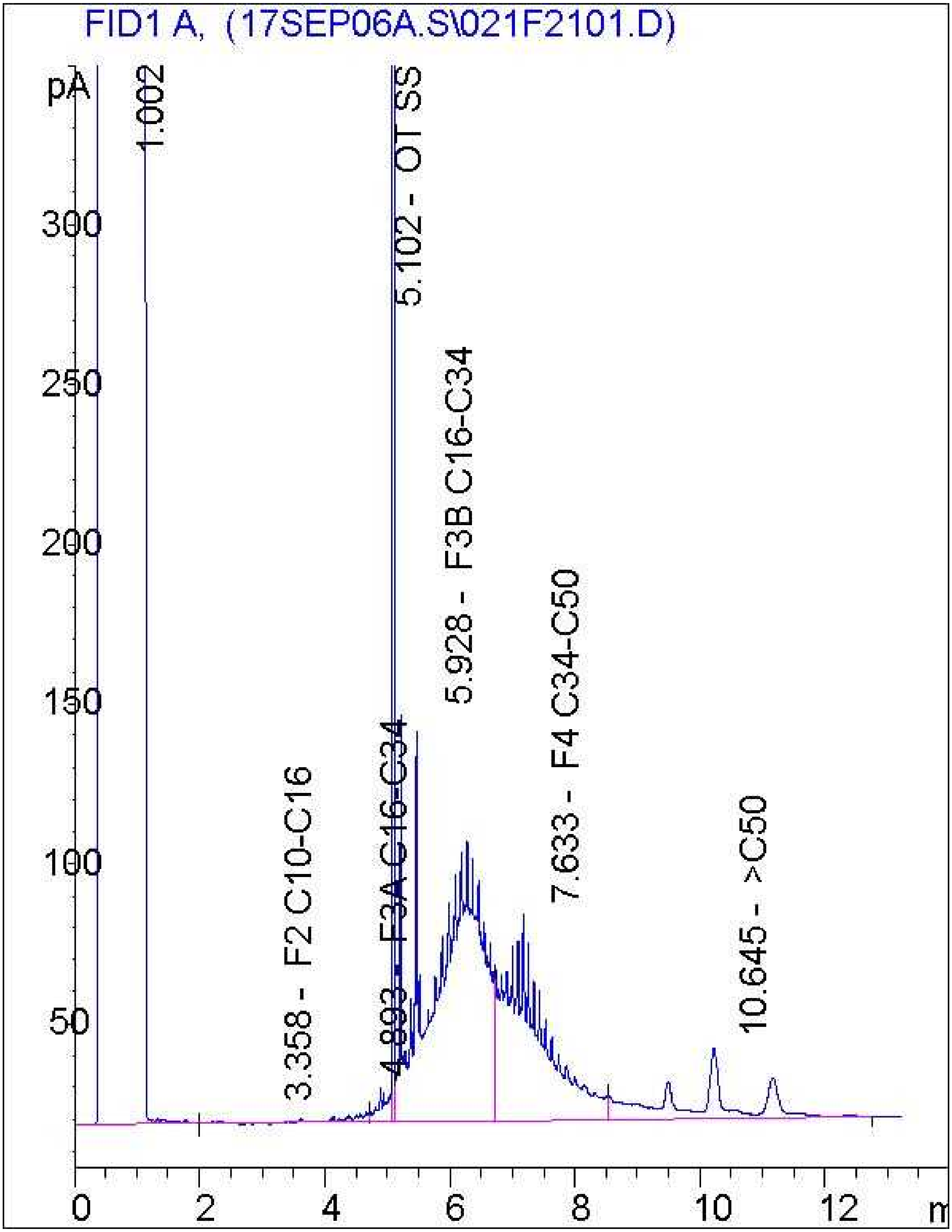
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam Job #: B7J0380
Report Date: 2017/09/12
Maxxam Sample: FAZ634

AEL Environment
Client Project #: 10888
Client ID: A0240- MW7/17

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

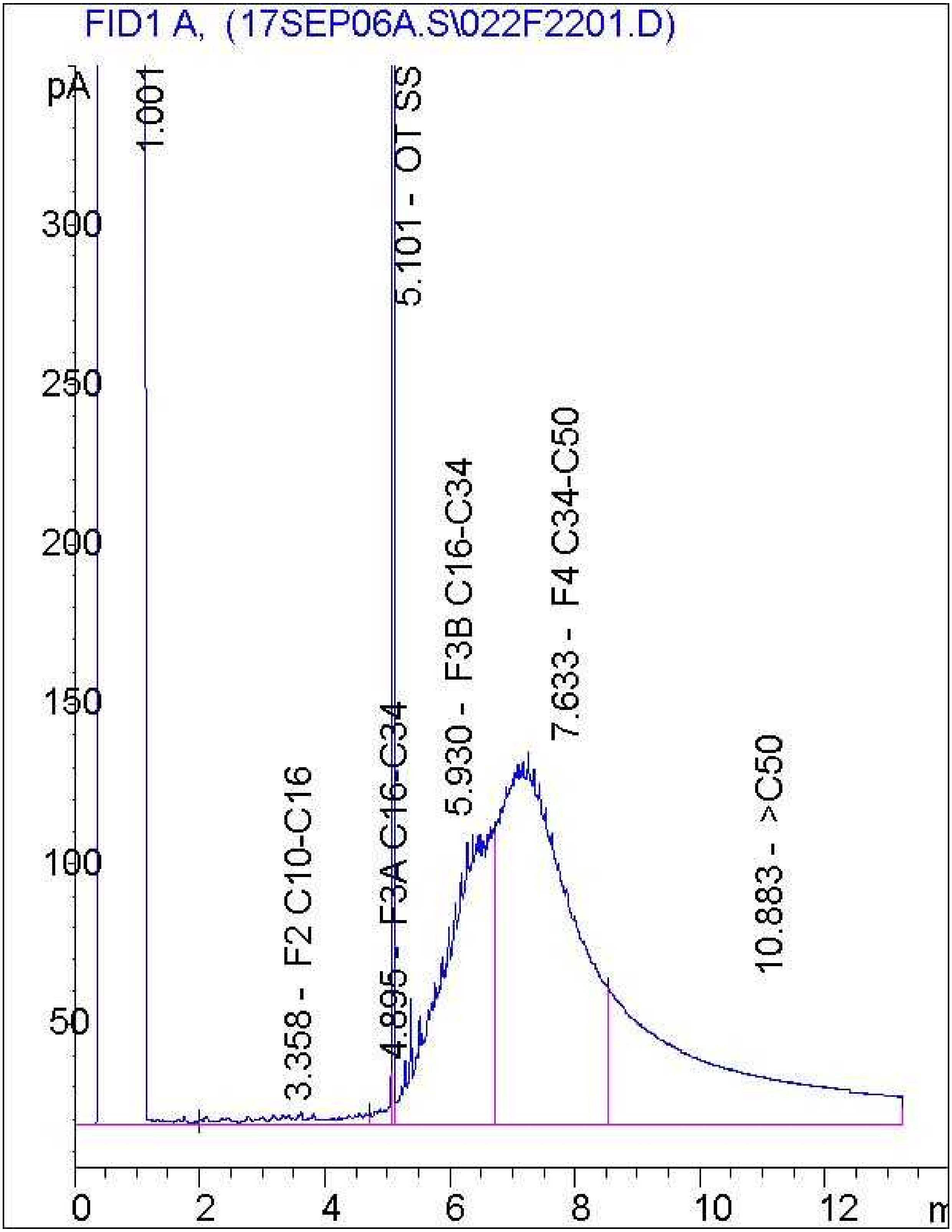


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7J0380
Report Date: 2017/09/12
Maxxam Sample: FAZ635

AEL Environment
Client Project #: 10888
Client ID: A0246- MW8/17

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

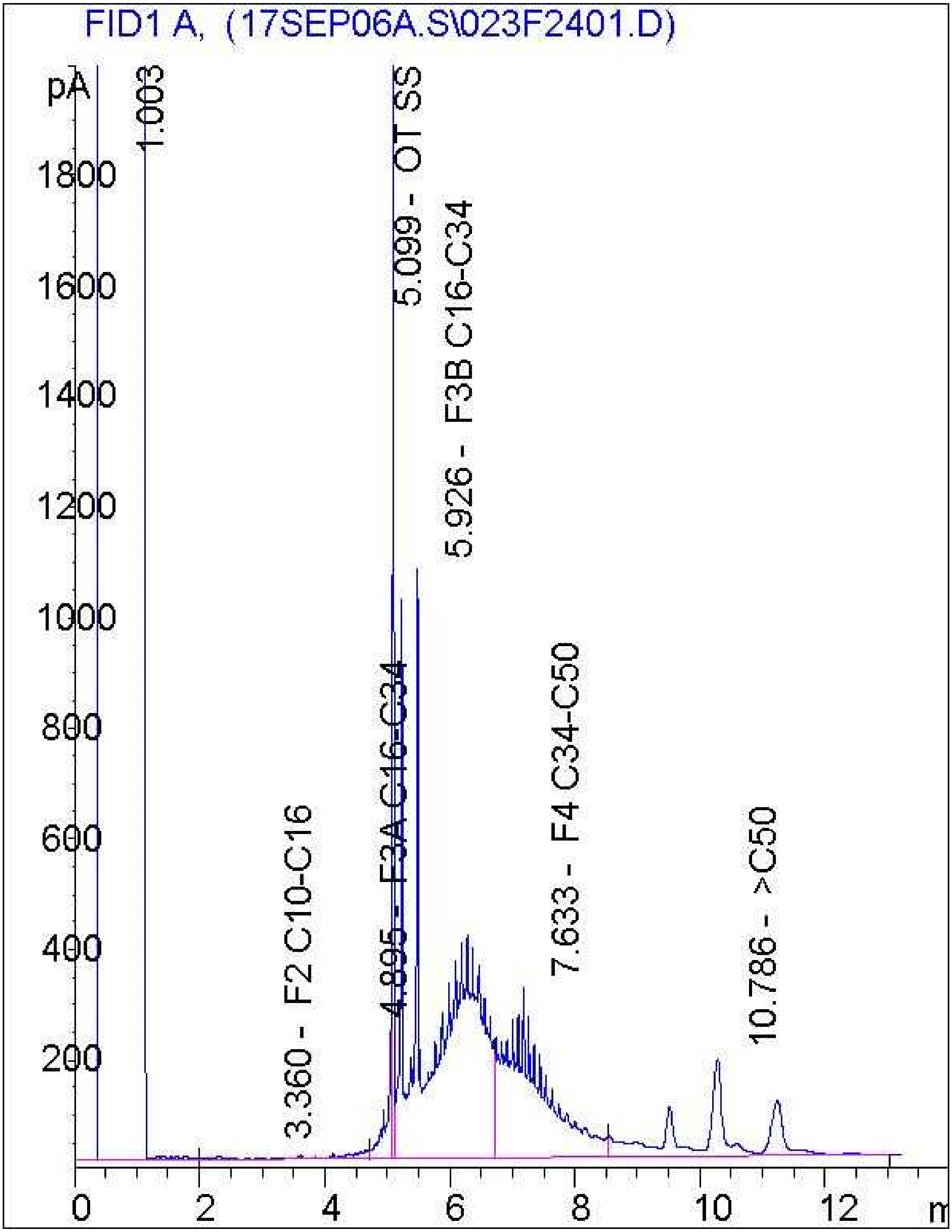


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7J0380
Report Date: 2017/09/12
Maxxam Sample: FAZ636

AEL Environment
Client Project #: 10888
Client ID: A0247- MW8/17

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

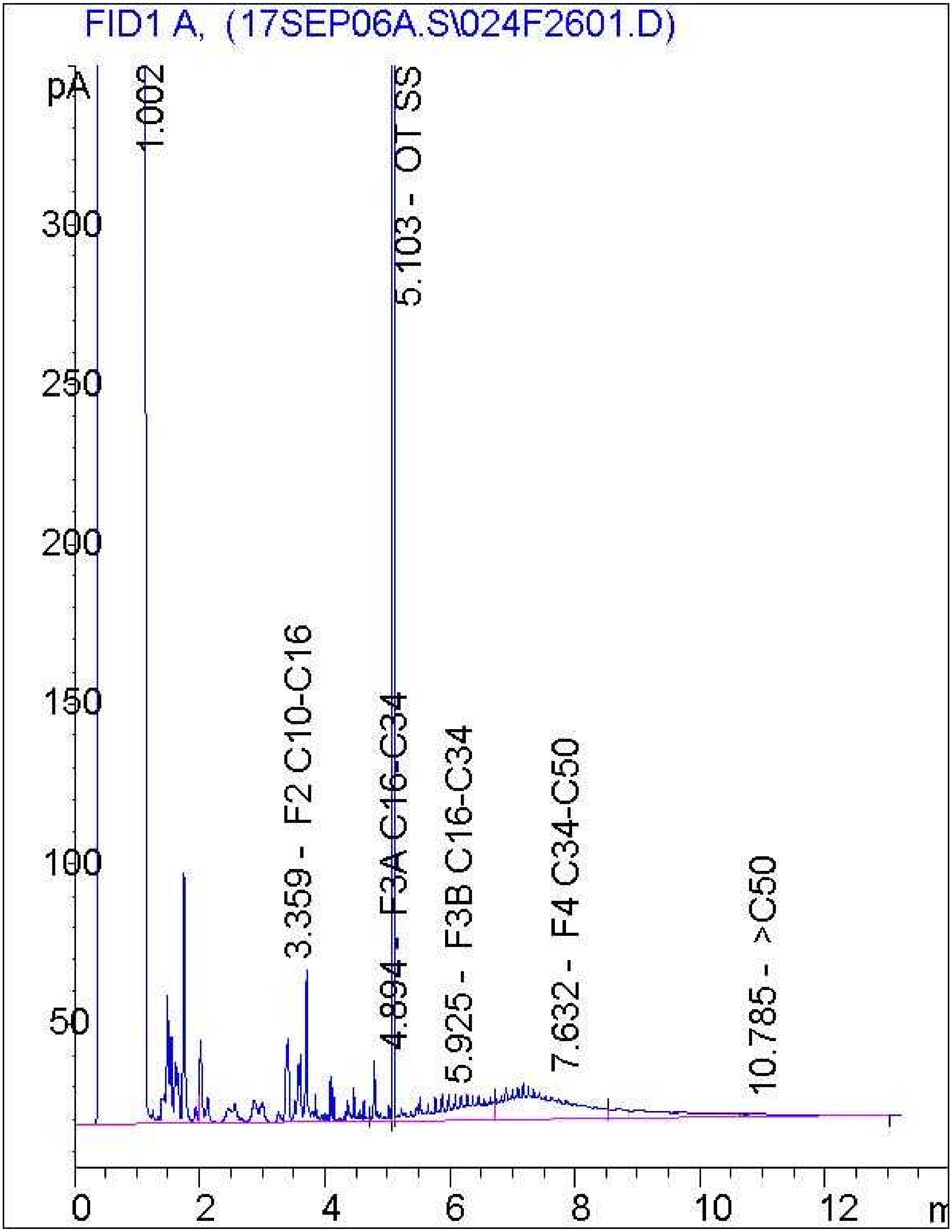


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7J0380
Report Date: 2017/09/12
Maxxam Sample: FAZ637

AEL Environment
Client Project #: 10888
Client ID: A0248- MW10/17

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

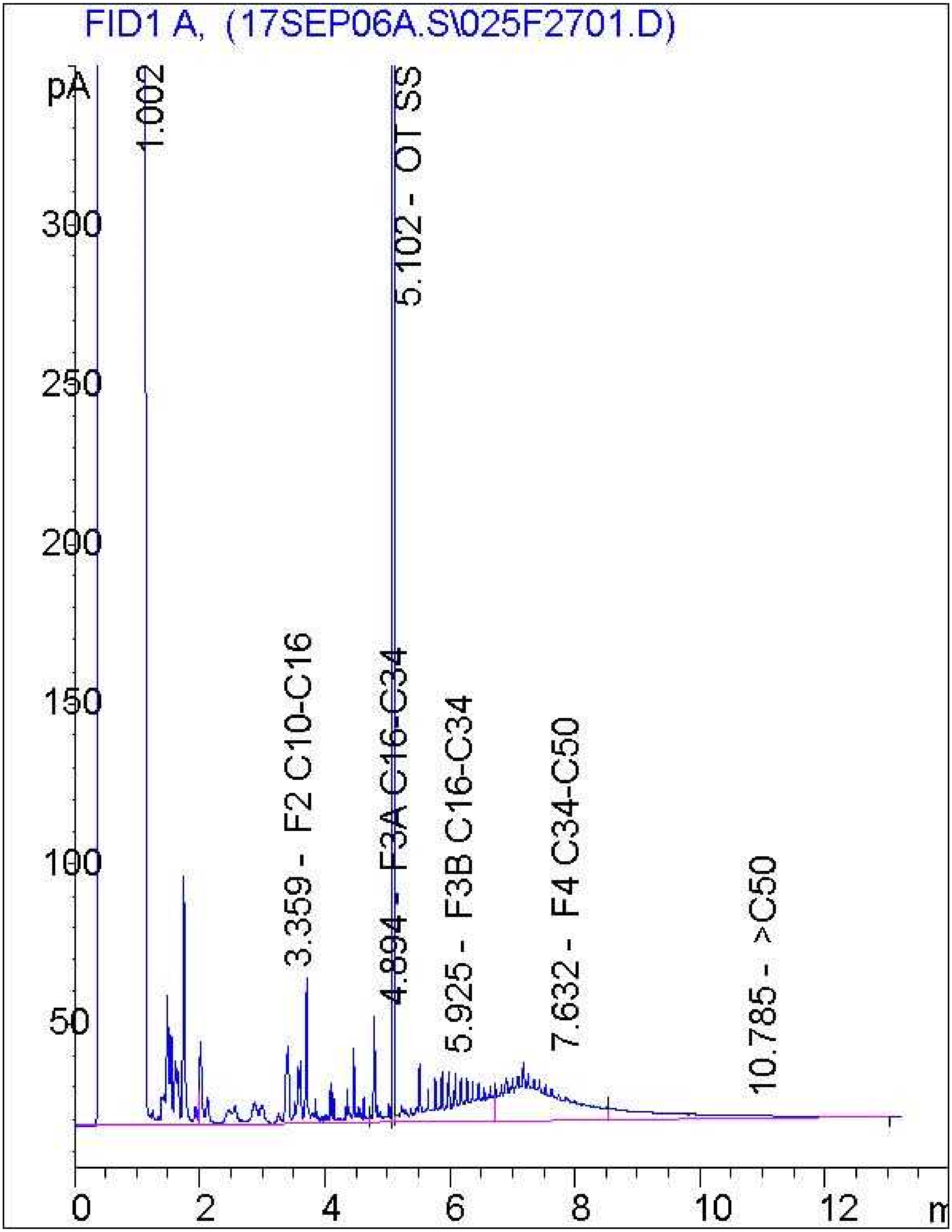


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7J0380
Report Date: 2017/09/12
Maxxam Sample: FAZ637 Lab-Dup

AEL Environment
Client Project #: 10888
Client ID: A0248- MW10/17

Petroleum Hydrocarbons F2-F4 in Water Chromatogram



Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Your Project #: MB776505
Site#: 10888
Your C.O.C. #: B7J0380-M058-01-01

Attention:ANTONELLA BRASIL

MAXXAM ANALYTICS
CAMPOBELLO
6740 CAMPOBELLO ROAD
MISSISSAUGA, ON
CANADA L5N 2L8

Report Date: 2017/09/08
Report #: R2440874
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B776505
Received: 2017/09/06, 09:00

Sample Matrix: Water
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Hardness (calculated as CaCO3)	4	N/A	2017/09/08	BBY WI-00033	Auto Calc
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	4	N/A	2017/09/08	BBY7SOP-00002	EPA 6020B R2 m
Elements by CRC ICPMS (dissolved)	4	N/A	2017/09/07	BBY7SOP-00002	EPA 6020B R2 m
Filter and HNO3 Preserve for Metals	3	N/A	2017/09/07	BBY7 WI-00004	BCMOE Reqs 08/14
Filter and HNO3 Preserve for Metals	1	N/A	2017/09/08	BBY7 WI-00004	BCMOE Reqs 08/14

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Your Project #: MB776505
Site#: 10888
Your C.O.C. #: B7J0380-M058-01-01

Attention:ANTONELLA BRASIL

MAXXAM ANALYTICS
CAMPOBELLO
6740 CAMPOBELLO ROAD
MISSISSAUGA, ON
CANADA L5N 2L8

Report Date: 2017/09/08
Report #: R2440874
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B776505
Received: 2017/09/06, 09:00

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Jenna Williamson, Project Manager 1
Email: JWilliamson@maxxam.ca
Phone# (604) 734 7276
==
This report has been generated and distributed using a secure automated process.
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		RX2993	RX2994	RX2995	
Sampling Date		2017/08/31 09:10	2017/08/31 11:20	2017/08/31 11:25	
COC Number		B7J0380-M058-01-01	B7J0380-M058-01-01	B7J0380-M058-01-01	
	UNITS	**A0240-MW7/17 (FAZ634)**	**A0246-MW8/17 (FAZ635)**	**A0247-MW8/17 (FAZ636)**	**QC Batch**
Calculated Parameters					
Filter and HNO3 Preservation	N/A	FIELD	FIELD	FIELD	ONSITE

Maxxam ID		RX2996	
Sampling Date		2017/08/31 12:35	
COC Number		B7J0380-M058-01-01	
	UNITS	**A0248-MW10/17 (FAZ637)**	**QC Batch**
Calculated Parameters			
Filter and HNO3 Preservation	N/A	FIELD	ONSITE

CCME DISSOLVED METALS IN WATER (WATER)

Maxxam ID		RX2993	RX2994	RX2995		
Sampling Date		2017/08/31 09:10	2017/08/31 11:20	2017/08/31 11:25		
COC Number		B7J0380-M058-01-01	B7J0380-M058-01-01	B7J0380-M058-01-01		
	UNITS	**A0240-MW7/17 (FAZ634)**	**A0246-MW8/17 (FAZ635)**	**A0247-MW8/17 (FAZ636)**	**RDL**	**QC Batch**
Misc. Inorganics						
Dissolved Hardness (CaCO3)	mg/L	192	215	211	0.50	8749948
Dissolved Metals by ICPMS						
Dissolved Aluminum (Al)	ug/L	8.1	6.7	7.5	3.0	8750536
Dissolved Antimony (Sb)	ug/L	<0.50	<0.50	<0.50	0.50	8750536
Dissolved Arsenic (As)	ug/L	2.19	0.43	0.31	0.10	8750536
Dissolved Barium (Ba)	ug/L	182	152	149	1.0	8750536
Dissolved Beryllium (Be)	ug/L	<0.10	<0.10	<0.10	0.10	8750536
Dissolved Bismuth (Bi)	ug/L	<1.0	<1.0	<1.0	1.0	8750536
Dissolved Boron (B)	ug/L	<50	<50	<50	50	8750536
Dissolved Cadmium (Cd)	ug/L	<0.010	<0.010	<0.010	0.010	8750536
Dissolved Chromium (Cr)	ug/L	<1.0	<1.0	<1.0	1.0	8750536
Dissolved Cobalt (Co)	ug/L	1.19	<0.20	<0.20	0.20	8750536
Dissolved Copper (Cu)	ug/L	<0.20	<0.20	<0.20	0.20	8750536
Dissolved Iron (Fe)	ug/L	18700	8790	8770	5.0	8750536
Dissolved Lead (Pb)	ug/L	0.29	<0.20	<0.20	0.20	8750536
Dissolved Lithium (Li)	ug/L	<2.0	<2.0	<2.0	2.0	8750536
Dissolved Manganese (Mn)	ug/L	1100	684	691	1.0	8750536
Dissolved Molybdenum (Mo)	ug/L	1.6	<1.0	<1.0	1.0	8750536
Dissolved Nickel (Ni)	ug/L	1.3	<1.0	<1.0	1.0	8750536
Dissolved Selenium (Se)	ug/L	<0.10	<0.10	<0.10	0.10	8750536
Dissolved Silicon (Si)	ug/L	5040	5300	5370	100	8750536
Dissolved Silver (Ag)	ug/L	<0.020	<0.020	<0.020	0.020	8750536
Dissolved Strontium (Sr)	ug/L	162	168	171	1.0	8750536
Dissolved Thallium (Tl)	ug/L	<0.010	<0.010	<0.010	0.010	8750536
Dissolved Tin (Sn)	ug/L	<5.0	<5.0	<5.0	5.0	8750536
Dissolved Titanium (Ti)	ug/L	<5.0	<5.0	<5.0	5.0	8750536
Dissolved Uranium (U)	ug/L	<0.10	<0.10	<0.10	0.10	8750536
Dissolved Vanadium (V)	ug/L	<5.0	<5.0	<5.0	5.0	8750536
Dissolved Zinc (Zn)	ug/L	<5.0	<5.0	<5.0	5.0	8750536
Dissolved Zirconium (Zr)	ug/L	<0.10	<0.10	<0.10	0.10	8750536
Dissolved Calcium (Ca)	mg/L	58.9	67.2	65.5	0.050	8750104
Dissolved Magnesium (Mg)	mg/L	10.9	11.5	11.5	0.050	8750104
Dissolved Potassium (K)	mg/L	1.28	1.46	1.49	0.050	8750104
RDL = Reportable Detection Limit						

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

CCME DISSOLVED METALS IN WATER (WATER)

Maxxam ID		RX2993	RX2994	RX2995		
Sampling Date		2017/08/31 09:10	2017/08/31 11:20	2017/08/31 11:25		
COC Number		B7J0380-M058-01-01	B7J0380-M058-01-01	B7J0380-M058-01-01		
	UNITS	**A0240-MW7/17 (FAZ634)**	**A0246-MW8/17 (FAZ635)**	**A0247-MW8/17 (FAZ636)**	**RDL**	**QC Batch**
Dissolved Sodium (Na)	mg/L	10.9	89.9	89.0	0.050	8750104
Dissolved Sulphur (S)	mg/L	<3.0	<3.0	<3.0	3.0	8750104
RDL = Reportable Detection Limit						

Maxxam Job #: B776505
Report Date: 2017/09/08

MAXXAM ANALYTICS
Client Project #: MB776505

CCME DISSOLVED METALS IN WATER (WATER)

Maxxam ID		RX2996		
Sampling Date		2017/08/31 12:35		
COC Number		B7J0380-M058-01-01		
	UNITS	A0248-MW10/17 (FAZ637)	RDL	QC Batch
Misc. Inorganics				
Dissolved Hardness (CaCO3)	mg/L	332	0.50	8749948
Dissolved Metals by ICPMS				
Dissolved Aluminum (Al)	ug/L	6.4	3.0	8750536
Dissolved Antimony (Sb)	ug/L	2.63	0.50	8750536
Dissolved Arsenic (As)	ug/L	4.74	0.10	8750536
Dissolved Barium (Ba)	ug/L	581	1.0	8750536
Dissolved Beryllium (Be)	ug/L	<0.10	0.10	8750536
Dissolved Bismuth (Bi)	ug/L	<1.0	1.0	8750536
Dissolved Boron (B)	ug/L	109	50	8750536
Dissolved Cadmium (Cd)	ug/L	<0.010	0.010	8750536
Dissolved Chromium (Cr)	ug/L	<1.0	1.0	8750536
Dissolved Cobalt (Co)	ug/L	2.15	0.20	8750536
Dissolved Copper (Cu)	ug/L	<0.20	0.20	8750536
Dissolved Iron (Fe)	ug/L	24800	5.0	8750536
Dissolved Lead (Pb)	ug/L	0.24	0.20	8750536
Dissolved Lithium (Li)	ug/L	7.6	2.0	8750536
Dissolved Manganese (Mn)	ug/L	1330	1.0	8750536
Dissolved Molybdenum (Mo)	ug/L	3.3	1.0	8750536
Dissolved Nickel (Ni)	ug/L	1.8	1.0	8750536
Dissolved Selenium (Se)	ug/L	<0.10	0.10	8750536
Dissolved Silicon (Si)	ug/L	12200	100	8750536
Dissolved Silver (Ag)	ug/L	<0.020	0.020	8750536
Dissolved Strontium (Sr)	ug/L	323	1.0	8750536
Dissolved Thallium (Tl)	ug/L	<0.010	0.010	8750536
Dissolved Tin (Sn)	ug/L	<5.0	5.0	8750536
Dissolved Titanium (Ti)	ug/L	<5.0	5.0	8750536
Dissolved Uranium (U)	ug/L	0.13	0.10	8750536
Dissolved Vanadium (V)	ug/L	<5.0	5.0	8750536
Dissolved Zinc (Zn)	ug/L	<5.0	5.0	8750536
Dissolved Zirconium (Zr)	ug/L	<0.10	0.10	8750536
Dissolved Calcium (Ca)	mg/L	109	0.050	8750104
Dissolved Magnesium (Mg)	mg/L	14.4	0.050	8750104
Dissolved Potassium (K)	mg/L	3.52	0.050	8750104
RDL = Reportable Detection Limit				

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B776505
Report Date: 2017/09/08

MAXXAM ANALYTICS
Client Project #: MB776505

CCME DISSOLVED METALS IN WATER (WATER)

Maxxam ID		RX2996		
Sampling Date		2017/08/31 12:35		
COC Number		B7J0380-M058-01-01		
	UNITS	A0248-MW10/17 (FAZ637)	RDL	QC Batch
Dissolved Sodium (Na)	mg/L	14.1	0.050	8750104
Dissolved Sulphur (S)	mg/L	<3.0	3.0	8750104
RDL = Reportable Detection Limit				

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B776505
Report Date: 2017/09/08

MAXXAM ANALYTICS
Client Project #: MB776505

TEST SUMMARY

Maxxam ID: RX2993
Sample ID: A0240-MW7/17 (FAZ634)
Matrix: Water

Collected: 2017/08/31
Shipped:
Received: 2017/09/06

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hardness (calculated as CaCO3)	CALC	8749948	N/A	2017/09/08	Automated Statchk
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	ICP/CRCM	8750104	N/A	2017/09/08	Automated Statchk
Elements by CRC ICPMS (dissolved)	ICP/CRCM	8750536	N/A	2017/09/07	Jeffrey Laporte
Filter and HNO3 Preserve for Metals	ICP	ONSITE	N/A	2017/09/07	Kevin Chong

Maxxam ID: RX2994
Sample ID: A0246-MW8/17 (FAZ635)
Matrix: Water

Collected: 2017/08/31
Shipped:
Received: 2017/09/06

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hardness (calculated as CaCO3)	CALC	8749948	N/A	2017/09/08	Automated Statchk
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	ICP/CRCM	8750104	N/A	2017/09/08	Automated Statchk
Elements by CRC ICPMS (dissolved)	ICP/CRCM	8750536	N/A	2017/09/07	Jeffrey Laporte
Filter and HNO3 Preserve for Metals	ICP	ONSITE	N/A	2017/09/07	Kevin Chong

Maxxam ID: RX2995
Sample ID: A0247-MW8/17 (FAZ636)
Matrix: Water

Collected: 2017/08/31
Shipped:
Received: 2017/09/06

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hardness (calculated as CaCO3)	CALC	8749948	N/A	2017/09/08	Automated Statchk
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	ICP/CRCM	8750104	N/A	2017/09/08	Automated Statchk
Elements by CRC ICPMS (dissolved)	ICP/CRCM	8750536	N/A	2017/09/07	Jeffrey Laporte
Filter and HNO3 Preserve for Metals	ICP	ONSITE	N/A	2017/09/07	Kevin Chong

Maxxam ID: RX2996
Sample ID: A0248-MW10/17 (FAZ637)
Matrix: Water

Collected: 2017/08/31
Shipped:
Received: 2017/09/06

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hardness (calculated as CaCO3)	CALC	8749948	N/A	2017/09/08	Automated Statchk
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	ICP/CRCM	8750104	N/A	2017/09/08	Automated Statchk
Elements by CRC ICPMS (dissolved)	ICP/CRCM	8750536	N/A	2017/09/07	Jeffrey Laporte
Filter and HNO3 Preserve for Metals	ICP	ONSITE	N/A	2017/09/07	Kevin Chong

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	3.7°C

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
8750536	Dissolved Aluminum (Al)	2017/09/07	115	80 - 120	112	80 - 120	<3.0	ug/L		
8750536	Dissolved Antimony (Sb)	2017/09/07	98	80 - 120	98	80 - 120	<0.50	ug/L		
8750536	Dissolved Arsenic (As)	2017/09/07	100	80 - 120	96	80 - 120	<0.10	ug/L	4.9 (1)	20
8750536	Dissolved Barium (Ba)	2017/09/07	NC	80 - 120	96	80 - 120	<1.0	ug/L	1.2 (1)	20
8750536	Dissolved Beryllium (Be)	2017/09/07	103	80 - 120	101	80 - 120	<0.10	ug/L		
8750536	Dissolved Bismuth (Bi)	2017/09/07	93	80 - 120	97	80 - 120	<1.0	ug/L		
8750536	Dissolved Boron (B)	2017/09/07	104	80 - 120	111	80 - 120	<50	ug/L		
8750536	Dissolved Cadmium (Cd)	2017/09/07	95	80 - 120	96	80 - 120	<0.010	ug/L	0 (1)	20
8750536	Dissolved Chromium (Cr)	2017/09/07	96	80 - 120	94	80 - 120	<1.0	ug/L	NC (1)	20
8750536	Dissolved Cobalt (Co)	2017/09/07	91	80 - 120	95	80 - 120	<0.20	ug/L		
8750536	Dissolved Copper (Cu)	2017/09/07	87	80 - 120	96	80 - 120	<0.20	ug/L	6.8 (1)	20
8750536	Dissolved Iron (Fe)	2017/09/07	105	80 - 120	106	80 - 120	<5.0	ug/L		
8750536	Dissolved Lead (Pb)	2017/09/07	96	80 - 120	99	80 - 120	<0.20	ug/L	1.3 (1)	20
8750536	Dissolved Lithium (Li)	2017/09/07	99	80 - 120	94	80 - 120	<2.0	ug/L		
8750536	Dissolved Manganese (Mn)	2017/09/07	NC	80 - 120	95	80 - 120	<1.0	ug/L		
8750536	Dissolved Molybdenum (Mo)	2017/09/07	NC	80 - 120	96	80 - 120	<1.0	ug/L		
8750536	Dissolved Nickel (Ni)	2017/09/07	90	80 - 120	97	80 - 120	<1.0	ug/L		
8750536	Dissolved Selenium (Se)	2017/09/07	102	80 - 120	103	80 - 120	<0.10	ug/L		
8750536	Dissolved Silicon (Si)	2017/09/07					<100	ug/L		
8750536	Dissolved Silver (Ag)	2017/09/07	99	80 - 120	103	80 - 120	<0.020	ug/L		
8750536	Dissolved Strontium (Sr)	2017/09/07	NC	80 - 120	97	80 - 120	<1.0	ug/L		
8750536	Dissolved Thallium (Tl)	2017/09/07	95	80 - 120	97	80 - 120	<0.010	ug/L		
8750536	Dissolved Tin (Sn)	2017/09/07	NC	80 - 120	91	80 - 120	<5.0	ug/L		
8750536	Dissolved Titanium (Ti)	2017/09/07	97	80 - 120	92	80 - 120	<5.0	ug/L		
8750536	Dissolved Uranium (U)	2017/09/07	99	80 - 120	96	80 - 120	<0.10	ug/L		
8750536	Dissolved Vanadium (V)	2017/09/07	93	80 - 120	94	80 - 120	<5.0	ug/L		
8750536	Dissolved Zinc (Zn)	2017/09/07	94	80 - 120	95	80 - 120	<5.0	ug/L	NC (1)	20

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
8750536	Dissolved Zirconium (Zr)	2017/09/07	93	80 - 120	92	80 - 120	<0.10	ug/L		

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Duplicate Parent ID

Maxxam Job #: B776505
Report Date: 2017/09/08

MAXXAM ANALYTICS
Client Project #: MB776505

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Andy Lu, Ph.D., P.Chem., Scientific Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam
A Bureau Veritas Group Company

Your Project #: 10888
Your C.O.C. #: 98218

Attention:Reporting Group
AEL Environment
1705 Argentia Rd
Unit 3
Mississauga, ON
CANADA L5N 3A9

Report Date: 2017/09/12
Report #: R4695894
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7J1336
Received: 2017/09/01, 14:35

Sample Matrix: Water
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
1,3-Dichloropropene Sum	2	N/A	2017/09/08		EPA 8260C m
Chloride by Automated Colourimetry	2	N/A	2017/09/07	CAM SOP-00463	EPA 325.2 m
Chromium (VI) in Water	2	N/A	2017/09/07	CAM SOP-00436	EPA 7199 m
Free (WAD) Cyanide	2	N/A	2017/09/07	CAM SOP-00457	OMOE E3015 m
Petroleum Hydrocarbons F2-F4 in Water (1)	2	2017/09/07	2017/09/08	CAM SOP-00316	CCME PHC-CWS m
F4G (CCME Hydrocarbons Gravimetric)	1	2017/09/11	2017/09/11	CAM SOP-00326	CCME PHC-CWS m
Fluoride	2	2017/09/07	2017/09/07	CAM SOP-00449	SM 22 4500-F C m
Mercury (low level)	2	2017/09/07	2017/09/08	CAM SOP-00453	EPA 7470 m
Nitrate (NO3) and Nitrite (NO2) in Water (2)	2	N/A	2017/09/07	CAM SOP-00440	SM 22 4500-NO3I/NO2B
PAH Compounds in Water by GC/MS (SIM)	2	2017/09/06	2017/09/07	CAM SOP-00318	EPA 8270 m
Polychlorinated Biphenyl (PCB)	2	2017/09/06	2017/09/07	CAM SOP-00309	EPA 8082A m
pH	2	N/A	2017/09/07	CAM SOP-00413	SM 4500H+ B m
Sulphate by Automated Colourimetry	2	N/A	2017/09/07	CAM SOP-00464	EPA 375.4 m
Volatile Organic Compounds and F1 PHCs	2	N/A	2017/09/07	CAM SOP-00230	EPA 8260C m

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested.

Maxxam
A Bureau Veritas Group Company

Your Project #: 10888
Your C.O.C. #: 98218

Attention:Reporting Group

AEL Environment
1705 Argentia Rd
Unit 3
Mississauga, ON
CANADA L5N 3A9

Report Date: 2017/09/12
Report #: R4695894
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7J1336
Received: 2017/09/01, 14:35

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) All CCME PHC results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Maxxam conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following “Alberta Environment’s Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Validation of Performance-Based Alternative Methods September 2003”. Documentation is available upon request. Modifications from Reference Method for the Canada-wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method: F2/F3/F4 data reported using validated cold solvent extraction instead of Soxhlet extraction.
(2) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Antonella Brasil, Senior Project Manager
Email: ABrasil@maxxam.ca
Phone# (905)817-5817
==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B7J1336
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888

CCME GROUNDWATER INORGANICS PACKAGE (WATER)

Maxxam ID		FBE473	FBE473			FBE474			
Sampling Date		2017/09/01 08:40	2017/09/01 08:40			2017/09/01 08:05			
COC Number		98218	98218			98218			
	UNITS	**A0262-MW9/17**	**A0262-MW9/17 Lab-Dup**	**RDL**	**MDL**	**A0261-MW5/17**	**RDL**	**MDL**	**QC Batch**
Inorganics									
Fluoride (F-)	mg/L	ND		0.10	0.020	0.12	0.10	0.020	5153456
pH	pH	7.61				7.42			5153459
Dissolved Sulphate (SO4)	mg/L	22		1.0	0.10	1.2	1.0	0.10	5152324
WAD Cyanide (Free)	mg/L	ND	ND	0.0010	0.00040	0.0012	0.0010	0.00040	5153042
Dissolved Chloride (Cl)	mg/L	220		3.0	0.90	68	1.0	0.30	5152319
Nitrite (N)	mg/L	ND		0.010	0.0020	ND	0.010	0.0020	5152042
Nitrate (N)	mg/L	0.15		0.10	0.010	ND	0.10	0.010	5152042
Nitrate + Nitrite (N)	mg/L	0.15		0.10	0.010	ND	0.10	0.010	5152042
Metals									
Mercury (Hg)	ug/L	ND		0.01	0.004	ND	0.01	0.004	5153882

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		FBE473	FBE474			
Sampling Date		2017/09/01 08:40	2017/09/01 08:05			
COC Number		98218	98218			
	UNITS	A0262-MW9/17	A0261-MW5/17	RDL	MDL	QC Batch
Metals						
Chromium (VI)	ug/L	ND	ND	0.50	0.30	5153336

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam Job #: B7J1336
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888

SEMI-VOLATILE ORGANICS BY GC-MS (WATER)

Maxxam ID		FBE473	FBE474			
Sampling Date		2017/09/01 08:40	2017/09/01 08:05			
COC Number		98218	98218			
	UNITS	**A0262-MW9/17**	**A0261-MW5/17**	**RDL**	**MDL**	**QC Batch**
Polyaromatic Hydrocarbons						
Acenaphthene	ug/L	ND	1.0	0.010	0.010	5152033
Acenaphthylene	ug/L	ND	0.024	0.010	0.010	5152033
Anthracene	ug/L	ND	0.12	0.010	0.010	5152033
Benzo(a)anthracene	ug/L	ND	0.063	0.010	0.010	5152033
Benzo(a)pyrene	ug/L	ND	0.060	0.010	0.010	5152033
Benzo(b/j)fluoranthene	ug/L	ND	0.079	0.010	0.010	5152033
Benzo(g,h,i)perylene	ug/L	ND	0.061	0.010	0.010	5152033
Benzo(k)fluoranthene	ug/L	ND	0.032	0.010	0.010	5152033
Chrysene	ug/L	ND	0.068	0.010	0.010	5152033
Dibenz(a,h)anthracene	ug/L	ND	0.015	0.010	0.010	5152033
Fluoranthene	ug/L	0.010	0.42	0.010	0.010	5152033
Fluorene	ug/L	ND	0.87	0.010	0.010	5152033
Indeno(1,2,3-cd)pyrene	ug/L	ND	0.054	0.010	0.010	5152033
1-Methylnaphthalene	ug/L	0.012	2.1	0.010	0.010	5152033
2-Methylnaphthalene	ug/L	0.015	0.19	0.010	0.010	5152033
Naphthalene	ug/L	0.016	0.31	0.010	0.010	5152033
Phenanthrene	ug/L	0.016	0.94	0.010	0.010	5152033
Pyrene	ug/L	0.013	0.24	0.010	0.010	5152033
Surrogate Recovery (%)						
D10-Anthracene	%	78	56			5152033
D14-Terphenyl (FS)	%	57	25 (1)			5152033
D8-Acenaphthylene	%	103	100			5152033

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected
(1) Surrogate recovery was below the lower control limit due to matrix interference. This may represent a low bias in some results.

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

PETROLEUM HYDROCARBONS (CCME)

Maxxam ID		FBE474			
Sampling Date		2017/09/01 08:05			
COC Number		98218			
	UNITS	A0261-MW5/17	RDL	MDL	QC Batch
F2-F4 Hydrocarbons					
F4G-sg (Grav. Heavy Hydrocarbons)	ug/L	6000	500	N/A	5158364

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

POLYCHLORINATED BIPHENYLS BY GC-ECD (WATER)

Maxxam ID		FBE473		FBE474	FBE474			
Sampling Date		2017/09/01 08:40		2017/09/01 08:05	2017/09/01 08:05			
COC Number		98218		98218	98218			
	UNITS	**A0262-MW9/17**	**RDL**	**A0261-MW5/17**	**A0261-MW5/17 Lab-Dup**	**RDL**	**MDL**	**QC Batch**
PCBs								
Aroclor 1016	ug/L	ND	0.05	ND	ND	0.01	N/A	5152144
Aroclor 1221	ug/L	ND	0.05	ND	ND	0.01	N/A	5152144
Aroclor 1232	ug/L	ND	0.05	ND	ND	0.01	N/A	5152144
Aroclor 1262	ug/L	ND	0.01	ND	ND	0.01	N/A	5152144
Aroclor 1268	ug/L	ND	0.01	0.02	0.01	0.01	N/A	5152144
Aroclor 1242	ug/L	ND	0.05	0.73	0.77	0.01	N/A	5152144
Aroclor 1248	ug/L	ND	0.02	ND	ND	0.01	N/A	5152144
Aroclor 1254	ug/L	ND	0.01	ND	ND	0.01	N/A	5152144
Aroclor 1260	ug/L	ND	0.01	0.04	0.04	0.01	N/A	5152144
Total PCB	ug/L	ND	0.05	0.79	0.82	0.01	N/A	5152144
Surrogate Recovery (%)								
Decachlorobiphenyl	%	75		91	88			5152144

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected
N/A = Not Applicable

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

O.REG 153 VOCS BY HS & F1-F4 (WATER)

Maxxam ID		FBE473	FBE474			
Sampling Date		2017/09/01 08:40	2017/09/01 08:05			
COC Number		98218	98218			
	UNITS	**A0262-MW9/17**	**A0261-MW5/17**	**RDL**	**MDL**	**QC Batch**
Calculated Parameters						
1,3-Dichloropropene (cis+trans)	ug/L	ND	ND	0.50	0.50	5149436
Volatile Organics						
Acetone (2-Propanone)	ug/L	ND	ND	10	1.0	5149355
Benzene	ug/L	ND	0.30	0.20	0.020	5149355
Bromodichloromethane	ug/L	ND	ND	0.50	0.050	5149355
Bromoform	ug/L	ND	ND	1.0	0.10	5149355
Bromomethane	ug/L	ND	ND	0.50	0.10	5149355
Carbon Tetrachloride	ug/L	ND	ND	0.20	0.050	5149355
Chlorobenzene	ug/L	ND	5.4	0.20	0.010	5149355
Chloroform	ug/L	ND	ND	0.20	0.050	5149355
Dibromochloromethane	ug/L	ND	ND	0.50	0.050	5149355
1,2-Dichlorobenzene	ug/L	ND	ND	0.50	0.050	5149355
1,3-Dichlorobenzene	ug/L	ND	ND	0.50	0.050	5149355
1,4-Dichlorobenzene	ug/L	ND	1.1	0.50	0.050	5149355
Dichlorodifluoromethane (FREON 12)	ug/L	ND	ND	1.0	0.050	5149355
1,1-Dichloroethane	ug/L	ND	ND	0.20	0.050	5149355
1,2-Dichloroethane	ug/L	ND	ND	0.50	0.020	5149355
1,1-Dichloroethylene	ug/L	ND	ND	0.20	0.050	5149355
cis-1,2-Dichloroethylene	ug/L	ND	ND	0.50	0.050	5149355
trans-1,2-Dichloroethylene	ug/L	ND	ND	0.50	0.050	5149355
1,2-Dichloropropane	ug/L	ND	ND	0.20	0.050	5149355
cis-1,3-Dichloropropene	ug/L	ND	ND	0.30	0.050	5149355
trans-1,3-Dichloropropene	ug/L	ND	ND	0.40	0.050	5149355
Ethylbenzene	ug/L	ND	ND	0.20	0.010	5149355
Ethylene Dibromide	ug/L	ND	ND	0.20	0.050	5149355
Hexane	ug/L	ND	ND	1.0	0.10	5149355
Methylene Chloride(Dichloromethane)	ug/L	ND	ND	2.0	0.10	5149355
Methyl Ethyl Ketone (2-Butanone)	ug/L	ND	ND	10	0.50	5149355
Methyl Isobutyl Ketone	ug/L	ND	ND	5.0	0.10	5149355
Methyl t-butyl ether (MTBE)	ug/L	ND	ND	0.50	0.050	5149355
Styrene	ug/L	ND	ND	0.50	0.050	5149355
1,1,1,2-Tetrachloroethane	ug/L	ND	ND	0.50	0.050	5149355
1,1,2,2-Tetrachloroethane	ug/L	ND	ND	0.50	0.050	5149355
Tetrachloroethylene	ug/L	ND	ND	0.20	0.050	5149355

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1336
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888

O.REG 153 VOCS BY HS & F1-F4 (WATER)

Maxxam ID		FBE473	FBE474			
Sampling Date		2017/09/01 08:40	2017/09/01 08:05			
COC Number		98218	98218			
	UNITS	**A0262-MW9/17**	**A0261-MW5/17**	**RDL**	**MDL**	**QC Batch**
Toluene	ug/L	ND	0.26	0.20	0.010	5149355
1,1,1-Trichloroethane	ug/L	ND	ND	0.20	0.050	5149355
1,1,2-Trichloroethane	ug/L	ND	ND	0.50	0.050	5149355
Trichloroethylene	ug/L	ND	ND	0.20	0.050	5149355
Trichlorofluoromethane (FREON 11)	ug/L	ND	ND	0.50	0.10	5149355
Vinyl Chloride	ug/L	ND	ND	0.20	0.050	5149355
p+m-Xylene	ug/L	ND	14	0.20	0.010	5149355
o-Xylene	ug/L	ND	0.37	0.20	0.010	5149355
Total Xylenes	ug/L	ND	15	0.20	0.010	5149355
F1 (C6-C10)	ug/L	ND	ND	25	N/A	5149355
F1 (C6-C10) - BTEX	ug/L	ND	ND	25	N/A	5149355
F2-F4 Hydrocarbons						
F2 (C10-C16 Hydrocarbons)	ug/L	ND	390	100	50	5154580
F3 (C16-C34 Hydrocarbons)	ug/L	ND	2600	200	70	5154580
F4 (C34-C50 Hydrocarbons)	ug/L	ND	2700	200	50	5154580
Reached Baseline at C50	ug/L	Yes	No			5154580
Surrogate Recovery (%)						
o-Terphenyl	%	100	101			5154580
4-Bromofluorobenzene	%	97	99			5149355
D4-1,2-Dichloroethane	%	106	106			5149355
D8-Toluene	%	92	92			5149355

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected
N/A = Not Applicable

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1336
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888

TEST SUMMARY

Maxxam ID: FBE473
Sample ID: A0262-MW9/17
Matrix: Water

Collected: 2017/09/01
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
1,3-Dichloropropene Sum	CALC	5149436	N/A	2017/09/08	Automated Statchk
Chloride by Automated Colourimetry	KONE	5152319	N/A	2017/09/07	Alina Dobreanu
Chromium (VI) in Water	IC	5153336	N/A	2017/09/07	Lang Le
Free (WAD) Cyanide	SKAL/CN	5153042	N/A	2017/09/07	Louise Harding
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	5154580	2017/09/07	2017/09/08	Dorina Popa
Fluoride	ISE	5153456	2017/09/07	2017/09/07	Surinder Rai
Mercury (low level)	CV/AA	5153882	2017/09/07	2017/09/08	Ron Morrison
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5152042	N/A	2017/09/07	Chandra Nandlal
PAH Compounds in Water by GC/MS (SIM)	GC/MS	5152033	2017/09/06	2017/09/07	Mitesh Raj
Polychlorinated Biphenyl (PCB)	GC/ECD	5152144	2017/09/06	2017/09/07	Dawn Alarie
pH	AT	5153459	N/A	2017/09/07	Surinder Rai
Sulphate by Automated Colourimetry	KONE	5152324	N/A	2017/09/07	Alina Dobreanu
Volatile Organic Compounds and F1 PHCs	GC/MSFD	5149355	N/A	2017/09/07	Xueming Jiang

Maxxam ID: FBE473 Dup
Sample ID: A0262-MW9/17
Matrix: Water

Collected: 2017/09/01
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Free (WAD) Cyanide	SKAL/CN	5153042	N/A	2017/09/07	Louise Harding

Maxxam ID: FBE474
Sample ID: A0261-MW5/17
Matrix: Water

Collected: 2017/09/01
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
1,3-Dichloropropene Sum	CALC	5149436	N/A	2017/09/08	Automated Statchk
Chloride by Automated Colourimetry	KONE	5152319	N/A	2017/09/07	Alina Dobreanu
Chromium (VI) in Water	IC	5153336	N/A	2017/09/07	Lang Le
Free (WAD) Cyanide	SKAL/CN	5153042	N/A	2017/09/07	Louise Harding
Petroleum Hydrocarbons F2-F4 in Water	GC/FID	5154580	2017/09/07	2017/09/08	Dorina Popa
F4G (CCME Hydrocarbons Gravimetric)	BAL	5158364	2017/09/11	2017/09/11	Francis Afonso
Fluoride	ISE	5153456	2017/09/07	2017/09/07	Surinder Rai
Mercury (low level)	CV/AA	5153882	2017/09/07	2017/09/08	Ron Morrison
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5152042	N/A	2017/09/07	Chandra Nandlal
PAH Compounds in Water by GC/MS (SIM)	GC/MS	5152033	2017/09/06	2017/09/07	Mitesh Raj
Polychlorinated Biphenyl (PCB)	GC/ECD	5152144	2017/09/06	2017/09/07	Dawn Alarie
pH	AT	5153459	N/A	2017/09/07	Surinder Rai
Sulphate by Automated Colourimetry	KONE	5152324	N/A	2017/09/07	Alina Dobreanu
Volatile Organic Compounds and F1 PHCs	GC/MSFD	5149355	N/A	2017/09/07	Xueming Jiang

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

TEST SUMMARY

Maxxam ID: FBE474 Dup
Sample ID: A0261-MW5/17
Matrix: Water

Collected: 2017/09/01
Shipped:
Received: 2017/09/01

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Polychlorinated Biphenyl (PCB)	GC/ECD	5152144	2017/09/06	2017/09/07	Dawn Alarie

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	2.7°C

Sample FBE473 [A0262-MW9/17] : PCB Analysis: Detection Limits were raised due to matrix interferences.

Results relate only to the items tested.

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1336
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
5149355	XJI	Matrix Spike	4-Bromofluorobenzene	2017/09/07		107	%	70 - 130
			D4-1,2-Dichloroethane	2017/09/07		100	%	70 - 130
			D8-Toluene	2017/09/07		100	%	70 - 130
			Acetone (2-Propanone)	2017/09/07		100	%	60 - 140
			Benzene	2017/09/07		108	%	70 - 130
			Bromodichloromethane	2017/09/07		98	%	70 - 130
			Bromoform	2017/09/07		108	%	70 - 130
			Bromomethane	2017/09/07		107	%	60 - 140
			Carbon Tetrachloride	2017/09/07		99	%	70 - 130
			Chlorobenzene	2017/09/07		102	%	70 - 130
			Chloroform	2017/09/07		102	%	70 - 130
			Dibromochloromethane	2017/09/07		103	%	70 - 130
			1,2-Dichlorobenzene	2017/09/07		100	%	70 - 130
			1,3-Dichlorobenzene	2017/09/07		101	%	70 - 130
			1,4-Dichlorobenzene	2017/09/07		102	%	70 - 130
			Dichlorodifluoromethane (FREON 12)	2017/09/07		117	%	60 - 140
			1,1-Dichloroethane	2017/09/07		107	%	70 - 130
			1,2-Dichloroethane	2017/09/07		102	%	70 - 130
			1,1-Dichloroethylene	2017/09/07		112	%	70 - 130
			cis-1,2-Dichloroethylene	2017/09/07		105	%	70 - 130
			trans-1,2-Dichloroethylene	2017/09/07		112	%	70 - 130
			1,2-Dichloropropane	2017/09/07		93	%	70 - 130
			cis-1,3-Dichloropropene	2017/09/07		89	%	70 - 130
			trans-1,3-Dichloropropene	2017/09/07		96	%	70 - 130
			Ethylbenzene	2017/09/07		97	%	70 - 130
			Ethylene Dibromide	2017/09/07		106	%	70 - 130
			Hexane	2017/09/07		110	%	70 - 130
			Methylene Chloride(Dichloromethane)	2017/09/07		110	%	70 - 130
			Methyl Ethyl Ketone (2-Butanone)	2017/09/07		97	%	60 - 140
			Methyl Isobutyl Ketone	2017/09/07		89	%	70 - 130
			Methyl t-butyl ether (MTBE)	2017/09/07		92	%	70 - 130
			Styrene	2017/09/07		90	%	70 - 130
			1,1,1,2-Tetrachloroethane	2017/09/07		110	%	70 - 130
			1,1,2,2-Tetrachloroethane	2017/09/07		107	%	70 - 130
			Tetrachloroethylene	2017/09/07		109	%	70 - 130
			Toluene	2017/09/07		100	%	70 - 130
			1,1,1-Trichloroethane	2017/09/07		98	%	70 - 130
			1,1,2-Trichloroethane	2017/09/07		106	%	70 - 130
			Trichloroethylene	2017/09/07		102	%	70 - 130
			Trichlorofluoromethane (FREON 11)	2017/09/07		109	%	70 - 130
			Vinyl Chloride	2017/09/07		103	%	70 - 130
			p+m-Xylene	2017/09/07		97	%	70 - 130
			o-Xylene	2017/09/07		94	%	70 - 130
			F1 (C6-C10)	2017/09/07		105	%	60 - 140
5149355	XJI	Spiked Blank	4-Bromofluorobenzene	2017/09/07		106	%	70 - 130
			D4-1,2-Dichloroethane	2017/09/07		100	%	70 - 130
			D8-Toluene	2017/09/07		101	%	70 - 130
			Acetone (2-Propanone)	2017/09/07		98	%	60 - 140
			Benzene	2017/09/07		103	%	70 - 130
			Bromodichloromethane	2017/09/07		93	%	70 - 130
			Bromoform	2017/09/07		102	%	70 - 130
			Bromomethane	2017/09/07		99	%	60 - 140
			Carbon Tetrachloride	2017/09/07		95	%	70 - 130
			Chlorobenzene	2017/09/07		96	%	70 - 130
			Chloroform	2017/09/07		97	%	70 - 130

Maxxam Job #: B7J1336
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dibromochloromethane	2017/09/07		97	%	70 - 130
			1,2-Dichlorobenzene	2017/09/07		95	%	70 - 130
			1,3-Dichlorobenzene	2017/09/07		96	%	70 - 130
			1,4-Dichlorobenzene	2017/09/07		97	%	70 - 130
			Dichlorodifluoromethane (FREON 12)	2017/09/07		112	%	60 - 140
			1,1-Dichloroethane	2017/09/07		101	%	70 - 130
			1,2-Dichloroethane	2017/09/07		97	%	70 - 130
			1,1-Dichloroethylene	2017/09/07		107	%	70 - 130
			cis-1,2-Dichloroethylene	2017/09/07		99	%	70 - 130
			trans-1,2-Dichloroethylene	2017/09/07		106	%	70 - 130
			1,2-Dichloropropane	2017/09/07		89	%	70 - 130
			cis-1,3-Dichloropropene	2017/09/07		83	%	70 - 130
			trans-1,3-Dichloropropene	2017/09/07		84	%	70 - 130
			Ethylbenzene	2017/09/07		92	%	70 - 130
			Ethylene Dibromide	2017/09/07		99	%	70 - 130
			Hexane	2017/09/07		105	%	70 - 130
			Methylene Chloride(Dichloromethane)	2017/09/07		104	%	70 - 130
			Methyl Ethyl Ketone (2-Butanone)	2017/09/07		96	%	60 - 140
			Methyl Isobutyl Ketone	2017/09/07		88	%	70 - 130
			Methyl t-butyl ether (MTBE)	2017/09/07		89	%	70 - 130
			Styrene	2017/09/07		88	%	70 - 130
			1,1,1,2-Tetrachloroethane	2017/09/07		103	%	70 - 130
			1,1,2,2-Tetrachloroethane	2017/09/07		99	%	70 - 130
			Tetrachloroethylene	2017/09/07		102	%	70 - 130
			Toluene	2017/09/07		94	%	70 - 130
			1,1,1-Trichloroethane	2017/09/07		94	%	70 - 130
			1,1,2-Trichloroethane	2017/09/07		99	%	70 - 130
			Trichloroethylene	2017/09/07		98	%	70 - 130
			Trichlorofluoromethane (FREON 11)	2017/09/07		104	%	70 - 130
			Vinyl Chloride	2017/09/07		103	%	70 - 130
			p+m-Xylene	2017/09/07		93	%	70 - 130
			o-Xylene	2017/09/07		90	%	70 - 130
			F1 (C6-C10)	2017/09/07		97	%	60 - 140
5149355	XJI	Method Blank	4-Bromofluorobenzene	2017/09/07		99	%	70 - 130
			D4-1,2-Dichloroethane	2017/09/07		97	%	70 - 130
			D8-Toluene	2017/09/07		95	%	70 - 130
			Acetone (2-Propanone)	2017/09/07	ND, RDL=10		ug/L	
			Benzene	2017/09/07	ND, RDL=0.20		ug/L	
			Bromodichloromethane	2017/09/07	ND, RDL=0.50		ug/L	
			Bromoform	2017/09/07	ND, RDL=1.0		ug/L	
			Bromomethane	2017/09/07	ND, RDL=0.50		ug/L	
			Carbon Tetrachloride	2017/09/07	ND, RDL=0.20		ug/L	
			Chlorobenzene	2017/09/07	ND, RDL=0.20		ug/L	
			Chloroform	2017/09/07	ND, RDL=0.20		ug/L	
			Dibromochloromethane	2017/09/07	ND, RDL=0.50		ug/L	

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1336
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			1,2-Dichlorobenzene	2017/09/07	ND, RDL=0.50		ug/L	
			1,3-Dichlorobenzene	2017/09/07	ND, RDL=0.50		ug/L	
			1,4-Dichlorobenzene	2017/09/07	ND, RDL=0.50		ug/L	
			Dichlorodifluoromethane (FREON 12)	2017/09/07	ND, RDL=1.0		ug/L	
			1,1-Dichloroethane	2017/09/07	ND, RDL=0.20		ug/L	
			1,2-Dichloroethane	2017/09/07	ND, RDL=0.50		ug/L	
			1,1-Dichloroethylene	2017/09/07	ND, RDL=0.20		ug/L	
			cis-1,2-Dichloroethylene	2017/09/07	ND, RDL=0.50		ug/L	
			trans-1,2-Dichloroethylene	2017/09/07	ND, RDL=0.50		ug/L	
			1,2-Dichloropropane	2017/09/07	ND, RDL=0.20		ug/L	
			cis-1,3-Dichloropropene	2017/09/07	ND, RDL=0.30		ug/L	
			trans-1,3-Dichloropropene	2017/09/07	ND, RDL=0.40		ug/L	
			Ethylbenzene	2017/09/07	ND, RDL=0.20		ug/L	
			Ethylene Dibromide	2017/09/07	ND, RDL=0.20		ug/L	
			Hexane	2017/09/07	ND, RDL=1.0		ug/L	
			Methylene Chloride(Dichloromethane)	2017/09/07	ND, RDL=2.0		ug/L	
			Methyl Ethyl Ketone (2-Butanone)	2017/09/07	ND, RDL=10		ug/L	
			Methyl Isobutyl Ketone	2017/09/07	ND, RDL=5.0		ug/L	
			Methyl t-butyl ether (MTBE)	2017/09/07	ND, RDL=0.50		ug/L	
			Styrene	2017/09/07	ND, RDL=0.50		ug/L	
			1,1,1,2-Tetrachloroethane	2017/09/07	ND, RDL=0.50		ug/L	
			1,1,2,2-Tetrachloroethane	2017/09/07	ND, RDL=0.50		ug/L	
			Tetrachloroethylene	2017/09/07	ND, RDL=0.20		ug/L	
			Toluene	2017/09/07	ND, RDL=0.20		ug/L	
			1,1,1-Trichloroethane	2017/09/07	ND, RDL=0.20		ug/L	
			1,1,2-Trichloroethane	2017/09/07	ND, RDL=0.50		ug/L	
			Trichloroethylene	2017/09/07	ND, RDL=0.20		ug/L	

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1336
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Trichlorofluoromethane (FREON 11)	2017/09/07	ND, RDL=0.50		ug/L	
			Vinyl Chloride	2017/09/07	ND, RDL=0.20		ug/L	
			p+m-Xylene	2017/09/07	ND, RDL=0.20		ug/L	
			o-Xylene	2017/09/07	ND, RDL=0.20		ug/L	
			Total Xylenes	2017/09/07	ND, RDL=0.20		ug/L	
			F1 (C6-C10)	2017/09/07	ND, RDL=25		ug/L	
			F1 (C6-C10) - BTEX	2017/09/07	ND, RDL=25		ug/L	
5149355	XJI	RPD	Acetone (2-Propanone)	2017/09/07	NC		%	30
			Benzene	2017/09/07	0.24		%	30
			Bromodichloromethane	2017/09/07	NC		%	30
			Bromoform	2017/09/07	NC		%	30
			Bromomethane	2017/09/07	NC		%	30
			Carbon Tetrachloride	2017/09/07	NC		%	30
			Chlorobenzene	2017/09/07	1.8		%	30
			Chloroform	2017/09/07	NC		%	30
			Dibromochloromethane	2017/09/07	NC		%	30
			1,2-Dichlorobenzene	2017/09/07	0.85		%	30
			1,3-Dichlorobenzene	2017/09/07	NC		%	30
			1,4-Dichlorobenzene	2017/09/07	0.62		%	30
			Dichlorodifluoromethane (FREON 12)	2017/09/07	NC		%	30
			1,1-Dichloroethane	2017/09/07	1.4		%	30
			1,2-Dichloroethane	2017/09/07	NC		%	30
			1,1-Dichloroethylene	2017/09/07	NC		%	30
			cis-1,2-Dichloroethylene	2017/09/07	NC		%	30
			trans-1,2-Dichloroethylene	2017/09/07	NC		%	30
			1,2-Dichloropropane	2017/09/07	NC		%	30
			cis-1,3-Dichloropropene	2017/09/07	NC		%	30
			trans-1,3-Dichloropropene	2017/09/07	NC		%	30
			Ethylbenzene	2017/09/07	0.13		%	30
			Ethylene Dibromide	2017/09/07	NC		%	30
			Hexane	2017/09/07	NC		%	30
			Methylene Chloride(Dichloromethane)	2017/09/07	NC		%	30
			Methyl Ethyl Ketone (2-Butanone)	2017/09/07	NC		%	30
			Methyl Isobutyl Ketone	2017/09/07	NC		%	30
			Methyl t-butyl ether (MTBE)	2017/09/07	NC		%	30
			Styrene	2017/09/07	NC		%	30
			1,1,1,2-Tetrachloroethane	2017/09/07	NC		%	30
			1,1,2,2-Tetrachloroethane	2017/09/07	NC		%	30
			Tetrachloroethylene	2017/09/07	NC		%	30
			Toluene	2017/09/07	0.14		%	30
			1,1,1-Trichloroethane	2017/09/07	NC		%	30
			1,1,2-Trichloroethane	2017/09/07	NC		%	30
			Trichloroethylene	2017/09/07	NC		%	30
			Trichlorofluoromethane (FREON 11)	2017/09/07	NC		%	30
			Vinyl Chloride	2017/09/07	NC		%	30
			p+m-Xylene	2017/09/07	2.4		%	30
			o-Xylene	2017/09/07	0.84		%	30
			Total Xylenes	2017/09/07	2.3		%	30

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			F1 (C6-C10)	2017/09/07	2.4		%	30
			F1 (C6-C10) - BTEX	2017/09/07	4.0		%	30
5152033	RAJ	Matrix Spike	D10-Anthracene	2017/09/07		83	%	50 - 130
			D14-Terphenyl (FS)	2017/09/07		92	%	50 - 130
			D8-Acenaphthylene	2017/09/07		100	%	50 - 130
			Acenaphthene	2017/09/07		80	%	50 - 130
			Acenaphthylene	2017/09/07		98	%	50 - 130
			Anthracene	2017/09/07		79	%	50 - 130
			Benzo(a)anthracene	2017/09/07		83	%	50 - 130
			Benzo(a)pyrene	2017/09/07		85	%	50 - 130
			Benzo(b/j)fluoranthene	2017/09/07		72	%	50 - 130
			Benzo(g,h,i)perylene	2017/09/07		82	%	50 - 130
			Benzo(k)fluoranthene	2017/09/07		73	%	50 - 130
			Chrysene	2017/09/07		95	%	50 - 130
			Dibenz(a,h)anthracene	2017/09/07		74	%	50 - 130
			Fluoranthene	2017/09/07		96	%	50 - 130
			Fluorene	2017/09/07		85	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2017/09/07		80	%	50 - 130
			1-Methylnaphthalene	2017/09/07		94	%	50 - 130
			2-Methylnaphthalene	2017/09/07		87	%	50 - 130
			Naphthalene	2017/09/07		76	%	50 - 130
			Phenanthrene	2017/09/07		85	%	50 - 130
			Pyrene	2017/09/07		94	%	50 - 130
5152033	RAJ	Spiked Blank	D10-Anthracene	2017/09/07		98	%	50 - 130
			D14-Terphenyl (FS)	2017/09/07		104	%	50 - 130
			D8-Acenaphthylene	2017/09/07		117	%	50 - 130
			Acenaphthene	2017/09/07		97	%	50 - 130
			Acenaphthylene	2017/09/07		115	%	50 - 130
			Anthracene	2017/09/07		94	%	50 - 130
			Benzo(a)anthracene	2017/09/07		99	%	50 - 130
			Benzo(a)pyrene	2017/09/07		107	%	50 - 130
			Benzo(b/j)fluoranthene	2017/09/07		104	%	50 - 130
			Benzo(g,h,i)perylene	2017/09/07		111	%	50 - 130
			Benzo(k)fluoranthene	2017/09/07		106	%	50 - 130
			Chrysene	2017/09/07		111	%	50 - 130
			Dibenz(a,h)anthracene	2017/09/07		95	%	50 - 130
			Fluoranthene	2017/09/07		104	%	50 - 130
			Fluorene	2017/09/07		100	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2017/09/07		113	%	50 - 130
			1-Methylnaphthalene	2017/09/07		115	%	50 - 130
			2-Methylnaphthalene	2017/09/07		98	%	50 - 130
			Naphthalene	2017/09/07		92	%	50 - 130
			Phenanthrene	2017/09/07		100	%	50 - 130
			Pyrene	2017/09/07		107	%	50 - 130
5152033	RAJ	Method Blank	D10-Anthracene	2017/09/07		89	%	50 - 130
			D14-Terphenyl (FS)	2017/09/07		93	%	50 - 130
			D8-Acenaphthylene	2017/09/07		106	%	50 - 130
			Acenaphthene	2017/09/07	ND, RDL=0.010		ug/L	
			Acenaphthylene	2017/09/07	ND, RDL=0.010		ug/L	
			Anthracene	2017/09/07	ND, RDL=0.010		ug/L	
			Benzo(a)anthracene	2017/09/07	ND, RDL=0.010		ug/L	

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1336
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Benzo(a)pyrene	2017/09/07	ND, RDL=0.010		ug/L	
			Benzo(b/j)fluoranthene	2017/09/07	ND, RDL=0.010		ug/L	
			Benzo(g,h,i)perylene	2017/09/07	ND, RDL=0.010		ug/L	
			Benzo(k)fluoranthene	2017/09/07	ND, RDL=0.010		ug/L	
			Chrysene	2017/09/07	ND, RDL=0.010		ug/L	
			Dibenz(a,h)anthracene	2017/09/07	ND, RDL=0.010		ug/L	
			Fluoranthene	2017/09/07	ND, RDL=0.010		ug/L	
			Fluorene	2017/09/07	ND, RDL=0.010		ug/L	
			Indeno(1,2,3-cd)pyrene	2017/09/07	ND, RDL=0.010		ug/L	
			1-Methylnaphthalene	2017/09/07	ND, RDL=0.010		ug/L	
			2-Methylnaphthalene	2017/09/07	ND, RDL=0.010		ug/L	
			Naphthalene	2017/09/07	ND, RDL=0.010		ug/L	
			Phenanthrene	2017/09/07	ND, RDL=0.010		ug/L	
			Pyrene	2017/09/07	ND, RDL=0.010		ug/L	
5152033	RAJ	RPD	Acenaphthene	2017/09/07	NC		%	30
			Acenaphthylene	2017/09/07	NC		%	30
			Anthracene	2017/09/07	NC		%	30
			Benzo(a)anthracene	2017/09/07	NC		%	30
			Benzo(a)pyrene	2017/09/07	NC		%	30
			Benzo(b/j)fluoranthene	2017/09/07	NC		%	30
			Benzo(g,h,i)perylene	2017/09/07	NC		%	30
			Benzo(k)fluoranthene	2017/09/07	NC		%	30
			Chrysene	2017/09/07	NC		%	30
			Dibenz(a,h)anthracene	2017/09/07	NC		%	30
			Fluoranthene	2017/09/07	1.6		%	30
			Fluorene	2017/09/07	NC		%	30
			Indeno(1,2,3-cd)pyrene	2017/09/07	NC		%	30
			1-Methylnaphthalene	2017/09/07	NC		%	30
			2-Methylnaphthalene	2017/09/07	NC		%	30
			Naphthalene	2017/09/07	NC		%	30
			Phenanthrene	2017/09/07	NC		%	30
			Pyrene	2017/09/07	NC		%	30
5152042	C_N	Matrix Spike	Nitrite (N)	2017/09/07		101	%	80 - 120
			Nitrate (N)	2017/09/07		96	%	80 - 120
5152042	C_N	Spiked Blank	Nitrite (N)	2017/09/07		102	%	80 - 120
			Nitrate (N)	2017/09/07		96	%	80 - 120
5152042	C_N	Method Blank	Nitrite (N)	2017/09/07	ND, RDL=0.010		mg/L	
			Nitrate (N)	2017/09/07	ND, RDL=0.10		mg/L	
5152042	C_N	RPD	Nitrite (N)	2017/09/07	1.7		%	20

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Nitrate (N)	2017/09/07	0.053		%	20
5152144	DH	Matrix Spike	Decachlorobiphenyl	2017/09/07		78	%	60 - 130
			Aroclor 1260	2017/09/07		78	%	60 - 130
			Total PCB	2017/09/07		78	%	60 - 130
5152144	DH	Spiked Blank	Decachlorobiphenyl	2017/09/07		107	%	60 - 130
			Aroclor 1260	2017/09/07		101	%	60 - 130
			Total PCB	2017/09/07		101	%	60 - 130
5152144	DH	Method Blank	Aroclor 1016	2017/09/07	ND, RDL=0.01		ug/L	
			Aroclor 1221	2017/09/07	ND, RDL=0.01		ug/L	
			Aroclor 1232	2017/09/07	ND, RDL=0.01		ug/L	
			Aroclor 1262	2017/09/07	ND, RDL=0.01		ug/L	
			Aroclor 1268	2017/09/07	ND, RDL=0.01		ug/L	
			Decachlorobiphenyl	2017/09/07		111	%	60 - 130
			Aroclor 1242	2017/09/07	ND, RDL=0.01		ug/L	
			Aroclor 1248	2017/09/07	ND, RDL=0.01		ug/L	
			Aroclor 1254	2017/09/07	ND, RDL=0.01		ug/L	
			Aroclor 1260	2017/09/07	ND, RDL=0.01		ug/L	
			Total PCB	2017/09/07	ND, RDL=0.01		ug/L	
5152144	DH	RPD [FBE474-01]	Aroclor 1016	2017/09/07	NC		%	40
			Aroclor 1221	2017/09/07	NC		%	40
			Aroclor 1232	2017/09/07	NC		%	40
			Aroclor 1262	2017/09/07	NC		%	40
			Aroclor 1268	2017/09/07	4.9		%	40
			Aroclor 1242	2017/09/07	4.2		%	40
			Aroclor 1248	2017/09/07	NC		%	40
			Aroclor 1254	2017/09/07	NC		%	40
			Aroclor 1260	2017/09/07	2.3		%	40
			Total PCB	2017/09/07	4.0		%	40
5152319	ADB	Matrix Spike	Dissolved Chloride (Cl)	2017/09/07		NC	%	80 - 120
5152319	ADB	Spiked Blank	Dissolved Chloride (Cl)	2017/09/07		103	%	80 - 120
5152319	ADB	Method Blank	Dissolved Chloride (Cl)	2017/09/07	ND, RDL=1.0		mg/L	
5152319	ADB	RPD	Dissolved Chloride (Cl)	2017/09/07	0.25		%	20
5152324	ADB	Matrix Spike	Dissolved Sulphate (SO4)	2017/09/07		NC	%	75 - 125
5152324	ADB	Spiked Blank	Dissolved Sulphate (SO4)	2017/09/07		96	%	80 - 120
5152324	ADB	Method Blank	Dissolved Sulphate (SO4)	2017/09/07	ND, RDL=1.0		mg/L	
5152324	ADB	RPD	Dissolved Sulphate (SO4)	2017/09/07	0.49		%	20
5153042	LHA	Matrix Spike [FBE473-04]	WAD Cyanide (Free)	2017/09/07		88	%	80 - 120
5153042	LHA	Spiked Blank	WAD Cyanide (Free)	2017/09/07		102	%	80 - 120
5153042	LHA	Method Blank	WAD Cyanide (Free)	2017/09/07	ND, RDL=0.0010		mg/L	
5153042	LHA	RPD [FBE473-04]	WAD Cyanide (Free)	2017/09/07	NC		%	20
5153336	LLE	Matrix Spike	Chromium (VI)	2017/09/07		99	%	80 - 120
5153336	LLE	Spiked Blank	Chromium (VI)	2017/09/07		102	%	80 - 120

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J1336
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
5153336	LLE	Method Blank	Chromium (VI)	2017/09/07	ND, RDL=0.50		ug/L	
5153336	LLE	RPD	Chromium (VI)	2017/09/07	2.9		%	20
5153456	SAU	Matrix Spike	Fluoride (F-)	2017/09/07		111	%	80 - 120
5153456	SAU	Spiked Blank	Fluoride (F-)	2017/09/07		104	%	80 - 120
5153456	SAU	Method Blank	Fluoride (F-)	2017/09/07	ND, RDL=0.10		mg/L	
5153456	SAU	RPD	Fluoride (F-)	2017/09/07	0		%	20
5153459	SAU	Spiked Blank	pH	2017/09/07		101	%	98 - 103
5153459	SAU	RPD	pH	2017/09/07	0.21		%	N/A
5153882	RON	Matrix Spike	Mercury (Hg)	2017/09/08		104	%	75 - 125
5153882	RON	Spiked Blank	Mercury (Hg)	2017/09/08		97	%	80 - 120
5153882	RON	Method Blank	Mercury (Hg)	2017/09/08	ND, RDL=0.01		ug/L	
5153882	RON	RPD	Mercury (Hg)	2017/09/08	NC		%	20
5154580	DPO	Matrix Spike	o-Terphenyl	2017/09/08		105	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2017/09/08		97	%	50 - 130
			F3 (C16-C34 Hydrocarbons)	2017/09/08		96	%	50 - 130
			F4 (C34-C50 Hydrocarbons)	2017/09/08		103	%	50 - 130
5154580	DPO	Spiked Blank	o-Terphenyl	2017/09/08		101	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2017/09/08		83	%	60 - 130
			F3 (C16-C34 Hydrocarbons)	2017/09/08		93	%	60 - 130
			F4 (C34-C50 Hydrocarbons)	2017/09/08		101	%	60 - 130
5154580	DPO	Method Blank	o-Terphenyl	2017/09/08		98	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2017/09/08	ND, RDL=100		ug/L	
			F3 (C16-C34 Hydrocarbons)	2017/09/08	ND, RDL=200		ug/L	
			F4 (C34-C50 Hydrocarbons)	2017/09/08	ND, RDL=200		ug/L	
5154580	DPO	RPD	F2 (C10-C16 Hydrocarbons)	2017/09/08	NC		%	30
			F3 (C16-C34 Hydrocarbons)	2017/09/08	NC		%	30
			F4 (C34-C50 Hydrocarbons)	2017/09/08	NC		%	30
5158364	FA	Spiked Blank	F4G-sg (Grav. Heavy Hydrocarbons)	2017/09/11		95	%	65 - 135
5158364	FA	RPD	F4G-sg (Grav. Heavy Hydrocarbons)	2017/09/11	NC		%	20
5158364	FA	Method Blank	F4G-sg (Grav. Heavy Hydrocarbons)	2017/09/11	ND, RDL=500		ug/L	

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Brad Newman, Scientific Service Specialist

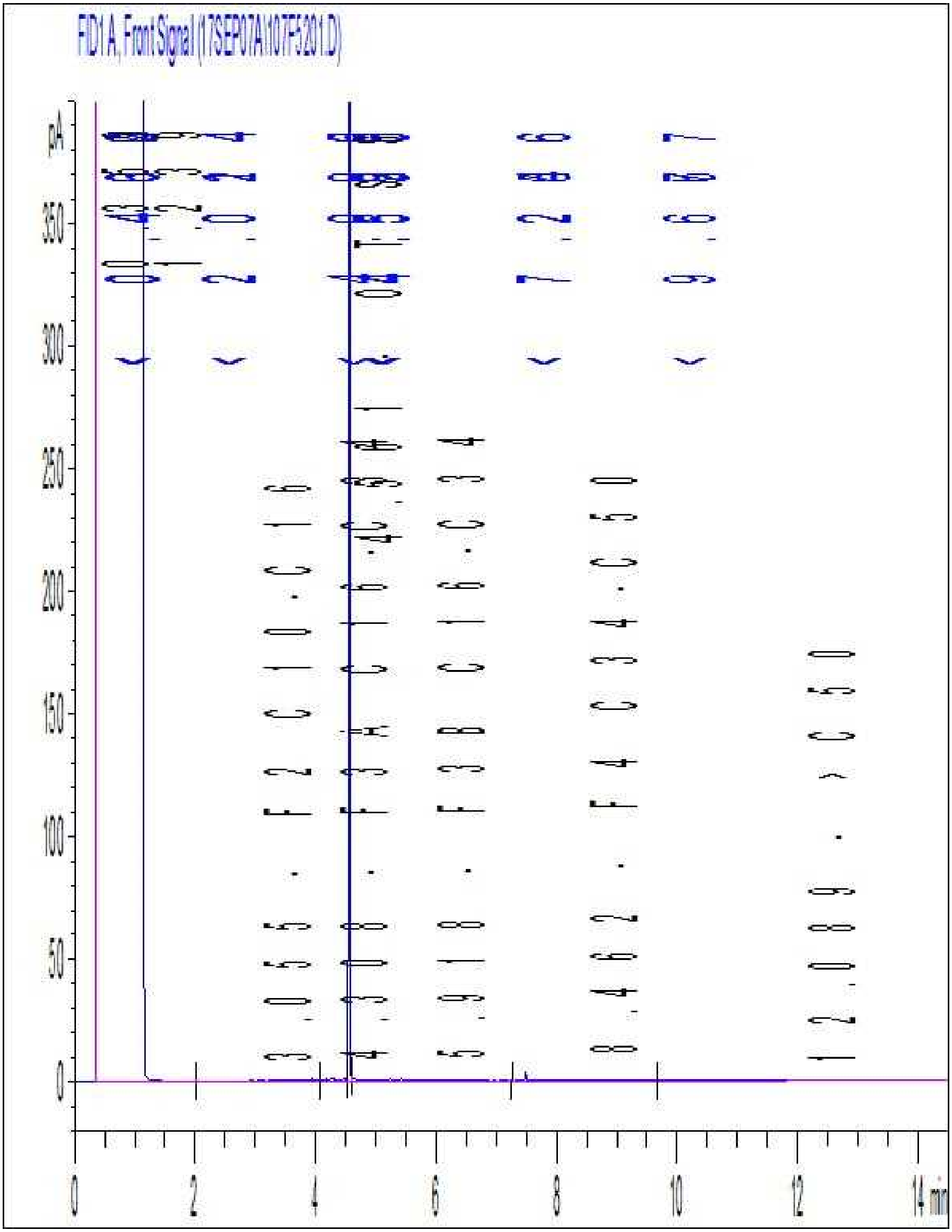
Cristina Carriere

Cristina Carriere, Scientific Service Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Petroleum Hydrocarbons F2-F4 in Water Chromatogram

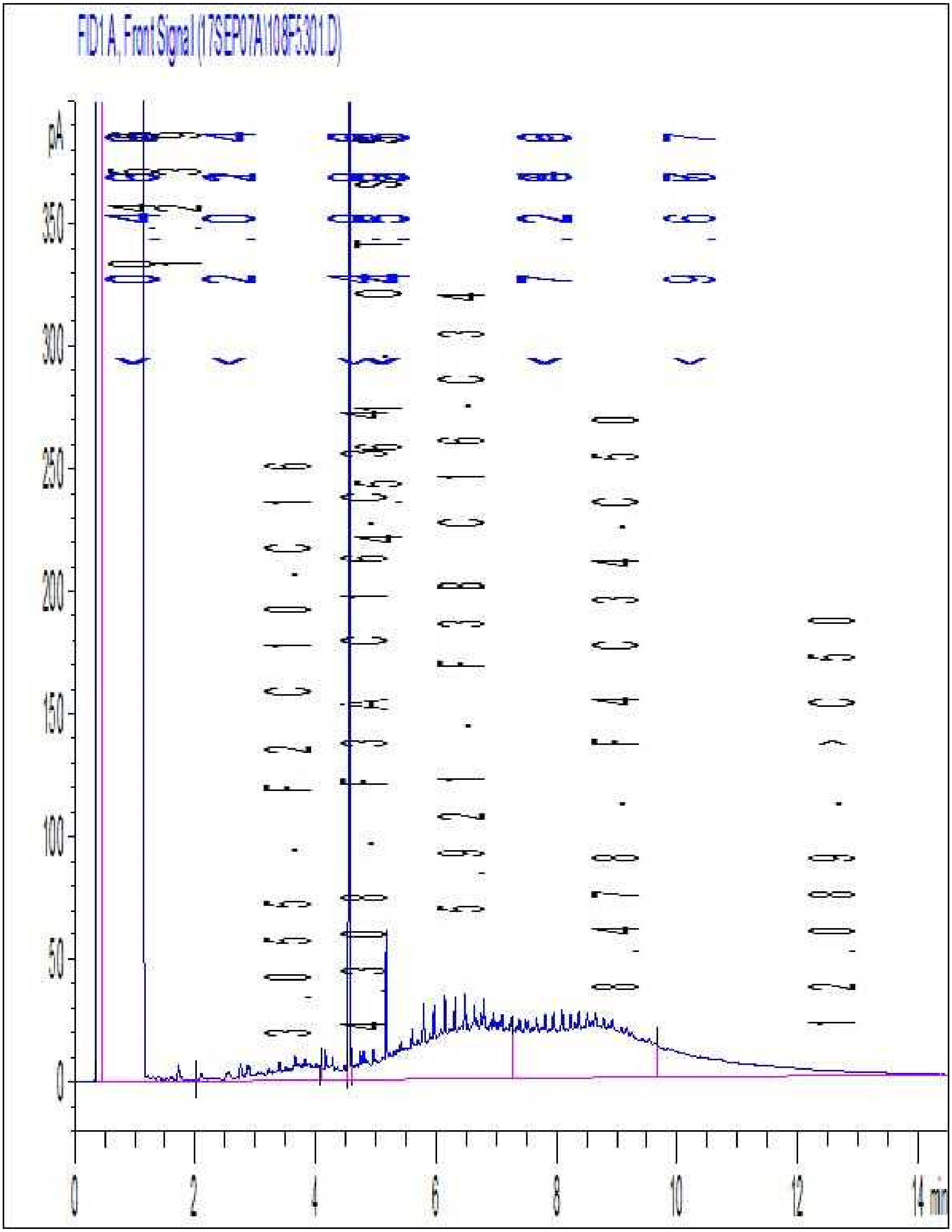


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7J1336
Report Date: 2017/09/12
Maxxam Sample: FBE474

AEL Environment
Client Project #: 10888
Client ID: A0261-MW5/17

Petroleum Hydrocarbons F2-F4 in Water Chromatogram



Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam
A Bureau Veritas Group Company

Success Through Science®

Your Project #: MB7J1336
Site Location: 10888
Your C.O.C. #: B7J1336-M058-01-01

Attention:ANTONELLA BRASIL

MAXXAM ANALYTICS
CAMPOBELLO
6740 CAMPOBELLO ROAD
MISSISSAUGA, ON
CANADA L5N 2L8

Report Date: 2017/09/11
Report #: R2441871
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B776676
Received: 2017/09/07, 08:45

Sample Matrix: Water
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Hardness (calculated as CaCO3)	2	N/A	2017/09/11	BBY WI-00033	Auto Calc
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	2	N/A	2017/09/11	BBY7SOP-00002	EPA 6020B R2 m
Elements by CRC ICPMS (dissolved)	2	N/A	2017/09/08	BBY7SOP-00002	EPA 6020B R2 m
Filter and HNO3 Preserve for Metals	2	N/A	2017/09/08	BBY7 WI-00004	BCMOE Reqs 08/14

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Your Project #: MB7J1336
Site Location: 10888
Your C.O.C. #: B7J1336-M058-01-01

Attention:ANTONELLA BRASIL

MAXXAM ANALYTICS
CAMPOBELLO
6740 CAMPOBELLO ROAD
MISSISSAUGA, ON
CANADA L5N 2L8

Report Date: 2017/09/11
Report #: R2441871
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B776676
Received: 2017/09/07, 08:45

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Jenna Williamson, Project Manager 1
Email: JWilliamson@maxxam.ca
Phone# (604) 734 7276
==
This report has been generated and distributed using a secure automated process.
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Job #: B776676
Report Date: 2017/09/11

MAXXAM ANALYTICS
Client Project #: MB7J1336
Site Location: 10888

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		RX3917	RX3918	
Sampling Date		2017/09/01 08:40	2017/09/01 08:05	
COC Number		B7J1336-M058-01-01	B7J1336-M058-01-01	
	UNITS	**A0262-MW9/17 (FBE473)**	**A0261-MW5/17 (FBE474)**	**QC Batch**
Calculated Parameters				
Filter and HNO3 Preservation	N/A	FIELD	FIELD	ONSITE

Maxxam Job #: B776676
Report Date: 2017/09/11

MAXXAM ANALYTICS
Client Project #: MB7J1336
Site Location: 10888

CCME DISSOLVED METALS IN WATER (WATER)

Maxxam ID		RX3917	RX3918		
Sampling Date		2017/09/01 08:40	2017/09/01 08:05		
COC Number		B7J1336-M058-01-01	B7J1336-M058-01-01		
	UNITS	**A0262-MW9/17 (FBE473)**	**A0261-MW5/17 (FBE474)**	**RDL**	**QC Batch**
Misc. Inorganics					
Dissolved Hardness (CaCO3)	mg/L	463	250	0.50	8751329
Dissolved Metals by ICPMS					
Dissolved Aluminum (Al)	ug/L	<3.0	6.2	3.0	8751690
Dissolved Antimony (Sb)	ug/L	<0.50	<0.50	0.50	8751690
Dissolved Arsenic (As)	ug/L	2.16	3.33	0.10	8751690
Dissolved Barium (Ba)	ug/L	410	399	1.0	8751690
Dissolved Beryllium (Be)	ug/L	<0.10	<0.10	0.10	8751690
Dissolved Bismuth (Bi)	ug/L	<1.0	<1.0	1.0	8751690
Dissolved Boron (B)	ug/L	55	52	50	8751690
Dissolved Cadmium (Cd)	ug/L	0.024	<0.010	0.010	8751690
Dissolved Chromium (Cr)	ug/L	<1.0	<1.0	1.0	8751690
Dissolved Cobalt (Co)	ug/L	7.78	0.81	0.20	8751690
Dissolved Copper (Cu)	ug/L	0.23	<0.20	0.20	8751690
Dissolved Iron (Fe)	ug/L	138	19800	5.0	8751690
Dissolved Lead (Pb)	ug/L	<0.20	<0.20	0.20	8751690
Dissolved Lithium (Li)	ug/L	<2.0	3.3	2.0	8751690
Dissolved Manganese (Mn)	ug/L	4930	666	1.0	8751690
Dissolved Molybdenum (Mo)	ug/L	1.8	1.1	1.0	8751690
Dissolved Nickel (Ni)	ug/L	7.1	1.5	1.0	8751690
Dissolved Selenium (Se)	ug/L	0.11	<0.10	0.10	8751690
Dissolved Silicon (Si)	ug/L	5650	6360	100	8751690
Dissolved Silver (Ag)	ug/L	<0.020	<0.020	0.020	8751690
Dissolved Strontium (Sr)	ug/L	259	253	1.0	8751690
Dissolved Thallium (Tl)	ug/L	0.287	<0.010	0.010	8751690
Dissolved Tin (Sn)	ug/L	<5.0	<5.0	5.0	8751690
Dissolved Titanium (Ti)	ug/L	<5.0	<5.0	5.0	8751690
Dissolved Uranium (U)	ug/L	0.66	0.16	0.10	8751690
Dissolved Vanadium (V)	ug/L	<5.0	<5.0	5.0	8751690
Dissolved Zinc (Zn)	ug/L	<5.0	<5.0	5.0	8751690
Dissolved Zirconium (Zr)	ug/L	0.24	<0.10	0.10	8751690
Dissolved Calcium (Ca)	mg/L	148	82.5	0.050	8751330
Dissolved Magnesium (Mg)	mg/L	22.8	10.7	0.050	8751330
RDL = Reportable Detection Limit					

Maxxam Job #: B776676
Report Date: 2017/09/11

MAXXAM ANALYTICS
Client Project #: MB7J1336
Site Location: 10888

CCME DISSOLVED METALS IN WATER (WATER)

Maxxam ID		RX3917	RX3918		
Sampling Date		2017/09/01 08:40	2017/09/01 08:05		
COC Number		B7J1336-M058-01-01	B7J1336-M058-01-01		
	UNITS	A0262-MW9/17 (FBE473)	A0261-MW5/17 (FBE474)	RDL	QC Batch
Dissolved Potassium (K)	mg/L	3.07	1.68	0.050	8751330
Dissolved Sodium (Na)	mg/L	141	40.4	0.050	8751330
Dissolved Sulphur (S)	mg/L	7.3	<3.0	3.0	8751330
RDL = Reportable Detection Limit					

TEST SUMMARY

Maxxam ID: RX3917
Sample ID: A0262-MW9/17 (FBE473)
Matrix: Water

Collected: 2017/09/01
Shipped:
Received: 2017/09/07

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hardness (calculated as CaCO3)	CALC	8751329	N/A	2017/09/11	Automated Statchk
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	ICP/CRCM	8751330	N/A	2017/09/11	Automated Statchk
Elements by CRC ICPMS (dissolved)	ICP/CRCM	8751690	N/A	2017/09/08	Jeffrey Laporte
Filter and HNO3 Preserve for Metals	ICP	ONSITE	N/A	2017/09/08	Marilou H. Truant

Maxxam ID: RX3918
Sample ID: A0261-MW5/17 (FBE474)
Matrix: Water

Collected: 2017/09/01
Shipped:
Received: 2017/09/07

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hardness (calculated as CaCO3)	CALC	8751329	N/A	2017/09/11	Automated Statchk
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	ICP/CRCM	8751330	N/A	2017/09/11	Automated Statchk
Elements by CRC ICPMS (dissolved)	ICP/CRCM	8751690	N/A	2017/09/08	Jeffrey Laporte
Filter and HNO3 Preserve for Metals	ICP	ONSITE	N/A	2017/09/08	Marilou H. Truant

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	1.7°C

CCME DISSOLVED METALS IN WATER (WATER) Comments

Matrix Spike Elements by CRC ICPMS (dissolved): RDL raised due to concentration over linear range, sample dilution required

Results relate only to the items tested.

Maxxam
A Bureau Veritas Group Company

Success Through Science®

Maxxam Job #: B776676
Report Date: 2017/09/11

QUALITY ASSURANCE REPORT

MAXXAM ANALYTICS
Client Project #: MB7J1336
Site Location: 10888

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
8751690	Dissolved Aluminum (Al)	2017/09/08	103	80 - 120	103	80 - 120	<3.0	ug/L	NC (1)	20
8751690	Dissolved Antimony (Sb)	2017/09/08	104	80 - 120	103	80 - 120	<0.50	ug/L	NC (1)	20
8751690	Dissolved Arsenic (As)	2017/09/08	101	80 - 120	100	80 - 120	<0.10	ug/L	6.7 (1)	20
8751690	Dissolved Barium (Ba)	2017/09/08	NC	80 - 120	101	80 - 120	<1.0	ug/L	0.42 (1)	20
8751690	Dissolved Beryllium (Be)	2017/09/08	100	80 - 120	100	80 - 120	<0.10	ug/L	NC (1)	20
8751690	Dissolved Bismuth (Bi)	2017/09/08	94	80 - 120	106	80 - 120	<1.0	ug/L	NC (1)	20
8751690	Dissolved Boron (B)	2017/09/08	NC	80 - 120	96	80 - 120	<50	ug/L	1.1 (1)	20
8751690	Dissolved Cadmium (Cd)	2017/09/08	100	80 - 120	102	80 - 120	<0.010	ug/L	NC (1)	20
8751690	Dissolved Chromium (Cr)	2017/09/08	100	80 - 120	104	80 - 120	<1.0	ug/L	NC (1)	20
8751690	Dissolved Cobalt (Co)	2017/09/08	99	80 - 120	102	80 - 120	<0.20	ug/L	NC (1)	20
8751690	Dissolved Copper (Cu)	2017/09/08	98	80 - 120	101	80 - 120	<0.20	ug/L	NC (1)	20
8751690	Dissolved Iron (Fe)	2017/09/08	NC	80 - 120	103	80 - 120	<5.0	ug/L	1.4 (1)	20
8751690	Dissolved Lead (Pb)	2017/09/08	97	80 - 120	104	80 - 120	<0.20	ug/L	NC (1)	20
8751690	Dissolved Lithium (Li)	2017/09/08	NC	80 - 120	97	80 - 120	<2.0	ug/L	5.2 (1)	20
8751690	Dissolved Manganese (Mn)	2017/09/08	NC	80 - 120	103	80 - 120	<1.0	ug/L	1.0 (1)	20
8751690	Dissolved Molybdenum (Mo)	2017/09/08	NC	80 - 120	104	80 - 120	<1.0	ug/L	NC (1)	20
8751690	Dissolved Nickel (Ni)	2017/09/08	102	80 - 120	103	80 - 120	<1.0	ug/L	NC (1)	20
8751690	Dissolved Selenium (Se)	2017/09/08	99	80 - 120	103	80 - 120	<0.10	ug/L	NC (1)	20
8751690	Dissolved Silicon (Si)	2017/09/08					<100	ug/L	3.4 (1)	20
8751690	Dissolved Silver (Ag)	2017/09/08	91	80 - 120	111	80 - 120	<0.020	ug/L	NC (1)	20
8751690	Dissolved Strontium (Sr)	2017/09/08	NC	80 - 120	99	80 - 120	<1.0	ug/L	0.094 (1)	20
8751690	Dissolved Thallium (Tl)	2017/09/08	98	80 - 120	104	80 - 120	<0.010	ug/L	NC (1)	20
8751690	Dissolved Tin (Sn)	2017/09/08	100	80 - 120	99	80 - 120	<5.0	ug/L	NC (1)	20
8751690	Dissolved Titanium (Ti)	2017/09/08	101	80 - 120	103	80 - 120	<5.0	ug/L	NC (1)	20
8751690	Dissolved Uranium (U)	2017/09/08	101	80 - 120	105	80 - 120	<0.10	ug/L	NC (1)	20
8751690	Dissolved Vanadium (V)	2017/09/08	102	80 - 120	101	80 - 120	<5.0	ug/L	NC (1)	20
8751690	Dissolved Zinc (Zn)	2017/09/08	114	80 - 120	102	80 - 120	<5.0	ug/L	NC (1)	20

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam
A Bureau Veritas Group Company

Success Through Science®

Maxxam Job #: B776676
Report Date: 2017/09/11

QUALITY ASSURANCE REPORT(CONT'D)

MAXXAM ANALYTICS
Client Project #: MB7J1336
Site Location: 10888

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
8751690	Dissolved Zirconium (Zr)	2017/09/08	95	80 - 120	101	80 - 120	<0.10	ug/L	NC (1)	20

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Duplicate Parent ID

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B776676
Report Date: 2017/09/11

MAXXAM ANALYTICS
Client Project #: MB7J1336
Site Location: 10888

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Andy Lu, Ph.D., P.Chem., Scientific Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Your Project #: 10888
Your C.O.C. #: 625118-01-01

Attention:Reporting Group

AEL Environment
1705 Argentia Rd
Unit 3
Mississauga, ON
CANADA L5N 3A9

Report Date: 2017/09/06
Report #: R4688813
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7I8095
Received: 2017/08/29, 17:30

Sample Matrix: Soil
Samples Received: 7

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Methylnaphthalene Sum (1)	7	N/A	2017/09/06	CAM SOP-00301	EPA 8270D m
Hot Water Extractable Boron (1)	6	2017/09/02	2017/09/05	CAM SOP-00408	R153 Ana. Prot. 2011
Hot Water Extractable Boron (1)	1	2017/09/05	2017/09/05	CAM SOP-00408	R153 Ana. Prot. 2011
1,3-Dichloropropene Sum (1)	7	N/A	2017/09/05		EPA 8260C m
Free (WAD) Cyanide (1)	7	2017/09/01	2017/09/05	CAM SOP-00457	OMOE E3015 m
Conductivity (1)	7	2017/09/05	2017/09/05	CAM SOP-00414	OMOE E3530 v1 m
Hexavalent Chromium in Soil by IC (1, 2)	5	2017/09/01	2017/09/01	CAM SOP-00436	EPA 3060/7199 m
Hexavalent Chromium in Soil by IC (1, 2)	2	2017/09/01	2017/09/05	CAM SOP-00436	EPA 3060/7199 m
Petroleum Hydrocarbons F2-F4 in Soil (1, 3)	7	2017/09/01	2017/09/02	CAM SOP-00316	CCME CWS m
Strong Acid Leachable Metals by ICPMS (1)	7	2017/09/02	2017/09/06	CAM SOP-00447	EPA 6020B m
Moisture (1)	7	N/A	2017/09/01	CAM SOP-00445	Carter 2nd ed 51.2 m
PAH Compounds in Soil by GC/MS (SIM) (1)	7	2017/09/01	2017/09/02	CAM SOP-00318	EPA 8270D m
Polychlorinated Biphenyl in Soil (1)	7	2017/09/01	2017/09/01	CAM SOP-00309	EPA 8082A m
pH CaCl2 EXTRACT (1)	7	2017/09/01	2017/09/01	CAM SOP-00413	EPA 9045 D m
Sodium Adsorption Ratio (SAR) (1)	7	N/A	2017/09/05	CAM SOP-00102	EPA 6010C
SAR - ICP Metals (1)	7	2017/09/05	2017/09/05	CAM SOP-00408	EPA 6010D m
Volatile Organic Compounds and F1 PHCs (1)	7	N/A	2017/09/01	CAM SOP-00230	EPA 8260C m

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Your Project #: 10888
Your C.O.C. #: 625118-01-01

Attention:Reporting Group

AEL Environment
1705 Argentia Rd
Unit 3
Mississauga, ON
CANADA L5N 3A9

Report Date: 2017/09/06
Report #: R4688813
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7I8095
Received: 2017/08/29, 17:30

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) This test was performed by Maxxam Analytics Mississauga
(2) Soils are reported on a dry weight basis unless otherwise specified.
(3) All CCME PHC results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Maxxam conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following “Alberta Environment’s Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Validation of Performance-Based Alternative Methods September 2003”. Documentation is available upon request. Modifications from Reference Method for the Canada-wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method: F2/F3/F4 data reported using validated cold solvent extraction instead of Soxhlet extraction.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Antonella Brasil, Senior Project Manager
Email: ABrasil@maxxam.ca
Phone# (905)817-5817
==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7I8095
Report Date: 2017/09/06

AEL Environment
Client Project #: 10888

O.REG 153 METALS & INORGANICS PKG (SOIL)

Maxxam ID		FAO977		FAO978	FAO979		FAO980		
Sampling Date		2017/08/29 09:30		2017/08/29 09:45	2017/08/29 10:40		2017/08/29 11:10		
COC Number		625118-01-01		625118-01-01	625118-01-01		625118-01-01		
	UNITS	**A0197**	**QC Batch**	**A0198**	**A0200**	**QC Batch**	**A0202**	**RDL**	**QC Batch**
Calculated Parameters									
Sodium Adsorption Ratio	N/A	0.22	5142827	0.31	0.28	5142827	0.28		5142827
Inorganics									
Conductivity	mS/cm	0.20	5149238	0.10	0.11	5149238	0.36	0.002	5149357
Available (CaCl2) pH	pH	6.37	5146357	6.61	5.87	5146357	6.16		5146357
WAD Cyanide (Free)	ug/g	0.07	5146766	0.02	0.20	5146766	0.20	0.01	5146766
Metals									
Soluble Calcium (Ca)	mg/L	29.6	5149224	17.6	19.8	5149224	43.0	0.5	5149341
Soluble Magnesium (Mg)	mg/L	6.3	5149224	1.4	3.0	5149224	11.3	0.5	5149341
Soluble Sodium (Na)	mg/L	5	5149224	ND	5	5149224	8	5	5149341
Inorganics									
Chromium (VI)	ug/g	ND	5146405	ND	ND	5146206	ND	0.2	5146206
Metals									
Hot Water Ext. Boron (B)	ug/g	0.37	5148365	0.11	0.67	5148365	0.32	0.050	5149073
Acid Extractable Antimony (Sb)	ug/g	0.21	5148391	0.64	0.42	5148391	0.27	0.20	5148391
Acid Extractable Arsenic (As)	ug/g	ND	5148391	1.6	82	5148391	1.5	1.0	5148391
Acid Extractable Barium (Ba)	ug/g	55	5148391	34	210	5148391	76	0.50	5148391
Acid Extractable Beryllium (Be)	ug/g	ND	5148391	ND	0.33	5148391	ND	0.20	5148391
Acid Extractable Boron (B)	ug/g	ND	5148391	ND	ND	5148391	5.8	5.0	5148391
Acid Extractable Cadmium (Cd)	ug/g	0.18	5148391	ND	0.46	5148391	0.30	0.10	5148391
Acid Extractable Chromium (Cr)	ug/g	8.2	5148391	4.0	8.8	5148391	12	1.0	5148391
Acid Extractable Cobalt (Co)	ug/g	1.5	5148391	0.85	54	5148391	2.0	0.10	5148391
Acid Extractable Copper (Cu)	ug/g	7.8	5148391	4.5	15	5148391	20	0.50	5148391
Acid Extractable Lead (Pb)	ug/g	29	5148391	15	31	5148391	100	1.0	5148391
Acid Extractable Molybdenum (Mo)	ug/g	ND	5148391	ND	4.9	5148391	ND	0.50	5148391
Acid Extractable Nickel (Ni)	ug/g	4.0	5148391	2.6	38	5148391	6.1	0.50	5148391
Acid Extractable Selenium (Se)	ug/g	ND	5148391	ND	1.1	5148391	0.68	0.50	5148391
Acid Extractable Silver (Ag)	ug/g	ND	5148391	ND	ND	5148391	0.27	0.20	5148391
Acid Extractable Thallium (Tl)	ug/g	0.067	5148391	ND	0.95	5148391	0.11	0.050	5148391
Acid Extractable Uranium (U)	ug/g	0.58	5148391	0.19	2.6	5148391	1.3	0.050	5148391
Acid Extractable Vanadium (V)	ug/g	9.8	5148391	8.9	15	5148391	9.2	5.0	5148391
Acid Extractable Zinc (Zn)	ug/g	46	5148391	7.9	52	5148391	71	5.0	5148391
Acid Extractable Mercury (Hg)	ug/g	0.19	5148391	ND	0.057	5148391	0.16	0.050	5148391

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam Job #: B7I8095
Report Date: 2017/09/06

AEL Environment
Client Project #: 10888

O.REG 153 METALS & INORGANICS PKG (SOIL)

Maxxam ID		FAO981		FAO982		FAO983		
Sampling Date		2017/08/29 12:00		2017/08/29 12:20		2017/08/29 09:32		
COC Number		625118-01-01		625118-01-01		625118-01-01		
	UNITS	**A0204**	**QC Batch**	**A0206**	**QC Batch**	**A0213**	**RDL**	**QC Batch**
Calculated Parameters								
Sodium Adsorption Ratio	N/A	0.40	5142827	0.33	5142827	0.25		5142827
Inorganics								
Conductivity	mS/cm	0.067	5149238	0.091	5149238	0.29	0.002	5149238
Available (CaCl2) pH	pH	6.50	5146357	7.25	5146357	6.54		5146357
WAD Cyanide (Free)	ug/g	0.02	5146766	0.01	5146766	0.10	0.01	5146766
Metals								
Soluble Calcium (Ca)	mg/L	8.4	5149224	12.7	5149224	39.4	0.5	5149224
Soluble Magnesium (Mg)	mg/L	1.9	5149224	2.7	5149224	7.4	0.5	5149224
Soluble Sodium (Na)	mg/L	ND	5149224	ND	5149224	7	5	5149224
Inorganics								
Chromium (VI)	ug/g	ND	5146206	ND	5146405	ND	0.2	5146206
Metals								
Hot Water Ext. Boron (B)	ug/g	0.22	5148365	0.16	5148365	0.13	0.050	5148365
Acid Extractable Antimony (Sb)	ug/g	0.77	5148391	0.47	5148391	0.22	0.20	5148391
Acid Extractable Arsenic (As)	ug/g	2.5	5148391	1.3	5148391	ND	1.0	5148391
Acid Extractable Barium (Ba)	ug/g	79	5148391	28	5148391	60	0.50	5148391
Acid Extractable Beryllium (Be)	ug/g	ND	5148391	ND	5148391	ND	0.20	5148391
Acid Extractable Boron (B)	ug/g	ND	5148391	ND	5148391	ND	5.0	5148391
Acid Extractable Cadmium (Cd)	ug/g	ND	5148391	ND	5148391	0.17	0.10	5148391
Acid Extractable Chromium (Cr)	ug/g	5.8	5148391	10	5148391	8.3	1.0	5148391
Acid Extractable Cobalt (Co)	ug/g	2.2	5148391	2.6	5148391	1.6	0.10	5148391
Acid Extractable Copper (Cu)	ug/g	6.1	5148391	14	5148391	7.5	0.50	5148391
Acid Extractable Lead (Pb)	ug/g	110	5148391	50	5148391	33	1.0	5148391
Acid Extractable Molybdenum (Mo)	ug/g	0.61	5148391	ND	5148391	ND	0.50	5148391
Acid Extractable Nickel (Ni)	ug/g	3.7	5148391	5.2	5148391	3.9	0.50	5148391
Acid Extractable Selenium (Se)	ug/g	ND	5148391	ND	5148391	ND	0.50	5148391
Acid Extractable Silver (Ag)	ug/g	ND	5148391	ND	5148391	ND	0.20	5148391
Acid Extractable Thallium (Tl)	ug/g	0.086	5148391	ND	5148391	0.064	0.050	5148391
Acid Extractable Uranium (U)	ug/g	0.17	5148391	0.42	5148391	0.61	0.050	5148391
Acid Extractable Vanadium (V)	ug/g	5.5	5148391	32	5148391	11	5.0	5148391
Acid Extractable Zinc (Zn)	ug/g	35	5148391	27	5148391	37	5.0	5148391
Acid Extractable Mercury (Hg)	ug/g	0.13	5148391	ND	5148391	0.11	0.050	5148391

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

O.REG 153 PAHS (SOIL)

Maxxam ID		FAO977		FAO978		FAO979		FAO980		
Sampling Date		2017/08/29 09:30		2017/08/29 09:45		2017/08/29 10:40		2017/08/29 11:10		
COC Number		625118-01-01		625118-01-01		625118-01-01		625118-01-01		
	UNITS	**A0197**	**RDL**	**A0198**	**RDL**	**A0200**	**RDL**	**A0202**	**RDL**	**QC Batch**
Calculated Parameters										
Methylnaphthalene, 2-(1-)	ug/g	ND	0.014	ND	0.0071	ND	0.014	0.028	0.028	5142859
Polyaromatic Hydrocarbons										
Acenaphthene	ug/g	ND	0.010	0.0078	0.0050	ND	0.010	ND	0.020	5147221
Acenaphthylene	ug/g	ND	0.010	ND	0.0050	ND	0.010	ND	0.020	5147221
Anthracene	ug/g	0.011	0.010	0.0062	0.0050	ND	0.010	0.024	0.020	5147221
Benzo(a)anthracene	ug/g	0.050	0.010	ND	0.0050	ND	0.010	0.073	0.020	5147221
Benzo(a)pyrene	ug/g	0.043	0.010	ND	0.0050	ND	0.010	0.065	0.020	5147221
Benzo(b/j)fluoranthene	ug/g	0.062	0.010	0.0090	0.0050	0.019	0.010	0.11	0.020	5147221
Benzo(g,h,i)perylene	ug/g	0.034	0.010	ND	0.0050	0.012	0.010	0.057	0.020	5147221
Benzo(k)fluoranthene	ug/g	0.024	0.010	ND	0.0050	ND	0.010	0.039	0.020	5147221
Chrysene	ug/g	0.043	0.010	0.0062	0.0050	0.012	0.010	0.071	0.020	5147221
Dibenz(a,h)anthracene	ug/g	ND	0.010	ND	0.0050	ND	0.010	ND	0.020	5147221
Fluoranthene	ug/g	0.095	0.010	0.025	0.0050	0.031	0.010	0.15	0.020	5147221
Fluorene	ug/g	ND	0.010	0.010	0.0050	ND	0.010	ND	0.020	5147221
Indeno(1,2,3-cd)pyrene	ug/g	0.037	0.010	ND	0.0050	0.011	0.010	0.055	0.020	5147221
1-Methylnaphthalene	ug/g	ND	0.010	ND	0.0050	ND	0.010	ND	0.020	5147221
2-Methylnaphthalene	ug/g	ND	0.010	ND	0.0050	ND	0.010	0.028	0.020	5147221
Naphthalene	ug/g	ND	0.010	ND	0.0050	ND	0.010	ND	0.020	5147221
Phenanthrene	ug/g	0.042	0.010	0.0088	0.0050	0.010	0.010	0.053	0.020	5147221
Pyrene	ug/g	0.077	0.010	0.021	0.0050	0.026	0.010	0.12	0.020	5147221
Surrogate Recovery (%)										
D10-Anthracene	%	95		97		96		100		5147221
D14-Terphenyl (FS)	%	86		88		87		84		5147221
D8-Acenaphthylene	%	107		106		108		107		5147221

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

O.REG 153 PAHS (SOIL)

Maxxam ID		FAO981	FAO982		FAO983		
Sampling Date		2017/08/29 12:00	2017/08/29 12:20		2017/08/29 09:32		
COC Number		625118-01-01	625118-01-01		625118-01-01		
	UNITS	A0204	A0206	RDL	A0213	RDL	QC Batch
Calculated Parameters							
Methylnaphthalene, 2-(1-)	ug/g	ND	ND	0.0071	ND	0.014	5142859
Polyaromatic Hydrocarbons							
Acenaphthene	ug/g	0.0098	ND	0.0050	ND	0.010	5147221
Acenaphthylene	ug/g	0.0086	ND	0.0050	ND	0.010	5147221
Anthracene	ug/g	0.021	ND	0.0050	ND	0.010	5147221
Benzo(a)anthracene	ug/g	0.073	0.015	0.0050	0.036	0.010	5147221
Benzo(a)pyrene	ug/g	0.063	0.012	0.0050	0.030	0.010	5147221
Benzo(b/j)fluoranthene	ug/g	0.097	0.032	0.0050	0.040	0.010	5147221
Benzo(g,h,i)perylene	ug/g	0.042	0.0095	0.0050	0.019	0.010	5147221
Benzo(k)fluoranthene	ug/g	0.035	0.0078	0.0050	0.016	0.010	5147221
Chrysene	ug/g	0.070	0.026	0.0050	0.029	0.010	5147221
Dibenz(a,h)anthracene	ug/g	0.011	ND	0.0050	ND	0.010	5147221
Fluoranthene	ug/g	0.14	0.056	0.0050	0.065	0.010	5147221
Fluorene	ug/g	0.0094	ND	0.0050	ND	0.010	5147221
Indeno(1,2,3-cd)pyrene	ug/g	0.046	0.0093	0.0050	0.020	0.010	5147221
1-Methylnaphthalene	ug/g	ND	ND	0.0050	ND	0.010	5147221
2-Methylnaphthalene	ug/g	ND	0.0052	0.0050	ND	0.010	5147221
Naphthalene	ug/g	ND	ND	0.0050	ND	0.010	5147221
Phenanthrene	ug/g	0.083	0.019	0.0050	0.027	0.010	5147221
Pyrene	ug/g	0.11	0.042	0.0050	0.052	0.010	5147221
Surrogate Recovery (%)							
D10-Anthracene	%	93	94		92		5147221
D14-Terphenyl (FS)	%	85	86		85		5147221
D8-Acenaphthylene	%	109	98		106		5147221

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam Job #: B7I8095
Report Date: 2017/09/06

AEL Environment
Client Project #: 10888

O.REG 153 PCBS (SOIL)

Maxxam ID		FAO977		FAO978		FAO979		FAO980		
Sampling Date		2017/08/29 09:30		2017/08/29 09:45		2017/08/29 10:40		2017/08/29 11:10		
COC Number		625118-01-01		625118-01-01		625118-01-01		625118-01-01		
	UNITS	A0197	RDL	A0198	RDL	A0200	RDL	A0202	RDL	QC Batch
PCBs										
Aroclor 1242	ug/g	ND	0.020	ND	0.010	ND	0.030	ND	0.050	5146552
Aroclor 1248	ug/g	ND	0.020	ND	0.010	ND	0.030	ND	0.050	5146552
Aroclor 1254	ug/g	ND	0.020	ND	0.010	ND	0.030	ND	0.050	5146552
Aroclor 1260	ug/g	ND	0.020	ND	0.010	ND	0.030	ND	0.050	5146552
Total PCB	ug/g	ND	0.020	ND	0.010	ND	0.030	ND	0.050	5146552
Surrogate Recovery (%)										
Decachlorobiphenyl	%	111		96		97		87		5146552

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam ID		FAO981	FAO982		FAO983		
Sampling Date		2017/08/29 12:00	2017/08/29 12:20		2017/08/29 09:32		
COC Number		625118-01-01	625118-01-01		625118-01-01		
	UNITS	A0204	A0206	RDL	A0213	RDL	QC Batch
PCBs							
Aroclor 1242	ug/g	ND	ND	0.010	ND	0.030	5146552
Aroclor 1248	ug/g	ND	ND	0.010	ND	0.030	5146552
Aroclor 1254	ug/g	ND	ND	0.010	ND	0.030	5146552
Aroclor 1260	ug/g	ND	ND	0.010	ND	0.030	5146552
Total PCB	ug/g	ND	ND	0.010	ND	0.030	5146552
Surrogate Recovery (%)							
Decachlorobiphenyl	%	102	101		131 (1)		5146552

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected
(1) Surrogate recovery was above the upper control limit. This may represent a high bias in some results. For results that are ND, this potential bias has no impact.

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7I8095
Report Date: 2017/09/06

AEL Environment
Client Project #: 10888

O.REG 153 VOCS BY HS & F1-F4 (SOIL)

Maxxam ID		FAO977		FAO978		FAO979		FAO980		
Sampling Date		2017/08/29 09:30		2017/08/29 09:45		2017/08/29 10:40		2017/08/29 11:10		
COC Number		625118-01-01		625118-01-01		625118-01-01		625118-01-01		
	UNITS	**A0197**	**RDL**	**A0198**	**RDL**	**A0200**	**RDL**	**A0202**	**RDL**	**QC Batch**
Inorganics										
Moisture	%	47	1.0	21	1.0	59	1.0	80	1.0	5146858
Calculated Parameters										
1,3-Dichloropropene (cis+trans)	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5142296
Volatile Organics										
Acetone (2-Propanone)	ug/g	ND	0.50	ND	0.50	ND	1.0	1.5	1.5	5144807
Benzene	ug/g	ND	0.020	ND	0.020	ND	0.040	ND	0.060	5144807
Bromodichloromethane	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807
Bromoform	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807
Bromomethane	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807
Carbon Tetrachloride	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807
Chlorobenzene	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807
Chloroform	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807
Dibromochloromethane	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807
1,2-Dichlorobenzene	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807
1,3-Dichlorobenzene	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807
1,4-Dichlorobenzene	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807
Dichlorodifluoromethane (FREON 12)	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807
1,1-Dichloroethane	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807
1,2-Dichloroethane	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807
1,1-Dichloroethylene	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807
cis-1,2-Dichloroethylene	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807
trans-1,2-Dichloroethylene	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807
1,2-Dichloropropane	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807
cis-1,3-Dichloropropene	ug/g	ND	0.030	ND	0.030	ND	0.060	ND	0.090	5144807
trans-1,3-Dichloropropene	ug/g	ND	0.040	ND	0.040	ND	0.080	ND	0.12	5144807
Ethylbenzene	ug/g	ND	0.020	ND	0.020	ND	0.040	ND	0.060	5144807
Ethylene Dibromide	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807
Hexane	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807
Methylene Chloride(Dichloromethane)	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807
Methyl Ethyl Ketone (2-Butanone)	ug/g	ND	0.50	ND	0.50	ND	1.0	ND	1.5	5144807
Methyl Isobutyl Ketone	ug/g	ND	0.50	ND	0.50	ND	1.0	ND	1.5	5144807
Methyl t-butyl ether (MTBE)	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807
Styrene	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807
1,1,1,2-Tetrachloroethane	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam Job #: B7I8095
Report Date: 2017/09/06

AEL Environment
Client Project #: 10888

O.REG 153 VOCS BY HS & F1-F4 (SOIL)

Maxxam ID		FAO977		FAO978		FAO979		FAO980		
Sampling Date		2017/08/29 09:30		2017/08/29 09:45		2017/08/29 10:40		2017/08/29 11:10		
COC Number		625118-01-01		625118-01-01		625118-01-01		625118-01-01		
	UNITS	**A0197**	**RDL**	**A0198**	**RDL**	**A0200**	**RDL**	**A0202**	**RDL**	**QC Batch**
1,1,2,2-Tetrachloroethane	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807
Tetrachloroethylene	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807
Toluene	ug/g	ND	0.020	ND	0.020	ND	0.040	0.079	0.060	5144807
1,1,1-Trichloroethane	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807
1,1,2-Trichloroethane	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807
Trichloroethylene	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807
Trichlorofluoromethane (FREON 11)	ug/g	ND	0.050	ND	0.050	ND	0.10	ND	0.15	5144807
Vinyl Chloride	ug/g	ND	0.020	ND	0.020	ND	0.040	ND	0.060	5144807
p+m-Xylene	ug/g	ND	0.020	ND	0.020	ND	0.040	ND	0.060	5144807
o-Xylene	ug/g	ND	0.020	ND	0.020	ND	0.040	ND	0.060	5144807
Total Xylenes	ug/g	ND	0.020	ND	0.020	ND	0.040	ND	0.060	5144807
F1 (C6-C10)	ug/g	ND	10	ND	10	ND	20	ND	30	5144807
F1 (C6-C10) - BTEX	ug/g	ND	10	ND	10	ND	20	ND	30	5144807
F2-F4 Hydrocarbons										
F2 (C10-C16 Hydrocarbons)	ug/g	ND	20	ND	10	ND	20	ND	50	5147212
F3 (C16-C34 Hydrocarbons)	ug/g	110	100	ND	50	ND	100	270	250	5147212
F4 (C34-C50 Hydrocarbons)	ug/g	ND	100	ND	50	ND	100	ND	250	5147212
Reached Baseline at C50	ug/g	Yes		Yes		Yes		Yes		5147212
Surrogate Recovery (%)										
o-Terphenyl	%	96		97		97		95		5147212
4-Bromofluorobenzene	%	94		94		94		95		5144807
D10-o-Xylene	%	80		80		75		75		5144807
D4-1,2-Dichloroethane	%	107		108		107		106		5144807
D8-Toluene	%	96		94		96		95		5144807

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

O.REG 153 VOCS BY HS & F1-F4 (SOIL)

Maxxam ID		FAO981	FAO982	FAO982		FAO983		
Sampling Date		2017/08/29 12:00	2017/08/29 12:20	2017/08/29 12:20		2017/08/29 09:32		
COC Number		625118-01-01	625118-01-01	625118-01-01		625118-01-01		
	UNITS	**A0204**	**A0206**	**A0206 Lab-Dup**	**RDL**	**A0213**	**RDL**	**QC Batch**
Inorganics								
Moisture	%	27	21	20	1.0	56	1.0	5146858
Calculated Parameters								
1,3-Dichloropropene (cis+trans)	ug/g	ND	ND		0.050	ND	0.050	5142296
Volatile Organics								
Acetone (2-Propanone)	ug/g	ND	ND		0.50	ND	0.50	5144807
Benzene	ug/g	ND	ND		0.020	ND	0.020	5144807
Bromodichloromethane	ug/g	ND	ND		0.050	ND	0.050	5144807
Bromoform	ug/g	ND	ND		0.050	ND	0.050	5144807
Bromomethane	ug/g	ND	ND		0.050	ND	0.050	5144807
Carbon Tetrachloride	ug/g	ND	ND		0.050	ND	0.050	5144807
Chlorobenzene	ug/g	ND	ND		0.050	ND	0.050	5144807
Chloroform	ug/g	ND	ND		0.050	ND	0.050	5144807
Dibromochloromethane	ug/g	ND	ND		0.050	ND	0.050	5144807
1,2-Dichlorobenzene	ug/g	ND	ND		0.050	ND	0.050	5144807
1,3-Dichlorobenzene	ug/g	ND	ND		0.050	ND	0.050	5144807
1,4-Dichlorobenzene	ug/g	ND	ND		0.050	ND	0.050	5144807
Dichlorodifluoromethane (FREON 12)	ug/g	ND	ND		0.050	ND	0.050	5144807
1,1-Dichloroethane	ug/g	ND	ND		0.050	ND	0.050	5144807
1,2-Dichloroethane	ug/g	ND	ND		0.050	ND	0.050	5144807
1,1-Dichloroethylene	ug/g	ND	ND		0.050	ND	0.050	5144807
cis-1,2-Dichloroethylene	ug/g	ND	ND		0.050	ND	0.050	5144807
trans-1,2-Dichloroethylene	ug/g	ND	ND		0.050	ND	0.050	5144807
1,2-Dichloropropane	ug/g	ND	ND		0.050	ND	0.050	5144807
cis-1,3-Dichloropropene	ug/g	ND	ND		0.030	ND	0.030	5144807
trans-1,3-Dichloropropene	ug/g	ND	ND		0.040	ND	0.040	5144807
Ethylbenzene	ug/g	ND	ND		0.020	ND	0.020	5144807
Ethylene Dibromide	ug/g	ND	ND		0.050	ND	0.050	5144807
Hexane	ug/g	ND	ND		0.050	ND	0.050	5144807
Methylene Chloride(Dichloromethane)	ug/g	ND	ND		0.050	ND	0.050	5144807
Methyl Ethyl Ketone (2-Butanone)	ug/g	ND	ND		0.50	ND	0.50	5144807
Methyl Isobutyl Ketone	ug/g	ND	ND		0.50	ND	0.50	5144807
Methyl t-butyl ether (MTBE)	ug/g	ND	ND		0.050	ND	0.050	5144807
Styrene	ug/g	ND	ND		0.050	ND	0.050	5144807

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

O.REG 153 VOCS BY HS & F1-F4 (SOIL)

Maxxam ID		FAO981	FAO982	FAO982		FAO983		
Sampling Date		2017/08/29 12:00	2017/08/29 12:20	2017/08/29 12:20		2017/08/29 09:32		
COC Number		625118-01-01	625118-01-01	625118-01-01		625118-01-01		
	UNITS	**A0204**	**A0206**	**A0206 Lab-Dup**	**RDL**	**A0213**	**RDL**	**QC Batch**
1,1,1,2-Tetrachloroethane	ug/g	ND	ND		0.050	ND	0.050	5144807
1,1,2,2-Tetrachloroethane	ug/g	ND	ND		0.050	ND	0.050	5144807
Tetrachloroethylene	ug/g	ND	ND		0.050	ND	0.050	5144807
Toluene	ug/g	ND	ND		0.020	0.13	0.020	5144807
1,1,1-Trichloroethane	ug/g	ND	ND		0.050	ND	0.050	5144807
1,1,2-Trichloroethane	ug/g	ND	ND		0.050	ND	0.050	5144807
Trichloroethylene	ug/g	ND	ND		0.050	ND	0.050	5144807
Trichlorofluoromethane (FREON 11)	ug/g	ND	ND		0.050	ND	0.050	5144807
Vinyl Chloride	ug/g	ND	ND		0.020	ND	0.020	5144807
p+m-Xylene	ug/g	ND	ND		0.020	ND	0.020	5144807
o-Xylene	ug/g	ND	ND		0.020	ND	0.020	5144807
Total Xylenes	ug/g	ND	ND		0.020	ND	0.020	5144807
F1 (C6-C10)	ug/g	ND	ND		10	ND	10	5144807
F1 (C6-C10) - BTEX	ug/g	ND	ND		10	ND	10	5144807
F2-F4 Hydrocarbons								
F2 (C10-C16 Hydrocarbons)	ug/g	ND	ND		10	ND	20	5147212
F3 (C16-C34 Hydrocarbons)	ug/g	ND	ND		50	ND	100	5147212
F4 (C34-C50 Hydrocarbons)	ug/g	ND	ND		50	ND	100	5147212
Reached Baseline at C50	ug/g	Yes	Yes			Yes		5147212
Surrogate Recovery (%)								
o-Terphenyl	%	98	97			96		5147212
4-Bromofluorobenzene	%	95	94			95		5144807
D10-o-Xylene	%	79	91			85		5144807
D4-1,2-Dichloroethane	%	105	107			107		5144807
D8-Toluene	%	97	96			96		5144807

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

TEST SUMMARY

Maxxam ID: FAO977
Sample ID: A0197
Matrix: Soil

Collected: 2017/08/29
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	5142859	N/A	2017/09/06	Automated Statchk
Hot Water Extractable Boron	ICP	5148365	2017/09/02	2017/09/05	Jolly John
1,3-Dichloropropene Sum	CALC	5142296	N/A	2017/09/05	Automated Statchk
Free (WAD) Cyanide	TECH	5146766	2017/09/01	2017/09/05	Louise Harding
Conductivity	AT	5149238	2017/09/05	2017/09/05	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	5146405	2017/09/01	2017/09/05	Manoj Kumar Gera
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	5147212	2017/09/01	2017/09/02	Zhiyue (Frank) Zhu
Strong Acid Leachable Metals by ICPMS	ICP/MS	5148391	2017/09/02	2017/09/06	Daniel Teclu
Moisture	BAL	5146858	N/A	2017/09/01	Valentina Kaftani
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	5147221	2017/09/01	2017/09/02	Mitesh Raj
Polychlorinated Biphenyl in Soil	GC/ECD	5146552	2017/09/01	2017/09/01	Dawn Alarie
pH CaCl2 EXTRACT	AT	5146357	2017/09/01	2017/09/01	Tahir Anwar
Sodium Adsorption Ratio (SAR)	CALC/MET	5142827	N/A	2017/09/05	Automated Statchk
SAR - ICP Metals	ICP	5149224	2017/09/05	2017/09/05	Jolly John
Volatile Organic Compounds and F1 PHCs	GC/MSFD	5144807	N/A	2017/09/01	Karen Hughes

Maxxam ID: FAO978
Sample ID: A0198
Matrix: Soil

Collected: 2017/08/29
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	5142859	N/A	2017/09/06	Automated Statchk
Hot Water Extractable Boron	ICP	5148365	2017/09/02	2017/09/05	Jolly John
1,3-Dichloropropene Sum	CALC	5142296	N/A	2017/09/05	Automated Statchk
Free (WAD) Cyanide	TECH	5146766	2017/09/01	2017/09/05	Louise Harding
Conductivity	AT	5149238	2017/09/05	2017/09/05	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	5146206	2017/09/01	2017/09/01	Sally Coughlin
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	5147212	2017/09/01	2017/09/02	Zhiyue (Frank) Zhu
Strong Acid Leachable Metals by ICPMS	ICP/MS	5148391	2017/09/02	2017/09/06	Daniel Teclu
Moisture	BAL	5146858	N/A	2017/09/01	Valentina Kaftani
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	5147221	2017/09/01	2017/09/02	Mitesh Raj
Polychlorinated Biphenyl in Soil	GC/ECD	5146552	2017/09/01	2017/09/01	Dawn Alarie
pH CaCl2 EXTRACT	AT	5146357	2017/09/01	2017/09/01	Tahir Anwar
Sodium Adsorption Ratio (SAR)	CALC/MET	5142827	N/A	2017/09/05	Automated Statchk
SAR - ICP Metals	ICP	5149224	2017/09/05	2017/09/05	Jolly John
Volatile Organic Compounds and F1 PHCs	GC/MSFD	5144807	N/A	2017/09/01	Karen Hughes

Maxxam ID: FAO979
Sample ID: A0200
Matrix: Soil

Collected: 2017/08/29
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	5142859	N/A	2017/09/06	Automated Statchk
Hot Water Extractable Boron	ICP	5148365	2017/09/02	2017/09/05	Jolly John
1,3-Dichloropropene Sum	CALC	5142296	N/A	2017/09/05	Automated Statchk
Free (WAD) Cyanide	TECH	5146766	2017/09/01	2017/09/05	Louise Harding

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7I8095
Report Date: 2017/09/06

AEL Environment
Client Project #: 10888

TEST SUMMARY

Maxxam ID: FAO979
Sample ID: A0200
Matrix: Soil

Collected: 2017/08/29
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	5149238	2017/09/05	2017/09/05	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	5146206	2017/09/01	2017/09/01	Sally Coughlin
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	5147212	2017/09/01	2017/09/02	Zhiyue (Frank) Zhu
Strong Acid Leachable Metals by ICPMS	ICP/MS	5148391	2017/09/02	2017/09/06	Daniel Teclu
Moisture	BAL	5146858	N/A	2017/09/01	Valentina Kaftani
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	5147221	2017/09/01	2017/09/02	Mitesh Raj
Polychlorinated Biphenyl in Soil	GC/ECD	5146552	2017/09/01	2017/09/01	Dawn Alarie
pH CaCl2 EXTRACT	AT	5146357	2017/09/01	2017/09/01	Tahir Anwar
Sodium Adsorption Ratio (SAR)	CALC/MET	5142827	N/A	2017/09/05	Automated Statchk
SAR - ICP Metals	ICP	5149224	2017/09/05	2017/09/05	Jolly John
Volatile Organic Compounds and F1 PHCs	GC/MSFD	5144807	N/A	2017/09/01	Karen Hughes

Maxxam ID: FAO980
Sample ID: A0202
Matrix: Soil

Collected: 2017/08/29
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	5142859	N/A	2017/09/06	Automated Statchk
Hot Water Extractable Boron	ICP	5149073	2017/09/05	2017/09/05	Jolly John
1,3-Dichloropropene Sum	CALC	5142296	N/A	2017/09/05	Automated Statchk
Free (WAD) Cyanide	TECH	5146766	2017/09/01	2017/09/05	Louise Harding
Conductivity	AT	5149357	2017/09/05	2017/09/05	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	5146206	2017/09/01	2017/09/01	Sally Coughlin
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	5147212	2017/09/01	2017/09/02	Zhiyue (Frank) Zhu
Strong Acid Leachable Metals by ICPMS	ICP/MS	5148391	2017/09/02	2017/09/06	Daniel Teclu
Moisture	BAL	5146858	N/A	2017/09/01	Valentina Kaftani
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	5147221	2017/09/01	2017/09/02	Mitesh Raj
Polychlorinated Biphenyl in Soil	GC/ECD	5146552	2017/09/01	2017/09/01	Dawn Alarie
pH CaCl2 EXTRACT	AT	5146357	2017/09/01	2017/09/01	Tahir Anwar
Sodium Adsorption Ratio (SAR)	CALC/MET	5142827	N/A	2017/09/05	Automated Statchk
SAR - ICP Metals	ICP	5149341	2017/09/05	2017/09/05	Azita Fazaeli
Volatile Organic Compounds and F1 PHCs	GC/MSFD	5144807	N/A	2017/09/01	Karen Hughes

Maxxam ID: FAO981
Sample ID: A0204
Matrix: Soil

Collected: 2017/08/29
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	5142859	N/A	2017/09/06	Automated Statchk
Hot Water Extractable Boron	ICP	5148365	2017/09/02	2017/09/05	Jolly John
1,3-Dichloropropene Sum	CALC	5142296	N/A	2017/09/05	Automated Statchk
Free (WAD) Cyanide	TECH	5146766	2017/09/01	2017/09/05	Louise Harding
Conductivity	AT	5149238	2017/09/05	2017/09/05	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	5146206	2017/09/01	2017/09/01	Sally Coughlin
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	5147212	2017/09/01	2017/09/02	Zhiyue (Frank) Zhu
Strong Acid Leachable Metals by ICPMS	ICP/MS	5148391	2017/09/02	2017/09/06	Daniel Teclu

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7I8095
Report Date: 2017/09/06

AEL Environment
Client Project #: 10888

TEST SUMMARY

Maxxam ID: FAO981
Sample ID: A0204
Matrix: Soil

Collected: 2017/08/29
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	5146858	N/A	2017/09/01	Valentina Kaftani
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	5147221	2017/09/01	2017/09/02	Mitesh Raj
Polychlorinated Biphenyl in Soil	GC/ECD	5146552	2017/09/01	2017/09/01	Dawn Alarie
pH CaCl2 EXTRACT	AT	5146357	2017/09/01	2017/09/01	Tahir Anwar
Sodium Adsorption Ratio (SAR)	CALC/MET	5142827	N/A	2017/09/05	Automated Statchk
SAR - ICP Metals	ICP	5149224	2017/09/05	2017/09/05	Jolly John
Volatile Organic Compounds and F1 PHCs	GC/MSFD	5144807	N/A	2017/09/01	Karen Hughes

Maxxam ID: FAO982
Sample ID: A0206
Matrix: Soil

Collected: 2017/08/29
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	5142859	N/A	2017/09/06	Automated Statchk
Hot Water Extractable Boron	ICP	5148365	2017/09/02	2017/09/05	Jolly John
1,3-Dichloropropene Sum	CALC	5142296	N/A	2017/09/05	Automated Statchk
Free (WAD) Cyanide	TECH	5146766	2017/09/01	2017/09/05	Louise Harding
Conductivity	AT	5149238	2017/09/05	2017/09/05	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	5146405	2017/09/01	2017/09/05	Manoj Kumar Gera
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	5147212	2017/09/01	2017/09/02	Zhiyue (Frank) Zhu
Strong Acid Leachable Metals by ICPMS	ICP/MS	5148391	2017/09/02	2017/09/06	Daniel Teclu
Moisture	BAL	5146858	N/A	2017/09/01	Valentina Kaftani
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	5147221	2017/09/01	2017/09/02	Mitesh Raj
Polychlorinated Biphenyl in Soil	GC/ECD	5146552	2017/09/01	2017/09/01	Dawn Alarie
pH CaCl2 EXTRACT	AT	5146357	2017/09/01	2017/09/01	Tahir Anwar
Sodium Adsorption Ratio (SAR)	CALC/MET	5142827	N/A	2017/09/05	Automated Statchk
SAR - ICP Metals	ICP	5149224	2017/09/05	2017/09/05	Jolly John
Volatile Organic Compounds and F1 PHCs	GC/MSFD	5144807	N/A	2017/09/01	Karen Hughes

Maxxam ID: FAO982 Dup
Sample ID: A0206
Matrix: Soil

Collected: 2017/08/29
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Moisture	BAL	5146858	N/A	2017/09/01	Valentina Kaftani

Maxxam ID: FAO983
Sample ID: A0213
Matrix: Soil

Collected: 2017/08/29
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Methylnaphthalene Sum	CALC	5142859	N/A	2017/09/06	Automated Statchk
Hot Water Extractable Boron	ICP	5148365	2017/09/02	2017/09/05	Jolly John
1,3-Dichloropropene Sum	CALC	5142296	N/A	2017/09/05	Automated Statchk
Free (WAD) Cyanide	TECH	5146766	2017/09/01	2017/09/05	Louise Harding
Conductivity	AT	5149238	2017/09/05	2017/09/05	Neil Dassanayake

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam Job #: B7I8095
Report Date: 2017/09/06

AEL Environment
Client Project #: 10888

TEST SUMMARY

Maxxam ID: FAO983
Sample ID: A0213
Matrix: Soil

Collected: 2017/08/29
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hexavalent Chromium in Soil by IC	IC/SPEC	5146206	2017/09/01	2017/09/01	Sally Coughlin
Petroleum Hydrocarbons F2-F4 in Soil	GC/FID	5147212	2017/09/01	2017/09/02	Zhiyue (Frank) Zhu
Strong Acid Leachable Metals by ICPMS	ICP/MS	5148391	2017/09/02	2017/09/06	Daniel Teclu
Moisture	BAL	5146858	N/A	2017/09/01	Valentina Kaftani
PAH Compounds in Soil by GC/MS (SIM)	GC/MS	5147221	2017/09/01	2017/09/02	Mitesh Raj
Polychlorinated Biphenyl in Soil	GC/ECD	5146552	2017/09/01	2017/09/01	Dawn Alarie
pH CaCl2 EXTRACT	AT	5146357	2017/09/01	2017/09/01	Tahir Anwar
Sodium Adsorption Ratio (SAR)	CALC/MET	5142827	N/A	2017/09/05	Automated Statchk
SAR - ICP Metals	ICP	5149224	2017/09/05	2017/09/05	Jolly John
Volatile Organic Compounds and F1 PHCs	GC/MSFD	5144807	N/A	2017/09/01	Karen Hughes

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	15.0°C

Sample FAO977 [A0197] : F24FID Analysis: Detection limits were adjusted for high moisture content.

PCB Analysis: Detection limits were adjusted for high moisture content.

PAH analysis: Detection limits were adjusted for high moisture content.

Sample FAO978 [A0198] : SAR Analysis: Sodium was not detected. To report SAR the sodium detection limit was used in the calculation. This value represents a maximum ratio.

Sample FAO979 [A0200] : F24FID Analysis: Detection limits were adjusted for high moisture content.

PCB Analysis: Detection limits were adjusted for high moisture content.

VOCF1 Analysis: Detection limits were raised due to high moisture content of soil provided.

PAH analysis: Detection limits were adjusted for high moisture content.

Sample FAO980 [A0202] : F24FID Analysis: Detection limits were adjusted for high moisture content.

SAR-ICP/CONDUCT-SB: Sample entirely absorbed the extraction fluid when 1:2 ratios were used. Due to the organic and highly absorbent nature of the sample, the sample/fluid ratio was changed to 1:4.Please view results with discretion.

PCB Analysis: Detection limits were adjusted for high moisture content.

VOCF1 Analysis: Detection limits were raised due to high moisture content of soil provided.

PAH analysis: Detection limits were adjusted for high moisture content.

Sample FAO981 [A0204] : SAR Analysis: Sodium was not detected. To report SAR the sodium detection limit was used in the calculation. This value represents a maximum ratio.

Sample FAO982 [A0206] : SAR Analysis: Sodium was not detected. To report SAR the sodium detection limit was used in the calculation. This value represents a maximum ratio.

Sample FAO983 [A0213] : F24FID Analysis: Detection limits were adjusted for high moisture content.

PCB Analysis: Detection limits were adjusted for high moisture content.
PAH analysis: Detection limits were adjusted for high moisture content.

Results relate only to the items tested.

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7I8095
Report Date: 2017/09/06

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
5144807	KH2	Matrix Spike	4-Bromofluorobenzene	2017/09/01		99	%	60 - 140
			D10-o-Xylene	2017/09/01		81	%	60 - 130
			D4-1,2-Dichloroethane	2017/09/01		104	%	60 - 140
			D8-Toluene	2017/09/01		101	%	60 - 140
			Acetone (2-Propanone)	2017/09/01		105	%	60 - 140
			Benzene	2017/09/01		103	%	60 - 140
			Bromodichloromethane	2017/09/01		99	%	60 - 140
			Bromoform	2017/09/01		106	%	60 - 140
			Bromomethane	2017/09/01		101	%	60 - 140
			Carbon Tetrachloride	2017/09/01		98	%	60 - 140
			Chlorobenzene	2017/09/01		97	%	60 - 140
			Chloroform	2017/09/01		99	%	60 - 140
			Dibromochloromethane	2017/09/01		103	%	60 - 140
			1,2-Dichlorobenzene	2017/09/01		94	%	60 - 140
			1,3-Dichlorobenzene	2017/09/01		96	%	60 - 140
			1,4-Dichlorobenzene	2017/09/01		94	%	60 - 140
			Dichlorodifluoromethane (FREON 12)	2017/09/01		107	%	60 - 140
			1,1-Dichloroethane	2017/09/01		105	%	60 - 140
			1,2-Dichloroethane	2017/09/01		99	%	60 - 140
			1,1-Dichloroethylene	2017/09/01		111	%	60 - 140
			cis-1,2-Dichloroethylene	2017/09/01		99	%	60 - 140
			trans-1,2-Dichloroethylene	2017/09/01		103	%	60 - 140
			1,2-Dichloropropane	2017/09/01		97	%	60 - 140
			cis-1,3-Dichloropropene	2017/09/01		91	%	60 - 140
			trans-1,3-Dichloropropene	2017/09/01		95	%	60 - 140
			Ethylbenzene	2017/09/01		94	%	60 - 140
			Ethylene Dibromide	2017/09/01		104	%	60 - 140
			Hexane	2017/09/01		102	%	60 - 140
			Methylene Chloride(Dichloromethane)	2017/09/01		102	%	60 - 140
			Methyl Ethyl Ketone (2-Butanone)	2017/09/01		109	%	60 - 140
			Methyl Isobutyl Ketone	2017/09/01		103	%	60 - 140
			Methyl t-butyl ether (MTBE)	2017/09/01		95	%	60 - 140
			Styrene	2017/09/01		93	%	60 - 140
			1,1,1,2-Tetrachloroethane	2017/09/01		104	%	60 - 140
			1,1,2,2-Tetrachloroethane	2017/09/01		106	%	60 - 140
			Tetrachloroethylene	2017/09/01		93	%	60 - 140
			Toluene	2017/09/01		95	%	60 - 140
			1,1,1-Trichloroethane	2017/09/01		96	%	60 - 140
			1,1,2-Trichloroethane	2017/09/01		99	%	60 - 140
			Trichloroethylene	2017/09/01		97	%	60 - 140
			Trichlorofluoromethane (FREON 11)	2017/09/01		103	%	60 - 140
			Vinyl Chloride	2017/09/01		111	%	60 - 140
			p+m-Xylene	2017/09/01		96	%	60 - 140
			o-Xylene	2017/09/01		93	%	60 - 140
			F1 (C6-C10)	2017/09/01		89	%	60 - 140
5144807	KH2	Spiked Blank	4-Bromofluorobenzene	2017/09/01		99	%	60 - 140
			D10-o-Xylene	2017/09/01		99	%	60 - 130
			D4-1,2-Dichloroethane	2017/09/01		106	%	60 - 140
			D8-Toluene	2017/09/01		100	%	60 - 140
			Acetone (2-Propanone)	2017/09/01		110	%	60 - 140
			Benzene	2017/09/01		104	%	60 - 130
			Bromodichloromethane	2017/09/01		101	%	60 - 130
			Bromoform	2017/09/01		109	%	60 - 130
			Bromomethane	2017/09/01		102	%	60 - 140
			Carbon Tetrachloride	2017/09/01		97	%	60 - 130

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Chlorobenzene	2017/09/01		97	%	60 - 130
			Chloroform	2017/09/01		100	%	60 - 130
			Dibromochloromethane	2017/09/01		105	%	60 - 130
			1,2-Dichlorobenzene	2017/09/01		93	%	60 - 130
			1,3-Dichlorobenzene	2017/09/01		94	%	60 - 130
			1,4-Dichlorobenzene	2017/09/01		94	%	60 - 130
			Dichlorodifluoromethane (FREON 12)	2017/09/01		107	%	60 - 140
			1,1-Dichloroethane	2017/09/01		106	%	60 - 130
			1,2-Dichloroethane	2017/09/01		102	%	60 - 130
			1,1-Dichloroethylene	2017/09/01		110	%	60 - 130
			cis-1,2-Dichloroethylene	2017/09/01		100	%	60 - 130
			trans-1,2-Dichloroethylene	2017/09/01		103	%	60 - 130
			1,2-Dichloropropane	2017/09/01		99	%	60 - 130
			cis-1,3-Dichloropropene	2017/09/01		95	%	60 - 130
			trans-1,3-Dichloropropene	2017/09/01		97	%	60 - 130
			Ethylbenzene	2017/09/01		92	%	60 - 130
			Ethylene Dibromide	2017/09/01		107	%	60 - 130
			Hexane	2017/09/01		101	%	60 - 130
			Methylene Chloride(Dichloromethane)	2017/09/01		105	%	60 - 130
			Methyl Ethyl Ketone (2-Butanone)	2017/09/01		116	%	60 - 140
			Methyl Isobutyl Ketone	2017/09/01		110	%	60 - 130
			Methyl t-butyl ether (MTBE)	2017/09/01		98	%	60 - 130
			Styrene	2017/09/01		93	%	60 - 130
			1,1,1,2-Tetrachloroethane	2017/09/01		104	%	60 - 130
			1,1,2,2-Tetrachloroethane	2017/09/01		108	%	60 - 130
			Tetrachloroethylene	2017/09/01		91	%	60 - 130
			Toluene	2017/09/01		94	%	60 - 130
			1,1,1-Trichloroethane	2017/09/01		96	%	60 - 130
			1,1,2-Trichloroethane	2017/09/01		100	%	60 - 130
			Trichloroethylene	2017/09/01		97	%	60 - 130
			Trichlorofluoromethane (FREON 11)	2017/09/01		102	%	60 - 130
			Vinyl Chloride	2017/09/01		104	%	60 - 130
			p+m-Xylene	2017/09/01		95	%	60 - 130
			o-Xylene	2017/09/01		92	%	60 - 130
			F1 (C6-C10)	2017/09/01		97	%	80 - 120
5144807	KH2	Method Blank	4-Bromofluorobenzene	2017/09/01		95	%	60 - 140
			D10-o-Xylene	2017/09/01		93	%	60 - 130
			D4-1,2-Dichloroethane	2017/09/01		101	%	60 - 140
			D8-Toluene	2017/09/01		98	%	60 - 140
			Acetone (2-Propanone)	2017/09/01	ND, RDL=0.50		ug/g	
			Benzene	2017/09/01	ND, RDL=0.020		ug/g	
			Bromodichloromethane	2017/09/01	ND, RDL=0.050		ug/g	
			Bromoform	2017/09/01	ND, RDL=0.050		ug/g	
			Bromomethane	2017/09/01	ND, RDL=0.050		ug/g	
			Carbon Tetrachloride	2017/09/01	ND, RDL=0.050		ug/g	
			Chlorobenzene	2017/09/01	ND, RDL=0.050		ug/g	
			Chloroform	2017/09/01	ND, RDL=0.050		ug/g	

Maxxam Job #: B7I8095
Report Date: 2017/09/06

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dibromochloromethane	2017/09/01	ND, RDL=0.050		ug/g	
			1,2-Dichlorobenzene	2017/09/01	ND, RDL=0.050		ug/g	
			1,3-Dichlorobenzene	2017/09/01	ND, RDL=0.050		ug/g	
			1,4-Dichlorobenzene	2017/09/01	ND, RDL=0.050		ug/g	
			Dichlorodifluoromethane (FREON 12)	2017/09/01	ND, RDL=0.050		ug/g	
			1,1-Dichloroethane	2017/09/01	ND, RDL=0.050		ug/g	
			1,2-Dichloroethane	2017/09/01	ND, RDL=0.050		ug/g	
			1,1-Dichloroethylene	2017/09/01	ND, RDL=0.050		ug/g	
			cis-1,2-Dichloroethylene	2017/09/01	ND, RDL=0.050		ug/g	
			trans-1,2-Dichloroethylene	2017/09/01	ND, RDL=0.050		ug/g	
			1,2-Dichloropropane	2017/09/01	ND, RDL=0.050		ug/g	
			cis-1,3-Dichloropropene	2017/09/01	ND, RDL=0.030		ug/g	
			trans-1,3-Dichloropropene	2017/09/01	ND, RDL=0.040		ug/g	
			Ethylbenzene	2017/09/01	ND, RDL=0.020		ug/g	
			Ethylene Dibromide	2017/09/01	ND, RDL=0.050		ug/g	
			Hexane	2017/09/01	ND, RDL=0.050		ug/g	
			Methylene Chloride(Dichloromethane)	2017/09/01	ND, RDL=0.050		ug/g	
			Methyl Ethyl Ketone (2-Butanone)	2017/09/01	ND, RDL=0.50		ug/g	
			Methyl Isobutyl Ketone	2017/09/01	ND, RDL=0.50		ug/g	
			Methyl t-butyl ether (MTBE)	2017/09/01	ND, RDL=0.050		ug/g	
			Styrene	2017/09/01	ND, RDL=0.050		ug/g	
			1,1,1,2-Tetrachloroethane	2017/09/01	ND, RDL=0.050		ug/g	
			1,1,2,2-Tetrachloroethane	2017/09/01	ND, RDL=0.050		ug/g	
			Tetrachloroethylene	2017/09/01	ND, RDL=0.050		ug/g	
			Toluene	2017/09/01	ND, RDL=0.020		ug/g	
			1,1,1-Trichloroethane	2017/09/01	ND, RDL=0.050		ug/g	
			1,1,2-Trichloroethane	2017/09/01	ND, RDL=0.050		ug/g	

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7I8095
Report Date: 2017/09/06

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Trichloroethylene	2017/09/01	ND, RDL=0.050		ug/g	
			Trichlorofluoromethane (FREON 11)	2017/09/01	ND, RDL=0.050		ug/g	
			Vinyl Chloride	2017/09/01	ND, RDL=0.020		ug/g	
			p+m-Xylene	2017/09/01	ND, RDL=0.020		ug/g	
			o-Xylene	2017/09/01	ND, RDL=0.020		ug/g	
			Total Xylenes	2017/09/01	ND, RDL=0.020		ug/g	
			F1 (C6-C10)	2017/09/01	ND, RDL=10		ug/g	
			F1 (C6-C10) - BTEX	2017/09/01	ND, RDL=10		ug/g	
5144807	KH2	RPD	Acetone (2-Propanone)	2017/09/01	NC		%	50
			Benzene	2017/09/01	NC		%	50
			Bromodichloromethane	2017/09/01	NC		%	50
			Bromoform	2017/09/01	NC		%	50
			Bromomethane	2017/09/01	NC		%	50
			Carbon Tetrachloride	2017/09/01	NC		%	50
			Chlorobenzene	2017/09/01	NC		%	50
			Chloroform	2017/09/01	NC		%	50
			Dibromochloromethane	2017/09/01	NC		%	50
			1,2-Dichlorobenzene	2017/09/01	NC		%	50
			1,3-Dichlorobenzene	2017/09/01	NC		%	50
			1,4-Dichlorobenzene	2017/09/01	NC		%	50
			Dichlorodifluoromethane (FREON 12)	2017/09/01	NC		%	50
			1,1-Dichloroethane	2017/09/01	NC		%	50
			1,2-Dichloroethane	2017/09/01	NC		%	50
			1,1-Dichloroethylene	2017/09/01	NC		%	50
			cis-1,2-Dichloroethylene	2017/09/01	NC		%	50
			trans-1,2-Dichloroethylene	2017/09/01	NC		%	50
			1,2-Dichloropropane	2017/09/01	NC		%	50
			cis-1,3-Dichloropropene	2017/09/01	NC		%	50
			trans-1,3-Dichloropropene	2017/09/01	NC		%	50
			Ethylbenzene	2017/09/01	NC		%	50
			Ethylene Dibromide	2017/09/01	NC		%	50
			Hexane	2017/09/01	NC		%	50
			Methylene Chloride(Dichloromethane)	2017/09/01	NC		%	50
			Methyl Ethyl Ketone (2-Butanone)	2017/09/01	NC		%	50
			Methyl Isobutyl Ketone	2017/09/01	NC		%	50
			Methyl t-butyl ether (MTBE)	2017/09/01	NC		%	50
			Styrene	2017/09/01	NC		%	50
			1,1,1,2-Tetrachloroethane	2017/09/01	NC		%	50
			1,1,2,2-Tetrachloroethane	2017/09/01	NC		%	50
			Tetrachloroethylene	2017/09/01	NC		%	50
			Toluene	2017/09/01	NC		%	50
			1,1,1-Trichloroethane	2017/09/01	NC		%	50
			1,1,2-Trichloroethane	2017/09/01	NC		%	50
			Trichloroethylene	2017/09/01	NC		%	50
			Trichlorofluoromethane (FREON 11)	2017/09/01	NC		%	50
			Vinyl Chloride	2017/09/01	NC		%	50
			p+m-Xylene	2017/09/01	NC		%	50

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7I8095
Report Date: 2017/09/06

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			o-Xylene	2017/09/01	NC		%	50
			Total Xylenes	2017/09/01	NC		%	50
			F1 (C6-C10)	2017/09/01	NC		%	30
			F1 (C6-C10) - BTEX	2017/09/01	NC		%	30
5146206	SAC	Matrix Spike	Chromium (VI)	2017/09/01		2.2 (1)	%	75 - 125
5146206	SAC	Spiked Blank	Chromium (VI)	2017/09/01		88	%	80 - 120
5146206	SAC	Method Blank	Chromium (VI)	2017/09/01	ND, RDL=0.2		ug/g	
5146206	SAC	RPD	Chromium (VI)	2017/09/01	NC		%	35
5146357	TA1	Spiked Blank	Available (CaCl2) pH	2017/09/01		99	%	97 - 103
5146357	TA1	RPD	Available (CaCl2) pH	2017/09/01	0.41		%	N/A
5146405	MGE	Matrix Spike	Chromium (VI)	2017/09/05		81	%	75 - 125
5146405	MGE	Spiked Blank	Chromium (VI)	2017/09/05		86	%	80 - 120
5146405	MGE	Method Blank	Chromium (VI)	2017/09/05	ND, RDL=0.2		ug/g	
5146405	MGE	RPD	Chromium (VI)	2017/09/05	22		%	35
5146552	DH	Matrix Spike	Decachlorobiphenyl	2017/09/05		80	%	60 - 130
			Aroclor 1260	2017/09/05		98	%	60 - 130
			Total PCB	2017/09/05		98	%	60 - 130
5146552	DH	Spiked Blank	Decachlorobiphenyl	2017/09/01		97	%	60 - 130
			Aroclor 1260	2017/09/01		101	%	60 - 130
			Total PCB	2017/09/01		101	%	60 - 130
5146552	DH	Method Blank	Decachlorobiphenyl	2017/09/01		102	%	60 - 130
			Aroclor 1242	2017/09/01	ND, RDL=0.010		ug/g	
			Aroclor 1248	2017/09/01	ND, RDL=0.010		ug/g	
			Aroclor 1254	2017/09/01	ND, RDL=0.010		ug/g	
			Aroclor 1260	2017/09/01	ND, RDL=0.010		ug/g	
			Total PCB	2017/09/01	ND, RDL=0.010		ug/g	
5146552	DH	RPD	Aroclor 1242	2017/09/05	NC		%	50
			Aroclor 1248	2017/09/05	NC		%	50
			Aroclor 1254	2017/09/05	28		%	50
			Aroclor 1260	2017/09/05	25		%	50
			Total PCB	2017/09/05	26		%	50
5146766	LHA	Matrix Spike	WAD Cyanide (Free)	2017/09/05		97	%	75 - 125
5146766	LHA	Spiked Blank	WAD Cyanide (Free)	2017/09/05		99	%	80 - 120
5146766	LHA	Method Blank	WAD Cyanide (Free)	2017/09/05	ND, RDL=0.01		ug/g	
5146766	LHA	RPD	WAD Cyanide (Free)	2017/09/05	NC		%	35
5146858	GKR	RPD [FAO982-03]	Moisture	2017/09/01	2.5		%	20
5147212	ZZ	Matrix Spike	o-Terphenyl	2017/09/02		94	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2017/09/02		96	%	50 - 130
			F3 (C16-C34 Hydrocarbons)	2017/09/02		95	%	50 - 130
			F4 (C34-C50 Hydrocarbons)	2017/09/02		93	%	50 - 130
5147212	ZZ	Spiked Blank	o-Terphenyl	2017/09/02		95	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2017/09/02		97	%	80 - 120
			F3 (C16-C34 Hydrocarbons)	2017/09/02		98	%	80 - 120
			F4 (C34-C50 Hydrocarbons)	2017/09/02		94	%	80 - 120
5147212	ZZ	Method Blank	o-Terphenyl	2017/09/01		97	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2017/09/01	ND, RDL=10		ug/g	

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam Job #: B7I8095
Report Date: 2017/09/06

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			F3 (C16-C34 Hydrocarbons)	2017/09/01	ND, RDL=50		ug/g	
			F4 (C34-C50 Hydrocarbons)	2017/09/01	ND, RDL=50		ug/g	
5147212	ZZ	RPD	F2 (C10-C16 Hydrocarbons)	2017/09/02	2.5		%	30
			F3 (C16-C34 Hydrocarbons)	2017/09/02	NC		%	30
			F4 (C34-C50 Hydrocarbons)	2017/09/02	NC		%	30
5147221	RAJ	Matrix Spike	D10-Anthracene	2017/09/02		93	%	50 - 130
			D14-Terphenyl (FS)	2017/09/02		86	%	50 - 130
			D8-Acenaphthylene	2017/09/02		107	%	50 - 130
			Acenaphthene	2017/09/02		79	%	50 - 130
			Acenaphthylene	2017/09/02		94	%	50 - 130
			Anthracene	2017/09/02		84	%	50 - 130
			Benzo(a)anthracene	2017/09/02		86	%	50 - 130
			Benzo(a)pyrene	2017/09/02		75	%	50 - 130
			Benzo(b/j)fluoranthene	2017/09/02		75	%	50 - 130
			Benzo(g,h,i)perylene	2017/09/02		75	%	50 - 130
			Benzo(k)fluoranthene	2017/09/02		77	%	50 - 130
			Chrysene	2017/09/02		83	%	50 - 130
			Dibenz(a,h)anthracene	2017/09/02		80	%	50 - 130
			Fluoranthene	2017/09/02		85	%	50 - 130
			Fluorene	2017/09/02		86	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2017/09/02		76	%	50 - 130
			1-Methylnaphthalene	2017/09/02		85	%	50 - 130
			2-Methylnaphthalene	2017/09/02		77	%	50 - 130
			Naphthalene	2017/09/02		71	%	50 - 130
			Phenanthrene	2017/09/02		82	%	50 - 130
			Pyrene	2017/09/02		84	%	50 - 130
5147221	RAJ	Spiked Blank	D10-Anthracene	2017/09/02		91	%	50 - 130
			D14-Terphenyl (FS)	2017/09/02		84	%	50 - 130
			D8-Acenaphthylene	2017/09/02		102	%	50 - 130
			Acenaphthene	2017/09/02		79	%	50 - 130
			Acenaphthylene	2017/09/02		92	%	50 - 130
			Anthracene	2017/09/02		80	%	50 - 130
			Benzo(a)anthracene	2017/09/02		83	%	50 - 130
			Benzo(a)pyrene	2017/09/02		76	%	50 - 130
			Benzo(b/j)fluoranthene	2017/09/02		72	%	50 - 130
			Benzo(g,h,i)perylene	2017/09/02		79	%	50 - 130
			Benzo(k)fluoranthene	2017/09/02		90	%	50 - 130
			Chrysene	2017/09/02		79	%	50 - 130
			Dibenz(a,h)anthracene	2017/09/02		81	%	50 - 130
			Fluoranthene	2017/09/02		83	%	50 - 130
			Fluorene	2017/09/02		84	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2017/09/02		78	%	50 - 130
			1-Methylnaphthalene	2017/09/02		87	%	50 - 130
			2-Methylnaphthalene	2017/09/02		78	%	50 - 130
			Naphthalene	2017/09/02		74	%	50 - 130
			Phenanthrene	2017/09/02		81	%	50 - 130
			Pyrene	2017/09/02		82	%	50 - 130
5147221	RAJ	Method Blank	D10-Anthracene	2017/09/02		90	%	50 - 130
			D14-Terphenyl (FS)	2017/09/02		84	%	50 - 130
			D8-Acenaphthylene	2017/09/02		101	%	50 - 130
			Acenaphthene	2017/09/02	ND, RDL=0.0050		ug/g	

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7I8095
Report Date: 2017/09/06

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Acenaphthylene	2017/09/02	ND, RDL=0.0050		ug/g	
			Anthracene	2017/09/02	ND, RDL=0.0050		ug/g	
			Benzo(a)anthracene	2017/09/02	ND, RDL=0.0050		ug/g	
			Benzo(a)pyrene	2017/09/02	ND, RDL=0.0050		ug/g	
			Benzo(b/j)fluoranthene	2017/09/02	ND, RDL=0.0050		ug/g	
			Benzo(g,h,i)perylene	2017/09/02	ND, RDL=0.0050		ug/g	
			Benzo(k)fluoranthene	2017/09/02	ND, RDL=0.0050		ug/g	
			Chrysene	2017/09/02	ND, RDL=0.0050		ug/g	
			Dibenz(a,h)anthracene	2017/09/02	ND, RDL=0.0050		ug/g	
			Fluoranthene	2017/09/02	ND, RDL=0.0050		ug/g	
			Fluorene	2017/09/02	ND, RDL=0.0050		ug/g	
			Indeno(1,2,3-cd)pyrene	2017/09/02	ND, RDL=0.0050		ug/g	
			1-Methylnaphthalene	2017/09/02	ND, RDL=0.0050		ug/g	
			2-Methylnaphthalene	2017/09/02	ND, RDL=0.0050		ug/g	
			Naphthalene	2017/09/02	ND, RDL=0.0050		ug/g	
			Phenanthrene	2017/09/02	ND, RDL=0.0050		ug/g	
			Pyrene	2017/09/02	ND, RDL=0.0050		ug/g	
5147221	RAJ	RPD	Acenaphthene	2017/09/02	NC		%	40
			Acenaphthylene	2017/09/02	NC		%	40
			Anthracene	2017/09/02	NC		%	40
			Benzo(a)anthracene	2017/09/02	NC		%	40
			Benzo(a)pyrene	2017/09/02	NC		%	40
			Benzo(b/j)fluoranthene	2017/09/02	NC		%	40
			Benzo(g,h,i)perylene	2017/09/02	NC		%	40
			Benzo(k)fluoranthene	2017/09/02	NC		%	40
			Chrysene	2017/09/02	NC		%	40
			Dibenz(a,h)anthracene	2017/09/02	NC		%	40
			Fluoranthene	2017/09/02	NC		%	40
			Fluorene	2017/09/02	NC		%	40
			Indeno(1,2,3-cd)pyrene	2017/09/02	NC		%	40
			1-Methylnaphthalene	2017/09/02	NC		%	40
			2-Methylnaphthalene	2017/09/02	NC		%	40
			Naphthalene	2017/09/02	NC		%	40
			Phenanthrene	2017/09/02	NC		%	40
			Pyrene	2017/09/02	NC		%	40
5148365	JOH	Matrix Spike	Hot Water Ext. Boron (B)	2017/09/05		107	%	75 - 125
5148365	JOH	Spiked Blank	Hot Water Ext. Boron (B)	2017/09/05		99	%	75 - 125

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7I8095
Report Date: 2017/09/06

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
5148365	JOH	Method Blank	Hot Water Ext. Boron (B)	2017/09/05	ND, RDL=0.050		ug/g	
5148365	JOH	RPD	Hot Water Ext. Boron (B)	2017/09/05	4.3		%	40
5148391	DT1	Matrix Spike	Acid Extractable Antimony (Sb)	2017/09/06		69 (2)	%	75 - 125
			Acid Extractable Arsenic (As)	2017/09/06		95	%	75 - 125
			Acid Extractable Barium (Ba)	2017/09/06		NC	%	75 - 125
			Acid Extractable Beryllium (Be)	2017/09/06		104	%	75 - 125
			Acid Extractable Boron (B)	2017/09/06		97	%	75 - 125
			Acid Extractable Cadmium (Cd)	2017/09/06		103	%	75 - 125
			Acid Extractable Chromium (Cr)	2017/09/06		NC	%	75 - 125
			Acid Extractable Cobalt (Co)	2017/09/06		NC	%	75 - 125
			Acid Extractable Copper (Cu)	2017/09/06		NC	%	75 - 125
			Acid Extractable Lead (Pb)	2017/09/06		98	%	75 - 125
			Acid Extractable Molybdenum (Mo)	2017/09/06		99	%	75 - 125
			Acid Extractable Nickel (Ni)	2017/09/06		NC	%	75 - 125
			Acid Extractable Selenium (Se)	2017/09/06		98	%	75 - 125
			Acid Extractable Silver (Ag)	2017/09/06		102	%	75 - 125
			Acid Extractable Thallium (Tl)	2017/09/06		98	%	75 - 125
			Acid Extractable Uranium (U)	2017/09/06		98	%	75 - 125
			Acid Extractable Vanadium (V)	2017/09/06		NC	%	75 - 125
			Acid Extractable Zinc (Zn)	2017/09/06		NC	%	75 - 125
			Acid Extractable Mercury (Hg)	2017/09/06		97	%	75 - 125
5148391	DT1	Spiked Blank	Acid Extractable Antimony (Sb)	2017/09/06		101	%	80 - 120
			Acid Extractable Arsenic (As)	2017/09/06		102	%	80 - 120
			Acid Extractable Barium (Ba)	2017/09/06		104	%	80 - 120
			Acid Extractable Beryllium (Be)	2017/09/06		102	%	80 - 120
			Acid Extractable Boron (B)	2017/09/06		100	%	80 - 120
			Acid Extractable Cadmium (Cd)	2017/09/06		100	%	80 - 120
			Acid Extractable Chromium (Cr)	2017/09/06		99	%	80 - 120
			Acid Extractable Cobalt (Co)	2017/09/06		101	%	80 - 120
			Acid Extractable Copper (Cu)	2017/09/06		103	%	80 - 120
			Acid Extractable Lead (Pb)	2017/09/06		100	%	80 - 120
			Acid Extractable Molybdenum (Mo)	2017/09/06		101	%	80 - 120
			Acid Extractable Nickel (Ni)	2017/09/06		99	%	80 - 120
			Acid Extractable Selenium (Se)	2017/09/06		102	%	80 - 120
			Acid Extractable Silver (Ag)	2017/09/06		99	%	80 - 120
			Acid Extractable Thallium (Tl)	2017/09/06		100	%	80 - 120
			Acid Extractable Uranium (U)	2017/09/06		97	%	80 - 120
			Acid Extractable Vanadium (V)	2017/09/06		101	%	80 - 120
			Acid Extractable Zinc (Zn)	2017/09/06		110	%	80 - 120
			Acid Extractable Mercury (Hg)	2017/09/06		103	%	80 - 120
5148391	DT1	Method Blank	Acid Extractable Antimony (Sb)	2017/09/06	ND, RDL=0.20		ug/g	
			Acid Extractable Arsenic (As)	2017/09/06	ND, RDL=1.0		ug/g	
			Acid Extractable Barium (Ba)	2017/09/06	ND, RDL=0.50		ug/g	
			Acid Extractable Beryllium (Be)	2017/09/06	ND, RDL=0.20		ug/g	
			Acid Extractable Boron (B)	2017/09/06	ND, RDL=5.0		ug/g	
			Acid Extractable Cadmium (Cd)	2017/09/06	ND, RDL=0.10		ug/g	
			Acid Extractable Chromium (Cr)	2017/09/06	ND, RDL=1.0		ug/g	

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7I8095
Report Date: 2017/09/06

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Acid Extractable Cobalt (Co)	2017/09/06	ND, RDL=0.10		ug/g	
			Acid Extractable Copper (Cu)	2017/09/06	ND, RDL=0.50		ug/g	
			Acid Extractable Lead (Pb)	2017/09/06	ND, RDL=1.0		ug/g	
			Acid Extractable Molybdenum (Mo)	2017/09/06	ND, RDL=0.50		ug/g	
			Acid Extractable Nickel (Ni)	2017/09/06	ND, RDL=0.50		ug/g	
			Acid Extractable Selenium (Se)	2017/09/06	ND, RDL=0.50		ug/g	
			Acid Extractable Silver (Ag)	2017/09/06	ND, RDL=0.20		ug/g	
			Acid Extractable Thallium (Tl)	2017/09/06	ND, RDL=0.050		ug/g	
			Acid Extractable Uranium (U)	2017/09/06	ND, RDL=0.050		ug/g	
			Acid Extractable Vanadium (V)	2017/09/06	ND, RDL=5.0		ug/g	
			Acid Extractable Zinc (Zn)	2017/09/06	ND, RDL=5.0		ug/g	
			Acid Extractable Mercury (Hg)	2017/09/06	ND, RDL=0.050		ug/g	
5148391	DT1	RPD	Acid Extractable Antimony (Sb)	2017/09/06	NC		%	30
			Acid Extractable Arsenic (As)	2017/09/06	19		%	30
			Acid Extractable Barium (Ba)	2017/09/06	1.9		%	30
			Acid Extractable Beryllium (Be)	2017/09/06	9.2		%	30
			Acid Extractable Cadmium (Cd)	2017/09/06	NC		%	30
			Acid Extractable Chromium (Cr)	2017/09/06	4.5		%	30
			Acid Extractable Cobalt (Co)	2017/09/06	1.1		%	30
			Acid Extractable Copper (Cu)	2017/09/06	0.68		%	30
			Acid Extractable Lead (Pb)	2017/09/06	4.0		%	30
			Acid Extractable Molybdenum (Mo)	2017/09/06	2.9		%	30
			Acid Extractable Nickel (Ni)	2017/09/06	1.6		%	30
			Acid Extractable Selenium (Se)	2017/09/06	NC		%	30
			Acid Extractable Silver (Ag)	2017/09/06	NC		%	30
			Acid Extractable Thallium (Tl)	2017/09/06	11		%	30
			Acid Extractable Uranium (U)	2017/09/06	3.7		%	30
			Acid Extractable Vanadium (V)	2017/09/06	5.4		%	30
			Acid Extractable Zinc (Zn)	2017/09/06	1.3		%	30
			Acid Extractable Mercury (Hg)	2017/09/06	NC		%	30
5149073	JOH	Matrix Spike	Hot Water Ext. Boron (B)	2017/09/05		101	%	75 - 125
5149073	JOH	Spiked Blank	Hot Water Ext. Boron (B)	2017/09/05		101	%	75 - 125
5149073	JOH	Method Blank	Hot Water Ext. Boron (B)	2017/09/05	ND, RDL=0.050		ug/g	
5149073	JOH	RPD	Hot Water Ext. Boron (B)	2017/09/05	3.4		%	40
5149224	JOH	Spiked Blank	Soluble Calcium (Ca)	2017/09/05		86	%	80 - 120
			Soluble Magnesium (Mg)	2017/09/05		87	%	80 - 120
			Soluble Sodium (Na)	2017/09/05		90	%	80 - 120
5149224	JOH	Method Blank	Soluble Calcium (Ca)	2017/09/05	ND, RDL=0.5		mg/L	
			Soluble Magnesium (Mg)	2017/09/05	ND, RDL=0.5		mg/L	
			Soluble Sodium (Na)	2017/09/05	ND,RDL=5		mg/L	

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7I8095
Report Date: 2017/09/06

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
5149224	JOH	RPD	Soluble Calcium (Ca)	2017/09/05	3.0		%	30
			Soluble Magnesium (Mg)	2017/09/05	7.8		%	30
			Soluble Sodium (Na)	2017/09/05	4.9		%	30
5149238	NYS	Spiked Blank	Conductivity	2017/09/05		101	%	90 - 110
5149238	NYS	Method Blank	Conductivity	2017/09/05	ND, RDL=0.002		mS/cm	
5149238	NYS	RPD	Conductivity	2017/09/05	0.35		%	10
5149341	AFZ	Spiked Blank	Soluble Calcium (Ca)	2017/09/05		98	%	80 - 120
			Soluble Magnesium (Mg)	2017/09/05		95	%	80 - 120
			Soluble Sodium (Na)	2017/09/05		102	%	80 - 120
5149341	AFZ	Method Blank	Soluble Calcium (Ca)	2017/09/05	ND, RDL=0.5		mg/L	
			Soluble Magnesium (Mg)	2017/09/05	ND, RDL=0.5		mg/L	
			Soluble Sodium (Na)	2017/09/05	ND,RDL=5		mg/L	
5149341	AFZ	RPD	Soluble Calcium (Ca)	2017/09/05	0.42		%	30
			Soluble Magnesium (Mg)	2017/09/05	0.66		%	30
			Soluble Sodium (Na)	2017/09/05	0.14		%	30
5149357	NYS	Spiked Blank	Conductivity	2017/09/05		100	%	90 - 110
5149357	NYS	Method Blank	Conductivity	2017/09/05	ND, RDL=0.002		mS/cm	
5149357	NYS	RPD	Conductivity	2017/09/05	2.0		%	10

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) The matrix spike recovery was below the lower control limit. This may be due in part to the reducing environment of the sample. The matrix spike was reanalyzed to confirm result.

(2) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam Job #: B7I8095
Report Date: 2017/09/06

AEL Environment
Client Project #: 10888

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

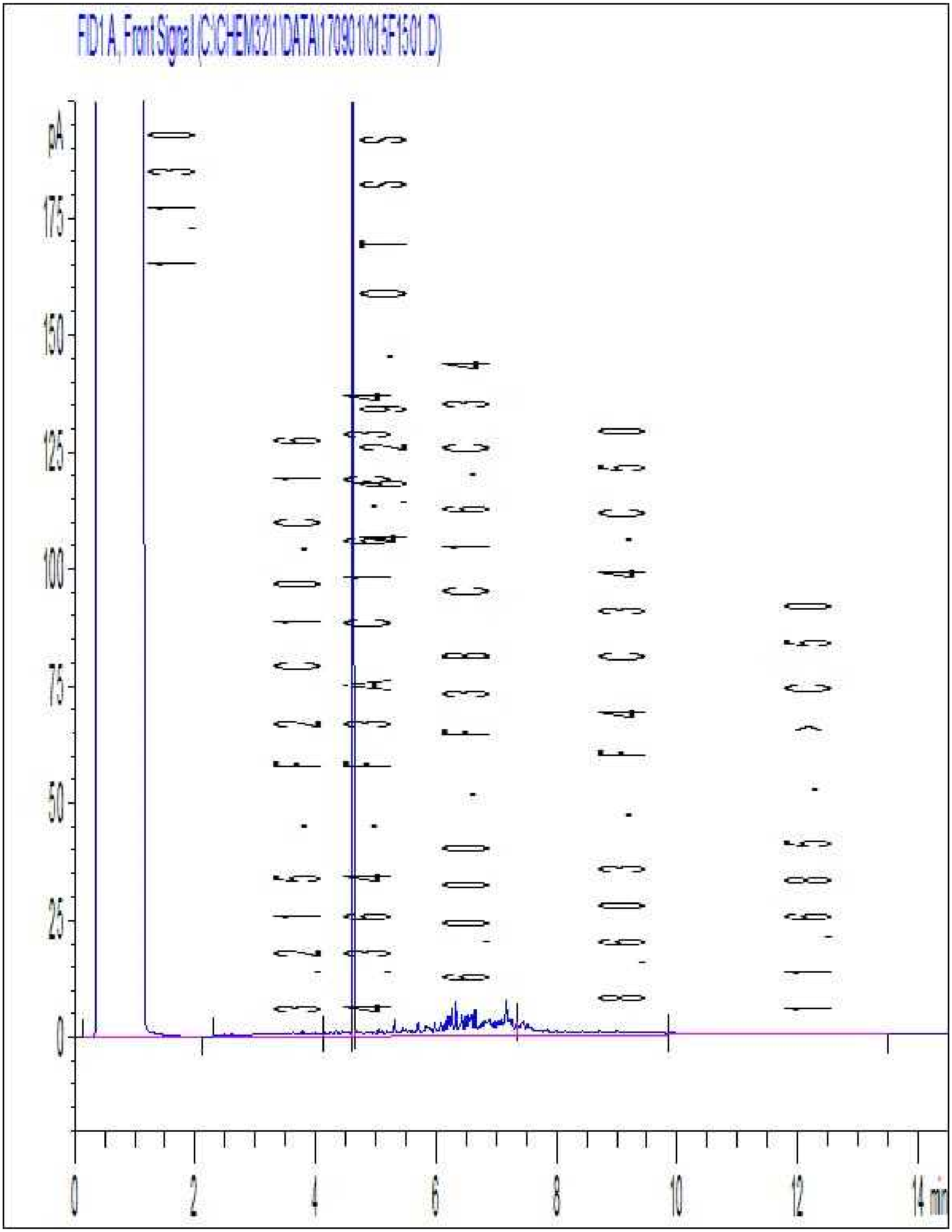
Cristina Carriere

Cristina Carriere, Scientific Service Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

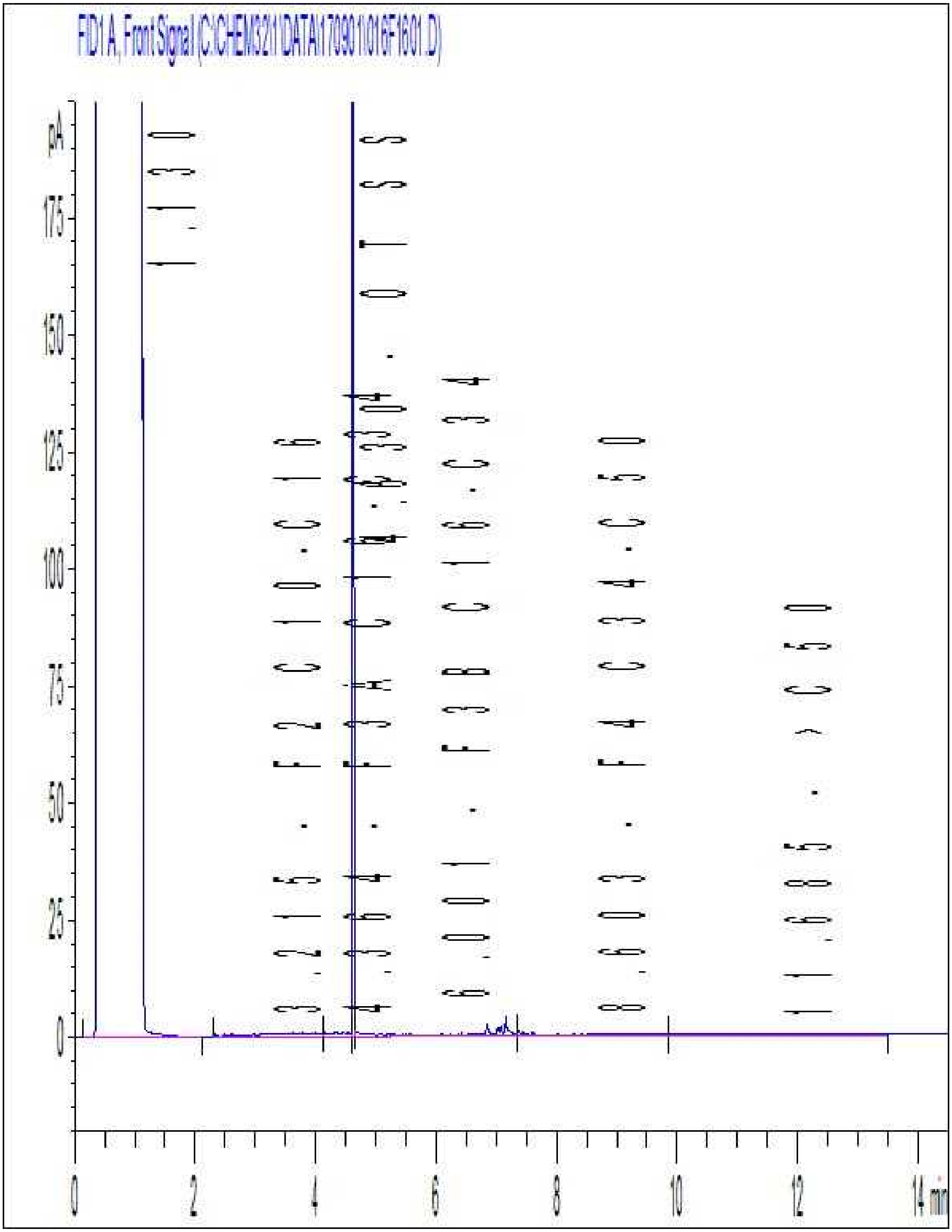


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7I8095
Report Date: 2017/09/06
Maxxam Sample: FAO978

AEL Environment
Client Project #: 10888
Client ID: A0198

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

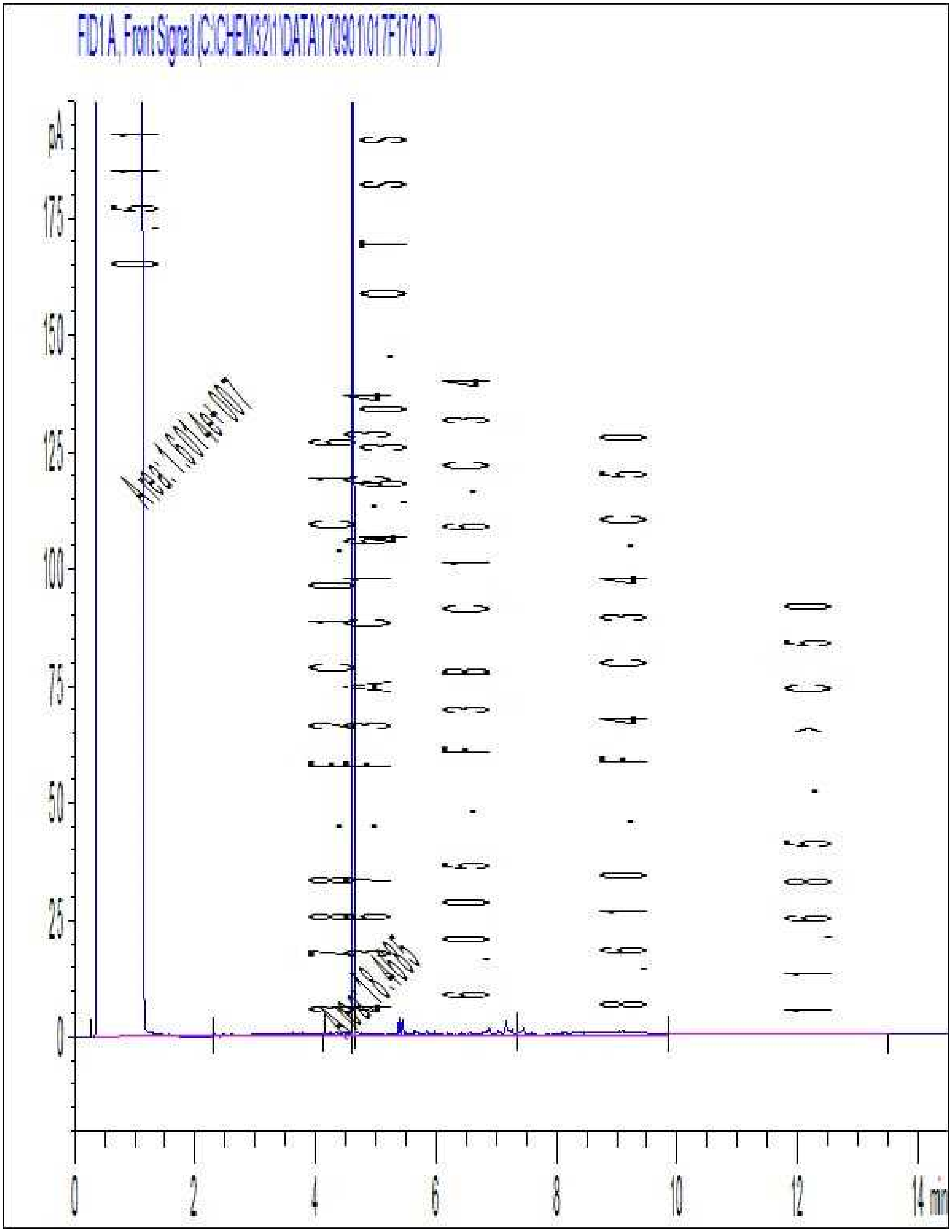


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7I8095
Report Date: 2017/09/06
Maxxam Sample: FAO979

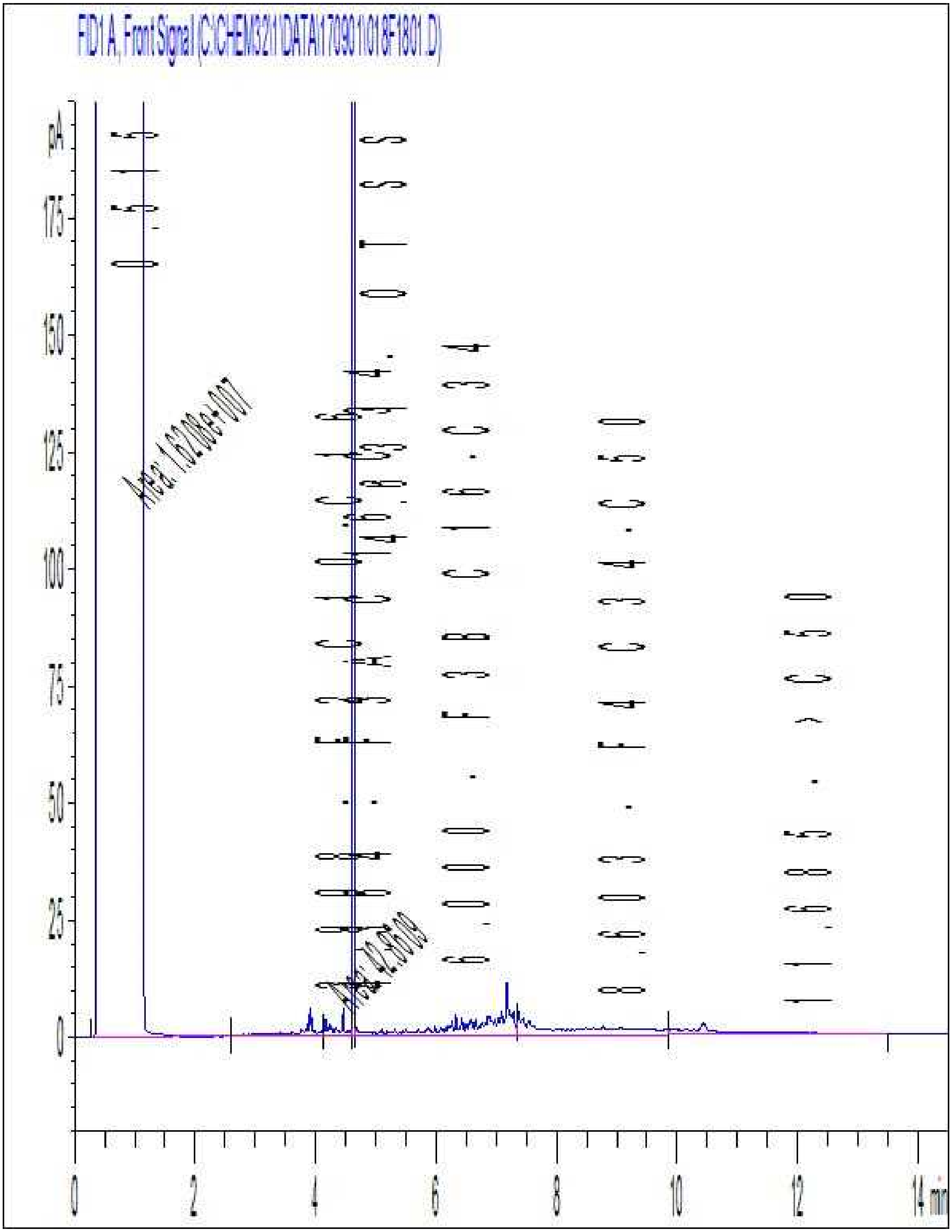
AEL Environment
Client Project #: 10888
Client ID: A0200

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

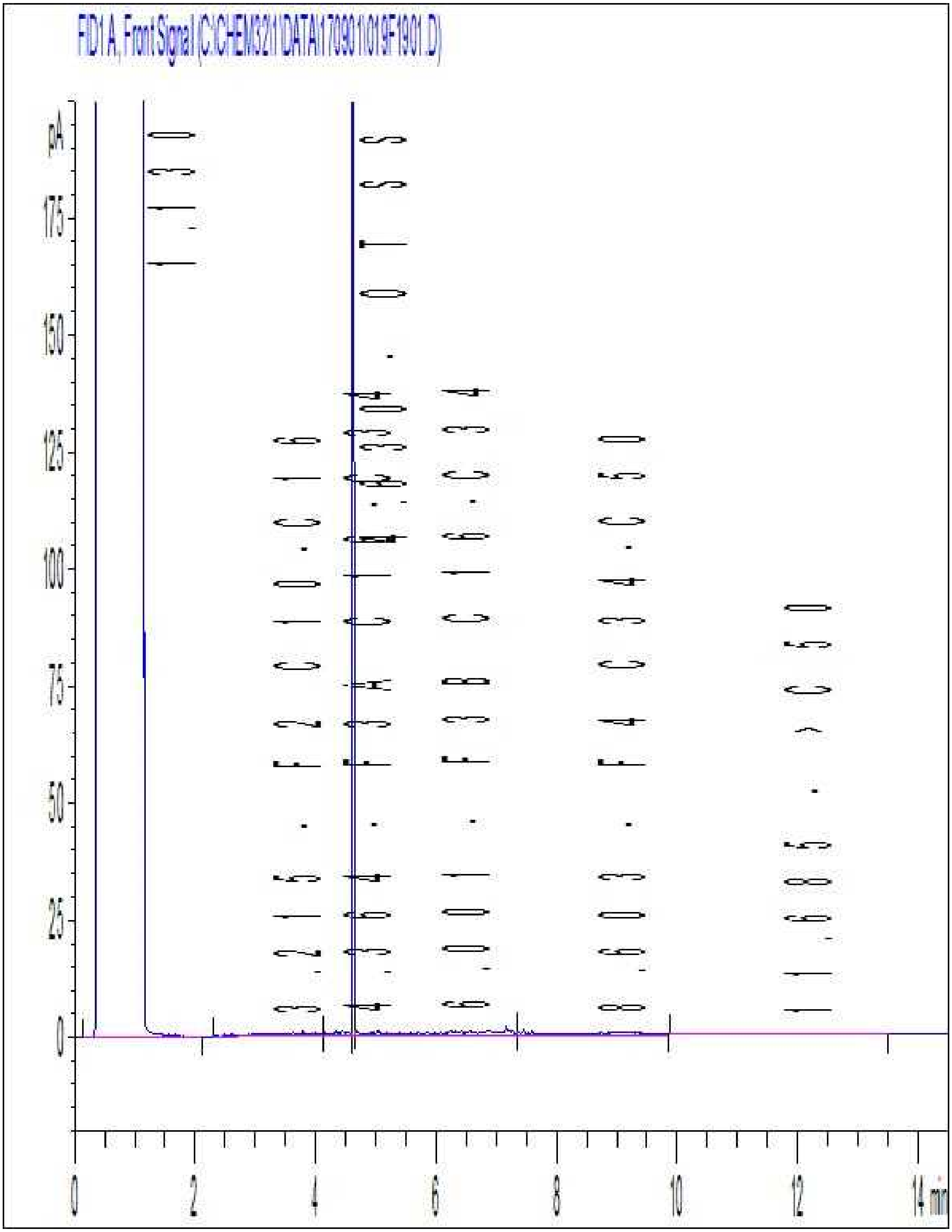


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7I8095
Report Date: 2017/09/06
Maxxam Sample: FAO981

AEL Environment
Client Project #: 10888
Client ID: A0204

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

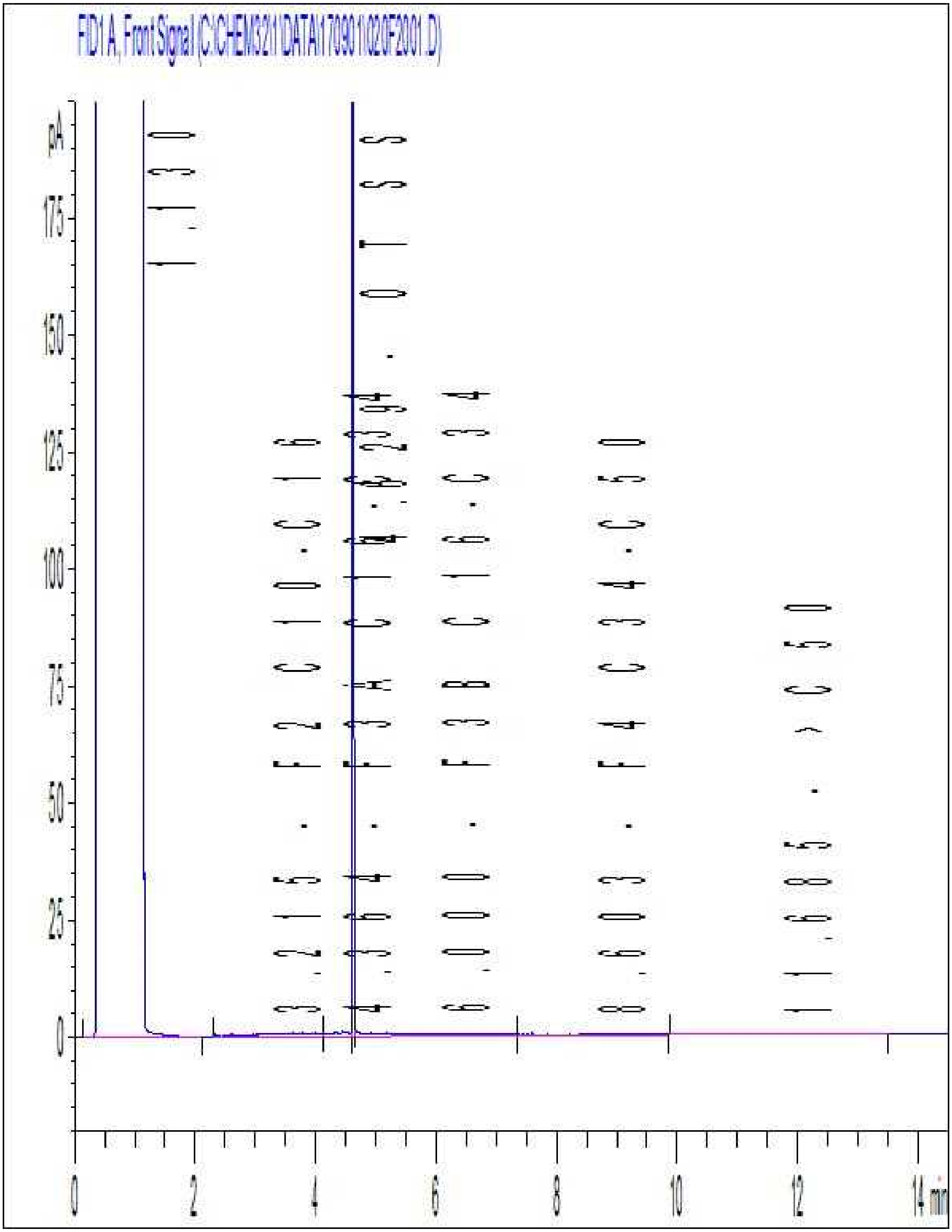


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7I8095
Report Date: 2017/09/06
Maxxam Sample: FAO982

AEL Environment
Client Project #: 10888
Client ID: A0206

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram

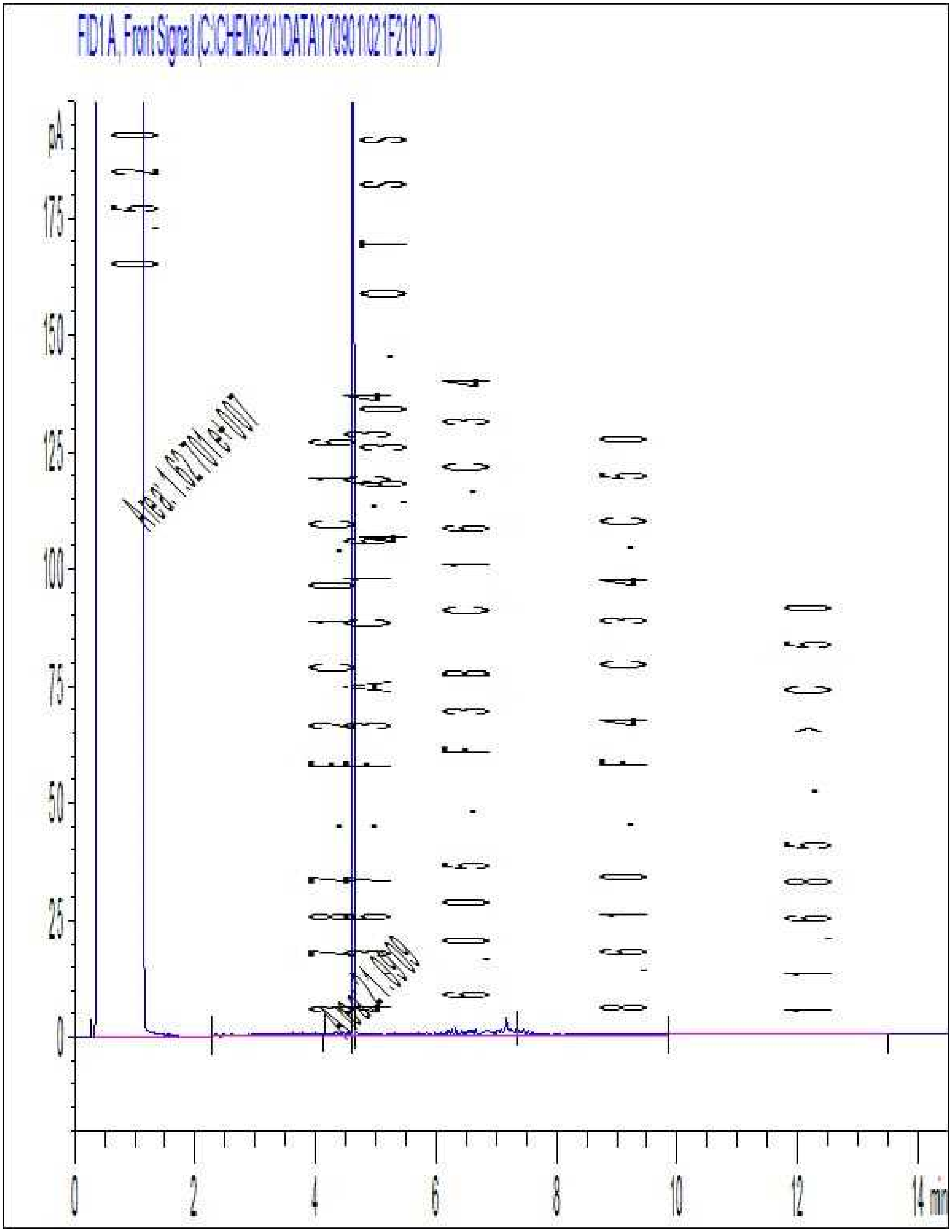


Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam Job #: B7I8095
Report Date: 2017/09/06
Maxxam Sample: FAO983

AEL Environment
Client Project #: 10888
Client ID: A0213

Petroleum Hydrocarbons F2-F4 in Soil Chromatogram



Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Maxxam
A Bureau Veritas Group Company

Your Project #: 10888
Your C.O.C. #: 625117-01-01

Attention:Reporting Group

AEL Environment
1705 Argentia Rd
Unit 3
Mississauga, ON
CANADA L5N 3A9

Report Date: 2017/09/07
Report #: R4690396
Version: 2 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7I8519
Received: 2017/08/29, 17:25

Sample Matrix: Water
Samples Received: 8

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Dissolved Aluminum (0.2 u, clay free) (1)	8	N/A	2017/09/05	CAM SOP-00447	EPA 6020B m
Alkalinity (1)	3	N/A	2017/08/31	CAM SOP-00448	SM 22 2320 B m
Alkalinity (1)	5	N/A	2017/09/01	CAM SOP-00448	SM 22 2320 B m
Chromium (VI) in Water (1)	8	N/A	2017/09/01	CAM SOP-00436	EPA 7199 m
Free (WAD) Cyanide (1)	8	N/A	2017/09/01	CAM SOP-00457	OMOE E3015 m
Dissolved Oxygen (1)	8	2017/08/30	2017/08/30	CAM SOP-00427	SM 22 4500 O G m
Hardness (calculated as CaCO3) (1)	7	N/A	2017/09/05	CAM SOP 00102/00408/00447	SM 2340 B
Hardness (calculated as CaCO3) (1)	1	N/A	2017/09/06	CAM SOP 00102/00408/00447	SM 2340 B
Mercury (1)	1	2017/08/31	2017/09/01	CAM SOP-00453	EPA 7470A m
Mercury (1)	7	2017/08/31	2017/09/05	CAM SOP-00453	EPA 7470A m
Total Metals Analysis by ICPMS (1)	8	N/A	2017/08/31	CAM SOP-00447	EPA 6020B m
Total Ammonia-N (1)	8	N/A	2017/09/01	CAM SOP-00441	EPA GS I-2522-90 m
pH (1)	3	N/A	2017/08/31	CAM SOP-00413	SM 4500H+ B m
pH (1)	5	N/A	2017/09/01	CAM SOP-00413	SM 4500H+ B m
Phenols (4AAP) (1)	5	N/A	2017/08/31	CAM SOP-00444	OMOE E3179 m
Phenols (4AAP) (1)	3	N/A	2017/09/05	CAM SOP-00444	OMOE E3179 m
Field pH (1, 2)	8	N/A	2017/09/01		Field pH Meter
Sulphide (1)	8	N/A	2017/09/01	CAM SOP-00455	SM 22 4500-S G m
Field Temperature (1, 2)	8	N/A	2017/09/01		Field Thermometer
Total Phosphorus (Colourimetric) (1)	8	2017/08/31	2017/09/01	CAM SOP-00407	SM 22 4500 P B H m
Turbidity (1)	8	N/A	2017/08/31	CAM SOP-00417	SM 22 2130 B m
Un-ionized Ammonia (1)	8	2017/08/30	2017/09/07		
Volatile Organic Compounds in Water (1)	8	N/A	2017/09/01	CAM SOP-00226	EPA 8260C m
Non-Routine Volatile Organic Compounds (1)	8	N/A	2017/09/05	CAM SOP-00226	EPA 8260 m

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Your Project #: 10888
Your C.O.C. #: 625117-01-01

Attention:Reporting Group
AEL Environment
1705 Argentia Rd
Unit 3
Mississauga, ON
CANADA L5N 3A9

Report Date: 2017/09/07
Report #: R4690396
Version: 2 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7I8519
Received: 2017/08/29, 17:25

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) This test was performed by Maxxam Analytics Mississauga
(2) This is a field test, therefore, the results relate to items that were not analysed at Maxxam Analytics Inc.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Antonella Brasil, Senior Project Manager
Email: ABrasil@maxxam.ca
Phone# (905)817-5817
==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam Job #: B7I8519
Report Date: 2017/09/07

AEL Environment
Client Project #: 10888

PWQO METALS AND INORGANICS (WATER)

Maxxam ID		FAQ916	FAQ916			FAQ917	FAQ917		
Sampling Date		2017/08/29 09:00	2017/08/29 09:00			2017/08/29 10:00	2017/08/29 10:00		
COC Number		625117-01-01	625117-01-01			625117-01-01	625117-01-01		
	UNITS	**A0196 RR2**	**A0196 RR2 Lab-Dup**	**RDL**	**QC Batch**	**A0199 SW10**	**A0199 SW10 Lab-Dup**	**RDL**	**QC Batch**
Calculated Parameters									
Hardness (CaCO3)	mg/L	96		1.0	5142464	97		1.0	5142464
Total Un-ionized Ammonia	mg/L	0.0020		0.0005	5143055	0.0042		0.0041	5143055
Field Measurements									
Field Temperature	Celcius	21.08		N/A	ONSITE	21.27		N/A	ONSITE
Field pH	pH	7.2			ONSITE	8.22			ONSITE
Inorganics									
Total Ammonia-N	mg/L	0.25		0.050	5145881	0.051		0.050	5145881
Dissolved Oxygen	mg/L	8.63	8.70		5144212	8.85			5144212
pH	pH	8.01			5144642	8.01			5144642
Phenols-4AAP	mg/L	0.0025		0.0010	5144786	0.0021		0.0010	5144786
Total Phosphorus	mg/L	0.011		0.004	5144836	0.013		0.004	5144836
Sulphide	mg/L	ND		0.020	5147077	ND		0.020	5147077
Turbidity	NTU	0.4		0.1	5144606	0.7		0.1	5144606
WAD Cyanide (Free)	ug/L	ND	ND	1	5145356	ND		1	5145356
Alkalinity (Total as CaCO3)	mg/L	92		1.0	5144635	93		1.0	5144635
Metals									
Dissolved (0.2u) Aluminum (Al)	ug/L	ND		5	5145294	ND	ND	5	5145294
Chromium (VI)	ug/L	ND		0.50	5143285	ND		0.50	5143285
Mercury (Hg)	ug/L	ND		0.1	5144772	ND		0.1	5145164
Total Antimony (Sb)	ug/L	ND	ND	0.50	5145102	ND		0.50	5145102
Total Arsenic (As)	ug/L	ND	ND	1.0	5145102	ND		1.0	5145102
Total Beryllium (Be)	ug/L	ND	ND	0.50	5145102	ND		0.50	5145102
Total Boron (B)	ug/L	13	13	10	5145102	14		10	5145102
Total Cadmium (Cd)	ug/L	ND	ND	0.10	5145102	ND		0.10	5145102
Total Chromium (Cr)	ug/L	ND	ND	5.0	5145102	ND		5.0	5145102
Total Cobalt (Co)	ug/L	ND	ND	0.50	5145102	ND		0.50	5145102
Total Copper (Cu)	ug/L	ND	ND	1.0	5145102	ND		1.0	5145102
Total Iron (Fe)	ug/L	ND	ND	100	5145102	220		100	5145102
Total Lead (Pb)	ug/L	ND	ND	0.50	5145102	ND		0.50	5145102
Total Molybdenum (Mo)	ug/L	ND	ND	0.50	5145102	ND		0.50	5145102
Total Nickel (Ni)	ug/L	ND	ND	1.0	5145102	ND		1.0	5145102
Total Selenium (Se)	ug/L	ND	ND	2.0	5145102	ND		2.0	5145102
Total Silver (Ag)	ug/L	ND	ND	0.10	5145102	ND		0.10	5145102

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

PWQO METALS AND INORGANICS (WATER)

Maxxam ID		FAQ916	FAQ916			FAQ917	FAQ917		
Sampling Date		2017/08/29 09:00	2017/08/29 09:00			2017/08/29 10:00	2017/08/29 10:00		
COC Number		625117-01-01	625117-01-01			625117-01-01	625117-01-01		
	UNITS	**A0196 RR2**	**A0196 RR2 Lab-Dup**	**RDL**	**QC Batch**	**A0199 SW10**	**A0199 SW10 Lab-Dup**	**RDL**	**QC Batch**
Total Thallium (Tl)	ug/L	ND	ND	0.050	5145102	ND		0.050	5145102
Total Tungsten (W)	ug/L	ND	ND	1.0	5145102	ND		1.0	5145102
Total Uranium (U)	ug/L	0.12	0.11	0.10	5145102	0.12		0.10	5145102
Total Vanadium (V)	ug/L	ND	ND	0.50	5145102	ND		0.50	5145102
Total Zinc (Zn)	ug/L	ND	ND	5.0	5145102	ND		5.0	5145102
Total Zirconium (Zr)	ug/L	ND	ND	1.0	5145102	ND		1.0	5145102

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7I8519
Report Date: 2017/09/07

AEL Environment
Client Project #: 10888

PWQO METALS AND INORGANICS (WATER)

Maxxam ID		FAQ918	FAQ918			FAQ919		
Sampling Date		2017/08/29 10:40	2017/08/29 10:40			2017/08/29 11:10		
COC Number		625117-01-01	625117-01-01			625117-01-01		
	UNITS	**A0201 SW8**	**A0201 SW8 Lab-Dup**	**RDL**	**QC Batch**	**A0203 SW9**	**RDL**	**QC Batch**
Calculated Parameters								
Hardness (CaCO3)	mg/L	120		1.0	5142464	96	1.0	5142464
Total Un-ionized Ammonia	mg/L	0.026		0.0047	5143055	0.034	0.0055	5143055
Field Measurements								
Field Temperature	Celcius	21.0		N/A	ONSITE	21.28	N/A	ONSITE
Field pH	pH	8.29			ONSITE	8.36		ONSITE
Inorganics								
Total Ammonia-N	mg/L	0.28		0.050	5145881	0.31	0.050	5145881
Dissolved Oxygen	mg/L	9.07			5144212	9.36		5144212
pH	pH	8.03			5144642	8.07		5144642
Phenols-4AAP	mg/L	0.0022		0.0010	5144786	0.0027	0.0010	5144786
Total Phosphorus	mg/L	0.015		0.004	5144836	0.021	0.004	5144836
Sulphide	mg/L	ND		0.020	5147077	ND	0.020	5147077
Turbidity	NTU	0.6		0.1	5144606	1.2	0.1	5144606
WAD Cyanide (Free)	ug/L	ND		1	5145356	ND	1	5145356
Alkalinity (Total as CaCO3)	mg/L	100		1.0	5144635	93	1.0	5144635
Metals								
Dissolved (0.2u) Aluminum (Al)	ug/L	8	6	5	5148683	7	5	5145294
Chromium (VI)	ug/L	ND		0.50	5143285	ND	0.50	5143285
Mercury (Hg)	ug/L	ND		0.1	5145164	ND	0.1	5145164
Total Antimony (Sb)	ug/L	ND		0.50	5145102	ND	0.50	5145102
Total Arsenic (As)	ug/L	ND		1.0	5145102	ND	1.0	5145102
Total Beryllium (Be)	ug/L	ND		0.50	5145102	ND	0.50	5145102
Total Boron (B)	ug/L	15		10	5145102	13	10	5145102
Total Cadmium (Cd)	ug/L	ND		0.10	5145102	ND	0.10	5145102
Total Chromium (Cr)	ug/L	ND		5.0	5145102	ND	5.0	5145102
Total Cobalt (Co)	ug/L	ND		0.50	5145102	ND	0.50	5145102
Total Copper (Cu)	ug/L	ND		1.0	5145102	ND	1.0	5145102
Total Iron (Fe)	ug/L	160		100	5145102	110	100	5145102
Total Lead (Pb)	ug/L	ND		0.50	5145102	1.4	0.50	5145102
Total Molybdenum (Mo)	ug/L	ND		0.50	5145102	ND	0.50	5145102
Total Nickel (Ni)	ug/L	ND		1.0	5145102	ND	1.0	5145102
Total Selenium (Se)	ug/L	ND		2.0	5145102	ND	2.0	5145102

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable
ND = Not detected

Maxxam
A Bureau Veritas Group Company

PWQO METALS AND INORGANICS (WATER)

Maxxam ID		FAQ918	FAQ918			FAQ919		
Sampling Date		2017/08/29 10:40	2017/08/29 10:40			2017/08/29 11:10		
COC Number		625117-01-01	625117-01-01			625117-01-01		
	UNITS	A0201 SW8	A0201 SW8 Lab-Dup	RDL	QC Batch	A0203 SW9	RDL	QC Batch
Total Silver (Ag)	ug/L	ND		0.10	5145102	ND	0.10	5145102
Total Thallium (Tl)	ug/L	ND		0.050	5145102	ND	0.050	5145102
Total Tungsten (W)	ug/L	ND		1.0	5145102	ND	1.0	5145102
Total Uranium (U)	ug/L	0.18		0.10	5145102	0.13	0.10	5145102
Total Vanadium (V)	ug/L	ND		0.50	5145102	ND	0.50	5145102
Total Zinc (Zn)	ug/L	ND		5.0	5145102	ND	5.0	5145102
Total Zirconium (Zr)	ug/L	ND		1.0	5145102	ND	1.0	5145102

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam Job #: B7I8519
Report Date: 2017/09/07

AEL Environment
Client Project #: 10888

PWQO METALS AND INORGANICS (WATER)

Maxxam ID		FAQ920	FAQ920			FAQ921		
Sampling Date		2017/08/29 12:00	2017/08/29 12:00			2017/08/29 12:40		
COC Number		625117-01-01	625117-01-01			625117-01-01		
	UNITS	**A0205 SW7**	**A0205 SW7 Lab-Dup**	**RDL**	**QC Batch**	**A0207 RR3**	**RDL**	**QC Batch**
Calculated Parameters								
Hardness (CaCO3)	mg/L	100		1.0	5142464	97	1.0	5142464
Total Un-ionized Ammonia	mg/L	ND		0.0049	5143055	0.030	0.0055	5143055
Field Measurements								
Field Temperature	Celcius	21.3		N/A	ONSITE	21.41	N/A	ONSITE
Field pH	pH	8.3			ONSITE	8.35		ONSITE
Inorganics								
Total Ammonia-N	mg/L	ND		0.050	5145881	0.28	0.050	5145881
Dissolved Oxygen	mg/L	8.97			5144212	9.00		5144212
pH	pH	7.90	7.92		5145435	8.06		5144642
Phenols-4AAP	mg/L	ND		0.0010	5149312	ND	0.0010	5149312
Total Phosphorus	mg/L	0.017		0.004	5144836	0.016	0.004	5144836
Sulphide	mg/L	ND	ND	0.020	5147108	ND	0.020	5147077
Turbidity	NTU	0.4	0.4	0.1	5144953	1.2	0.1	5144606
WAD Cyanide (Free)	ug/L	ND		1	5145356	ND	1	5145356
Alkalinity (Total as CaCO3)	mg/L	94	95	1.0	5145431	92	1.0	5144635
Metals								
Dissolved (0.2u) Aluminum (Al)	ug/L	5		5	5145294	7	5	5145294
Chromium (VI)	ug/L	ND		0.50	5143285	ND	0.50	5143285
Mercury (Hg)	ug/L	ND		0.1	5145164	ND	0.1	5145164
Total Antimony (Sb)	ug/L	ND		0.50	5145102	ND	0.50	5145102
Total Arsenic (As)	ug/L	ND		1.0	5145102	ND	1.0	5145102
Total Beryllium (Be)	ug/L	ND		0.50	5145102	ND	0.50	5145102
Total Boron (B)	ug/L	14		10	5145102	13	10	5145102
Total Cadmium (Cd)	ug/L	ND		0.10	5145102	ND	0.10	5145102
Total Chromium (Cr)	ug/L	ND		5.0	5145102	ND	5.0	5145102
Total Cobalt (Co)	ug/L	ND		0.50	5145102	ND	0.50	5145102
Total Copper (Cu)	ug/L	ND		1.0	5145102	ND	1.0	5145102
Total Iron (Fe)	ug/L	130		100	5145102	ND	100	5145102
Total Lead (Pb)	ug/L	1.5		0.50	5145102	ND	0.50	5145102
Total Molybdenum (Mo)	ug/L	ND		0.50	5145102	ND	0.50	5145102
Total Nickel (Ni)	ug/L	ND		1.0	5145102	ND	1.0	5145102
Total Selenium (Se)	ug/L	ND		2.0	5145102	ND	2.0	5145102

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected
N/A = Not Applicable

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

PWQO METALS AND INORGANICS (WATER)

Maxxam ID		FAQ920	FAQ920			FAQ921		
Sampling Date		2017/08/29 12:00	2017/08/29 12:00			2017/08/29 12:40		
COC Number		625117-01-01	625117-01-01			625117-01-01		
	UNITS	A0205 SW7	A0205 SW7 Lab-Dup	RDL	QC Batch	A0207 RR3	RDL	QC Batch
Total Silver (Ag)	ug/L	ND		0.10	5145102	ND	0.10	5145102
Total Thallium (Tl)	ug/L	ND		0.050	5145102	ND	0.050	5145102
Total Tungsten (W)	ug/L	ND		1.0	5145102	ND	1.0	5145102
Total Uranium (U)	ug/L	0.13		0.10	5145102	0.11	0.10	5145102
Total Vanadium (V)	ug/L	ND		0.50	5145102	ND	0.50	5145102
Total Zinc (Zn)	ug/L	ND		5.0	5145102	ND	5.0	5145102
Total Zirconium (Zr)	ug/L	ND		1.0	5145102	ND	1.0	5145102

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

PWQO METALS AND INORGANICS (WATER)

Maxxam ID		FAQ924	FAQ924			FAQ925		
Sampling Date		2017/08/29 09:10	2017/08/29 09:10			2017/08/29 14:30		
COC Number		625117-01-01	625117-01-01			625117-01-01		
	UNITS	**A0210 RR2**	**A0210 RR2 Lab-Dup**	**RDL**	**QC Batch**	**A0211 SW1**	**RDL**	**QC Batch**
Calculated Parameters								
Hardness (CaCO3)	mg/L	97		1.0	5142464	96	1.0	5142464
Total Un-ionized Ammonia	mg/L	0.0032		0.0005	5143055	0.020	0.0069	5143055
Field Measurements								
Field Temperature	Celcius	21.08		N/A	ONSITE	22.44	N/A	ONSITE
Field pH	pH	7.2			ONSITE	8.43		ONSITE
Inorganics								
Total Ammonia-N	mg/L	0.38		0.050	5145881	0.15	0.050	5145881
Dissolved Oxygen	mg/L	9.22			5144212	9.45		5144212
pH	pH	8.07			5144642	8.11		5144642
Phenols-4AAP	mg/L	0.0020	0.0019	0.0010	5149581	0.0023	0.0010	5144786
Total Phosphorus	mg/L	0.015		0.004	5144836	0.011	0.004	5144836
Sulphide	mg/L	ND		0.020	5147077	ND	0.020	5147108
Turbidity	NTU	0.5		0.1	5144953	0.7	0.1	5144606
WAD Cyanide (Free)	ug/L	ND		1	5145356	6	1	5145356
Alkalinity (Total as CaCO3)	mg/L	92		1.0	5144635	92	1.0	5144635
Metals								
Dissolved (0.2u) Aluminum (Al)	ug/L	6		5	5145294	5	5	5145294
Chromium (VI)	ug/L	ND		0.50	5143285	ND	0.50	5143285
Mercury (Hg)	ug/L	ND		0.1	5145164	ND	0.1	5145164
Total Antimony (Sb)	ug/L	ND		0.50	5145102	ND	0.50	5145102
Total Arsenic (As)	ug/L	ND		1.0	5145102	ND	1.0	5145102
Total Beryllium (Be)	ug/L	ND		0.50	5145102	ND	0.50	5145102
Total Boron (B)	ug/L	17		10	5145102	13	10	5145102
Total Cadmium (Cd)	ug/L	ND		0.10	5145102	ND	0.10	5145102
Total Chromium (Cr)	ug/L	ND		5.0	5145102	ND	5.0	5145102
Total Cobalt (Co)	ug/L	ND		0.50	5145102	ND	0.50	5145102
Total Copper (Cu)	ug/L	ND		1.0	5145102	1.4	1.0	5145102
Total Iron (Fe)	ug/L	ND		100	5145102	ND	100	5145102
Total Lead (Pb)	ug/L	ND		0.50	5145102	ND	0.50	5145102
Total Molybdenum (Mo)	ug/L	ND		0.50	5145102	ND	0.50	5145102
Total Nickel (Ni)	ug/L	ND		1.0	5145102	ND	1.0	5145102
Total Selenium (Se)	ug/L	ND		2.0	5145102	ND	2.0	5145102

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable
ND = Not detected

Maxxam Job #: B7I8519
Report Date: 2017/09/07

AEL Environment
Client Project #: 10888

PWQO METALS AND INORGANICS (WATER)

Maxxam ID		FAQ924	FAQ924			FAQ925		
Sampling Date		2017/08/29 09:10	2017/08/29 09:10			2017/08/29 14:30		
COC Number		625117-01-01	625117-01-01			625117-01-01		
	UNITS	**A0210 RR2**	**A0210 RR2 Lab-Dup**	**RDL**	**QC Batch**	**A0211 SW1**	**RDL**	**QC Batch**
Total Silver (Ag)	ug/L	ND		0.10	5145102	ND	0.10	5145102
Total Thallium (Tl)	ug/L	ND		0.050	5145102	ND	0.050	5145102
Total Tungsten (W)	ug/L	ND		1.0	5145102	ND	1.0	5145102
Total Uranium (U)	ug/L	0.11		0.10	5145102	0.10	0.10	5145102
Total Vanadium (V)	ug/L	ND		0.50	5145102	ND	0.50	5145102
Total Zinc (Zn)	ug/L	ND		5.0	5145102	ND	5.0	5145102
Total Zirconium (Zr)	ug/L	ND		1.0	5145102	ND	1.0	5145102

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam Job #: B7I8519
Report Date: 2017/09/07

AEL Environment
Client Project #: 10888

PWQO VOCS (WATER)

Maxxam ID		FAQ916	FAQ917	FAQ917	FAQ918	FAQ919		
Sampling Date		2017/08/29 09:00	2017/08/29 10:00	2017/08/29 10:00	2017/08/29 10:40	2017/08/29 11:10		
COC Number		625117-01-01	625117-01-01	625117-01-01	625117-01-01	625117-01-01		
	UNITS	**A0196 RR2**	**A0199 SW10**	**A0199 SW10 Lab-Dup**	**A0201 SW8**	**A0203 SW9**	**RDL**	**QC Batch**
Volatile Organics								
Benzene	ug/L	ND	ND	ND	ND	ND	0.10	5142779
Bromodichloromethane	ug/L	ND	ND	ND	0.12	ND	0.10	5142779
Acrolein	ug/L	ND	ND	ND	ND	ND	10	5142771
Bromoform	ug/L	ND	ND	ND	ND	ND	0.20	5142779
Bromomethane	ug/L	ND	ND	ND	ND	ND	0.50	5142779
Chlorobenzene	ug/L	ND	ND	ND	ND	ND	0.10	5142779
Chloromethane	ug/L	ND	ND	ND	ND	ND	0.50	5142779
Dibromochloromethane	ug/L	ND	ND	ND	ND	ND	0.20	5142779
1,2-Dichlorobenzene	ug/L	ND	ND	ND	ND	ND	0.20	5142779
1,3-Dichlorobenzene	ug/L	ND	ND	ND	ND	ND	0.20	5142779
1,4-Dichlorobenzene	ug/L	ND	ND	ND	ND	ND	0.20	5142779
1,1-Dichloroethane	ug/L	ND	ND	ND	ND	ND	0.10	5142779
1,2-Dichloroethane	ug/L	ND	ND	ND	ND	ND	0.20	5142779
1,1-Dichloroethylene	ug/L	ND	ND	ND	ND	ND	0.10	5142779
cis-1,2-Dichloroethylene	ug/L	ND	ND	ND	ND	ND	0.10	5142779
trans-1,2-Dichloroethylene	ug/L	ND	ND	ND	ND	ND	0.10	5142779
1,2-Dichloropropane	ug/L	ND	ND	ND	ND	ND	0.10	5142779
trans-1,3-Dichloropropene	ug/L	ND	ND	ND	ND	ND	0.20	5142779
Ethylbenzene	ug/L	ND	ND	ND	ND	ND	0.10	5142779
Ethylene Dibromide	ug/L	ND	ND	ND	ND	ND	0.20	5142779
Methylene Chloride(Dichloromethane)	ug/L	ND	ND	ND	ND	ND	0.50	5142779
Methyl Ethyl Ketone (2-Butanone)	ug/L	ND	ND	ND	ND	ND	5.0	5142779
Methyl t-butyl ether (MTBE)	ug/L	ND	ND	ND	ND	ND	0.20	5142779
Styrene	ug/L	ND	ND	ND	ND	ND	0.20	5142779
1,1,1,2-Tetrachloroethane	ug/L	ND	ND	ND	ND	ND	0.20	5142779
1,1,2,2-Tetrachloroethane	ug/L	ND	ND	ND	ND	ND	0.20	5142779
Tetrachloroethylene	ug/L	ND	ND	ND	ND	ND	0.10	5142779
Toluene	ug/L	0.22	ND	ND	ND	ND	0.20	5142779
1,1,1-Trichloroethane	ug/L	ND	ND	ND	ND	ND	0.10	5142779
1,1,2-Trichloroethane	ug/L	ND	ND	ND	ND	ND	0.20	5142779
Trichloroethylene	ug/L	ND	ND	ND	ND	ND	0.10	5142779
Vinyl Chloride	ug/L	ND	ND	ND	ND	ND	0.20	5142779
p+m-Xylene	ug/L	ND	ND	ND	ND	ND	0.10	5142779

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

PWQO VOCS (WATER)

Maxxam ID		FAQ916	FAQ917	FAQ917	FAQ918	FAQ919		
Sampling Date		2017/08/29 09:00	2017/08/29 10:00	2017/08/29 10:00	2017/08/29 10:40	2017/08/29 11:10		
COC Number		625117-01-01	625117-01-01	625117-01-01	625117-01-01	625117-01-01		
	UNITS	**A0196 RR2**	**A0199 SW10**	**A0199 SW10 Lab-Dup**	**A0201 SW8**	**A0203 SW9**	**RDL**	**QC Batch**
o-Xylene	ug/L	ND	ND	ND	ND	ND	0.10	5142779
Surrogate Recovery (%)								
4-Bromofluorobenzene	%	98	97	97	99	99		5142779
D4-1,2-Dichloroethane	%	102	101	102	103	103		5142779
D8-Toluene	%	98	99	97	97	97		5142779

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7I8519
Report Date: 2017/09/07

AEL Environment
Client Project #: 10888

PWQO VOCS (WATER)

Maxxam ID		FAQ920	FAQ921	FAQ924	FAQ925		
Sampling Date		2017/08/29 12:00	2017/08/29 12:40	2017/08/29 09:10	2017/08/29 14:30		
COC Number		625117-01-01	625117-01-01	625117-01-01	625117-01-01		
	UNITS	**A0205 SW7**	**A0207 RR3**	**A0210 RR2**	**A0211 SW1**	**RDL**	**QC Batch**
Volatile Organics							
Benzene	ug/L	ND	ND	ND	ND	0.10	5142779
Bromodichloromethane	ug/L	ND	ND	ND	ND	0.10	5142779
Acrolein	ug/L	ND	ND	ND	ND	10	5142771
Bromoform	ug/L	ND	ND	ND	ND	0.20	5142779
Bromomethane	ug/L	ND	ND	ND	ND	0.50	5142779
Chlorobenzene	ug/L	ND	ND	ND	ND	0.10	5142779
Chloromethane	ug/L	ND	ND	ND	ND	0.50	5142779
Dibromochloromethane	ug/L	ND	ND	ND	ND	0.20	5142779
1,2-Dichlorobenzene	ug/L	ND	ND	ND	ND	0.20	5142779
1,3-Dichlorobenzene	ug/L	ND	ND	ND	ND	0.20	5142779
1,4-Dichlorobenzene	ug/L	ND	ND	ND	ND	0.20	5142779
1,1-Dichloroethane	ug/L	ND	ND	ND	ND	0.10	5142779
1,2-Dichloroethane	ug/L	ND	ND	ND	ND	0.20	5142779
1,1-Dichloroethylene	ug/L	ND	ND	ND	ND	0.10	5142779
cis-1,2-Dichloroethylene	ug/L	ND	ND	ND	ND	0.10	5142779
trans-1,2-Dichloroethylene	ug/L	ND	ND	ND	ND	0.10	5142779
1,2-Dichloropropane	ug/L	ND	ND	ND	ND	0.10	5142779
trans-1,3-Dichloropropene	ug/L	ND	ND	ND	ND	0.20	5142779
Ethylbenzene	ug/L	ND	ND	ND	ND	0.10	5142779
Ethylene Dibromide	ug/L	ND	ND	ND	ND	0.20	5142779
Methylene Chloride(Dichloromethane)	ug/L	ND	ND	ND	ND	0.50	5142779
Methyl Ethyl Ketone (2-Butanone)	ug/L	ND	ND	ND	ND	5.0	5142779
Methyl t-butyl ether (MTBE)	ug/L	ND	ND	ND	ND	0.20	5142779
Styrene	ug/L	ND	ND	ND	ND	0.20	5142779
1,1,1,2-Tetrachloroethane	ug/L	ND	ND	ND	ND	0.20	5142779
1,1,2,2-Tetrachloroethane	ug/L	ND	ND	ND	ND	0.20	5142779
Tetrachloroethylene	ug/L	ND	ND	ND	ND	0.10	5142779
Toluene	ug/L	ND	ND	ND	ND	0.20	5142779
1,1,1-Trichloroethane	ug/L	ND	ND	ND	ND	0.10	5142779
1,1,2-Trichloroethane	ug/L	ND	ND	ND	ND	0.20	5142779
Trichloroethylene	ug/L	ND	ND	ND	ND	0.10	5142779
Vinyl Chloride	ug/L	ND	ND	ND	ND	0.20	5142779
p+m-Xylene	ug/L	ND	ND	ND	ND	0.10	5142779

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

PWQO VOCS (WATER)

Maxxam ID		FAQ920	FAQ921	FAQ924	FAQ925		
Sampling Date		2017/08/29 12:00	2017/08/29 12:40	2017/08/29 09:10	2017/08/29 14:30		
COC Number		625117-01-01	625117-01-01	625117-01-01	625117-01-01		
	UNITS	**A0205 SW7**	**A0207 RR3**	**A0210 RR2**	**A0211 SW1**	**RDL**	**QC Batch**
o-Xylene	ug/L	ND	ND	ND	ND	0.10	5142779
Surrogate Recovery (%)							
4-Bromofluorobenzene	%	98	98	98	98		5142779
D4-1,2-Dichloroethane	%	103	103	104	103		5142779
D8-Toluene	%	98	98	97	98		5142779

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7I8519
Report Date: 2017/09/07

AEL Environment
Client Project #: 10888

TEST SUMMARY

Maxxam ID: FAQ916
Sample ID: A0196 RR2
Matrix: Water

Collected: 2017/08/29
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5145294	N/A	2017/09/05	Thao Nguyen
Alkalinity	AT	5144635	N/A	2017/08/31	Yogesh Patel
Chromium (VI) in Water	IC	5143285	N/A	2017/09/01	Lang Le
Free (WAD) Cyanide	SKAL/CN	5145356	N/A	2017/09/01	Xuanhong Qiu
Dissolved Oxygen	DO	5144212	2017/08/30	2017/08/30	Frank Zhang
Hardness (calculated as CaCO3)		5142464	N/A	2017/09/05	Automated Statchk
Mercury	CV/AA	5144772	2017/08/31	2017/09/01	Ron Morrison
Total Metals Analysis by ICPMS	ICP/MS	5145102	N/A	2017/08/31	Prempal Bhatti
Total Ammonia-N	LACH/NH4	5145881	N/A	2017/09/01	Charles Opoku-Ware
pH	AT	5144642	N/A	2017/08/31	Yogesh Patel
Phenols (4AAP)	TECH/PHEN	5144786	N/A	2017/08/31	Zahid Soikot
Field pH	PH	ONSITE	N/A	2017/08/29	Antonella Brasil
Sulphide	ISE/S	5147077	N/A	2017/09/01	Tahir Anwar
Field pH	PH	ONSITE	N/A	2017/08/29	Antonella Brasil
Total Phosphorus (Colourimetric)	LACH/P	5144836	2017/08/31	2017/09/01	Amanpreet Sappal
Turbidity	AT	5144606	N/A	2017/08/31	Neil Dassanayake
Un-ionized Ammonia	CALC/NH3	5143055	2017/09/07	2017/09/07	Automated Statchk
Volatile Organic Compounds in Water	P&T/MS	5142779	N/A	2017/09/01	Juan Pangilinan
Non-Routine Volatile Organic Compounds	P&T/MS	5142771	N/A	2017/09/05	Juan Pangilinan

Maxxam ID: FAQ916 Dup
Sample ID: A0196 RR2
Matrix: Water

Collected: 2017/08/29
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Free (WAD) Cyanide	SKAL/CN	5145356	N/A	2017/09/01	Xuanhong Qiu
Dissolved Oxygen	DO	5144212	2017/08/30	2017/08/30	Frank Zhang
Total Metals Analysis by ICPMS	ICP/MS	5145102	N/A	2017/08/31	Prempal Bhatti

Maxxam ID: FAQ917
Sample ID: A0199 SW10
Matrix: Water

Collected: 2017/08/29
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5145294	N/A	2017/09/05	Thao Nguyen
Alkalinity	AT	5144635	N/A	2017/08/31	Yogesh Patel
Chromium (VI) in Water	IC	5143285	N/A	2017/09/01	Lang Le
Free (WAD) Cyanide	SKAL/CN	5145356	N/A	2017/09/01	Xuanhong Qiu
Dissolved Oxygen	DO	5144212	2017/08/30	2017/08/30	Frank Zhang
Hardness (calculated as CaCO3)		5142464	N/A	2017/09/05	Automated Statchk
Mercury	CV/AA	5145164	2017/08/31	2017/09/05	Ron Morrison
Total Metals Analysis by ICPMS	ICP/MS	5145102	N/A	2017/08/31	Prempal Bhatti
Total Ammonia-N	LACH/NH4	5145881	N/A	2017/09/01	Charles Opoku-Ware
pH	AT	5144642	N/A	2017/08/31	Yogesh Patel
Phenols (4AAP)	TECH/PHEN	5144786	N/A	2017/08/31	Zahid Soikot
Field pH	PH	ONSITE	N/A	2017/08/29	Antonella Brasil

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam Job #: B7I8519
Report Date: 2017/09/07

AEL Environment
Client Project #: 10888

TEST SUMMARY

Maxxam ID: FAQ917
Sample ID: A0199 SW10
Matrix: Water

Collected: 2017/08/29
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sulphide	ISE/S	5147077	N/A	2017/09/01	Tahir Anwar
Field pH	PH	ONSITE	N/A	2017/08/29	Antonella Brasil
Total Phosphorus (Colourimetric)	LACH/P	5144836	2017/08/31	2017/09/01	Amanpreet Sappal
Turbidity	AT	5144606	N/A	2017/08/31	Neil Dassanayake
Un-ionized Ammonia	CALC/NH3	5143055	2017/09/07	2017/09/07	Automated Statchk
Volatile Organic Compounds in Water	P&T/MS	5142779	N/A	2017/09/01	Juan Pangilinan
Non-Routine Volatile Organic Compounds	P&T/MS	5142771	N/A	2017/09/05	Juan Pangilinan

Maxxam ID: FAQ917 Dup
Sample ID: A0199 SW10
Matrix: Water

Collected: 2017/08/29
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5145294	N/A	2017/09/05	Thao Nguyen
Volatile Organic Compounds in Water	P&T/MS	5142779	N/A	2017/09/01	Juan Pangilinan
Non-Routine Volatile Organic Compounds	P&T/MS	5142771	N/A	2017/09/05	Juan Pangilinan

Maxxam ID: FAQ918
Sample ID: A0201 SW8
Matrix: Water

Collected: 2017/08/29
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5148683	N/A	2017/09/05	Prempal Bhatti
Alkalinity	AT	5144635	N/A	2017/08/31	Yogesh Patel
Chromium (VI) in Water	IC	5143285	N/A	2017/09/01	Lang Le
Free (WAD) Cyanide	SKAL/CN	5145356	N/A	2017/09/01	Xuanhong Qiu
Dissolved Oxygen	DO	5144212	2017/08/30	2017/08/30	Frank Zhang
Hardness (calculated as CaCO3)		5142464	N/A	2017/09/06	Automated Statchk
Mercury	CV/AA	5145164	2017/08/31	2017/09/05	Ron Morrison
Total Metals Analysis by ICPMS	ICP/MS	5145102	N/A	2017/08/31	Prempal Bhatti
Total Ammonia-N	LACH/NH4	5145881	N/A	2017/09/01	Charles Opoku-Ware
pH	AT	5144642	N/A	2017/08/31	Yogesh Patel
Phenols (4AAP)	TECH/PHEN	5144786	N/A	2017/08/31	Zahid Soikot
Field pH	PH	ONSITE	N/A	2017/08/29	Antonella Brasil
Sulphide	ISE/S	5147077	N/A	2017/09/01	Tahir Anwar
Field pH	PH	ONSITE	N/A	2017/08/29	Antonella Brasil
Total Phosphorus (Colourimetric)	LACH/P	5144836	2017/08/31	2017/09/01	Amanpreet Sappal
Turbidity	AT	5144606	N/A	2017/08/31	Neil Dassanayake
Un-ionized Ammonia	CALC/NH3	5143055	2017/09/07	2017/09/07	Automated Statchk
Volatile Organic Compounds in Water	P&T/MS	5142779	N/A	2017/09/01	Juan Pangilinan
Non-Routine Volatile Organic Compounds	P&T/MS	5142771	N/A	2017/09/05	Juan Pangilinan

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7I8519
Report Date: 2017/09/07

AEL Environment
Client Project #: 10888

TEST SUMMARY

Maxxam ID: FAQ918 Dup
Sample ID: A0201 SW8
Matrix: Water

Collected: 2017/08/29
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5148683	N/A	2017/09/05	Prempal Bhatti

Maxxam ID: FAQ919
Sample ID: A0203 SW9
Matrix: Water

Collected: 2017/08/29
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5145294	N/A	2017/09/05	Thao Nguyen
Alkalinity	AT	5144635	N/A	2017/09/01	Yogesh Patel
Chromium (VI) in Water	IC	5143285	N/A	2017/09/01	Lang Le
Free (WAD) Cyanide	SKAL/CN	5145356	N/A	2017/09/01	Xuanhong Qiu
Dissolved Oxygen	DO	5144212	2017/08/30	2017/08/30	Frank Zhang
Hardness (calculated as CaCO3)		5142464	N/A	2017/09/05	Automated Statchk
Mercury	CV/AA	5145164	2017/08/31	2017/09/05	Ron Morrison
Total Metals Analysis by ICPMS	ICP/MS	5145102	N/A	2017/08/31	Prempal Bhatti
Total Ammonia-N	LACH/NH4	5145881	N/A	2017/09/01	Charles Opoku-Ware
pH	AT	5144642	N/A	2017/09/01	Yogesh Patel
Phenols (4AAP)	TECH/PHEN	5144786	N/A	2017/08/31	Zahid Soikot
Field pH	PH	ONSITE	N/A	2017/08/29	Antonella Brasil
Sulphide	ISE/S	5147077	N/A	2017/09/01	Tahir Anwar
Field pH	PH	ONSITE	N/A	2017/08/29	Antonella Brasil
Total Phosphorus (Colourimetric)	LACH/P	5144836	2017/08/31	2017/09/01	Amanpreet Sappal
Turbidity	AT	5144606	N/A	2017/08/31	Neil Dassanayake
Un-ionized Ammonia	CALC/NH3	5143055	2017/09/07	2017/09/07	Automated Statchk
Volatile Organic Compounds in Water	P&T/MS	5142779	N/A	2017/09/01	Juan Pangilinan
Non-Routine Volatile Organic Compounds	P&T/MS	5142771	N/A	2017/09/05	Juan Pangilinan

Maxxam ID: FAQ920
Sample ID: A0205 SW7
Matrix: Water

Collected: 2017/08/29
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5145294	N/A	2017/09/05	Thao Nguyen
Alkalinity	AT	5145431	N/A	2017/09/01	Neil Dassanayake
Chromium (VI) in Water	IC	5143285	N/A	2017/09/01	Lang Le
Free (WAD) Cyanide	SKAL/CN	5145356	N/A	2017/09/01	Xuanhong Qiu
Dissolved Oxygen	DO	5144212	2017/08/30	2017/08/30	Frank Zhang
Hardness (calculated as CaCO3)		5142464	N/A	2017/09/05	Automated Statchk
Mercury	CV/AA	5145164	2017/08/31	2017/09/05	Ron Morrison
Total Metals Analysis by ICPMS	ICP/MS	5145102	N/A	2017/08/31	Prempal Bhatti
Total Ammonia-N	LACH/NH4	5145881	N/A	2017/09/01	Charles Opoku-Ware
pH	AT	5145435	N/A	2017/09/01	Neil Dassanayake
Phenols (4AAP)	TECH/PHEN	5149312	N/A	2017/09/05	Zahid Soikot
Field pH	PH	ONSITE	N/A	2017/08/29	Antonella Brasil
Sulphide	ISE/S	5147108	N/A	2017/09/01	Tahir Anwar
Field pH	PH	ONSITE	N/A	2017/08/29	Antonella Brasil

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

TEST SUMMARY

Maxxam ID: FAQ920 **Collected:** 2017/08/29
Sample ID: A0205 SW7 **Shipped:**
Matrix: Water **Received:** 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Total Phosphorus (Colourimetric)	LACH/P	5144836	2017/08/31	2017/09/01	Amanpreet Sappal
Turbidity	AT	5144953	N/A	2017/08/31	Neil Dassanayake
Un-ionized Ammonia	CALC/NH3	5143055	2017/09/07	2017/09/07	Automated Statchk
Volatile Organic Compounds in Water	P&T/MS	5142779	N/A	2017/09/01	Juan Pangilinan
Non-Routine Volatile Organic Compounds	P&T/MS	5142771	N/A	2017/09/05	Juan Pangilinan

Maxxam ID: FAQ920 Dup **Collected:** 2017/08/29
Sample ID: A0205 SW7 **Shipped:**
Matrix: Water **Received:** 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5145431	N/A	2017/09/01	Neil Dassanayake
pH	AT	5145435	N/A	2017/09/01	Neil Dassanayake
Sulphide	ISE/S	5147108	N/A	2017/09/01	Tahir Anwar
Turbidity	AT	5144953	N/A	2017/09/01	Neil Dassanayake

Maxxam ID: FAQ921 **Collected:** 2017/08/29
Sample ID: A0207 RR3 **Shipped:**
Matrix: Water **Received:** 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5145294	N/A	2017/09/05	Thao Nguyen
Alkalinity	AT	5144635	N/A	2017/09/01	Yogesh Patel
Chromium (VI) in Water	IC	5143285	N/A	2017/09/01	Lang Le
Free (WAD) Cyanide	SKAL/CN	5145356	N/A	2017/09/01	Xuanhong Qiu
Dissolved Oxygen	DO	5144212	2017/08/30	2017/08/30	Frank Zhang
Hardness (calculated as CaCO3)		5142464	N/A	2017/09/05	Automated Statchk
Mercury	CV/AA	5145164	2017/08/31	2017/09/05	Ron Morrison
Total Metals Analysis by ICPMS	ICP/MS	5145102	N/A	2017/08/31	Prempal Bhatti
Total Ammonia-N	LACH/NH4	5145881	N/A	2017/09/01	Charles Opoku-Ware
pH	AT	5144642	N/A	2017/09/01	Yogesh Patel
Phenols (4AAP)	TECH/PHEN	5149312	N/A	2017/09/05	Zahid Soikot
Field pH	PH	ONSITE	N/A	2017/08/29	Antonella Brasil
Sulphide	ISE/S	5147077	N/A	2017/09/01	Tahir Anwar
Field pH	PH	ONSITE	N/A	2017/08/29	Antonella Brasil
Total Phosphorus (Colourimetric)	LACH/P	5144836	2017/08/31	2017/09/01	Amanpreet Sappal
Turbidity	AT	5144606	N/A	2017/08/31	Neil Dassanayake
Un-ionized Ammonia	CALC/NH3	5143055	2017/09/07	2017/09/07	Automated Statchk
Volatile Organic Compounds in Water	P&T/MS	5142779	N/A	2017/09/01	Juan Pangilinan
Non-Routine Volatile Organic Compounds	P&T/MS	5142771	N/A	2017/09/05	Juan Pangilinan

TEST SUMMARY

Maxxam ID: FAQ924
Sample ID: A0210 RR2
Matrix: Water

Collected: 2017/08/29
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5145294	N/A	2017/09/05	Thao Nguyen
Alkalinity	AT	5144635	N/A	2017/09/01	Yogesh Patel
Chromium (VI) in Water	IC	5143285	N/A	2017/09/01	Lang Le
Free (WAD) Cyanide	SKAL/CN	5145356	N/A	2017/09/01	Xuanhong Qiu
Dissolved Oxygen	DO	5144212	2017/08/30	2017/08/30	Frank Zhang
Hardness (calculated as CaCO3)		5142464	N/A	2017/09/05	Automated Statchk
Mercury	CV/AA	5145164	2017/08/31	2017/09/05	Ron Morrison
Total Metals Analysis by ICPMS	ICP/MS	5145102	N/A	2017/08/31	Prempal Bhatti
Total Ammonia-N	LACH/NH4	5145881	N/A	2017/09/01	Charles Opoku-Ware
pH	AT	5144642	N/A	2017/09/01	Yogesh Patel
Phenols (4AAP)	TECH/PHEN	5149581	N/A	2017/09/05	Zahid Soikot
Field pH	PH	ONSITE	N/A	2017/08/29	Antonella Brasil
Sulphide	ISE/S	5147077	N/A	2017/09/01	Tahir Anwar
Field pH	PH	ONSITE	N/A	2017/08/29	Antonella Brasil
Total Phosphorus (Colourimetric)	LACH/P	5144836	2017/08/31	2017/09/01	Amanpreet Sappal
Turbidity	AT	5144953	N/A	2017/08/31	Neil Dassanayake
Un-ionized Ammonia	CALC/NH3	5143055	2017/09/07	2017/09/07	Automated Statchk
Volatile Organic Compounds in Water	P&T/MS	5142779	N/A	2017/09/01	Juan Pangilinan
Non-Routine Volatile Organic Compounds	P&T/MS	5142771	N/A	2017/09/05	Juan Pangilinan

Maxxam ID: FAQ924 Dup
Sample ID: A0210 RR2
Matrix: Water

Collected: 2017/08/29
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Phenols (4AAP)	TECH/PHEN	5149581	N/A	2017/09/05	Zahid Soikot

Maxxam ID: FAQ925
Sample ID: A0211 SW1
Matrix: Water

Collected: 2017/08/29
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5145294	N/A	2017/09/05	Thao Nguyen
Alkalinity	AT	5144635	N/A	2017/09/01	Yogesh Patel
Chromium (VI) in Water	IC	5143285	N/A	2017/09/01	Lang Le
Free (WAD) Cyanide	SKAL/CN	5145356	N/A	2017/09/01	Xuanhong Qiu
Dissolved Oxygen	DO	5144212	2017/08/30	2017/08/30	Frank Zhang
Hardness (calculated as CaCO3)		5142464	N/A	2017/09/05	Automated Statchk
Mercury	CV/AA	5145164	2017/08/31	2017/09/05	Ron Morrison
Total Metals Analysis by ICPMS	ICP/MS	5145102	N/A	2017/08/31	Prempal Bhatti
Total Ammonia-N	LACH/NH4	5145881	N/A	2017/09/01	Charles Opoku-Ware
pH	AT	5144642	N/A	2017/09/01	Yogesh Patel
Phenols (4AAP)	TECH/PHEN	5144786	N/A	2017/08/31	Zahid Soikot
Field pH	PH	ONSITE	N/A	2017/08/29	Antonella Brasil
Sulphide	ISE/S	5147108	N/A	2017/09/01	Tahir Anwar
Field pH	PH	ONSITE	N/A	2017/08/29	Antonella Brasil

Maxxam Job #: B7I8519
Report Date: 2017/09/07

AEL Environment
Client Project #: 10888

TEST SUMMARY

Maxxam ID: FAQ925
Sample ID: A0211 SW1
Matrix: Water

Collected: 2017/08/29
Shipped:
Received: 2017/08/29

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Total Phosphorus (Colourimetric)	LACH/P	5144836	2017/08/31	2017/09/01	Amanpreet Sappal
Turbidity	AT	5144606	N/A	2017/08/31	Neil Dassanayake
Un-ionized Ammonia	CALC/NH3	5143055	2017/09/07	2017/09/07	Automated Statchk
Volatile Organic Compounds in Water	P&T/MS	5142779	N/A	2017/09/01	Juan Pangilinan
Non-Routine Volatile Organic Compounds	P&T/MS	5142771	N/A	2017/09/05	Juan Pangilinan

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	18.3°C
Package 2	6.0°C
Package 3	19.0°C

Cooler custody seal was present and intact.

Results relate only to the items tested.

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
5142771	JPN	Matrix Spike [FAQ916-10]	Acrolein	2017/09/05		89	%	60 - 140
5142771	JPN	Spiked Blank	Acrolein	2017/09/05		96	%	60 - 140
5142771	JPN	Method Blank	Acrolein	2017/09/05	ND, RDL=10		ug/L	
5142771	JPN	RPD [FAQ917-10]	Acrolein	2017/09/05	NC		%	30
5142779	JPN	Matrix Spike [FAQ916-10]	4-Bromofluorobenzene	2017/09/01		100	%	70 - 130
			D4-1,2-Dichloroethane	2017/09/01		95	%	70 - 130
			D8-Toluene	2017/09/01		101	%	70 - 130
			Benzene	2017/09/01		103	%	70 - 130
			Bromodichloromethane	2017/09/01		100	%	70 - 130
			Bromoform	2017/09/01		113	%	70 - 130
			Bromomethane	2017/09/01		91	%	60 - 140
			Chlorobenzene	2017/09/01		100	%	70 - 130
			Chloromethane	2017/09/01		96	%	60 - 140
			Dibromochloromethane	2017/09/01		109	%	70 - 130
			1,2-Dichlorobenzene	2017/09/01		100	%	70 - 130
			1,3-Dichlorobenzene	2017/09/01		106	%	70 - 130
			1,4-Dichlorobenzene	2017/09/01		106	%	70 - 130
			1,1-Dichloroethane	2017/09/01		102	%	70 - 130
			1,2-Dichloroethane	2017/09/01		98	%	70 - 130
			1,1-Dichloroethylene	2017/09/01		110	%	70 - 130
			cis-1,2-Dichloroethylene	2017/09/01		99	%	70 - 130
			trans-1,2-Dichloroethylene	2017/09/01		104	%	70 - 130
			1,2-Dichloropropane	2017/09/01		94	%	70 - 130
			trans-1,3-Dichloropropene	2017/09/01		109	%	70 - 130
			Ethylbenzene	2017/09/01		102	%	70 - 130
			Ethylene Dibromide	2017/09/01		105	%	70 - 130
			Methylene Chloride(Dichloromethane)	2017/09/01		92	%	70 - 130
			Methyl Ethyl Ketone (2-Butanone)	2017/09/01		91	%	60 - 140
			Methyl t-butyl ether (MTBE)	2017/09/01		95	%	70 - 130
			Styrene	2017/09/01		106	%	70 - 130
			1,1,1,2-Tetrachloroethane	2017/09/01		111	%	70 - 130
			1,1,2,2-Tetrachloroethane	2017/09/01		103	%	70 - 130
			Tetrachloroethylene	2017/09/01		98	%	70 - 130
			Toluene	2017/09/01		100	%	70 - 130
			1,1,1-Trichloroethane	2017/09/01		100	%	70 - 130
			1,1,2-Trichloroethane	2017/09/01		99	%	70 - 130
			Trichloroethylene	2017/09/01		100	%	70 - 130
			Vinyl Chloride	2017/09/01		101	%	70 - 130
			p+m-Xylene	2017/09/01		107	%	70 - 130
			o-Xylene	2017/09/01		105	%	70 - 130
5142779	JPN	Spiked Blank	4-Bromofluorobenzene	2017/09/01		101	%	70 - 130
			D4-1,2-Dichloroethane	2017/09/01		100	%	70 - 130
			D8-Toluene	2017/09/01		99	%	70 - 130
			Benzene	2017/09/01		106	%	70 - 130
			Bromodichloromethane	2017/09/01		105	%	70 - 130
			Bromoform	2017/09/01		119	%	70 - 130
			Bromomethane	2017/09/01		86	%	60 - 140
			Chlorobenzene	2017/09/01		102	%	70 - 130
			Chloromethane	2017/09/01		100	%	60 - 140
			Dibromochloromethane	2017/09/01		114	%	70 - 130
			1,2-Dichlorobenzene	2017/09/01		103	%	70 - 130
			1,3-Dichlorobenzene	2017/09/01		106	%	70 - 130
			1,4-Dichlorobenzene	2017/09/01		106	%	70 - 130
			1,1-Dichloroethane	2017/09/01		106	%	70 - 130

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7I8519
Report Date: 2017/09/07

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			1,2-Dichloroethane	2017/09/01		104	%	70 - 130
			1,1-Dichloroethylene	2017/09/01		111	%	70 - 130
			cis-1,2-Dichloroethylene	2017/09/01		102	%	70 - 130
			trans-1,2-Dichloroethylene	2017/09/01		105	%	70 - 130
			1,2-Dichloropropane	2017/09/01		99	%	70 - 130
			trans-1,3-Dichloropropene	2017/09/01		114	%	70 - 130
			Ethylbenzene	2017/09/01		104	%	70 - 130
			Ethylene Dibromide	2017/09/01		112	%	70 - 130
			Methylene Chloride(Dichloromethane)	2017/09/01		96	%	70 - 130
			Methyl Ethyl Ketone (2-Butanone)	2017/09/01		102	%	60 - 140
			Methyl t-butyl ether (MTBE)	2017/09/01		106	%	70 - 130
			Styrene	2017/09/01		109	%	70 - 130
			1,1,1,2-Tetrachloroethane	2017/09/01		115	%	70 - 130
			1,1,2,2-Tetrachloroethane	2017/09/01		110	%	70 - 130
			Tetrachloroethylene	2017/09/01		99	%	70 - 130
			Toluene	2017/09/01		101	%	70 - 130
			1,1,1-Trichloroethane	2017/09/01		103	%	70 - 130
			1,1,2-Trichloroethane	2017/09/01		104	%	70 - 130
			Trichloroethylene	2017/09/01		102	%	70 - 130
			Vinyl Chloride	2017/09/01		101	%	70 - 130
			p+m-Xylene	2017/09/01		110	%	70 - 130
			o-Xylene	2017/09/01		108	%	70 - 130
5142779	JPN	Method Blank	4-Bromofluorobenzene	2017/09/01		98	%	70 - 130
			D4-1,2-Dichloroethane	2017/09/01		101	%	70 - 130
			D8-Toluene	2017/09/01		98	%	70 - 130
			Benzene	2017/09/01	ND, RDL=0.10		ug/L	
			Bromodichloromethane	2017/09/01	ND, RDL=0.10		ug/L	
			Bromoform	2017/09/01	ND, RDL=0.20		ug/L	
			Bromomethane	2017/09/01	ND, RDL=0.50		ug/L	
			Chlorobenzene	2017/09/01	ND, RDL=0.10		ug/L	
			Chloromethane	2017/09/01	ND, RDL=0.50		ug/L	
			Dibromochloromethane	2017/09/01	ND, RDL=0.20		ug/L	
			1,2-Dichlorobenzene	2017/09/01	ND, RDL=0.20		ug/L	
			1,3-Dichlorobenzene	2017/09/01	ND, RDL=0.20		ug/L	
			1,4-Dichlorobenzene	2017/09/01	ND, RDL=0.20		ug/L	
			1,1-Dichloroethane	2017/09/01	ND, RDL=0.10		ug/L	
			1,2-Dichloroethane	2017/09/01	ND, RDL=0.20		ug/L	
			1,1-Dichloroethylene	2017/09/01	ND, RDL=0.10		ug/L	
			cis-1,2-Dichloroethylene	2017/09/01	ND, RDL=0.10		ug/L	
			trans-1,2-Dichloroethylene	2017/09/01	ND, RDL=0.10		ug/L	

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			1,2-Dichloropropane	2017/09/01	ND, RDL=0.10		ug/L	
			trans-1,3-Dichloropropene	2017/09/01	ND, RDL=0.20		ug/L	
			Ethylbenzene	2017/09/01	ND, RDL=0.10		ug/L	
			Ethylene Dibromide	2017/09/01	ND, RDL=0.20		ug/L	
			Methylene Chloride(Dichloromethane)	2017/09/01	ND, RDL=0.50		ug/L	
			Methyl Ethyl Ketone (2-Butanone)	2017/09/01	ND, RDL=5.0		ug/L	
			Methyl t-butyl ether (MTBE)	2017/09/01	ND, RDL=0.20		ug/L	
			Styrene	2017/09/01	ND, RDL=0.20		ug/L	
			1,1,1,2-Tetrachloroethane	2017/09/01	ND, RDL=0.20		ug/L	
			1,1,2,2-Tetrachloroethane	2017/09/01	ND, RDL=0.20		ug/L	
			Tetrachloroethylene	2017/09/01	ND, RDL=0.10		ug/L	
			Toluene	2017/09/01	ND, RDL=0.20		ug/L	
			1,1,1-Trichloroethane	2017/09/01	ND, RDL=0.10		ug/L	
			1,1,2-Trichloroethane	2017/09/01	ND, RDL=0.20		ug/L	
			Trichloroethylene	2017/09/01	ND, RDL=0.10		ug/L	
			Vinyl Chloride	2017/09/01	ND, RDL=0.20		ug/L	
			p+m-Xylene	2017/09/01	ND, RDL=0.10		ug/L	
			o-Xylene	2017/09/01	ND, RDL=0.10		ug/L	
5142779	JPN	RPD [FAQ917-10]	Benzene	2017/09/01	NC		%	30
			Bromodichloromethane	2017/09/01	NC		%	30
			Bromoform	2017/09/01	NC		%	30
			Bromomethane	2017/09/01	NC		%	30
			Chlorobenzene	2017/09/01	NC		%	30
			Chloromethane	2017/09/01	NC		%	30
			Dibromochloromethane	2017/09/01	NC		%	30
			1,2-Dichlorobenzene	2017/09/01	NC		%	30
			1,3-Dichlorobenzene	2017/09/01	NC		%	30
			1,4-Dichlorobenzene	2017/09/01	NC		%	30
			1,1-Dichloroethane	2017/09/01	NC		%	30
			1,2-Dichloroethane	2017/09/01	NC		%	30
			1,1-Dichloroethylene	2017/09/01	NC		%	30
			cis-1,2-Dichloroethylene	2017/09/01	NC		%	30
			trans-1,2-Dichloroethylene	2017/09/01	NC		%	30
			1,2-Dichloropropane	2017/09/01	NC		%	30
			trans-1,3-Dichloropropene	2017/09/01	NC		%	30
			Ethylbenzene	2017/09/01	NC		%	30
			Ethylene Dibromide	2017/09/01	NC		%	30

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7I8519
Report Date: 2017/09/07

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Methylene Chloride(Dichloromethane)	2017/09/01	NC		%	30
			Methyl Ethyl Ketone (2-Butanone)	2017/09/01	NC		%	30
			Methyl t-butyl ether (MTBE)	2017/09/01	NC		%	30
			Styrene	2017/09/01	NC		%	30
			1,1,1,2-Tetrachloroethane	2017/09/01	NC		%	30
			1,1,2,2-Tetrachloroethane	2017/09/01	NC		%	30
			Tetrachloroethylene	2017/09/01	NC		%	30
			Toluene	2017/09/01	NC		%	30
			1,1,1-Trichloroethane	2017/09/01	NC		%	30
			1,1,2-Trichloroethane	2017/09/01	NC		%	30
			Trichloroethylene	2017/09/01	NC		%	30
			Vinyl Chloride	2017/09/01	NC		%	30
			p+m-Xylene	2017/09/01	NC		%	30
			o-Xylene	2017/09/01	NC		%	30
5143285	LLE	Matrix Spike	Chromium (VI)	2017/09/01		103	%	80 - 120
5143285	LLE	Spiked Blank	Chromium (VI)	2017/09/01		102	%	80 - 120
5143285	LLE	Method Blank	Chromium (VI)	2017/09/01	ND, RDL=0.50		ug/L	
5143285	LLE	RPD	Chromium (VI)	2017/09/01	NC		%	20
5144606	NYS	Spiked Blank	Turbidity	2017/08/31		100	%	85 - 115
5144606	NYS	Method Blank	Turbidity	2017/08/31	ND, RDL=0.1		NTU	
5144606	NYS	RPD	Turbidity	2017/08/31	2.4		%	20
5144635	YPA	Spiked Blank	Alkalinity (Total as CaCO3)	2017/08/31		94	%	85 - 115
5144635	YPA	Method Blank	Alkalinity (Total as CaCO3)	2017/08/31	ND, RDL=1.0		mg/L	
5144635	YPA	RPD	Alkalinity (Total as CaCO3)	2017/08/31	0.078		%	20
5144642	YPA	Spiked Blank	pH	2017/08/31		101	%	98 - 103
5144642	YPA	RPD	pH	2017/08/31	0.027		%	N/A
5144772	RON	Matrix Spike	Mercury (Hg)	2017/09/01		107	%	75 - 125
5144772	RON	Spiked Blank	Mercury (Hg)	2017/09/01		101	%	80 - 120
5144772	RON	Method Blank	Mercury (Hg)	2017/09/01	ND, RDL=0.1		ug/L	
5144772	RON	RPD	Mercury (Hg)	2017/09/01	NC		%	20
5144786	ZSK	Matrix Spike	Phenols-4AAP	2017/08/31		99	%	80 - 120
5144786	ZSK	Spiked Blank	Phenols-4AAP	2017/08/31		100	%	85 - 115
5144786	ZSK	Method Blank	Phenols-4AAP	2017/08/31	ND, RDL=0.0010		mg/L	
5144786	ZSK	RPD	Phenols-4AAP	2017/08/31	13		%	20
5144836	ASP	Matrix Spike	Total Phosphorus	2017/09/01		NC	%	80 - 120
5144836	ASP	QC Standard	Total Phosphorus	2017/09/01		94	%	80 - 120
5144836	ASP	Spiked Blank	Total Phosphorus	2017/09/01		94	%	80 - 120
5144836	ASP	Method Blank	Total Phosphorus	2017/09/01	ND, RDL=0.004		mg/L	
5144836	ASP	RPD	Total Phosphorus	2017/09/01	0.24		%	20
5144953	NYS	Spiked Blank	Turbidity	2017/08/31		101	%	85 - 115
5144953	NYS	Method Blank	Turbidity	2017/08/31	ND, RDL=0.1		NTU	
5144953	NYS	RPD [FAQ920-01]	Turbidity	2017/09/01	2.3		%	20
5145102	PBA	Matrix Spike [FAQ916-08]	Total Antimony (Sb)	2017/08/31		99	%	80 - 120
			Total Arsenic (As)	2017/08/31		103	%	80 - 120
			Total Beryllium (Be)	2017/08/31		98	%	80 - 120
			Total Boron (B)	2017/08/31		91	%	80 - 120
			Total Cadmium (Cd)	2017/08/31		101	%	80 - 120
			Total Chromium (Cr)	2017/08/31		99	%	80 - 120

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7I8519
Report Date: 2017/09/07

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Cobalt (Co)	2017/08/31		107	%	80 - 120
			Total Copper (Cu)	2017/08/31		96	%	80 - 120
			Total Iron (Fe)	2017/08/31		103	%	80 - 120
			Total Lead (Pb)	2017/08/31		100	%	80 - 120
			Total Molybdenum (Mo)	2017/08/31		98	%	80 - 120
			Total Nickel (Ni)	2017/08/31		102	%	80 - 120
			Total Selenium (Se)	2017/08/31		108	%	80 - 120
			Total Silver (Ag)	2017/08/31		97	%	80 - 120
			Total Thallium (Tl)	2017/08/31		101	%	80 - 120
			Total Tungsten (W)	2017/08/31		105	%	80 - 120
			Total Uranium (U)	2017/08/31		100	%	80 - 120
			Total Vanadium (V)	2017/08/31		97	%	80 - 120
			Total Zinc (Zn)	2017/08/31		104	%	80 - 120
			Total Zirconium (Zr)	2017/08/31		99	%	80 - 120
5145102	PBA	Spiked Blank	Total Antimony (Sb)	2017/08/31		100	%	80 - 120
			Total Arsenic (As)	2017/08/31		102	%	80 - 120
			Total Beryllium (Be)	2017/08/31		98	%	80 - 120
			Total Boron (B)	2017/08/31		91	%	80 - 120
			Total Cadmium (Cd)	2017/08/31		101	%	80 - 120
			Total Chromium (Cr)	2017/08/31		98	%	80 - 120
			Total Cobalt (Co)	2017/08/31		105	%	80 - 120
			Total Copper (Cu)	2017/08/31		100	%	80 - 120
			Total Iron (Fe)	2017/08/31		103	%	80 - 120
			Total Lead (Pb)	2017/08/31		102	%	80 - 120
			Total Molybdenum (Mo)	2017/08/31		98	%	80 - 120
			Total Nickel (Ni)	2017/08/31		101	%	80 - 120
			Total Selenium (Se)	2017/08/31		107	%	80 - 120
			Total Silver (Ag)	2017/08/31		98	%	80 - 120
			Total Thallium (Tl)	2017/08/31		102	%	80 - 120
			Total Tungsten (W)	2017/08/31		103	%	80 - 120
			Total Uranium (U)	2017/08/31		102	%	80 - 120
			Total Vanadium (V)	2017/08/31		96	%	80 - 120
			Total Zinc (Zn)	2017/08/31		104	%	80 - 120
			Total Zirconium (Zr)	2017/08/31		99	%	80 - 120
5145102	PBA	Method Blank	Total Antimony (Sb)	2017/08/31	ND, RDL=0.50		ug/L	
			Total Arsenic (As)	2017/08/31	ND, RDL=1.0		ug/L	
			Total Beryllium (Be)	2017/08/31	ND, RDL=0.50		ug/L	
			Total Boron (B)	2017/08/31	ND, RDL=10		ug/L	
			Total Cadmium (Cd)	2017/08/31	ND, RDL=0.10		ug/L	
			Total Chromium (Cr)	2017/08/31	ND, RDL=5.0		ug/L	
			Total Cobalt (Co)	2017/08/31	ND, RDL=0.50		ug/L	
			Total Copper (Cu)	2017/08/31	ND, RDL=1.0		ug/L	
			Total Iron (Fe)	2017/08/31	ND, RDL=100		ug/L	
			Total Lead (Pb)	2017/08/31	ND, RDL=0.50		ug/L	

Maxxam Analytics International Corporation o/a Maxxam Analytics 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.maxxam.ca

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Molybdenum (Mo)	2017/08/31	ND, RDL=0.50		ug/L	
			Total Nickel (Ni)	2017/08/31	ND, RDL=1.0		ug/L	
			Total Selenium (Se)	2017/08/31	ND, RDL=2.0		ug/L	
			Total Silver (Ag)	2017/08/31	ND, RDL=0.10		ug/L	
			Total Thallium (Tl)	2017/08/31	ND, RDL=0.050		ug/L	
			Total Tungsten (W)	2017/08/31	ND, RDL=1.0		ug/L	
			Total Uranium (U)	2017/08/31	ND, RDL=0.10		ug/L	
			Total Vanadium (V)	2017/08/31	ND, RDL=0.50		ug/L	
			Total Zinc (Zn)	2017/08/31	ND, RDL=5.0		ug/L	
			Total Zirconium (Zr)	2017/08/31	ND, RDL=1.0		ug/L	
5145102	PBA	RPD [FAQ916-08]	Total Antimony (Sb)	2017/08/31	NC		%	20
			Total Arsenic (As)	2017/08/31	NC		%	20
			Total Beryllium (Be)	2017/08/31	NC		%	20
			Total Boron (B)	2017/08/31	0.23		%	20
			Total Cadmium (Cd)	2017/08/31	NC		%	20
			Total Chromium (Cr)	2017/08/31	NC		%	20
			Total Cobalt (Co)	2017/08/31	NC		%	20
			Total Copper (Cu)	2017/08/31	NC		%	20
			Total Iron (Fe)	2017/08/31	NC		%	20
			Total Lead (Pb)	2017/08/31	NC		%	20
			Total Molybdenum (Mo)	2017/08/31	NC		%	20
			Total Nickel (Ni)	2017/08/31	NC		%	20
			Total Selenium (Se)	2017/08/31	NC		%	20
			Total Silver (Ag)	2017/08/31	NC		%	20
			Total Thallium (Tl)	2017/08/31	NC		%	20
			Total Tungsten (W)	2017/08/31	NC		%	20
			Total Uranium (U)	2017/08/31	5.1		%	20
			Total Vanadium (V)	2017/08/31	NC		%	20
			Total Zinc (Zn)	2017/08/31	NC		%	20
			Total Zirconium (Zr)	2017/08/31	NC		%	20
5145164	RON	Matrix Spike	Mercury (Hg)	2017/09/05		99	%	75 - 125
5145164	RON	Spiked Blank	Mercury (Hg)	2017/09/05		109	%	80 - 120
5145164	RON	Method Blank	Mercury (Hg)	2017/09/05	ND, RDL=0.1		ug/L	
5145164	RON	RPD	Mercury (Hg)	2017/09/05	NC		%	20
5145294	TNG	Matrix Spike [FAQ917-01]	Dissolved (0.2u) Aluminum (Al)	2017/09/05		101	%	80 - 120
5145294	TNG	Spiked Blank	Dissolved (0.2u) Aluminum (Al)	2017/09/01		96	%	80 - 120
5145294	TNG	Method Blank	Dissolved (0.2u) Aluminum (Al)	2017/09/05	ND,RDL=5		ug/L	
5145294	TNG	RPD [FAQ917-01]	Dissolved (0.2u) Aluminum (Al)	2017/09/05	NC		%	20
5145356	XQI	Matrix Spike [FAQ916-07]	WAD Cyanide (Free)	2017/09/01		104	%	80 - 120
5145356	XQI	Spiked Blank	WAD Cyanide (Free)	2017/09/01		101	%	80 - 120
5145356	XQI	Method Blank	WAD Cyanide (Free)	2017/09/01	ND,RDL=1		ug/L	
5145356	XQI	RPD [FAQ916-07]	WAD Cyanide (Free)	2017/09/01	NC		%	20
5145431	NYS	Spiked Blank	Alkalinity (Total as CaCO3)	2017/09/01		95	%	85 - 115

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7I8519
Report Date: 2017/09/07

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
5145431	NYS	Method Blank	Alkalinity (Total as CaCO3)	2017/09/01	ND, RDL=1.0		mg/L	
5145431	NYS	RPD [FAQ920-01]	Alkalinity (Total as CaCO3)	2017/09/01	0.65		%	20
5145435	NYS	Spiked Blank	pH	2017/09/01		102	%	98 - 103
5145435	NYS	RPD [FAQ920-01]	pH	2017/09/01	0.16		%	N/A
5145881	COP	Matrix Spike	Total Ammonia-N	2017/09/01		85	%	80 - 120
5145881	COP	Spiked Blank	Total Ammonia-N	2017/09/01		103	%	85 - 115
5145881	COP	Method Blank	Total Ammonia-N	2017/09/01	ND, RDL=0.050		mg/L	
5145881	COP	RPD	Total Ammonia-N	2017/09/01	0.65		%	20
5147077	TA1	Matrix Spike	Sulphide	2017/09/01		91	%	80 - 120
5147077	TA1	Spiked Blank	Sulphide	2017/09/01		92	%	80 - 120
5147077	TA1	Method Blank	Sulphide	2017/09/01	ND, RDL=0.020		mg/L	
5147077	TA1	RPD	Sulphide	2017/09/01	3.6		%	20
5147108	TA1	Matrix Spike [FAQ920-05]	Sulphide	2017/09/01		92	%	80 - 120
5147108	TA1	Spiked Blank	Sulphide	2017/09/01		92	%	80 - 120
5147108	TA1	Method Blank	Sulphide	2017/09/01	ND, RDL=0.020		mg/L	
5147108	TA1	RPD [FAQ920-05]	Sulphide	2017/09/01	NC		%	20
5148683	PBA	Matrix Spike [FAQ918-01]	Dissolved (0.2u) Aluminum (Al)	2017/09/05		101	%	80 - 120
5148683	PBA	Spiked Blank	Dissolved (0.2u) Aluminum (Al)	2017/09/05		101	%	80 - 120
5148683	PBA	Method Blank	Dissolved (0.2u) Aluminum (Al)	2017/09/05	ND,RDL=5		ug/L	
5148683	PBA	RPD [FAQ918-01]	Dissolved (0.2u) Aluminum (Al)	2017/09/05	20		%	20
5149312	ZSK	Matrix Spike	Phenols-4AAP	2017/09/05		104	%	80 - 120
5149312	ZSK	Spiked Blank	Phenols-4AAP	2017/09/05		103	%	85 - 115
5149312	ZSK	Method Blank	Phenols-4AAP	2017/09/05	ND, RDL=0.0010		mg/L	
5149312	ZSK	RPD	Phenols-4AAP	2017/09/05	NC		%	20
5149581	ZSK	Matrix Spike [FAQ924-03]	Phenols-4AAP	2017/09/05		100	%	80 - 120
5149581	ZSK	Spiked Blank	Phenols-4AAP	2017/09/05		100	%	85 - 115
5149581	ZSK	Method Blank	Phenols-4AAP	2017/09/05	ND, RDL=0.0010		mg/L	
5149581	ZSK	RPD [FAQ924-03]	Phenols-4AAP	2017/09/05	5.1		%	20

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Cristina Carriere

Cristina Carriere, Scientific Service Specialist

Maxxam
A Bureau Veritas Group Company

Your Project #: 10888
Your C.O.C. #: 625117-02-01

Attention:Reporting Group

AEL Environment
1705 Argentia Rd
Unit 3
Mississauga, ON
CANADA L5N 3A9

Report Date: 2017/09/12
Report #: R4695495
Version: 2 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7J0329
Received: 2017/08/31, 16:00

Sample Matrix: Water
Samples Received: 3

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Dissolved Aluminum (0.2 u, clay free)	3	N/A	2017/09/06	CAM SOP-00447	EPA 6020B m
Alkalinity	1	N/A	2017/09/05	CAM SOP-00448	SM 22 2320 B m
Alkalinity	2	N/A	2017/09/06	CAM SOP-00448	SM 22 2320 B m
Chromium (VI) in Water	3	N/A	2017/09/07	CAM SOP-00436	EPA 7199 m
Free (WAD) Cyanide	3	N/A	2017/09/06	CAM SOP-00457	OMOE E3015 m
Dissolved Oxygen	3	2017/09/01	2017/09/01	CAM SOP-00427	SM 22 4500 O G m
Hardness (calculated as CaCO3)	3	N/A	2017/09/06	CAM SOP 00102/00408/00447	SM 2340 B
Mercury	3	2017/09/06	2017/09/07	CAM SOP-00453	EPA 7470A m
Total Metals Analysis by ICPMS	3	N/A	2017/09/06	CAM SOP-00447	EPA 6020B m
Total Ammonia-N	1	N/A	2017/09/06	CAM SOP-00441	EPA GS I-2522-90 m
Total Ammonia-N	2	N/A	2017/09/07	CAM SOP-00441	EPA GS I-2522-90 m
pH	1	N/A	2017/09/05	CAM SOP-00413	SM 4500H+ B m
pH	2	N/A	2017/09/06	CAM SOP-00413	SM 4500H+ B m
Phenols (4AAP)	3	N/A	2017/09/06	CAM SOP-00444	OMOE E3179 m
Field pH (1)	3	N/A	2017/09/01		Field pH Meter
Sulphide	3	N/A	2017/09/02	CAM SOP-00455	SM 22 4500-S G m
Field Temperature (1)	3	N/A	2017/09/01		Field Thermometer
Total Phosphorus (Colourimetric)	3	2017/09/05	2017/09/05	CAM SOP-00407	SM 22 4500 P B H m
Turbidity	3	N/A	2017/09/01	CAM SOP-00417	SM 22 2130 B m
Un-ionized Ammonia	3	2017/09/01	2017/09/12		
Volatile Organic Compounds in Water	3	N/A	2017/09/06	CAM SOP-00226	EPA 8260C m
Non-Routine Volatile Organic Compounds	3	N/A	2017/09/06	CAM SOP-00226	EPA 8260 m

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Your Project #: 10888
Your C.O.C. #: 625117-02-01

Attention:Reporting Group

AEL Environment
1705 Argentia Rd
Unit 3
Mississauga, ON
CANADA L5N 3A9

Report Date: 2017/09/12
Report #: R4695495
Version: 2 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7J0329
Received: 2017/08/31, 16:00
indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) This is a field test, therefore, the results relate to items that were not analysed at Maxxam Analytics Inc.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Antonella Brasil, Senior Project Manager
Email: ABrasil@maxxam.ca
Phone# (905)817-5817
==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J0329
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888

PWQO METALS AND INORGANICS (WATER)

Maxxam ID			FAZ340	FAZ340			FAZ341			
Sampling Date			2017/08/31 07:30	2017/08/31 07:30			2017/08/31 13:10			
COC Number			625117-02-01	625117-02-01			625117-02-01			
	UNITS	Criteria	A0237-SW3	A0237-SW3 Lab-Dup	RDL	QC Batch	A0239-LOCK 1	RDL	MDL	QC Batch
Calculated Parameters										
Hardness (CaCO3)	mg/L	-	180		1.0	5146840	110	1.0	1.0	5146840
Total Un-ionized Ammonia	mg/L	-	0.046		0.0053	5146841	0.014	0.0051	N/A	5146841
Field Measurements										
Field Temperature	Celcius	-	20.57		N/A	ONSITE	21.94	N/A	N/A	ONSITE
Field pH	pH	6.5:8.5	8.36			ONSITE	8.30			ONSITE
Inorganics										
Total Ammonia-N	mg/L	-	0.44		0.050	5148602	0.14	0.050	0.0080	5148225
Dissolved Oxygen	mg/L	-	4.57			5147470	8.44			5147470
pH	pH	6.5:8.5	7.81			5148269	8.04			5148269
Phenols-4AAP	mg/L	0.001	ND	ND	0.0010	5151964	0.0024	0.0010	0.00060	5151964
Total Phosphorus	mg/L	0.01	0.025		0.004	5149317	0.013	0.004	0.002	5149317
Sulphide	mg/L	0.02	ND		0.020	5148084	ND	0.020	0.010	5148084
Turbidity	NTU	-	8.4		0.1	5147493	0.6	0.1	0.1	5147493
WAD Cyanide (Free)	ug/L	5	ND		1	5150275	ND	1	0.4	5150275
Alkalinity (Total as CaCO3)	mg/L	-	160		1.0	5148260	92	1.0	0.20	5148260
Metals										
Dissolved (0.2u) Aluminum (Al)	ug/L	15	ND		5	5150227	7	5	N/A	5150227
Chromium (VI)	ug/L	1	ND		0.50	5152223	ND	0.50	0.30	5152223
Mercury (Hg)	ug/L	0.2	ND		0.1	5151311	ND	0.1	0.02	5151311
Total Antimony (Sb)	ug/L	20	ND		0.50	5149536	ND	0.50	0.30	5149536
Total Arsenic (As)	ug/L	100	ND		1.0	5149536	ND	1.0	0.50	5149536
Total Beryllium (Be)	ug/L	11	ND		0.50	5149536	ND	0.50	0.10	5149536
Total Boron (B)	ug/L	200	20		10	5149536	13	10	0.30	5149536
Total Cadmium (Cd)	ug/L	0.2	ND		0.10	5149536	ND	0.10	0.090	5149536
Total Chromium (Cr)	ug/L	-	ND		5.0	5149536	ND	5.0	5.0	5149536
Total Cobalt (Co)	ug/L	0.9	0.51		0.50	5149536	ND	0.50	0.10	5149536
Total Copper (Cu)	ug/L	5	ND		1.0	5149536	ND	1.0	0.50	5149536
Total Iron (Fe)	ug/L	300	2800		100	5149536	150	100	10	5149536
Total Lead (Pb)	ug/L	5	ND		0.50	5149536	ND	0.50	0.10	5149536
Total Molybdenum (Mo)	ug/L	40	ND		0.50	5149536	ND	0.50	0.20	5149536

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
Criteria: Ontario Provincial Water Quality Objectives
Ref. to MOEE Water Management document dated Feb.1999
N/A = Not Applicable
ND = Not detected

PWQO METALS AND INORGANICS (WATER)

Maxxam ID			FAZ340	FAZ340			FAZ341			
Sampling Date			2017/08/31 07:30	2017/08/31 07:30			2017/08/31 13:10			
COC Number			625117-02-01	625117-02-01			625117-02-01			
	UNITS	**Criteria**	**A0237-SW3**	**A0237-SW3 Lab-Dup**	**RDL**	**QC Batch**	**A0239-LOCK 1**	**RDL**	**MDL**	**QC Batch**
Total Nickel (Ni)	ug/L	25	1.6		1.0	5149536	ND	1.0	0.50	5149536
Total Selenium (Se)	ug/L	100	ND		2.0	5149536	ND	2.0	0.50	5149536
Total Silver (Ag)	ug/L	0.1	ND		0.10	5149536	ND	0.10	0.070	5149536
Total Thallium (Tl)	ug/L	0.3	ND		0.050	5149536	ND	0.050	0.020	5149536
Total Tungsten (W)	ug/L	30	ND		1.0	5149536	ND	1.0	0.50	5149536
Total Uranium (U)	ug/L	5	ND		0.10	5149536	0.11	0.10	0.050	5149536
Total Vanadium (V)	ug/L	6	0.64		0.50	5149536	0.78	0.50	0.40	5149536
Total Zinc (Zn)	ug/L	30	5.5		5.0	5149536	ND	5.0	3.0	5149536
Total Zirconium (Zr)	ug/L	4	ND		1.0	5149536	ND	1.0	0.50	5149536

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

Lab-Dup = Laboratory Initiated Duplicate

Criteria: Ontario Provincial Water Quality Objectives
Ref. to MOEE Water Management document dated Feb.1999

ND = Not detected

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J0329
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888

PWQO METALS AND INORGANICS (WATER)

Maxxam ID			FAZ341		FAZ342			
Sampling Date			2017/08/31 13:10		2017/08/31 13:12			
COC Number			625117-02-01		625117-02-01			
	UNITS	**Criteria**	**A0239-LOCK 1 Lab-Dup**	**QC Batch**	**A0249-LOCK 1**	**RDL**	**MDL**	**QC Batch**
Calculated Parameters								
Hardness (CaCO3)	mg/L	-		5146840	110	1.0	1.0	5146840
Total Un-ionized Ammonia	mg/L	-		5146841	ND	0.0051	N/A	5146841
Field Measurements								
Field Temperature	Celcius	-		ONSITE	21.94	N/A	N/A	ONSITE
Field pH	pH	6.5:8.5		ONSITE	8.30			ONSITE
Inorganics								
Total Ammonia-N	mg/L	-		5148225	ND	0.050	0.0080	5148602
Dissolved Oxygen	mg/L	-	8.45	5147470	8.52			5147470
pH	pH	6.5:8.5		5148269	8.04			5149933
Phenols-4AAP	mg/L	0.001		5151964	0.0021	0.0010	0.00060	5151964
Total Phosphorus	mg/L	0.01		5149317	0.019	0.004	0.002	5149317
Sulphide	mg/L	0.02		5148084	ND	0.020	0.010	5148084
Turbidity	NTU	-		5147493	0.5	0.1	0.1	5147493
WAD Cyanide (Free)	ug/L	5		5150275	ND	1	0.4	5150275
Alkalinity (Total as CaCO3)	mg/L	-		5148260	92	1.0	0.20	5149870
Metals								
Dissolved (0.2u) Aluminum (Al)	ug/L	15		5150227	7	5	N/A	5150227
Chromium (VI)	ug/L	1		5152223	ND	0.50	0.30	5152223
Mercury (Hg)	ug/L	0.2		5151311	ND	0.1	0.02	5151311
Total Antimony (Sb)	ug/L	20		5149536	ND	0.50	0.30	5149536
Total Arsenic (As)	ug/L	100		5149536	ND	1.0	0.50	5149536
Total Beryllium (Be)	ug/L	11		5149536	ND	0.50	0.10	5149536
Total Boron (B)	ug/L	200		5149536	13	10	0.30	5149536
Total Cadmium (Cd)	ug/L	0.2		5149536	ND	0.10	0.090	5149536
Total Chromium (Cr)	ug/L	-		5149536	ND	5.0	5.0	5149536
Total Cobalt (Co)	ug/L	0.9		5149536	ND	0.50	0.10	5149536
Total Copper (Cu)	ug/L	5		5149536	ND	1.0	0.50	5149536
Total Iron (Fe)	ug/L	300		5149536	140	100	10	5149536
Total Lead (Pb)	ug/L	5		5149536	ND	0.50	0.10	5149536
Total Molybdenum (Mo)	ug/L	40		5149536	ND	0.50	0.20	5149536

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
Criteria: Ontario Provincial Water Quality Objectives
Ref. to MOEE Water Management document dated Feb.1999
ND = Not detected
N/A = Not Applicable

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B7J0329
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888

PWQO METALS AND INORGANICS (WATER)

Maxxam ID			FAZ341		FAZ342			
Sampling Date			2017/08/31 13:10		2017/08/31 13:12			
COC Number			625117-02-01		625117-02-01			
	UNITS	**Criteria**	**A0239-LOCK 1 Lab-Dup**	**QC Batch**	**A0249-LOCK 1**	**RDL**	**MDL**	**QC Batch**
Total Nickel (Ni)	ug/L	25		5149536	ND	1.0	0.50	5149536
Total Selenium (Se)	ug/L	100		5149536	ND	2.0	0.50	5149536
Total Silver (Ag)	ug/L	0.1		5149536	ND	0.10	0.070	5149536
Total Thallium (Tl)	ug/L	0.3		5149536	ND	0.050	0.020	5149536
Total Tungsten (W)	ug/L	30		5149536	ND	1.0	0.50	5149536
Total Uranium (U)	ug/L	5		5149536	0.11	0.10	0.050	5149536
Total Vanadium (V)	ug/L	6		5149536	0.88	0.50	0.40	5149536
Total Zinc (Zn)	ug/L	30		5149536	ND	5.0	3.0	5149536
Total Zirconium (Zr)	ug/L	4		5149536	ND	1.0	0.50	5149536

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
Criteria: Ontario Provincial Water Quality Objectives
Ref. to MOEE Water Management document dated Feb.1999
ND = Not detected

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J0329
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888

PWQO VOCS (WATER)

Maxxam ID			FAZ340	FAZ341	FAZ341	FAZ342			
Sampling Date			2017/08/31 07:30	2017/08/31 13:10	2017/08/31 13:10	2017/08/31 13:12			
COC Number			625117-02-01	625117-02-01	625117-02-01	625117-02-01			
	UNITS	**Criteria**	**A0237-SW3**	**A0239-LOCK 1**	**A0239-LOCK 1 Lab-Dup**	**A0249-LOCK 1**	**RDL**	**MDL**	**QC Batch**
Volatile Organics									
Benzene	ug/L	100	ND	ND	ND	ND	0.10	0.020	5148484
Bromodichloromethane	ug/L	200	ND	ND	ND	ND	0.10	0.050	5148484
Acrolein	ug/L	0.03	**ND (1)**	**ND (1)**	**ND (1)**	**ND (1)**	10	N/A	5148486
Bromoform	ug/L	60	ND	ND	ND	ND	0.20	0.10	5148484
Bromomethane	ug/L	0.9	ND	ND	ND	ND	0.50	0.10	5148484
Chlorobenzene	ug/L	15	ND	ND	ND	ND	0.10	0.010	5148484
Chloromethane	ug/L	700	ND	ND	ND	ND	0.50	0.050	5148484
Dibromochloromethane	ug/L	40	ND	ND	ND	ND	0.20	0.050	5148484
1,2-Dichlorobenzene	ug/L	2.5	ND	ND	ND	ND	0.20	0.050	5148484
1,3-Dichlorobenzene	ug/L	2.5	ND	ND	ND	ND	0.20	0.050	5148484
1,4-Dichlorobenzene	ug/L	4	ND	ND	ND	ND	0.20	0.050	5148484
1,1-Dichloroethane	ug/L	200	ND	ND	ND	ND	0.10	0.050	5148484
1,2-Dichloroethane	ug/L	100	ND	ND	ND	ND	0.20	0.050	5148484
1,1-Dichloroethylene	ug/L	40	ND	ND	ND	ND	0.10	0.050	5148484
cis-1,2-Dichloroethylene	ug/L	200	ND	ND	ND	ND	0.10	0.050	5148484
trans-1,2-Dichloroethylene	ug/L	200	ND	ND	ND	ND	0.10	0.050	5148484
1,2-Dichloropropane	ug/L	0.7	ND	ND	ND	ND	0.10	0.050	5148484
trans-1,3-Dichloropropene	ug/L	7	ND	ND	ND	ND	0.20	0.050	5148484
Ethylbenzene	ug/L	8	ND	ND	ND	ND	0.10	0.010	5148484
Ethylene Dibromide	ug/L	5	ND	ND	ND	ND	0.20	0.050	5148484
Methylene Chloride(Dichloromethane)	ug/L	100	ND	ND	ND	ND	0.50	0.10	5148484
Methyl Ethyl Ketone (2-Butanone)	ug/L	400	ND	ND	ND	ND	5.0	0.50	5148484
Methyl t-butyl ether (MTBE)	ug/L	200	ND	ND	ND	ND	0.20	0.050	5148484
Styrene	ug/L	4	ND	ND	ND	ND	0.20	0.050	5148484
1,1,1,2-Tetrachloroethane	ug/L	20	ND	ND	ND	ND	0.20	0.050	5148484
1,1,2,2-Tetrachloroethane	ug/L	70	ND	ND	ND	ND	0.20	0.050	5148484
Tetrachloroethylene	ug/L	50	ND	ND	ND	ND	0.10	0.050	5148484
Toluene	ug/L	0.8	0.30	ND	ND	ND	0.20	0.010	5148484
1,1,1-Trichloroethane	ug/L	10	ND	ND	ND	ND	0.10	0.050	5148484

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

Lab-Dup = Laboratory Initiated Duplicate

Criteria: Ontario Provincial Water Quality Objectives
Ref. to MOEE Water Management document dated Feb.1999

ND = Not detected

N/A = Not Applicable

(1) RDL exceeds criteria

PWQO VOCS (WATER)

Maxxam ID			FAZ340	FAZ341	FAZ341	FAZ342			
Sampling Date			2017/08/31 07:30	2017/08/31 13:10	2017/08/31 13:10	2017/08/31 13:12			
COC Number			625117-02-01	625117-02-01	625117-02-01	625117-02-01			
	UNITS	**Criteria**	**A0237-SW3**	**A0239-LOCK 1**	**A0239-LOCK 1 Lab-Dup**	**A0249-LOCK 1**	**RDL**	**MDL**	**QC Batch**
1,1,2-Trichloroethane	ug/L	800	ND	ND	ND	ND	0.20	0.050	5148484
Trichloroethylene	ug/L	20	ND	ND	ND	ND	0.10	0.050	5148484
Vinyl Chloride	ug/L	600	ND	ND	ND	ND	0.20	0.050	5148484
p+m-Xylene	ug/L	-	ND	ND	ND	ND	0.10	0.010	5148484
o-Xylene	ug/L	40	ND	ND	ND	ND	0.10	0.010	5148484
Surrogate Recovery (%)									
4-Bromofluorobenzene	%	-	98	99	99	100			5148484
D4-1,2-Dichloroethane	%	-	102	104	105	104			5148484
D8-Toluene	%	-	98	97	98	97			5148484

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
Criteria: Ontario Provincial Water Quality Objectives
Ref. to MOEE Water Management document dated Feb.1999
ND = Not detected

TEST SUMMARY

Maxxam ID: FAZ340
Sample ID: A0237-SW3
Matrix: Water

Collected: 2017/08/31
Shipped:
Received: 2017/08/31

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5150227	N/A	2017/09/06	Arefa Dabhad
Alkalinity	AT	5148260	N/A	2017/09/06	Yogesh Patel
Chromium (VI) in Water	IC	5152223	N/A	2017/09/07	Lang Le
Free (WAD) Cyanide	SKAL/CN	5150275	N/A	2017/09/06	Louise Harding
Dissolved Oxygen	DO	5147470	2017/09/01	2017/09/01	Prakash Piya
Hardness (calculated as CaCO3)		5146840	N/A	2017/09/06	Automated Statchk
Mercury	CV/AA	5151311	2017/09/06	2017/09/07	Ron Morrison
Total Metals Analysis by ICPMS	ICP/MS	5149536	N/A	2017/09/06	Arefa Dabhad
Total Ammonia-N	LACH/NH4	5148602	N/A	2017/09/07	Charles Opoku-Ware
pH	AT	5148269	N/A	2017/09/06	Yogesh Patel
Phenols (4AAP)	TECH/PHEN	5151964	N/A	2017/09/06	Zahid Soikot
Field pH	PH	ONSITE	N/A	2017/08/31	Antonella Brasil
Sulphide	ISE/S	5148084	N/A	2017/09/02	Tahir Anwar
Field pH	PH	ONSITE	N/A	2017/08/31	Antonella Brasil
Total Phosphorus (Colourimetric)	LACH/P	5149317	2017/09/05	2017/09/05	Amanpreet Sappal
Turbidity	AT	5147493	N/A	2017/09/01	Neil Dassanayake
Un-ionized Ammonia	CALC/NH3	5146841	2017/09/12	2017/09/12	Automated Statchk
Volatile Organic Compounds in Water	P&T/MS	5148484	N/A	2017/09/06	Juan Pangilinan
Non-Routine Volatile Organic Compounds	P&T/MS	5148486	N/A	2017/09/06	Juan Pangilinan

Maxxam ID: FAZ340 Dup
Sample ID: A0237-SW3
Matrix: Water

Collected: 2017/08/31
Shipped:
Received: 2017/08/31

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Phenols (4AAP)	TECH/PHEN	5151964	N/A	2017/09/06	Zahid Soikot

Maxxam ID: FAZ341
Sample ID: A0239-LOCK 1
Matrix: Water

Collected: 2017/08/31
Shipped:
Received: 2017/08/31

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5150227	N/A	2017/09/06	Arefa Dabhad
Alkalinity	AT	5148260	N/A	2017/09/06	Yogesh Patel
Chromium (VI) in Water	IC	5152223	N/A	2017/09/07	Lang Le
Free (WAD) Cyanide	SKAL/CN	5150275	N/A	2017/09/06	Louise Harding
Dissolved Oxygen	DO	5147470	2017/09/01	2017/09/01	Prakash Piya
Hardness (calculated as CaCO3)		5146840	N/A	2017/09/06	Automated Statchk
Mercury	CV/AA	5151311	2017/09/06	2017/09/07	Ron Morrison
Total Metals Analysis by ICPMS	ICP/MS	5149536	N/A	2017/09/06	Arefa Dabhad
Total Ammonia-N	LACH/NH4	5148225	N/A	2017/09/06	Charles Opoku-Ware
pH	AT	5148269	N/A	2017/09/06	Yogesh Patel
Phenols (4AAP)	TECH/PHEN	5151964	N/A	2017/09/06	Zahid Soikot
Field pH	PH	ONSITE	N/A	2017/08/31	Antonella Brasil
Sulphide	ISE/S	5148084	N/A	2017/09/02	Tahir Anwar
Field pH	PH	ONSITE	N/A	2017/08/31	Antonella Brasil

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B7J0329
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888

TEST SUMMARY

Maxxam ID: FAZ341
Sample ID: A0239-LOCK 1
Matrix: Water

Collected: 2017/08/31
Shipped:
Received: 2017/08/31

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Total Phosphorus (Colourimetric)	LACH/P	5149317	2017/09/05	2017/09/05	Amanpreet Sappal
Turbidity	AT	5147493	N/A	2017/09/01	Neil Dassanayake
Un-ionized Ammonia	CALC/NH3	5146841	2017/09/12	2017/09/12	Automated Statchk
Volatile Organic Compounds in Water	P&T/MS	5148484	N/A	2017/09/06	Juan Pangilinan
Non-Routine Volatile Organic Compounds	P&T/MS	5148486	N/A	2017/09/06	Juan Pangilinan

Maxxam ID: FAZ341 Dup
Sample ID: A0239-LOCK 1
Matrix: Water

Collected: 2017/08/31
Shipped:
Received: 2017/08/31

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Oxygen	DO	5147470	2017/09/01	2017/09/01	Prakash Piya
Volatile Organic Compounds in Water	P&T/MS	5148484	N/A	2017/09/06	Juan Pangilinan
Non-Routine Volatile Organic Compounds	P&T/MS	5148486	N/A	2017/09/06	Juan Pangilinan

Maxxam ID: FAZ342
Sample ID: A0249-LOCK 1
Matrix: Water

Collected: 2017/08/31
Shipped:
Received: 2017/08/31

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	5150227	N/A	2017/09/06	Arefa Dabhad
Alkalinity	AT	5149870	N/A	2017/09/05	Yogesh Patel
Chromium (VI) in Water	IC	5152223	N/A	2017/09/07	Lang Le
Free (WAD) Cyanide	SKAL/CN	5150275	N/A	2017/09/06	Louise Harding
Dissolved Oxygen	DO	5147470	2017/09/01	2017/09/01	Prakash Piya
Hardness (calculated as CaCO3)		5146840	N/A	2017/09/06	Automated Statchk
Mercury	CV/AA	5151311	2017/09/06	2017/09/07	Ron Morrison
Total Metals Analysis by ICPMS	ICP/MS	5149536	N/A	2017/09/06	Arefa Dabhad
Total Ammonia-N	LACH/NH4	5148602	N/A	2017/09/07	Charles Opoku-Ware
pH	AT	5149933	N/A	2017/09/05	Yogesh Patel
Phenols (4AAP)	TECH/PHEN	5151964	N/A	2017/09/06	Zahid Soikot
Field pH	PH	ONSITE	N/A	2017/08/31	Automated Statchk
Sulphide	ISE/S	5148084	N/A	2017/09/02	Tahir Anwar
Field pH	PH	ONSITE	N/A	2017/08/31	Automated Statchk
Total Phosphorus (Colourimetric)	LACH/P	5149317	2017/09/05	2017/09/05	Amanpreet Sappal
Turbidity	AT	5147493	N/A	2017/09/01	Neil Dassanayake
Un-ionized Ammonia	CALC/NH3	5146841	2017/09/12	2017/09/12	Automated Statchk
Volatile Organic Compounds in Water	P&T/MS	5148484	N/A	2017/09/06	Juan Pangilinan
Non-Routine Volatile Organic Compounds	P&T/MS	5148486	N/A	2017/09/06	Juan Pangilinan

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	7.0°C

Custody Seal Present but not Intact

Results relate only to the items tested.

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J0329
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
5147493	NYS	Spiked Blank	Turbidity	2017/09/01		100	%	85 - 115
5147493	NYS	Method Blank	Turbidity	2017/09/01	ND, RDL=0.1		NTU	
5147493	NYS	RPD	Turbidity	2017/09/01	2.2		%	20
5148084	TA1	Matrix Spike	Sulphide	2017/09/01		86	%	80 - 120
5148084	TA1	Spiked Blank	Sulphide	2017/09/01		96	%	80 - 120
5148084	TA1	Method Blank	Sulphide	2017/09/01	ND, RDL=0.020		mg/L	
5148084	TA1	RPD	Sulphide	2017/09/01	NC		%	20
5148225	COP	Matrix Spike	Total Ammonia-N	2017/09/06		98	%	80 - 120
5148225	COP	Spiked Blank	Total Ammonia-N	2017/09/06		97	%	85 - 115
5148225	COP	Method Blank	Total Ammonia-N	2017/09/06	ND, RDL=0.050		mg/L	
5148225	COP	RPD	Total Ammonia-N	2017/09/06	0.89		%	20
5148260	YPA	Spiked Blank	Alkalinity (Total as CaCO3)	2017/09/06		95	%	85 - 115
5148260	YPA	Method Blank	Alkalinity (Total as CaCO3)	2017/09/06	ND, RDL=1.0		mg/L	
5148260	YPA	RPD	Alkalinity (Total as CaCO3)	2017/09/06	1.2		%	20
5148269	YPA	Spiked Blank	pH	2017/09/06		101	%	98 - 103
5148269	YPA	RPD	pH	2017/09/06	0.26		%	N/A
5148484	JPN	Matrix Spike [FAZ340-10]	4-Bromofluorobenzene	2017/09/06		100	%	70 - 130
			D4-1,2-Dichloroethane	2017/09/06		98	%	70 - 130
			D8-Toluene	2017/09/06		100	%	70 - 130
			Benzene	2017/09/06		103	%	70 - 130
			Bromodichloromethane	2017/09/06		102	%	70 - 130
			Bromoform	2017/09/06		117	%	70 - 130
			Bromomethane	2017/09/06		82	%	60 - 140
			Chlorobenzene	2017/09/06		102	%	70 - 130
			Chloromethane	2017/09/06		91	%	60 - 140
			Dibromochloromethane	2017/09/06		112	%	70 - 130
			1,2-Dichlorobenzene	2017/09/06		101	%	70 - 130
			1,3-Dichlorobenzene	2017/09/06		107	%	70 - 130
			1,4-Dichlorobenzene	2017/09/06		107	%	70 - 130
			1,1-Dichloroethane	2017/09/06		101	%	70 - 130
			1,2-Dichloroethane	2017/09/06		101	%	70 - 130
			1,1-Dichloroethylene	2017/09/06		105	%	70 - 130
			cis-1,2-Dichloroethylene	2017/09/06		99	%	70 - 130
			trans-1,2-Dichloroethylene	2017/09/06		102	%	70 - 130
			1,2-Dichloropropane	2017/09/06		97	%	70 - 130
			trans-1,3-Dichloropropene	2017/09/06		111	%	70 - 130
			Ethylbenzene	2017/09/06		102	%	70 - 130
			Ethylene Dibromide	2017/09/06		109	%	70 - 130
			Methylene Chloride(Dichloromethane)	2017/09/06		91	%	70 - 130
			Methyl Ethyl Ketone (2-Butanone)	2017/09/06		96	%	60 - 140
			Methyl t-butyl ether (MTBE)	2017/09/06		97	%	70 - 130
			Styrene	2017/09/06		107	%	70 - 130
			1,1,1,2-Tetrachloroethane	2017/09/06		114	%	70 - 130
			1,1,2,2-Tetrachloroethane	2017/09/06		106	%	70 - 130
			Tetrachloroethylene	2017/09/06		96	%	70 - 130
			Toluene	2017/09/06		98	%	70 - 130
			1,1,1-Trichloroethane	2017/09/06		99	%	70 - 130
			1,1,2-Trichloroethane	2017/09/06		102	%	70 - 130
			Trichloroethylene	2017/09/06		100	%	70 - 130
			Vinyl Chloride	2017/09/06		92	%	70 - 130
			p+m-Xylene	2017/09/06		108	%	70 - 130

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			o-Xylene	2017/09/06		105	%	70 - 130
5148484	JPN	Spiked Blank	4-Bromofluorobenzene	2017/09/06		101	%	70 - 130
			D4-1,2-Dichloroethane	2017/09/06		101	%	70 - 130
			D8-Toluene	2017/09/06		99	%	70 - 130
			Benzene	2017/09/06		106	%	70 - 130
			Bromodichloromethane	2017/09/06		107	%	70 - 130
			Bromoform	2017/09/06		122	%	70 - 130
			Bromomethane	2017/09/06		79	%	60 - 140
			Chlorobenzene	2017/09/06		103	%	70 - 130
			Chloromethane	2017/09/06		95	%	60 - 140
			Dibromochloromethane	2017/09/06		117	%	70 - 130
			1,2-Dichlorobenzene	2017/09/06		104	%	70 - 130
			1,3-Dichlorobenzene	2017/09/06		108	%	70 - 130
			1,4-Dichlorobenzene	2017/09/06		108	%	70 - 130
			1,1-Dichloroethane	2017/09/06		104	%	70 - 130
			1,2-Dichloroethane	2017/09/06		105	%	70 - 130
			1,1-Dichloroethylene	2017/09/06		108	%	70 - 130
			cis-1,2-Dichloroethylene	2017/09/06		101	%	70 - 130
			trans-1,2-Dichloroethylene	2017/09/06		103	%	70 - 130
			1,2-Dichloropropane	2017/09/06		100	%	70 - 130
			trans-1,3-Dichloropropene	2017/09/06		116	%	70 - 130
			Ethylbenzene	2017/09/06		105	%	70 - 130
			Ethylene Dibromide	2017/09/06		114	%	70 - 130
			Methylene Chloride(Dichloromethane)	2017/09/06		94	%	70 - 130
			Methyl Ethyl Ketone (2-Butanone)	2017/09/06		102	%	60 - 140
			Methyl t-butyl ether (MTBE)	2017/09/06		103	%	70 - 130
			Styrene	2017/09/06		110	%	70 - 130
			1,1,1,2-Tetrachloroethane	2017/09/06		117	%	70 - 130
			1,1,2,2-Tetrachloroethane	2017/09/06		112	%	70 - 130
			Tetrachloroethylene	2017/09/06		99	%	70 - 130
			Toluene	2017/09/06		101	%	70 - 130
			1,1,1-Trichloroethane	2017/09/06		102	%	70 - 130
			1,1,2-Trichloroethane	2017/09/06		106	%	70 - 130
			Trichloroethylene	2017/09/06		102	%	70 - 130
			Vinyl Chloride	2017/09/06		94	%	70 - 130
			p+m-Xylene	2017/09/06		111	%	70 - 130
			o-Xylene	2017/09/06		109	%	70 - 130
5148484	JPN	Method Blank	4-Bromofluorobenzene	2017/09/06		98	%	70 - 130
			D4-1,2-Dichloroethane	2017/09/06		99	%	70 - 130
			D8-Toluene	2017/09/06		99	%	70 - 130
			Benzene	2017/09/06	ND, RDL=0.10		ug/L	
			Bromodichloromethane	2017/09/06	ND, RDL=0.10		ug/L	
			Bromoform	2017/09/06	ND, RDL=0.20		ug/L	
			Bromomethane	2017/09/06	ND, RDL=0.50		ug/L	
			Chlorobenzene	2017/09/06	ND, RDL=0.10		ug/L	
			Chloromethane	2017/09/06	ND, RDL=0.50		ug/L	
			Dibromochloromethane	2017/09/06	ND, RDL=0.20		ug/L	

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			1,2-Dichlorobenzene	2017/09/06	ND, RDL=0.20		ug/L	
			1,3-Dichlorobenzene	2017/09/06	ND, RDL=0.20		ug/L	
			1,4-Dichlorobenzene	2017/09/06	ND, RDL=0.20		ug/L	
			1,1-Dichloroethane	2017/09/06	ND, RDL=0.10		ug/L	
			1,2-Dichloroethane	2017/09/06	ND, RDL=0.20		ug/L	
			1,1-Dichloroethylene	2017/09/06	ND, RDL=0.10		ug/L	
			cis-1,2-Dichloroethylene	2017/09/06	ND, RDL=0.10		ug/L	
			trans-1,2-Dichloroethylene	2017/09/06	ND, RDL=0.10		ug/L	
			1,2-Dichloropropane	2017/09/06	ND, RDL=0.10		ug/L	
			trans-1,3-Dichloropropene	2017/09/06	ND, RDL=0.20		ug/L	
			Ethylbenzene	2017/09/06	ND, RDL=0.10		ug/L	
			Ethylene Dibromide	2017/09/06	ND, RDL=0.20		ug/L	
			Methylene Chloride(Dichloromethane)	2017/09/06	ND, RDL=0.50		ug/L	
			Methyl Ethyl Ketone (2-Butanone)	2017/09/06	ND, RDL=5.0		ug/L	
			Methyl t-butyl ether (MTBE)	2017/09/06	ND, RDL=0.20		ug/L	
			Styrene	2017/09/06	ND, RDL=0.20		ug/L	
			1,1,1,2-Tetrachloroethane	2017/09/06	ND, RDL=0.20		ug/L	
			1,1,2,2-Tetrachloroethane	2017/09/06	ND, RDL=0.20		ug/L	
			Tetrachloroethylene	2017/09/06	ND, RDL=0.10		ug/L	
			Toluene	2017/09/06	ND, RDL=0.20		ug/L	
			1,1,1-Trichloroethane	2017/09/06	ND, RDL=0.10		ug/L	
			1,1,2-Trichloroethane	2017/09/06	ND, RDL=0.20		ug/L	
			Trichloroethylene	2017/09/06	ND, RDL=0.10		ug/L	
			Vinyl Chloride	2017/09/06	ND, RDL=0.20		ug/L	
			p+m-Xylene	2017/09/06	ND, RDL=0.10		ug/L	
			o-Xylene	2017/09/06	ND, RDL=0.10		ug/L	
5148484	JPN	RPD [FAZ341-10]	Benzene	2017/09/06	NC		%	30
			Bromodichloromethane	2017/09/06	NC		%	30
			Bromoform	2017/09/06	NC		%	30

Maxxam
A Bureau Veritas Group Company

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Bromomethane	2017/09/06	NC		%	30
			Chlorobenzene	2017/09/06	NC		%	30
			Chloromethane	2017/09/06	NC		%	30
			Dibromochloromethane	2017/09/06	NC		%	30
			1,2-Dichlorobenzene	2017/09/06	NC		%	30
			1,3-Dichlorobenzene	2017/09/06	NC		%	30
			1,4-Dichlorobenzene	2017/09/06	NC		%	30
			1,1-Dichloroethane	2017/09/06	NC		%	30
			1,2-Dichloroethane	2017/09/06	NC		%	30
			1,1-Dichloroethylene	2017/09/06	NC		%	30
			cis-1,2-Dichloroethylene	2017/09/06	NC		%	30
			trans-1,2-Dichloroethylene	2017/09/06	NC		%	30
			1,2-Dichloropropane	2017/09/06	NC		%	30
			trans-1,3-Dichloropropene	2017/09/06	NC		%	30
			Ethylbenzene	2017/09/06	NC		%	30
			Ethylene Dibromide	2017/09/06	NC		%	30
			Methylene Chloride(Dichloromethane)	2017/09/06	NC		%	30
			Methyl Ethyl Ketone (2-Butanone)	2017/09/06	NC		%	30
			Methyl t-butyl ether (MTBE)	2017/09/06	NC		%	30
			Styrene	2017/09/06	NC		%	30
			1,1,1,2-Tetrachloroethane	2017/09/06	NC		%	30
			1,1,2,2-Tetrachloroethane	2017/09/06	NC		%	30
			Tetrachloroethylene	2017/09/06	NC		%	30
			Toluene	2017/09/06	NC		%	30
			1,1,1-Trichloroethane	2017/09/06	NC		%	30
			1,1,2-Trichloroethane	2017/09/06	NC		%	30
			Trichloroethylene	2017/09/06	NC		%	30
			Vinyl Chloride	2017/09/06	NC		%	30
			p+m-Xylene	2017/09/06	NC		%	30
			o-Xylene	2017/09/06	NC		%	30
5148486	JPN	Matrix Spike [FAZ340-10]	Acrolein	2017/09/06		91	%	60 - 140
5148486	JPN	Spiked Blank	Acrolein	2017/09/06		96	%	60 - 140
5148486	JPN	Method Blank	Acrolein	2017/09/06	ND, RDL=10		ug/L	
5148486	JPN	RPD [FAZ341-10]	Acrolein	2017/09/06	NC		%	30
5148602	COP	Matrix Spike	Total Ammonia-N	2017/09/07		100	%	80 - 120
5148602	COP	Spiked Blank	Total Ammonia-N	2017/09/07		99	%	85 - 115
5148602	COP	Method Blank	Total Ammonia-N	2017/09/07	ND, RDL=0.050		mg/L	
5148602	COP	RPD	Total Ammonia-N	2017/09/07	NC		%	20
5149317	ASP	Matrix Spike	Total Phosphorus	2017/09/05		97	%	80 - 120
5149317	ASP	QC Standard	Total Phosphorus	2017/09/05		93	%	80 - 120
5149317	ASP	Spiked Blank	Total Phosphorus	2017/09/05		96	%	80 - 120
5149317	ASP	Method Blank	Total Phosphorus	2017/09/05	ND, RDL=0.004		mg/L	
5149317	ASP	RPD	Total Phosphorus	2017/09/05	NC		%	20
5149536	ADA	Matrix Spike	Total Antimony (Sb)	2017/09/07		103	%	80 - 120
			Total Arsenic (As)	2017/09/07		102	%	80 - 120
			Total Beryllium (Be)	2017/09/07		99	%	80 - 120
			Total Boron (B)	2017/09/07		NC	%	80 - 120
			Total Cadmium (Cd)	2017/09/07		99	%	80 - 120
			Total Chromium (Cr)	2017/09/07		100	%	80 - 120
			Total Cobalt (Co)	2017/09/07		99	%	80 - 120
			Total Copper (Cu)	2017/09/07		99	%	80 - 120
			Total Iron (Fe)	2017/09/07		100	%	80 - 120

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J0329
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Lead (Pb)	2017/09/07		98	%	80 - 120
			Total Molybdenum (Mo)	2017/09/07		106	%	80 - 120
			Total Nickel (Ni)	2017/09/07		97	%	80 - 120
			Total Selenium (Se)	2017/09/07		106	%	80 - 120
			Total Silver (Ag)	2017/09/07		96	%	80 - 120
			Total Thallium (Tl)	2017/09/07		95	%	80 - 120
			Total Tungsten (W)	2017/09/07		103	%	80 - 120
			Total Uranium (U)	2017/09/07		100	%	80 - 120
			Total Vanadium (V)	2017/09/07		101	%	80 - 120
			Total Zinc (Zn)	2017/09/07		100	%	80 - 120
			Total Zirconium (Zr)	2017/09/07		105	%	80 - 120
5149536	ADA	Spiked Blank	Total Antimony (Sb)	2017/09/06		103	%	80 - 120
			Total Arsenic (As)	2017/09/06		101	%	80 - 120
			Total Beryllium (Be)	2017/09/06		102	%	80 - 120
			Total Boron (B)	2017/09/06		98	%	80 - 120
			Total Cadmium (Cd)	2017/09/06		101	%	80 - 120
			Total Chromium (Cr)	2017/09/06		100	%	80 - 120
			Total Cobalt (Co)	2017/09/06		100	%	80 - 120
			Total Copper (Cu)	2017/09/06		103	%	80 - 120
			Total Iron (Fe)	2017/09/06		100	%	80 - 120
			Total Lead (Pb)	2017/09/06		99	%	80 - 120
			Total Molybdenum (Mo)	2017/09/06		106	%	80 - 120
			Total Nickel (Ni)	2017/09/06		101	%	80 - 120
			Total Selenium (Se)	2017/09/06		105	%	80 - 120
			Total Silver (Ag)	2017/09/06		100	%	80 - 120
			Total Thallium (Tl)	2017/09/06		95	%	80 - 120
			Total Tungsten (W)	2017/09/06		101	%	80 - 120
			Total Uranium (U)	2017/09/06		99	%	80 - 120
			Total Vanadium (V)	2017/09/06		100	%	80 - 120
			Total Zinc (Zn)	2017/09/06		102	%	80 - 120
			Total Zirconium (Zr)	2017/09/06		105	%	80 - 120
5149536	ADA	Method Blank	Total Antimony (Sb)	2017/09/06	ND, RDL=0.50		ug/L	
			Total Arsenic (As)	2017/09/06	ND, RDL=1.0		ug/L	
			Total Beryllium (Be)	2017/09/06	ND, RDL=0.50		ug/L	
			Total Boron (B)	2017/09/06	ND, RDL=10		ug/L	
			Total Cadmium (Cd)	2017/09/06	ND, RDL=0.10		ug/L	
			Total Chromium (Cr)	2017/09/06	ND, RDL=5.0		ug/L	
			Total Cobalt (Co)	2017/09/06	ND, RDL=0.50		ug/L	
			Total Copper (Cu)	2017/09/06	ND, RDL=1.0		ug/L	
			Total Iron (Fe)	2017/09/06	ND, RDL=100		ug/L	
			Total Lead (Pb)	2017/09/06	ND, RDL=0.50		ug/L	
			Total Molybdenum (Mo)	2017/09/06	ND, RDL=0.50		ug/L	
			Total Nickel (Ni)	2017/09/06	ND, RDL=1.0		ug/L	

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B7J0329
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Selenium (Se)	2017/09/06	ND, RDL=2.0		ug/L	
			Total Silver (Ag)	2017/09/06	ND, RDL=0.10		ug/L	
			Total Thallium (Tl)	2017/09/06	ND, RDL=0.050		ug/L	
			Total Tungsten (W)	2017/09/06	ND, RDL=1.0		ug/L	
			Total Uranium (U)	2017/09/06	ND, RDL=0.10		ug/L	
			Total Vanadium (V)	2017/09/06	ND, RDL=0.50		ug/L	
			Total Zinc (Zn)	2017/09/06	ND, RDL=5.0		ug/L	
			Total Zirconium (Zr)	2017/09/06	ND, RDL=1.0		ug/L	
5149536	ADA	RPD	Total Antimony (Sb)	2017/09/06	2.0		%	20
			Total Arsenic (As)	2017/09/06	0.19		%	20
			Total Cadmium (Cd)	2017/09/06	NC		%	20
			Total Chromium (Cr)	2017/09/06	NC		%	20
			Total Cobalt (Co)	2017/09/06	0.59		%	20
			Total Copper (Cu)	2017/09/06	NC		%	20
			Total Iron (Fe)	2017/09/06	0.86		%	20
			Total Lead (Pb)	2017/09/06	NC		%	20
			Total Molybdenum (Mo)	2017/09/06	0.088		%	20
			Total Nickel (Ni)	2017/09/06	13		%	20
			Total Selenium (Se)	2017/09/06	NC		%	20
			Total Silver (Ag)	2017/09/06	NC		%	20
			Total Zinc (Zn)	2017/09/06	NC		%	20
5149870	YPA	Spiked Blank	Alkalinity (Total as CaCO3)	2017/09/05		95	%	85 - 115
5149870	YPA	Method Blank	Alkalinity (Total as CaCO3)	2017/09/05	ND, RDL=1.0		mg/L	
5149870	YPA	RPD	Alkalinity (Total as CaCO3)	2017/09/05	1.3		%	20
5149933	YPA	Spiked Blank	pH	2017/09/05		102	%	98 - 103
5149933	YPA	RPD	pH	2017/09/05	0.62		%	N/A
5150227	ADA	Matrix Spike	Dissolved (0.2u) Aluminum (Al)	2017/09/06		113	%	80 - 120
5150227	ADA	Spiked Blank	Dissolved (0.2u) Aluminum (Al)	2017/09/06		104	%	80 - 120
5150227	ADA	Method Blank	Dissolved (0.2u) Aluminum (Al)	2017/09/06	ND,RDL=5		ug/L	
5150227	ADA	RPD	Dissolved (0.2u) Aluminum (Al)	2017/09/06	6.1		%	20
5150275	LHA	Matrix Spike	WAD Cyanide (Free)	2017/09/06		95	%	80 - 120
5150275	LHA	Spiked Blank	WAD Cyanide (Free)	2017/09/06		95	%	80 - 120
5150275	LHA	Method Blank	WAD Cyanide (Free)	2017/09/06	ND,RDL=1		ug/L	
5150275	LHA	RPD	WAD Cyanide (Free)	2017/09/06	NC		%	20
5151311	RON	Matrix Spike	Mercury (Hg)	2017/09/07		105	%	75 - 125
5151311	RON	Spiked Blank	Mercury (Hg)	2017/09/07		96	%	80 - 120
5151311	RON	Method Blank	Mercury (Hg)	2017/09/07	ND, RDL=0.1		ug/L	
5151311	RON	RPD	Mercury (Hg)	2017/09/07	NC		%	20
5151964	ZSK	Matrix Spike [FAZ340-09]	Phenols-4AAP	2017/09/06		97	%	80 - 120
5151964	ZSK	Spiked Blank	Phenols-4AAP	2017/09/06		97	%	85 - 115
5151964	ZSK	Method Blank	Phenols-4AAP	2017/09/06	ND, RDL=0.0010		mg/L	
5151964	ZSK	RPD [FAZ340-09]	Phenols-4AAP	2017/09/06	NC		%	20
5152223	LLE	Matrix Spike	Chromium (VI)	2017/09/07		93	%	80 - 120
5152223	LLE	Spiked Blank	Chromium (VI)	2017/09/07		102	%	80 - 120

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B7J0329
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
5152223	LLE	Method Blank	Chromium (VI)	2017/09/07	ND, RDL=0.50		ug/L	
5152223	LLE	RPD	Chromium (VI)	2017/09/07	NC		%	20

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B7J0329
Report Date: 2017/09/12

AEL Environment
Client Project #: 10888

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Cristina Carriere

Cristina Carriere, Scientific Service Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

1705 Argentia Road, Unit 3 | Mississauga, Ontario, L5N 3A9
Tel/Fax: 416-657-2367| Toll free: 1-800-267-4797
info@aelenv.com | www.aelenv.com

APPENDIX 4
Benthic Invertebrate Assessment

Old Sly Locks: Rideau River Benthic Invertebrate Assessment

Report prepared for:

AEL Environment
1705 Argentia Road, Unit 3
Mississauga, ON
L5N 3A9

Report prepared by:

ECOMETRIX INCORPORATED
6800 Campobello Road
Mississauga, Ontario
L5N 2L8

Ref : 17-2409
Date: January 2018.

Old Sly Locks: Rideau River Benthic Invertebrate Assessment

Michael White

Mike White, Ph.D.
EcoMetrix Incorporated
Aquatic Scientist

Brian Fraser

Brian Fraser, M.Sc.
EcoMetrix Incorporated
Senior Aquatic Ecologist, Reviewer

EXECUTIVE SUMMARY

Old Sly Locks is located in Smiths Falls, Ontario, and is part of the Rideau Canal system that connects the St. Lawrence River with the Ottawa River. The area adjacent to the lock is a former landfill site and has been monitored since 1994 due to concern that leachate associated with the waste from the landfill may be draining into the aquatic environment.

A benthic invertebrate survey was conducted to evaluate the possible influence of the historic landfill on the benthic invertebrate community. A total of five stations were sampled: one 'least-impacted' upstream lentic station; two canal exposed stations; and, two lotic exposed stations.

Comparison of the exposed lotic stations to a CABIN reference model was not possible as no suitable model existed. Evaluation of biotic endpoints indicated that the benthic invertebrate community at one of the lotic exposed stations may experience anthropogenic impacts as it had very low composition of EPT (Ephemeroptera + Plecoptera + Trichoptera) taxa and a Hilsenhoff BI (Biotic Index) value that indicates 'fairly poor' water quality. The cause of the impact to the benthic invertebrate community may not be due to the historic landfill as many anthropogenic disturbances likely affect this area. No biotic endpoints suggested the benthic community at the second lotic exposed station had appreciable anthropogenic impacts.

Richness and abundance was as high, or higher, at the canal exposed stations than at the upstream 'least-impacted' lentic station. Diversity measures and FFG's (Functional Feeding Groups) were also similar between the upstream station and both canal stations. The community structure at the upstream station was different than that of the two canal stations but such a difference is expected as the upstream station is truly lentic, whereas the canal stations would experience flow in the summer months during canal operation. Hilsenhoff BI values indicated that the upstream lentic station and the canal stations have benthic invertebrate communities that are representative of 'good' to 'fair' water quality conditions.

Based on the evaluation of the biotic endpoints presented in this report it is unlikely that the historical landfill has impacted the benthic invertebrate community of the Old Sly Locks area.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

Old Sly Locks is located in Smiths Falls, Ontario, and is part of the Rideau Canal system that connects the St. Lawrence River with the Ottawa River. The area adjacent to the lock is a former landfill site and has been monitored since 1994 due to concern that leachate associated with the waste from the landfill may be draining into the aquatic environment.

Sediment monitoring has demonstrated exceedances for various parameters based on Canadian Council of Ministers of the Environment (CCME) and Ministry of the Environment and Climate Change (MOECC) sediment guidelines at a number of locations (Figure 1-1). The sediment exceedances suggest that benthic communities may be influenced by leachate from the historical landfill. Therefore, a benthic community survey was conducted to support a site assessment being conducted by AEL environment.

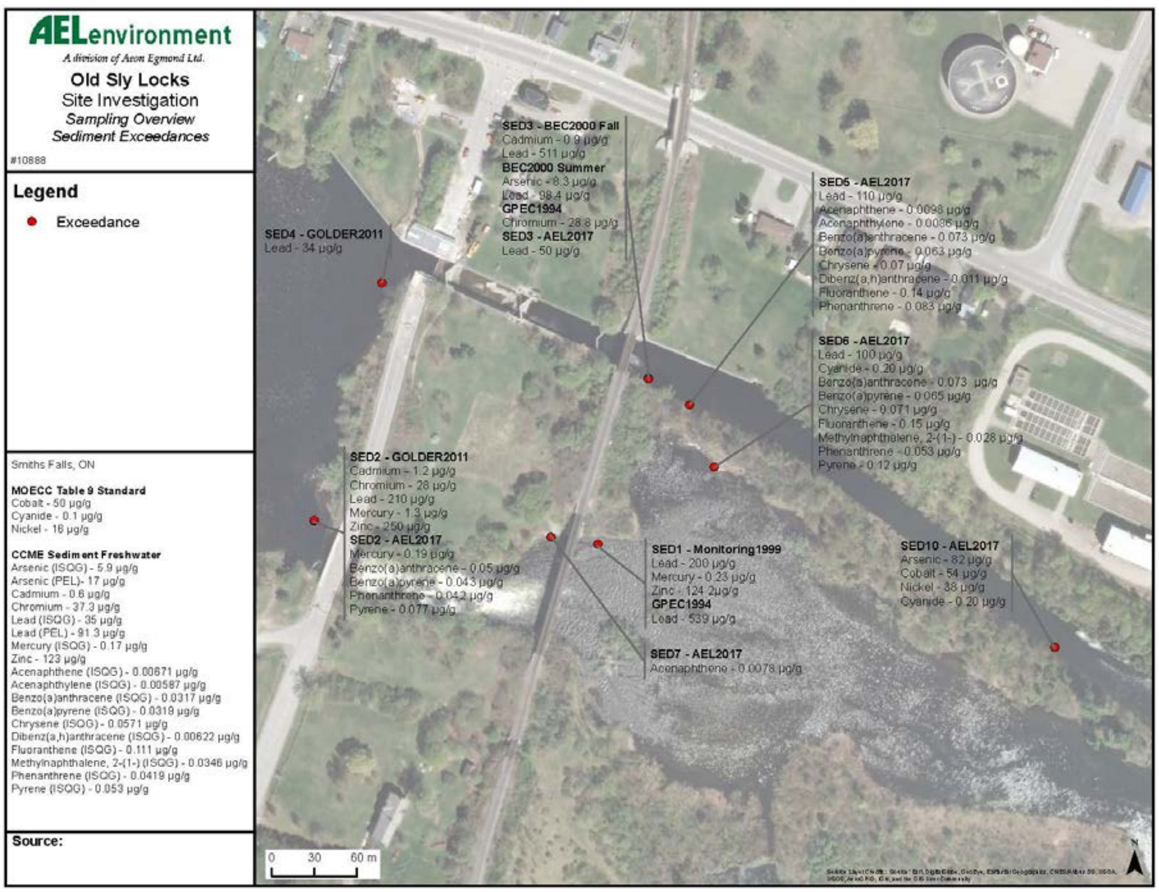


Figure 1-1: Historical sediment monitoring locations, Old Sly Locks, November 2017.

2.0 Methods

2.1 Sampling Locations

Sampling locations were determined based on existing information on sediment quality. A total of five locations were selected for benthic community sampling: SED4 upstream least impacted; SED3, SED5 and SED10 canal exposed; and SED6 lotic exposed (Figure 1-1). At the time of sampling, station SED10 could not be sampled as the water at that location was frozen over; therefore, an additional station was selected for sampling. The additional station was chosen from the three other stations where sediment had previously been sampled. Station SED7 was chosen as the additional station as the flow was typical of that sampled in CABIN reference datasets – SED1 had water too deep and current too fast to properly sample and SED2 is a lentic station.

The final stations sampled represent three area types: an upstream least-impacted lentic station (SED4); two exposed canal stations (SED3 and 5); and, two exposed lotic stations (SED6 and 7).

2.2 Benthic Sampling Procedure

Benthic invertebrate sampling followed the Canadian Aquatic Biomonitoring Network (CABIN) protocol (Environment Canada, 2010), which involves a 3-minute travelling kick into a net with a triangular aperture measuring 36 cm per side and mesh having 400 µm openings. During sampling, the field technician moved across the stream channel (from bank to bank, dependent on stream depth and width) in an upstream direction. With the net being held immediately downstream of the technician’s feet, the detritus and invertebrates disturbed from the substrate were passively collected in the kick-net by the stream current. After three minutes of sampling time, the sampler stopped and returned to the stream bank with the sample. The kick-net was rinsed with water to move all debris and invertebrates into the collection cup at the bottom of the net. The collection cup was then removed so the contents could be poured into a labelled plastic jar and preserved in a 10% buffered formalin solution. A single sample was collected at each station. Consistent with the requirements of the CABIN sampling protocol, supporting information was collected concurrent with benthic sampling (Appendix B).

At three of the sampling locations the stream sampling protocol was modified as the area was either lentic (SED4) or had insufficient flow (SED3 and 5) to sequester organisms in the kick-net. At these three stations a lentic sampling procedure was used whereby debris was kicked and collected as the technician conducts ‘figure 8 sweeps’ to collect dislodged organisms. A timed 3-minute travelling kick sample was collected.

2.3 Laboratory Processing Procedure

Benthic invertebrate community samples were sent to Cordillera Consulting (lead taxonomist Sue Salter), in Summerland BC, for sorting and taxonomic identification. Taxonomists at Cordillera have achieved certification for Group 1 (general Arthropods West), 2 (EPT East and West), and 3 (Chironomids West) benthic organisms in the

Taxonomic Certification Program (http://nabstcp.atlanticwebfitters.ca/) of the Society for Freshwater Science (formerly the North American Benthological Society). Organisms were identified to the lowest practical level (LPL) (typically genus or species) using up-to-date taxonomic keys.

At the beginning of the sorting process, each sample was examined to estimate total invertebrate numbers. If the total number was estimated to be greater than 600, then the CABIN sub-sampling protocol was followed. The CABIN subsampling procedure requires that a sufficient number of sub-samples be analyzed to result in the sorting of at least 300 organisms (Environment Canada, 2012). Sorting efficiency was calculated for one of the five samples (Environment Canada, 2012).

2.4 Habitat

Water velocity and depth were measured at each station at multiple equidistantly-spaced points along the kick-net transect. Pebble count and other habitat measurements were also taken at each benthic invertebrate sampling location according to CABIN protocols (Environment Canada, 2010). All sampling locations were recorded using a hand-held global positioning system (GPS) unit.

2.5 Water Quality

Field-based water quality measurements were collected at all five benthic invertebrate community stations. Measurements included pH, temperature, dissolved oxygen, conductivity and specific conductance, which were measured using a YSI hand held water quality meter and sonde.

2.6 Biological Endpoints

Benthic invertebrate communities were evaluated using summary metrics calculated at the lowest practical level and family level of taxonomic identifications for the following: mean invertebrate abundance (number of organisms per 3-min kick); mean taxon richness; Simpson's Diversity; and, Evenness. Metric calculation at the lowest practical level, excluded any life stages that could not be conclusively identified as separate taxa. In some instances, for the purposes of data analysis, invertebrate taxa were combined at a generic taxonomic level in order to incorporate abundance associated with indeterminate taxa. This was only done when there were few species in the genus and indeterminates made up a significant proportion of generic abundance. Simpson's diversity and evenness indices were computed from custom MS Excel spreadsheets following the formulae presented by Smith and Wilson (1996) and Environment Canada (2012). These indices take into account both the relative abundance of taxa and the number of taxa.

The relative proportions of the most abundant taxa were also computed (calculated as the abundance of each respective dominant taxon relative to the total number of organisms in the sample). Dominant taxon groups were defined as those groups representing greater than 5% of total organism abundance.

The percent composition of each functional feeding group (FFG) was calculated at the genus level using 'An Introduction to the Aquatic Insects of North America' (Merritt *et al*., 2008).

Hilsenhoff's biotic index (BI) was calculated at the genus level using genus specific tolerance values derived by its prevalence in organically polluted waters (Hilsenhoff, 1987). The BI value for a community is derived using the following calculation:

$BI = \sum(x_i \times t_i)/(n)$

Where:

x_i = number of individuals within a taxon

t_i = tolerance value of a taxon

n = total number of organisms in the sample

The site BI value is then evaluated against the following table:

Table 2-1: Hilsenhoff biotic index values and their relationship with water quality (Hilsenhoff, 1987).

Biotic Index	Water Quality	Degree of Organic Pollution
0.00 - 3.50	Excellent	No apparent organic pollution
3.51 - 4.50	Very good	Possible slight organic pollution
4.51 - 5.50	Good	Some organic pollution
5.51 - 6.50	Fair	Fairly substantial organic pollution
6.51 - 7.50	Fairly poor	Substantial organic pollution
7.51 - 8.50	Poor	Very substantial organic pollution
8.51 - 10.00	Very poor	Severe organic pollution

2.7 Site Assessment Against CABIN RCA Model

The data collected from the Old Sly Locks was input into the CABIN database by Cordillera Consulting. The reference condition approach (RCA) models available on the CABIN database were considered for comparison with the two lotic exposed stations (SED6 and 7) of the Old Sly Locks project.

2.8 Site Assessment Using Biological Endpoints

A descriptive assessment using biological endpoints was provided to allow for inference of possible effects on the benthic invertebrate community due to leachate from the historical landfill. It is expected that the exposed canal stations should demonstrate similarity among endpoint values due to there close proximity and similar habitat. While all calculated endpoints are considered, the Hilsenhoff BI values were used to infer potential community impairment as this organic pollution index performs well in indicating many types of anthropogenic disturbance.

3.0 Results

3.1 Habitat and Water Quality

The habitat of the upstream station (SED4) and the canal stations (SED3 and 5) was similar. All three had rocky substrate with sparse (less than 25%) *Myriophyllum sp.* present. All three stations had no flow (mean water velocity measurement at each area was 0.00 m/s) and mean depths of 43, 50, and 40 cm at stations SED4, SED3, and SED5, respectively (Appendix A). The lotic exposed stations had much different water velocities with mean water velocity for SED6 and SED7 of 0.05 and 0.67 m/s, respectively (Appendix A).

Water temperature was higher at stations SED3 and 5 compared to the other station. This difference may be due to ground water inputs (Table 3-1). Date and time of day are unlikely to explain the difference in temperature as the upstream lentic station (SED4) was sampled on the same day but later in the morning but it's temperature was lower than that of SED3 and 5. The lower dissolved oxygen values at stations SED3 and 5 are explained by the higher water temperature found at these stations, as dissolved oxygen decreases with increasing water temperature. Increased conductivity values were found at stations SED3 and 5, suggesting solute inputs not found at the other stations (Table 3-1).

Table 3-1: Water quality readings taken at time of benthic invertebrate sampling, Old Sly Locks, November 2017.

Area Type	Area ID	Water Temperature (°C)	Dissolved oxygen (mg/L)	Dissolved oxygen (%)	Conductivity (µs/cm)	Specific Conductivity (µs/cm)	pH
Upstream (Lentic)	SED4	1.91	15.64	112.8	128	229	8.14
Exposed (Canal)	SED3	5.57	10.61	84.3	355	565	7.48
	SED5	5.86	10.66	85	376	593	7.41
Exposed (Lotic)	SED6	1.52	14.25	101.7	123	224	7.23
	SED7	1.4	15.01	106.6	122	222	7.95

3.2 CABIN RCA Model

The project "Old Slys" was created and benthic invertebrate community data were entered into the CABIN database by Cordillera Consulting. A total of fifteen RCA models were available; however, no southeastern Ontario model exists. Evaluation of the RCA models available on the CABIN database revealed that none were suitable for evaluation with the lotic exposed stations (SED6 and 7) of the Old Sly Locks project as none included reference stations south of the 46th parallel (in Ontario this is approximately Lake Nipissing).

3.3 Biological Endpoints

Total abundance was greater at stations SED3 and 5 than the other stations (Figure 3-1 a). Abundance estimates resulting from the use of a kick-net must be interpreted with caution as a kick-net samples semi-quantitatively (Merritt *et al*., 2008). A similar pattern among stations was found for family richness, with stations SED3 and 5 having higher values than the other three stations (Figure 3-1 c). Richness at the LPL level demonstrated more variability between the canal stations, however all stations had similar LPL richness (Figure 3-1 b).

Simpson's diversity was similar across all stations, regardless of taxonomic resolution (Figure 3-2 a and c). Simpson's evenness calculated at LPL suggested that the lentic upstream station (SED4) had similar values to that of both exposed canal stations (SED3 and 5), with all three having slightly lower evenness values than the exposed lotic stations (SED6 and 7; Figure 3-2 b). At the family level of taxonomic resolution, the two canal exposed stations (SED3 and 5) had slightly lower evenness than the upstream lentic station, which was similar to that of the two lotic exposed stations (SED6 and 7; Figure 3-1 d).

Community composition of the major taxonomic groups indicated that the two exposed canal stations (SED3 and 5) and lotic exposed station SED6 had similar community composition (Figure 3-3 a). All three of these stations were dominated by Ephemeroptera (mean = 48% mayflies), followed by Amphipoda (mean = 34% freshwater shrimp). Community proportion of the upstream lentic station (SED4) was dominated by Amphipoda (67%), followed by Oligocheata (11% worms) and Chironomidae (9% midges). The exposed station SED7 was proportionally dominated by Oligocheata (29%) and Chironomidae (24%). Generally, healthy lotic environments are proportionally dominated by Ephemeroptera, Plecoptera, and Trichoptera taxa (Merritt *et al.*, 2008); therefore, the community composition at station SED7 may be indicative of impaired conditions.

The most dominant FFG among all stations was collector-gatherers (mean = 65%; Figure 3-3 b). Though all stations had similar proportions of FFGs, exposed lotic station SED7 had notably higher proportion of collector-filterer and lower proportion of scrapers. The difference in FFG is attributable to the swift water velocity present at station SED7, which is preferable for most filter feeders (Merrritt *et al*., 2008).

Hilsenhoff biotic index values indicated that the benthic communities present at four of the five stations (SED3, 4, 5, and 6) are composed of taxa that are indicative of 'good' to 'fair' water quality (Tables 2-1 and 3-2). The benthic invertebrate community present at station SED7 resulted in the water quality there to be characterized as 'fairly poor' (Table 3-2).

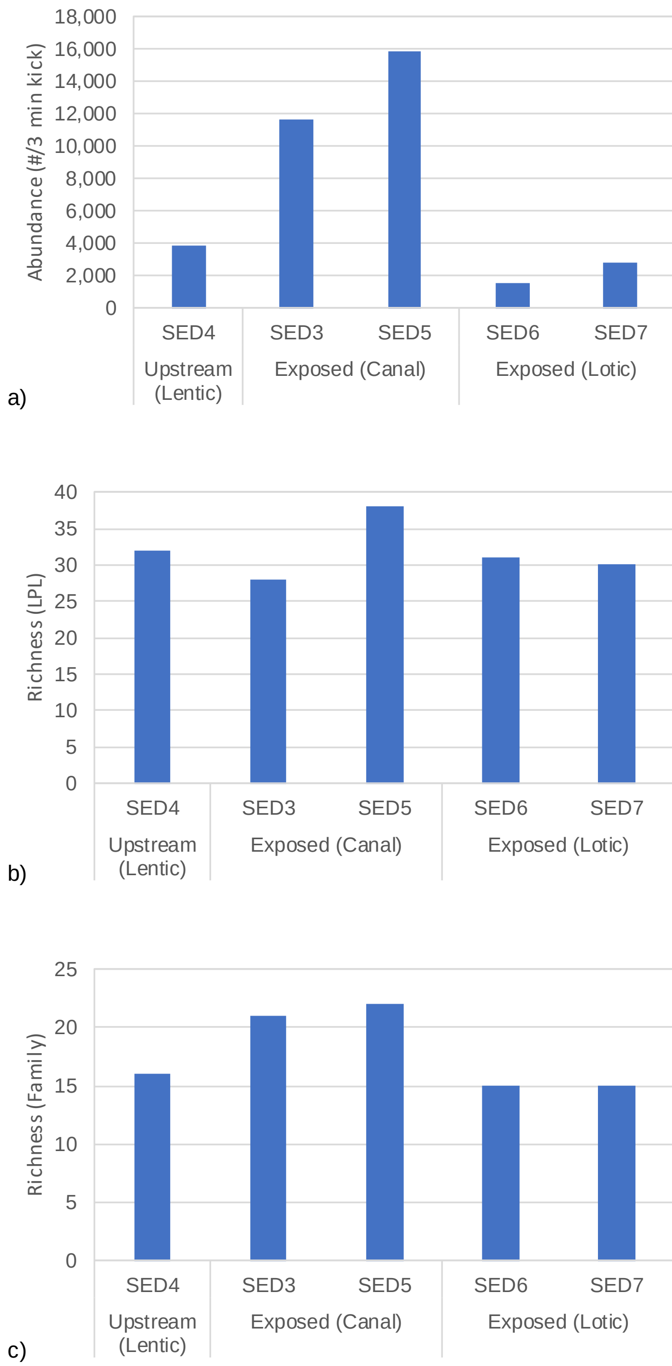


Figure 3-1: Benthic invertebrate a) abundance, b) lowest practical level (LPL) richness, and c) family level richness, Old Sly Locks, November 2017.

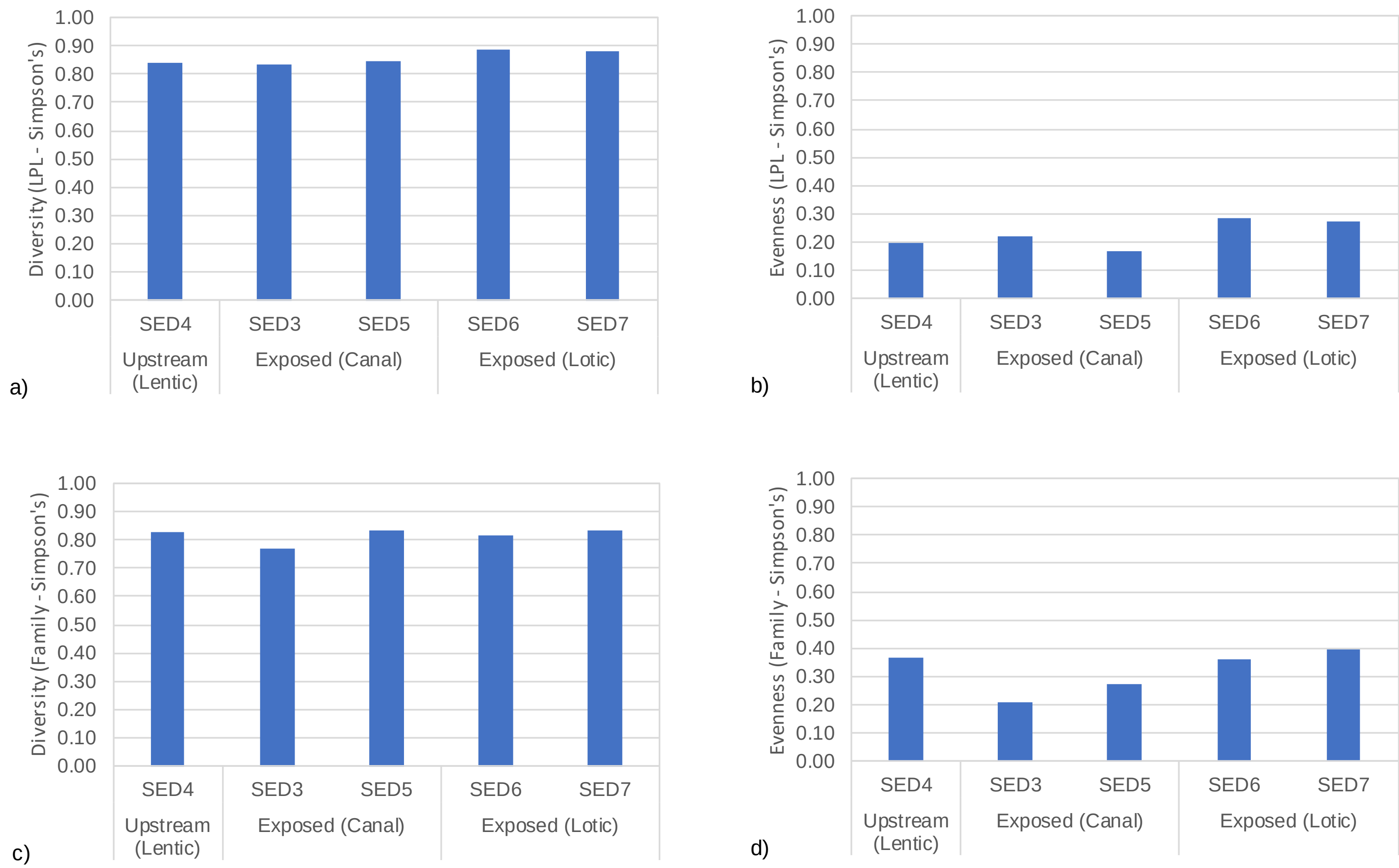


Figure 3-2: Simpson's diversity and evenness values calculated at the lowest practical level (LPL, a and b) and family level (c and d) of taxonomy. Both indices (diversity and evenness) range from 0 to 1, higher diversity values indicate that more taxa are present, while higher evenness values indicate that each taxon has increasingly similar relative abundances (i.e. less dominated by a few taxa), Old Sly Locks, November 2017.

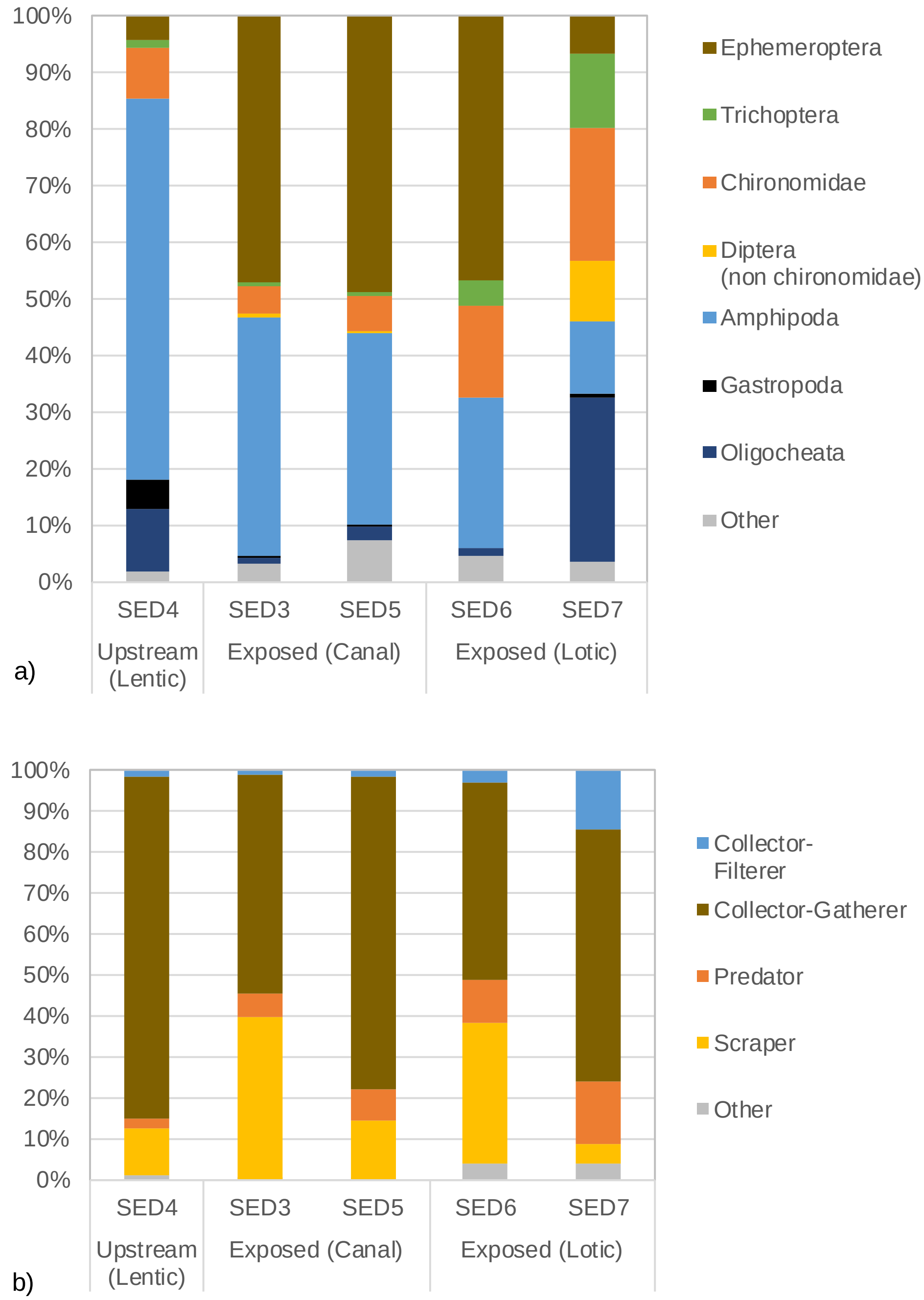


Figure 3-3: Benthic invertebrate a) major group community composition, and b) functional feeding group composition, Old Sly Locks, November 2017. Major groups and functional groups displayed are those that comprise at least 5% of the total community composition at a station.

Table 3-2: Hilsenhoff biotic index values for five benthic invertebrate study locations, Old Sly Locks, November 2017.

Area Type	Area ID	Hilsenhoff Biotic Index	Water Quality
Upstream (Lentic)	SED4	5.29	Good
Exposed (Canal)	SED3	5.03	Good
	SED5	5.91	Fair
Exposed (Lotic)	SED6	5.23	Good
	SED7	6.69	Fairly Poor

Note: Shading is defined in Table 2-1.

4.0 Conclusions and Recommendations

Based on the evaluation of the biotic endpoints presented in this report it is unlikely that the historical landfill has impacted the benthic invertebrate community of the Old Sly Locks area.

Richness and abundance was as high, or higher, at the canal exposed stations than at the upstream 'least-impacted' lentic station. Diversity measures and FFG's were also similar between the upstream station (SED4) and the canal stations (SED3 and 5). The community structure at the upstream station was different than that of the two canal stations (SED3 and 5) but such a difference is expected as the upstream station is truly lentic, whereas the canal stations would experience flow in the summer months during canal operation. Hilsenhoff BI values indicate that the upstream lentic station (SED4) and both exposed canal stations (SED3 and 5) have benthic invertebrate communities that are representative of 'good' to 'fair' water quality conditions.

Comparison of the exposed lotic stations to a CABIN reference model was not possible as no suitable model existed. Evaluation of biotic endpoints indicated that the benthic invertebrate community at station SED7 may experience anthropogenic impacts as it had very low composition of EPT taxa and a Hilsenhoff BI value that indicates 'fairly poor' water quality. The cause of the impact to the benthic invertebrate community may not be due to the historic landfill as many anthropogenic disturbances likely affect this area. No biotic endpoints suggested the benthic community at station SED6 had appreciable anthropogenic impacts.

Recommendations

- To better understand the impact that the historical landfill may be having on the benthic invertebrate community of Old Sly Locks a comparison could be made to a similar lock that is not subjected to historical landfill influence. This would help account for other anthropogenic factors (boating in canal, municipal waste, zebra mussels) which cannot be accounted for in a CABIN reference model. Such a study could include replication (within a habitat type) to allow statistical inference of biological endpoint differences between locks.

5.0 References

Environment Canada. 2010. Field Manual: Wadeable Streams. Canadian Aquatic Biomonitoring Network (CABIN). March 2010.

Environment Canada. 2012. Laboratory Methods: Processing, Taxonomy, and Quality Control of Benthic Macroinvertebrate Samples. Canadian Aquatic Biomonitoring Network (CABIN). April 2012.

Environment Canada 2012. Metal Mining Environmental Effects Monitoring (EEM) Technical Guidance Document. Environment Canada Report. http://www.ec.gc.ca/Publications/default.asp?lang=En&xml=D175537B-24E3-46E8-9BB4-C3B0D0DA806D

Hilsenhoff, W.L. 1987. An improved biotic index of organic stream pollution. The Great Lakes Entomologist. 20(1):31-40.

Merritt, R. W., K. W. Cummins, and M. B. Berg. 2008. An Introduction to the aquatic insects of North America. 4th edition. Kendall/Hunt Publishing Company.

Smith, B. and J.B. Wilson. 1996. A Consumer's Guide to Evenness Indices. Oikos 76: 70 - 82.

Appendix A Benthic Data

Table A-1: GPS locations of benthic invertebrate community samples, Old Sly Locks, November 2017.

Area Type	Area ID	UTM	Easting	Northing
Upstream (Lentic)	**SED4**	18	420645	4971575
Exposed (Canal)	**SED3**	18	420767	4971531
	SED5	18	420783	4971520
Exposed (Lotic)	**SED6**	18	420803	4971483
	SED7	18	420727	4971415

Table A-2: Depth and velocity taken at time of benthic invertebrate sampling, Old Sly Locks, November 2017.

Area Type	Area ID	Parameter	1	2	3	4	5	6	7	8	9	10	Mean
Upstream (Lentic)	SED4	Depth (cm)	48	50	22	39	41	55	-	-	-	-	43
		Velocity (m/s)	0	0	0	0	0	0	-	-	-	-	0.00
Exposed (Canal)	SED3	Depth (cm)	29	40	28	49	60	71	62	66	48	42	50
		Velocity (m/s)	0	0.02	0	0	0.01	0	0	0	0	0	0.00
	SED5	Depth (cm)	25	41	58	46	25	43	41	-	-	-	40
		Velocity (m/s)	0	0	0	0	0	0	0	-	-	-	0.00
Exposed (Lotic)	SED6	Depth (cm)	50	51	45	67	60	41	33	-	-	-	50
		Velocity (m/s)	0.12	0.09	0.03	0.04	0.01	0.05	0.02	-	-	-	0.05
	SED7	Depth (cm)	35	28	42	37	33	41	52	-	-	-	38
		Velocity (m/s)	0.75	1.02	0.82	0.63	0.38	0.57	0.55	-	-	-	0.67

Table A-3: Benthic invertebrate abundance, richness, diversity, and evenness calcualted at lowest practical level (LPL) and family level of taxonomic resolution, Old Sly Locks, November 2017.

Endpoint \ Area	Upstream (Lentic)	Exposed (Canal)		Exposed (Lotic)	
	SED4	SED3	SED5	SED6	SED7
Abundance (Relative)	3885	11680	15880	1570	2816
Richness (LPL)	32	28	38	31	30
Richness (Family)	16	21	22	15	15
Diversity (LPL - Simpson's)	0.84	0.84	0.84	0.89	0.88
Evenness (LPL - Simpson's)	0.20	0.22	0.17	0.29	0.28
Diversity (Family - Simpson's)	0.83	0.77	0.83	0.81	0.83
Evenness (Family - Simpson's)	0.37	0.21	0.27	0.36	0.40

Table A-4: Proportion of major group benthic invertebrate community composition, Old Sly Locks, November 2017.

Endpoint \ Area	Upstream (Lentic)	Exposed (Canal)		Exposed (Lotic)	
	SED4	SED3	SED5	SED6	SED7
Ephemeroptera	4.20	47.09	48.87	46.82	6.75
Trichoptera	1.34	0.68	0.50	4.46	12.89
Chironomidae	9.09	4.97	6.30	16.24	23.54
Diptera (no chiro)	0.00	0.51	0.38	0.00	10.97
Amphipoda	67.28	42.29	33.75	26.43	12.61
Gastropoda	5.15	0.17	0.38	0.00	0.64
Oligocheata	10.99	1.20	2.52	1.59	29.05
Coleoptera	0.00	0.68	0.00	0.00	0.00
Hemiptera	0.33	1.54	4.91	0.32	0.00
Megaloptera	0.33	0.00	0.00	0.00	0.00
Odonata	0.64	0.00	0.25	0.00	0.00
Hydracarina	0.00	0.34	1.13	0.32	2.27
Decapoda	0.00	0.34	0.13	0.32	0.00
Isopoda	0.64	0.17	0.50	3.50	1.28
Bivalvia	0.00	0.00	0.38	0.00	0.00

- indicates community proportion greater than 5%.

Table A-5: Proportion of functional feeding group composition of benthic invertebrate community, Old Sly Locks, November 2017.

FFG \ Area	Upstream (Lentic)	Exposed (Canal)		Exposed (Lotic)	
	SED4	SED3	SED5	SED6	SED7
Collector-Filterer	1.62	1.03	1.64	3.18	14.52
Collector-Gatherer	83.45	53.60	76.32	48.09	61.29
Predator	2.32	5.48	7.81	10.51	15.52
Scraper	11.61	39.55	13.98	34.08	4.83
Piercer-Herbivore	0.33	0.00	0.13	3.50	2.24
Omnivore	0.00	0.00	0.00	0.00	0.32
Shredder-Herbivore	0.67	0.34	0.13	0.64	0.00
Not designated	0.00	0.00	0.00	0.00	1.28

- indicates community proportion greater than 5%.

Table A-6: Benthic invertebrate community data (# per 3-min kick), Old Sly Locks, November 2017.

Taxon	SED3	SED4	SED5	SED6	SED7	Functional Feeding Groups	Hilsenhoff Value
Phylum: Arthropoda	0	0	0	0	0	Unclassified	
Subphylum: Hexapoda	0	0	0	0	0	Unclassified	
| Class: Insecta	0	0	0	0	0	Unclassified	
| Order: Ephemeroptera	0	0	0	0	0	Collector-Gatherer	
| Family: Baetidae	80	0	0	0	18	Collector-Gatherer	4
Neocloeon	0	0	660	0	9	Collector-Gatherer	4
| Family: Caenidae	280	0	480	45	9	Collector-Gatherer	7
Caenis	0	0	1200	0	0	Collector-Gatherer	7
Caenis latipennis	560	0	3260	145	36	Collector-Gatherer	7
| Family: Ephemerellidae	40	0	0	0	0	Collector-Gatherer	1
Eurylophella	20	0	20	10	0	Collector-Gatherer	1
| Family: Heptageniidae	960	75	900	185	55	Scraper	4
Stenacron interpunctatum	1000	13	80	90	27	Scraper	7
Stenonema femoratum	2560	75	1160	260	36	Scraper	2
| Order: Trichoptera	0	0	0	0	36	Unclassified	
| Family: Hydropsychidae	0	0	0	0	0	Collector-Filterer	4
Cheumatopsyche	0	0	0	0	36	Collector-Filterer	5
Hydropsyche	0	0	0	0	64	Collector-Filterer	4
| Family: Hydroptilidae	0	0	0	0	9	Unclassified	4
Hydroptila	0	0	0	0	27	Piercer-Herbivore	6
Oxyethira	0	13	20	55	27	Piercer-Herbivore	3
| Family: Leptoceridae	0	0	0	0	0	Collector-Gatherer	4
Leptocerus	0	13	0	0	0	Shredder-Herbivore	
Triaenodes	0	13	0	0	0	Shredder-Herbivore	6
| Family: Philopotamidae	0	0	0	0	0	Collector-Filterer	3
Chimarra	0	0	0	0	164	Collector-Filterer	4
| Family: Polycentropodidae	0	0	20	0	0	Predator	6
Nyctiophylax	0	0	0	5	0	Predator	5
Polycentropus	80	13	40	10	0	Predator	6
| Order: Coleoptera	0	0	0	0	0	Predator	
| Family: Elmidae	20	0	0	0	0	Collector-Gatherer	4
Stenelmis	40	0	0	0	0	Scraper	7
| Family: Psephenidae	0	0	0	0	0	Unclassified	4
Ectopria	20	0	0	0	0	Scraper	5
| Order: Diptera	0	0	0	0	0	Unclassified	
| Family: Ceratopogonidae	0	0	0	0	0	Predator	6
Bezzia/ Palpomyia	20	0	60	0	0	Predator	6
| Family: Chironomidae	0	0	0	0	0	Unclassified	6
| Subfamily: Chironominae	0	0	0	0	0	Collector-Gatherer	6
| Tribe: Chironomini	0	0	0	0	0	Collector-Gatherer	6
Chironomus	0	25	0	0	0	Collector-Gatherer	10
Cryptochironomus	0	0	0	5	0	Predator	8
Dicrotendipes	100	75	0	25	18	Collector-Gatherer	8
Microtendipes	0	25	20	5	0	Collector-Filterer	6
Parachironomus	0	13	0	0	0	Predator	10
Paratendipes	0	0	220	5	0	Collector-Gatherer	8
Phaenopsectra	20	88	20	0	0	Scraper	7
Polypedilum	0	13	60	0	82	Collector-Gatherer	6
Stenochironomus	0	13	0	0	0	Collector-Gatherer	5
Stictochironomus	0	0	0	0	9	Collector-Gatherer	9
Xenochironomus	0	0	0	5	0	Predator	
| Tribe: Tanytarsini	20	0	120	0	9	Collector-Gatherer	6
Micropsectra	40	50	260	10	9	Collector-Gatherer	7
Paratanytarsus	60	13	60	0	0	Collector-Filterer	6
Rheotanytarsus	60	25	120	20	127	Collector-Filterer	6
Tanytarsus	0	0	0	25	0	Collector-Filterer	6
| Subfamily: Orthocladiinae	0	0	0	0	0	Collector-Gatherer	5
Cardiocladius	0	0	0	0	9	Predator	5
Cricotopus (Nostococladius)	0	0	0	5	0	Shredder-Herbivore	7
Eukiefferiella	0	0	0	0	9	Omnivore	8
Heterotrissocladius	0	0	0	0	9	Collector-Gatherer	
Nanocladius	0	0	0	0	9	Collector-Gatherer	3
Orthocladius complex	0	0	0	15	218	Collector-Gatherer	6
Synorthocladius	0	0	0	5	0	Collector-Gatherer	2
Tvetenia	0	0	0	0	82	Collector-Gatherer	5
| Subfamily: Tanypodinae	0	0	0	0	0	Predator	7
Labrundinia	0	0	0	15	0	Predator	6
Paramerina	0	0	60	0	0	Predator	6
| Tribe: Pentaneurini	0	0	0	0	0	Predator	6
Pentaneura	0	13	0	0	18	Predator	6
Thienemannimyia group	280	0	40	115	55	Predator	6
| Tribe: Procladiini	0	0	0	0	0	Predator	9
Procladius	0	0	20	0	0	Predator	9
| Family: Empididae	0	0	0	0	155	Predator	6
Hemerodromia	40	0	0	0	136	Predator	6
| Family: Simuliidae	0	0	0	0	18	Collector-Filterer	6

Table A-6: Benthic invertebrate community data (# per 3-min kick), Old Sly Locks, November 2017.

Taxon	SED3	SED4	SED5	SED6	SED7	Functional Feeding Groups	Hilsenhoff Value
| Order: Hemiptera	0	0	0	0	0	Unclassified	
| Family: Belostomatidae	0	0	0	0	0	Predator	8
Belostoma	40	0	0	5	0	Predator	8
| Family: Corixidae	0	0	100	0	0	Predator	8
Callicorixa	0	0	220	0	0	Predator	8
Sigara	140	13	460	0	0	Predator	8
| Order: Megaloptera	0	0	0	0	0	Unclassified	
| Family: Sialidae	0	0	0	0	0	Unclassified	4
Sialis	0	13	0	0	0	Predator	4
| Order: Odonata	0	0	20	0	0	Unclassified	
| Family: Coenagrionidae	0	25	20	0	0	Predator	9
Subphylum: Chelicerata	0	0	0	0	0	Unclassified	
| Class: Arachnida	0	0	0	0	0	Predator	5
| Order: Trombidiformes	0	0	0	0	0	Predator	5
| Family: Hygrobatidae	0	0	0	0	0	Predator	8
Hygrobates	20	0	140	0	64	Predator	8
| Family: Lebertiidae	0	0	0	0	0	Predator	5
Lebertia	20	0	20	5	0	Predator	8
| Family: Mideopsidae	0	0	0	0	0	Predator	5
Mideopsis	0	0	20	0	0	Predator	5
| Class: Malacostraca	0	0	0	0	0	Unclassified	
| Order: Amphipoda	2600	2188	2980	125	145	Collector-Gatherer	4
| Family: Crangonyctidae	0	0	0	0	0	Collector-Gatherer	8
Crangonyx	200	163	200	85	55	Collector-Gatherer	4
| Family: Gammaridae	0	0	0	0	0	Collector-Gatherer	4
Gammarus	260	113	400	50	155	Collector-Gatherer	6
| Family: Hyalellidae	0	0	0	0	0	Unclassified	
Hyalella	1880	150	1780	155	0	Collector-Gatherer	8
| Order: Decapoda	0	0	0	0	0	Shredder-Herbivore	8
| Family: Cambaridae	0	0	0	0	0	Collector-Gatherer	6
Orconectes	40	0	20	5	0	Shredder-Herbivore	6
| Order: Isopoda	0	0	0	10	0	Collector-Gatherer	8
| Family: Asellidae	0	0	0	0	0	Collector-Gatherer	8
Caecidotea	20	25	80	45	36	Collector-Gatherer	8
Phylum: Mollusca	0	0	0	0	0	Unclassified	
| Class: Bivalvia	0	0	0	0	0	Collector-Filterer	8
| Order: Veneroida	0	0	0	0	0	Unclassified	
| Family: Pisidiidae	0	0	40	0	0	Collector-Filterer	8
Pisidium	0	0	20	0	0	Collector-Filterer	8
| Class: Gastropoda	20	50	0	0	0	Scraper	7
| Order: Basommatophora	0	0	0	0	0	Unclassified	
| Family: Ancylidae	0	0	0	0	0	Scraper	6
Ferrissia	0	100	20	0	18	Scraper	6
| Family: Planorbidae	0	50	40	0	0	Scraper	7
Phylum: Annelida	0	0	0	0	0	Unclassified	
Subphylum: Clitellata	0	0	0	0	0	Unclassified	
| Class: Oligochaeta	0	0	0	0	0	Collector-Gatherer	5
| Order: Lumbriculida	0	0	0	0	0	Collector-Gatherer	7.3
| Family: Lumbriculidae	0	88	0	5	0	Collector-Gatherer	8
| Order: Tubificida	0	0	0	0	0	Unclassified	
| Family: Naididae	0	0	0	0	36	Collector-Gatherer	10
Dero	0	13	20	0	0	Collector-Gatherer	10
Nais	40	50	20	10	782	Collector-Gatherer	10
Pristina	0	38	0	5	0	Collector-Gatherer	10
Ripistes parasita	0	0	20	0	0	Collector-Gatherer	10
| Subfamily: Tubificinae	0	0	0	0	0	Collector-Gatherer	10
Branchiura sowerby	0	0	20	0	0	Collector-Gatherer	
| Subfamily: Tubificinae with hair chaetae	0	88	140	0	0	Collector-Gatherer	10
| Subfamily: Tubificinae without hair chaetae	100	150	180	5	0	Collector-Gatherer	10
Total Abundance	11680	3885	15880	1570	2816		

Table A-7: Material resorted to determine sorting efficiency, Old Sly Locks, November 2017.

		SED6
Taxa found in Resort	Chironomidae	2
	Ephemeroptera	5
	Bivalvia	1
Total Missed		8
Total counted		314
Efficiency		97.5

Table A-8: Percent of sample sorted, Old Sly Locks, November 2017.

	SED3	SED4	SED5	SED6	SED7
Percent of total sample sorted	5%	8%	5%	20%	11%

Appendix B Field Sheets

Stream Habitat Characterization
(And CABIN Samples) 1 of 3

Client/Project: AEL (Parks Canada) Area ID: SED 3 Ref / Exp: exp.
Project #: 17-2409 Waterbody: Rideau River
Date / Time: 24 NOV 2017 10:30 Coordinates: 420 767 Elevation:
Field Crew: M. White, N. Wiemann 4971531 18
Weather, air temp: 4°C, partly cloudy Map Datum: NAD 83 or other:
Site Access: Slys Lock

Surrounding Land Use (check all that apply)

☐ Forest ☐ Field Crops ☐ Logging ☐ Commercial
☐ Livestock ☒ Residential ☐ Mining ☒ Other: landfill

Anthropogenic Influences: rail bridge u/s; lock channel, park.

Reach Assessed (consider ~6 X wetted width): ☐ 10m ☐ 30m ☒ 50m ☐ 100m

Habitat (percentage of assessed reach)

riffle — rapids —
straight run — pool/back eddy 100 (lentic)

Substrate (percentage of assessed reach)

bedrock — cobble 50 gravel 10 organic —
boulder 20 pebble 20 sand/finer —

Substrate Size Class	
organic cover	
<0.1 cm	sand/silt/clay
0.1-0.2 cm	sand
0.2-1.6 cm	gravel
1.6-6.4 cm	pebble
6.4-25.6 cm	cobble
>25.6 cm	boulder
bedrock	

Streamside Vegetation (check all that apply, circle dominant)

☒ ferns/grass ☒ shrubs ☒ deciduous trees ☐ coniferous trees

Canopy Coverage

☐ 0% ☒ 1 - 25% ☐ 26 - 50% ☐ 51 - 75% ☐ 76% - 100%

Macrophyte Coverage

☐ 0% ☒ 1 - 25% ☐ 26 - 50% ☐ 51 - 75% ☐ 76% - 100%

List dominant macrophyte type(s): Myriophyllum, bryophytes (?)

Periphyton Coverage

☐ 1 - Rocks not slippery, no obvious colour (<0.5mm thick)
☐ 2 - Rocks slightly slippery, yellow-brown to light green colour (0.5-1mm thick)
☒ 3 - Rocks have noticeable slippery feel, patches of thicker green to brown algae (1-5mm thick)
☐ 4 - Rocks are very slippery, numerous clumps (5-20mm thick)
☐ 5 - Rocks mostly obscured by algae mat, may have long strands (>20mm thick)

Bank Stability

☐ stable, no erosion
☒ moderate
☐ unstable, substantial erosion

Water Appearance

colour: clear
clarity: cloudy

Photos (take all in order) yes

1. field sheet
2. upstream
3. downstream
4. across
5. substrate
6. other:

Comments:

visible hydrocarbon patches on surface (see photos)
all rocks from concrete pillar with orange (iron) deposit
lots of leaf litter

Signature: Nichole

Stream Habitat Characterization
(And CABIN Samples) 2 of 3

Station Diagram include: North arrow, flow direction, major features, sampling locations (all types)

Channel Measurements

Bankfull Width: 23 m   Bankfull - Wetted Depth: 25 cm

Wetted Width: 21 m   Gradient (%): 0   ☒ clinometer   ☐ other:

Interval:	1	2	3	4	5	6	7	8	9
Distance from shore (m)	N/A								
Depth (cm)	29	40	28	49	60	71	62	66	48
Velocity (m/s)	0	0.02	0	0	0.01	0	0	0	0
depth	42								
velocity	0								

Water Quality

Temperature (°C): 5.57   Specific Conductance (uS/cm): 565

Dissolved Oxygen - mg/L: 10.61   Conductivity (uS/cm): 355

% Sat: 84.3   pH (pH units): 7.48

Water sample collected? Yes / No   Sediment collected? Yes / No

Duplicate water sample? Yes / No   ID: Dup. sed. sample? Yes / No   ID:

CABIN Invertebrate Community Samples

Equipment:

☒ triangle net   ☐ D-net   ☐ other:

Sieve Size (um)

☐ 500   ☒ 400   ☐ 250

sampling time (min): 3   sampler initials: MW

total kick distance (m) 14   number of jars: 2

full transects?: Yes / No

OR   # of transects: N/A

distance from shore (m): N/A

Stream Habitat Characterization
(And CABIN Samples) 3 of 3

Client: AEL (Parks Canada)
Date/Time: 24Nov2017 10:30
Waterbody: Rideau River

Project Name/Number: 17:2409
Field Crew: M.White, N.Wiemann
Area ID: SED3

METHOD DESCRIPTION

CABIN protocol - zigzag through sampling area, stopping every 2 steps. Touch the rock nearest to your toe without looking. Pull out the piece of substrate the tip of finger is touching (try not to bias by size). Measure the intermediate axis (perpendicular to the longest axis). For every 10th rock, estimate the amount of the rock embedded in the surrounding material (in 1/4 fractions).

DATA

Rock #	Intermediate Axis Length (cm)	Embed (as 1/4 fractions)	Rock #	Intermediate Axis Length (cm)	Embed (as 1/4 fractions)	Rock #	Intermediate Axis Length (cm)	Embed (as 1/4 fractions)	Rock #	Intermediate Axis Length (cm)	Embed (as 1/4 fractions)
1	10.5		26	7		51			76		
2	10		27	8		52			77		
3	7		28	8.5		53			78		
4	21		29	8		54			79		
5	9.5		30	10	1/4	55			80		
6	10		31	7		56			81		
7	4		32	8.5		57			82		
8	8		33	3.5		58			83		
9	7.5		34	10		59			84		
10	3.5	1/2	35	3.5		60			85		
11	15		36	6.5		61			86		
12	11.5		37	5.5		62			87		
13	22		38	6		63			88		
14	10.5		39	4		64			89		
15	4.5		40	10	1/2	65			90		
16	13.5		41	5.5		66			91		
17	14		42	5		67			92		
18	15.5		43	11		68			93		
19	6.5		44	6.5		69			94		
20	4.5	1/4	45	3.5		70			95		
21	17		46	4		71			96		
22	14		47	11		72			97		
23	13		48	5		73			98		
24	27		49	5.5		74			99		
25	13		50	6	1/4	75			100		

Description of Interstitial material: sand.

Stream Habitat Characterization
(And CABIN Samples) 1 of 3

Client/Project: AEL (Parks Canada) Area ID: SED4 Ref / Exp: ref (for study)
Project #: 17-2409 Waterbody: Rideau River
Date / Time: 24 NOV 2017 11:50 Coordinates: 420645 Elevation:
Field Crew: M. White, N. Wiemann 4971575 18
Weather, air temp: 6° partly cloudy Map Datum: NAD 83 or other:
Site Access: Slys Lock - access from bridge/roadway

Surrounding Land Use (check all that apply)

- ☐ Forest ☐ Field Crops ☐ Logging ☐ Commercial
- ☐ Livestock ☒ Residential ☐ Mining ☐ Other:

Anthropogenic Influences: road + bridge

Reach Assessed (consider ~6 X wetted width): ☐ 10m ☐ 30m ☒ 50m ☐ 100m

Habitat (percentage of assessed reach)

riffle — rapids —
straight run — pool/back eddy 100 (lentic)

Substrate (percentage of assessed reach)

bedrock — cobble 50 gravel — organic —
boulder 30 pebble 20 sand/finer —

Substrate Size Class	
organic cover	
<0.1 cm	sand/silt/clay
0.1-0.2 cm	sand
0.2-1.6 cm	gravel
1.6-6.4 cm	pebble
6.4-25.6 cm	cobble
>25.6 cm	boulder
bedrock	

Streamside Vegetation (check all that apply, circle dominant)

☒ ferns/grass ☒ shrubs ☒ deciduous trees ☐ coniferous trees

Canopy Coverage

☐ 0% ☒ 1 - 25% ☐ 26 - 50% ☐ 51 - 75% ☐ 76% - 100%

Macrophyte Coverage

☐ 0% ☒ 1 - 25% ☐ 26 - 50% ☐ 51 - 75% ☐ 76% - 100%

List dominant macrophyte type(s): Myriophyllum.

Periphyton Coverage

- ☐ 1 - Rocks not slippery, no obvious colour (<0.5mm thick)
- ☒ 2 - Rocks slightly slippery, yellow-brown to light green colour (0.5-1mm thick)
- ☐ 3 - Rocks have noticeable slippery feel, patches of thicker green to brown algae (1-5mm thick)
- ☐ 4 - Rocks are very slippery, numerous clumps (5-20mm thick)
- ☐ 5 - Rocks mostly obscured by algae mat, may have long strands (>20mm thick)

Bank Stability

- ☐ stable, no erosion
- ☒ moderate
- ☐ unstable, substantial erosion

Water Appearance

colour: none
clarity: slight cloudy/ ~~clear~~

Photos (take all in order)

1. field sheet
2. upstream
3. downstream
4. across
5. substrate
6. other:

yes

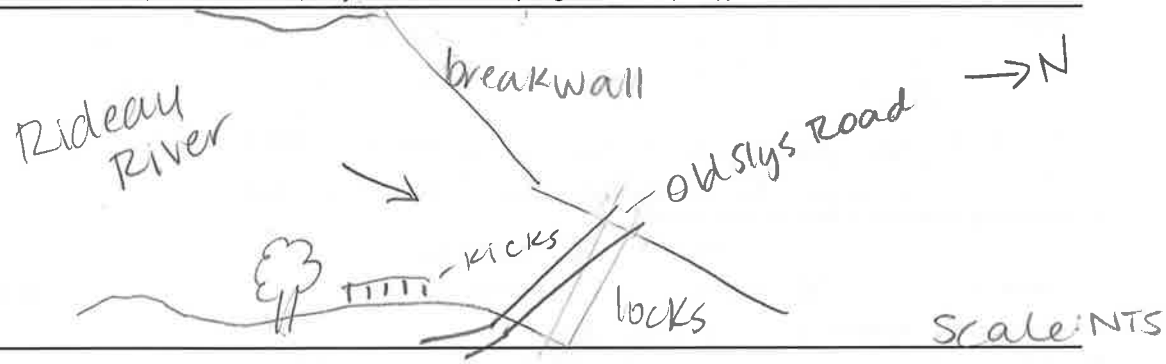
Comments:

Opposed lake shoreline (beyond range of rangefinder, approx 400m)
leaf litter

Signature: MWhite

Stream Habitat Characterization
(And CABIN Samples) 2 of 3

Station Diagram include: North arrow, flow direction, major features, sampling locations (all types)



Channel Measurements

Bankfull Width: N/A Bankfull - Wetted Depth: N/A

Wetted Width: N/A Gradient (%): N/A ☐ clinometer ☐ other:

Interval:	1	2	3	4	5	6	7	8
Distance from shore (m)	N/A →							
Depth (cm)	48	50	22	39	41	55		
Velocity (m/s)	N/A	N/A	N/A	N/A	N/A	N/A		

Water Quality

Temperature (°C): 1.91 Specific Conductance (uS/cm): 229

Dissolved Oxygen - mg/L: 15.64 Conductivity (uS/cm): 128

% Sat: 112.8 pH (pH units): 8.14

Water sample collected? Yes / No Sediment collected? Yes / No

Duplicate water sample? Yes / No ID: Dup. sed. sample? Yes / No ID:

CABIN Invertebrate Community Samples

Equipment:

☒ triangle net ☐ D-net ☐ other:

Sieve Size (um)

☐ 500 ☒ 400 ☐ 250

sampling time (min): 3 sampler initials: MW

total kick distance (m) 12 number of jars: 3

full transects?: Yes / No

OR # of transects:

distance from shore (m):

Stream Habitat Characterization
(And CABIN Samples) 3 of 3

Client: AEL (Parks Canada)
Date/Time: 24NOV2017 11:50
Waterbody: Rideau River

Project Name/Number: 17-2409
Field Crew: M. White, N. Wiemann
Area ID: SED4

METHOD DESCRIPTION

CABIN protocol - zigzag through sampling area, stopping every 2 steps. Touch the rock nearest to your toe without looking. Pull out the piece of substrate the tip of finger is touching (try not to bias by size). Measure the intermediate axis (perpendicular to the longest axis). For every 10th rock, estimate the amount of the rock embedded in the surrounding material (in 1/4 fractions).

DATA

Rock #	Intermediate Axis Length (cm)	Embed (as 1/4 fractions)	Rock #	Intermediate Axis Length (cm)	Embed (as 1/4 fractions)	Rock #	Intermediate Axis Length (cm)	Embed (as 1/4 fractions)	Rock #	Intermediate Axis Length (cm)	Embed (as 1/4 fractions)
1	17		26	30		51			76		
2	5		27	16		52			77		
3	4		28	9.5		53			78		
4	6.5		29	10		54			79		
5	5.5		30	12	1/4	55			80		
6	17		31	18		56			81		
7	12		32	13.5		57			82		
8	26		33	12		58			83		
9	33		34	6		59			84		
10	9	1/2	35	65		60			85		
11	12		36	13.5		61			86		
12	18		37	5		62			87		
13	11		38	10.5		63			88		
14	4.5		39	10		64			89		
15	17.5		40	18	1/2	65			90		
16	12.5		41	14.5		66			91		
17	24		42	40		67			92		
18	4		43	4.5		68			93		
19	4.5		44	10		69			94		
20	5	1/4	45	12		70			95		
21	8		46	8		71			96		
22	13.5		47	6.5		72			97		
23	7		48	10		73			98		
24	29		49	10		74			99		
25	34		50	15	1/4	75			100		

Description of Interstitial material: Sand.

Stream Habitat Characterization
(And CABIN Samples) 1 of 3

Client/Project: AEL (Parks Canada) Area ID: SED 5 Ref / Exp: exp.
Project #: 17-2409 Waterbody: Rideau River
Date / Time: 24 NOV 2017 9:30 Coordinates: 420783 Elevation:
Field Crew: M. White; N. Wiemann 4971570 18
Weather, air temp: 2°C, partly cloudy Map Datum: NAD 83 or other:
Site Access: Slys Lock

Surrounding Land Use (check all that apply)
☐ Forest ☐ Field Crops ☐ Logging ☐ Commercial
☐ Livestock ☒ Residential ☐ Mining ☒ Other: landfill

Anthropogenic Influences: rail bridge u/s; in lock channel, park
Reach Assessed (consider ~6 X wetted width): ☐ 10m ☐ 30m ☒ 50m ☐ 100m

Habitat (percentage of assessed reach)
riffle — rapids —
straight run — pool/back eddy 100 (lentic habitat)

Substrate (percentage of assessed reach)
bedrock 10 cobble 50 gravel 10 organic —
boulder 10 pebble 20 sand/finer —

Substrate Size Class	
organic cover	
<0.1 cm	sand/silt/clay
0.1-0.2 cm	sand
0.2-1.6 cm	gravel
1.6-6.4 cm	pebble
6.4-25.6 cm	cobble
>25.6 cm	boulder
bedrock	

Streamside Vegetation (check all that apply, circle dominant)
☐ ferns/grass ☒ shrubs ☒ deciduous trees ☐ coniferous trees

Canopy Coverage
☐ 0% ☒ 1 - 25% ☐ 26 - 50% ☐ 51 - 75% ☐ 76% - 100%

Macrophyte Coverage
☐ 0% ☒ 1 - 25% ☐ 26 - 50% ☐ 51 - 75% ☐ 76% - 100%

List dominant macrophyte type(s): Myrophylum., bryophyte?

Periphyton Coverage
☐ 1 - Rocks not slippery, no obvious colour (<0.5mm thick)
☐ 2 - Rocks slightly slippery, yellow-brown to light green colour (0.5-1mm thick)
☒ 3 - Rocks have noticeable slippery feel, patches of thicker green to brown algae (1-5mm thick)
☐ 4 - Rocks are very slippery, numerous clumps (5-20mm thick)
☐ 5 - Rocks mostly obscured by algae mat, may have long strands (>20mm thick)

Bank Stability
☐ stable, no erosion
☒ moderate
☐ unstable, substantial erosion

Water Appearance
colour: clear
clarity: cloudy

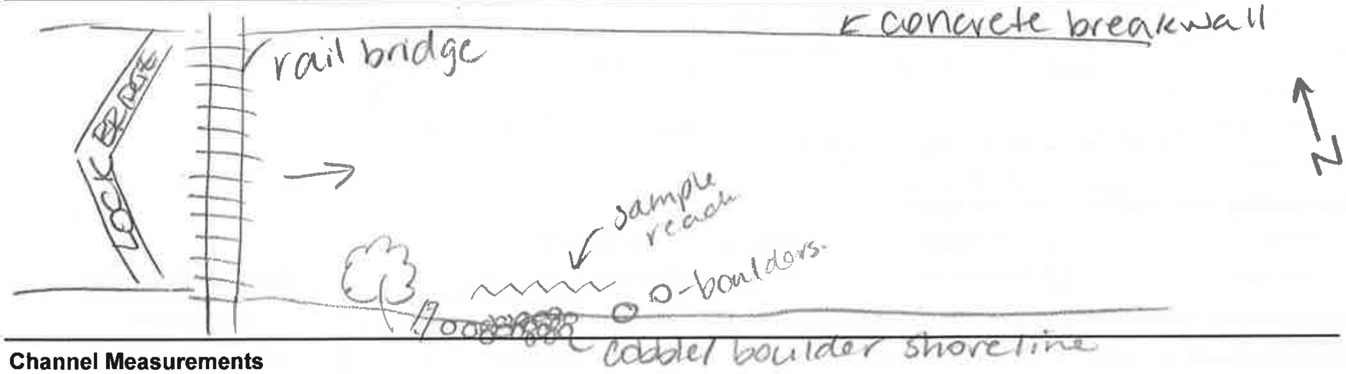
Photos (take all in order) yes
1. field sheet
2. upstream
3. downstream
4. across
5. substrate
6. other:

Comments:
lots of leaf litter in stream

Signature: MWhite

Stream Habitat Characterization
(And CABIN Samples) 2 of 3

Station Diagram include: North arrow, flow direction, major features, sampling locations (all types)



Channel Measurements

Bankfull Width: 25 m Bankfull - Wetted Depth: 25 cm

Wetted Width: 22 m Gradient (%): 0 ☒ clinometer ☐ other:

Interval:	1	2	3	4	5	6	7	8
Distance from shore (m)	N/A							
Depth (cm)	~~10~~ 25	~~16~~ 41	~~23~~ 58	~~18~~ 46	~~10~~ 25	~~17~~ 43	~~16~~ 41	
Velocity (m/s)	0	0	0	0	0	0	0	

Water Quality

Temperature (°C): ~~5.96~~ 5.86 Specific Conductance (uS/cm): ~~400~~ 593

Dissolved Oxygen - mg/L: ~~9.84~~ 10.66 Conductivity (uS/cm): ~~254~~ 376

% Sat: ~~79.0~~ 85.0 pH (pH units): ~~7.50~~ 7.41

Water sample collected? Yes / No Sediment collected? Yes / No

Duplicate water sample? Yes / No ID: Dup. sed. sample? Yes / No ID:

CABIN Invertebrate Community Samples

Equipment:

☒ triangle net ☐ D-net ☐ other:

Sieve Size (um)

☐ 500 ☒ 400 ☐ 250

sampling time (min): 3 sampler initials: MW

total kick distance (m) 12 number of jars: 1

full transects?: Yes / No

OR # of transects:

distance from shore (m): N/A

Stream Habitat Characterization
(And CABIN Samples) 3 of 3

Client: AEL (Parks Canada)
Date/Time: 24 NOV 2017 9:30
Waterbody: Rideau River

Project Name/Number: 17-2409
Field Crew: M. White, N. Wiemann
Area ID: SED 5

METHOD DESCRIPTION

CABIN protocol - zigzag through sampling area, stopping every 2 steps. Touch the rock nearest to your toe without looking. Pull out the piece of substrate the tip of finger is touching (try not to bias by size). Measure the intermediate axis (perpendicular to the longest axis). For every 10th rock, estimate the amount of the rock embedded in the surrounding material (in 1/4 fractions).

DATA

Rock #	Intermediate Axis Length (cm)	Embed (as 1/4 fractions)	Rock #	Intermediate Axis Length (cm)	Embed (as 1/4 fractions)	Rock #	Intermediate Axis Length (cm)	Embed (as 1/4 fractions)	Rock #	Intermediate Axis Length (cm)	Embed (as 1/4 fractions)
1	13		26	12		51			76		
2	11		27	28		52			77		
3	13		28	12		53			78		
4	10.5		29	18		54			79		
5	10		30	9.5	1/4	55			80		
6	9		31	6		56			81		
7	5.5		32	7.5		57			82		
8	7		33	3		58			83		
9	15		34	4.5		59			84		
10	5	1/4	35	8.5		60			85		
11	3.5		36	16		61			86		
12	3.5		37	8		62			87		
13	4		38	7.5		63			88		
14	9		39	7.5		64			89		
15	11		40	11.5	1/2	65			90		
16	8		41	11		66			91		
17	14		42	7.5		67			92		
18	4		43	11		68			93		
19	7.5		44	8		69			94		
20	5	1/4	45	15		70			95		
21	20		46	10		71			96		
22	4.5		47	14.5		72			97		
23	4.5		48	19		73			98		
24	12		49	6		74			99		
25	10		50	4.5	1/4	75			100		

Description of Interstitial material: sand.

Stream Habitat Characterization
(And CABIN Samples) 1 of 3

Client/Project: AEL (Parks Canada) Area ID: SED 6 Ref / Exp: EXP.
Project #: 17-2409 Waterbody: Rideau River
Date / Time: 23NOV2017 15:30 Coordinates: 420 803 Elevation:
Field Crew: M.White N.Wiemann 4971483 18
Weather, air temp: 0°C, cloudy Map Datum: NAD 83 or other:
Site Access: Slys Locks property

Surrounding Land Use (check all that apply)

- ☐ Forest ☐ Field Crops ☐ Logging ☐ Commercial
- ☐ Livestock ☒ Residential ☐ Mining ☑ Other: landfill

Anthropogenic Influences: rail bridge u/s; path along shore

Reach Assessed (consider ~6 X wetted width): ☐ 10m ☐ 30m ☒ 50m ☐ 100m

Habitat (percentage of assessed reach) * See photos

riffle — rapids —
straight run 70 pool/back eddy 30

Substrate (percentage of assessed reach)

bedrock — cobble 60 gravel 20 organic —
boulder 20 pebble — sand/finer —

Substrate Size Class	
organic cover	
<0.1 cm	sand/silt/clay
0.1-0.2 cm	sand
0.2-1.6 cm	gravel
1.6-6.4 cm	pebble
6.4-25.6 cm	cobble
>25.6 cm	boulder
bedrock	

Streamside Vegetation (check all that apply, circle dominant)

☒ ferns/grass ☑ shrubs ☒ deciduous trees ☑ coniferous trees

Canopy Coverage

☐ 0% ☒ 1 - 25% ☐ 26 - 50% ☐ 51 - 75% ☐ 76% - 100%

Macrophyte Coverage

☐ 0% ☒ 1 - 25% ☐ 26 - 50% ☐ 51 - 75% ☐ 76% - 100%

List dominant macrophyte type(s): Typha sp.; Myriophylum;

Periphyton Coverage

- ☐ 1 - Rocks not slippery, no obvious colour (<0.5mm thick)
- ☒ 2 - Rocks slightly slippery, yellow-brown to light green colour (0.5-1mm thick)
- ☐ 3 - Rocks have noticeable slippery feel, patches of thicker green to brown algae (1-5mm thick)
- ☐ 4 - Rocks are very slippery, numerous clumps (5-20mm thick)
- ☐ 5 - Rocks mostly obscured by algae mat, may have long strands (>20mm thick)

Bank Stability

- ☒ stable, no erosion
- ☐ moderate
- ☐ unstable, substantial erosion

Water Appearance

colour none
clarity clear

Photos (take all in order) yes.

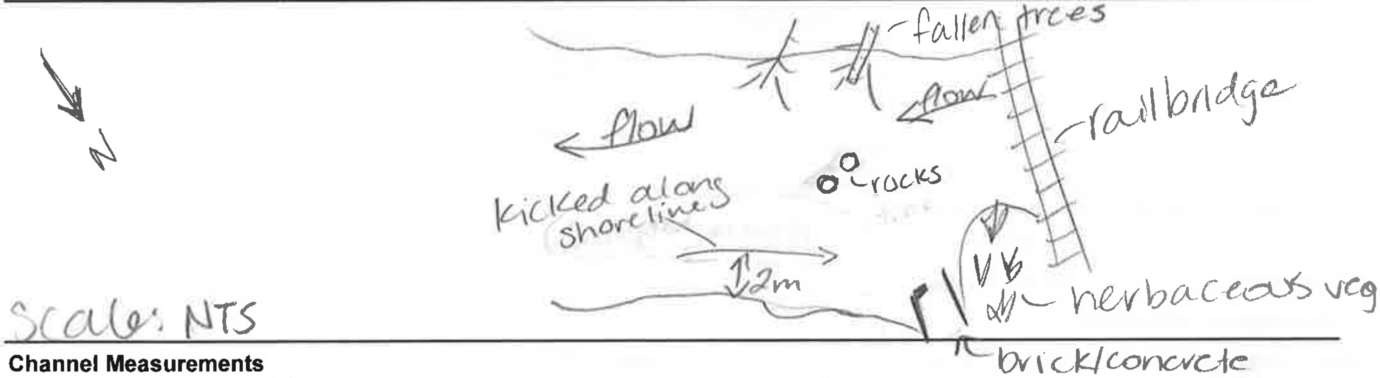
1. field sheet
2. upstream
3. downstream
4. across
5. substrate
6. other:

Comments:

Signature: [signature]

Stream Habitat Characterization
(And CABIN Samples) 2 of 3

Station Diagram include: North arrow, flow direction, major features, sampling locations (all types)



Channel Measurements

Bankfull Width: N/A   Bankfull - Wetted Depth: N/A

Wetted Width: 120 m   Gradient (%): N/A   ☐ clinometer   ☐ other:

Interval:	1	2	3	4	5	6	7	8
Distance from shore (m)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Depth (cm)	~~18~~	~~24~~	~~25~~	~~24~~	~~20~~			
Velocity (m/s)	~~0.34~~	~~0.36~~	~~0.35~~	~~0.36~~	~~0.35~~			
	50 0.12	51 0.09	45 0.03	67 0.04	60 0.01	41 0.05	33 0.02	

Water Quality

Temperature (°C): 1.52   Specific Conductance (uS/cm): 224

Dissolved Oxygen - mg/L: 14.25   Conductivity (uS/cm): 123

% Sat: 101.7   pH (pH units): 7.23

Water sample collected? Yes / No (circled: No)   Sediment collected? Yes / No (circled: No)

Duplicate water sample? Yes / No (circled: No) ID: Dup. sed. sample? Yes / No (circled: No) ID:

CABIN Invertebrate Community Samples

Equipment:

☒ triangle net   ☐ D-net   ☑ other: kick net

Sieve Size (um)

☐ 500   ☒ 400   ☐ 250

sampling time (min): 3   sampler initials: MW

total kick distance (m) 10   number of jars: 1

full transects?: Yes / No (circled: No)

OR   # of transects: Ø

distance from shore (m): ~~2~~ N/A

Stream Habitat Characterization
(And CABIN Samples) 3 of 3

Client: AEL (Parks Canada)
Date/Time: 23 NOV 2017 15:30
Waterbody: Rideau River

Project Name/Number: 17-2409
Field Crew: M. White N. Niemann
Area ID: SED6

METHOD DESCRIPTION

CABIN protocol - zigzag through sampling area, stopping every 2 steps. Touch the rock nearest to your toe without looking. Pull out the piece of substrate the tip of finger is touching (try not to bias by size). Measure the intermediate axis (perpendicular to the longest axis). For every 10th rock, estimate the amount of the rock embedded in the surrounding material (in 1/4 fractions).

DATA

Rock #	Intermediate Axis Length (cm)	Embed (as 1/4 fractions)	Rock #	Intermediate Axis Length (cm)	Embed (as 1/4 fractions)	Rock #	Intermediate Axis Length (cm)	Embed (as 1/4 fractions)	Rock #	Intermediate Axis Length (cm)	Embed (as 1/4 fractions)
1	13		26	11		51			76		
2	18		27	16		52			77		
3	8.5		28	11.5		53			78		
4	7		29	8.5		54			79		
5	9		30	6.5	1/4	55			80		
6	1		31	4		56			81		
7	26		32	1		57			82		
8	13		33	4		58			83		
9	5.5		34	27		59			84		
10	14	1/4	35	7		60			85		
11	9.5		36	12		61			86		
12	9		37	10		62			87		
13	6		38	16		63			88		
14	10.5		39	10		64			89		
15	19		40	18	1/4	65			90		
16	15		41	12		66			91		
17	18		42	8		67			92		
18	24		43	12		68			93		
19	25		44	7.5		69			94		
20	25	1/4	45	11.5		70			95		
21	26		46	10		71			96		
22	16		47	7		72			97		
23	15		48	7.5		73			98		
24	11		49	14		74			99		
25	2		50	9.5	1/4	75			100		

Description of Interstitial material: Sand and gravel

Stream Habitat Characterization (And CABIN Samples) 1 of 3

Client/Project: AEL (Parks Canada) Area ID: SED7 Ref / Exp: exp.
Project #: 17-2409 Waterbody: Rideau River
Date / Time: 23NOV2017 16:30 Coordinates: 420727 Elevation:
Field Crew: M. White, N. Wiemann 4971451 18
Weather, air temp: 0°C, cloudy Map Datum: NAD 83 or other:
Site Access: Slys Lock Park.

Surrounding Land Use (check all that apply)

☐ Forest ☐ Field Crops ☐ Logging ☐ Commercial
☐ Livestock ☒ Residential ☐ Mining ☒ Other: landfill

Anthropogenic Influences: under rail bridge, nearby park.

Reach Assessed (consider ~6 X wetted width): ☐ 10m ☐ 30m ☒ 50m ☐ 100m

Habitat (percentage of assessed reach)

riffle 40 rapids —
straight run 40 pool/back eddy 20

Substrate (percentage of assessed reach)

bedrock — cobble 60 gravel — organic —
boulder 10 pebble 30 sand/finer —

Substrate Size Class	
organic cover	
<0.1 cm	sand/silt/clay
0.1-0.2 cm	sand
0.2-1.6 cm	gravel
1.6-6.4 cm	pebble
6.4-25.6 cm	cobble
>25.6 cm	boulder
bedrock	

Streamside Vegetation (check all that apply, circle dominant)

☐ ferns/grass ☒ shrubs ☒ deciduous trees ☐ coniferous trees

Canopy Coverage

☐ 0% ☒ 1 - 25% ☐ 26 - 50% ☐ 51 - 75% ☐ 76% - 100%

Macrophyte Coverage

☐ 0% ☒ 1 - 25% ☐ 26 - 50% ☐ 51 - 75% ☐ 76% - 100%

List dominant macrophyte type(s): Typha sp; small patch of grass (2-3) aquatic

Periphyton Coverage

☐ 1 - Rocks not slippery, no obvious colour (<0.5mm thick)
☐ 2 - Rocks slightly slippery, yellow-brown to light green colour (0.5-1mm thick)
☒ 3 - Rocks have noticeable slippery feel, patches of thicker green to brown algae (1-5mm thick)
☐ 4 - Rocks are very slippery, numerous clumps (5-20mm thick)
☐ 5 - Rocks mostly obscured by algae mat, may have long strands (>20mm thick)

Bank Stability

☐ stable, no erosion
☒ moderate
☐ unstable, substantial erosion

Water Appearance

colour none.
clarity transparent

Photos (take all in order)

1. field sheet
2. upstream
3. downstream
4. across
5. substrate
6. other:

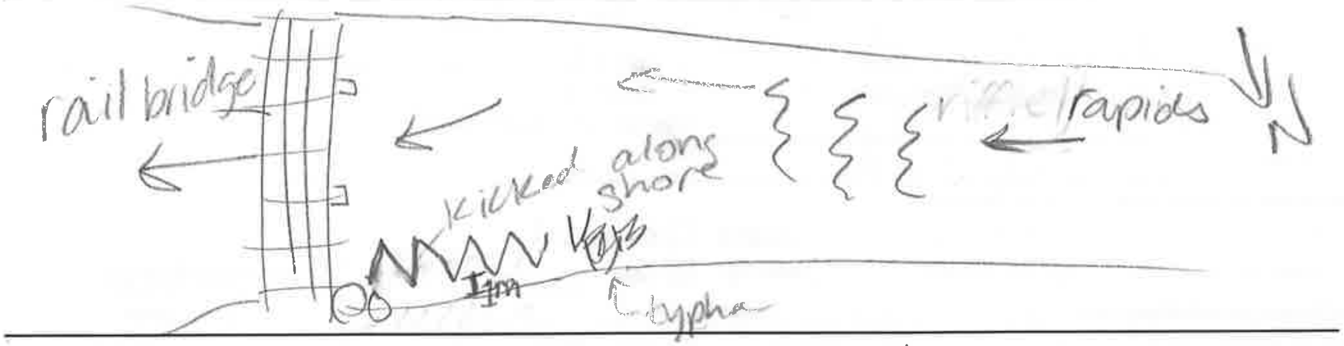
yes

Comments:
near fast rapids (hydrolic)

Signature: Nicholette

Stream Habitat Characterization
(And CABIN Samples) 2 of 3

Station Diagram include: North arrow, flow direction, major features, sampling locations (all types)



Channel Measurements

Bankfull Width: 55 m   Bankfull - Wetted Depth: ~~24~~ 51 cm

Wetted Width: 50 m   Gradient (%): 1   ☒ clinometer   ☐ other:

Interval:	1	2	3	4	5	6	7	8
Distance from shore (m)	N/A	→						
Depth (cm)	35	28	42	37	33	41	52	
Velocity (m/s)	0.75	1.02	0.82	0.63	0.38	0.57	0.55	

Water Quality

Temperature (°C): 1.40   Specific Conductance (uS/cm): 222

Dissolved Oxygen - mg/L: 15.01   Conductivity (uS/cm): 122

% Sat: 106.6   pH (pH units): 7.95

Water sample collected? Yes / **No**   Sediment collected? Yes / **No**

Duplicate water sample? Yes / **No**   ID: —   Dup. sed. sample? Yes / **No**   ID: —

CABIN Invertebrate Community Samples

Equipment:

☒ triangle net   ☐ D-net   ☐ other:

Sieve Size (um)

☐ 500   ☒ 400   ☐ 250

sampling time (min): 3   sampler initials: MW

total kick distance (m): 12   number of jars: 1

full transects?: Yes / **No**

OR   # of transects:

distance from shore (m): N/A

Stream Habitat Characterization
(And CABIN Samples) 3 of 3

Client: AEL (Parks Canada)
Date/Time: 23 NOV 2017 16:30
Waterbody: Rideau River

Project Name/Number: 17-2409
Field Crew: MW NW
Area ID: SED7

METHOD DESCRIPTION

CABIN protocol - zigzag through sampling area, stopping every 2 steps. Touch the rock nearest to your toe without looking. Pull out the piece of substrate the tip of finger is touching (try not to bias by size). Measure the intermediate axis (perpendicular to the longest axis). For every 10th rock, estimate the amount of the rock embedded in the surrounding material (in 1/4 fractions).

DATA

Rock #	Intermediate Axis Length (cm)	Embed (as 1/4 fractions)	Rock #	Intermediate Axis Length (cm)	Embed (as 1/4 fractions)	Rock #	Intermediate Axis Length (cm)	Embed (as 1/4 fractions)	Rock #	Intermediate Axis Length (cm)	Embed (as 1/4 fractions)
1	6		26	10		51			76		
2	8		27	6		52			77		
3	13		28	6.5		53			78		
4	13.5		29	5		54			79		
5	6		30	7	1/4	55			80		
6	22		31	11		56			81		
7	11		32	12		57			82		
8	7.5		33	23		58			83		
9	9		34	19		59			84		
10	8	1/2	35	16		60			85		
11	7.5		36	20		61			86		
12	6		37	12.5		62			87		
13	7.5		38	4.5		63			88		
14	6		39	5.5		64			89		
15	5.5		40	13.5	1/2	65			90		
16	7		41	8.5		66			91		
17	6.5		42	5.5		67			92		
18	5		43	8.5		68			93		
19	23		44	10.5		69			94		
20	20	1/4	45	4.5		70			95		
21	8		46	18		71			96		
22	10		47	10		72			97		
23	16		48	26		73			98		
24	22		49	14		74			99		
25	15		50	15.5	1/2	75			100		

Description of Interstitial material: Sand and gravel.

1705 Argentia Road, Unit 3 | Mississauga, Ontario, L5N 3A9
Tel/Fax: 416-657-2367| Toll free: 1-800-267-4797
info@aelenv.com | www.aelenv.com

APPENDIX 5
Equations for Human Health Exposure Assessment

APPENDIX 4: Equations for Human Health Exposure Assessment

The equations used to calculate the dose of each COC, to each receptor, are shown below.

Incidental Ingestion of Soil

The dose of each COC, via incidental ingestion of soil, is calculated from the following equation:

$$Dose_{Ing} = C_S \times SIR \times AF_{git} \times EF_1 \times EF_{out} \times ED / (BW \times AT \times 365\ d/y \times 1000\ \mu g/mg)$$

where:

$Dose_{Ing}$	=	Dose due to ingestion of soil (mg/kg/d)
C_S	=	Concentration in soil (µg/g)
SIR	=	Soil ingestion rate (g/day)
AF_{git}	=	Absorption factor from the gastrointestinal tract (unitless)
EF_1	=	Exposure frequency (days per week exposed)
EF_{out}	=	Exposure frequency (weeks per year exposed)
ED	=	Exposure duration (y)
BW	=	Body weight (kg)
AT	=	Averaging time (y)

Dermal Contact with Soil

The dose of each COC, via dermal contact with soil, is calculated from the following equation:

$$Dose_{Derm\ Soil} = C_S \times SSA \times E \times ADH \times AF_s \times EF_1 \times EF_{out} \times ED/(BW \times AT \times 365\ d/y \times 1000\ \mu g/mg)$$

where:

$Dose_{Derm\ Soil}$	=	Dose due to dermal contact with soil (mg/kg/d)
SSA	=	Surface area of skin exposed to soil (cm^2)
E	=	Events of skin exposure per day (events/day)
ADH	=	Adherence of soil to skin (g/cm^2/event)
AF_S	=	Dermal absorption factor (unitless)

Inhalation of Particulate Matter

The dose of chemical, via inhalation of particulate matter, is calculated from the following equation:

$$Dose_{Inh\ PM} = C_S \times INH \times C_{PM10} \times AF_I \times EF_1 \times EF_{out} \times EF \times ED / (BW \times AT \times 365\ d/y \times 10^6\ \mu g/g \times 10^3\ \mu g/mg)$$

where:
$Dose_{Inh\ PM}$ = Dose due to inhalation of particulate matter (mg/kg/d)
INH = Inhalation rate (m^3/h)
C_{PM10} = Concentration of particulate matter, 10 µm or less, in air (µg/m^3)
AF_I = Absorption factor for inhalation (unitless)
EF = Exposure frequency (hours per day)

Dermal Contact with Groundwater

The dose of each COC, via dermal contact with groundwater, is calculated from the following equation (USEPA, 2004):

$$Dose_{Derm\ W} = SSA \times DA_{event} \times EV \times EF_1 \times EF_{out} \times ED/(BW \times AT \times 365\ d/y)$$

where:
$Dose_{Derm\ W}$ = Dose due to dermal contact with groundwater (mg/kg/d)
SSA = Skin surface area in contact with groundwater (cm^2)
DA_{event} = Absorbed dose per event (mg/cm^2/event)
EV = Number of times per day groundwater contacted (events/d)

For organic COCs, the absorbed dose per event is calculated from the following equation:

$$DA_{event} = 2 \times FA \times PC \times C_{GW} \times (6 \times LT \times ET / 3.14159)^{0.5} / (1000\ cm^3/L \times 1000\ ug/mg)$$

where:
FA = Fraction absorbed from water (no units)
PC = Dermal permeability constant (cm/h)
C_{GW} = Concentration of COC in groundwater (ug/L)
LT = Lag time (h)
ET = Exposure time for contact with groundwater (h)

Ingestion of Groundwater

The dose of each COC via incidental ingestion of groundwater is calculated from the following equation:

$$Dose_{Ing\ W} = C_{GW} \times IR_{GW} \times AF_{git} \times EF_1 \times EF_{out} \times ED/(BW \times AT \times 365\ d/y \times 1000\ ug/mg)$$

where:
$Dose_{Ing\ W}$ = Dose due to ingestion of groundwater (mg/kg/d)
IR_{GW} = Ingestion rate of groundwater (L/d)

AF_{git} = Absorption factor from the gastrointestinal tract (unitless)

AELenvironment
A division of Aeon Egmond Ltd.
1705 Argentia Road, Unit 3 | Mississauga, Ontario, L5N 3A9
Tel/Fax: 416-657-2367| Toll free: 1-800-267-4797
info@aelenv.com | www.aelenv.com

APPENDIX 6
Species At Risk Evaluation

MEMORANDUM

To: Charna Kozole **From: Sarah Mainguy**

Re: Potential for SAR on the Old Sly Lockstation site **Date: 25 August 2017**

I have reviewed existing information on Species at Risk (SAR) in the vicinity of the Old Sly Lockstation site. Sources used were the Ministry of Natural Resources and Forestry Natural Heritage Information Centre (NHIC) interactive mapping site that shows species that are provincially tracked, and the Department of Fisheries and Oceans SAR mapping website. I am also providing additional observations of species in my experience that are very widespread and would be expected to be in the vicinity of Smiths Falls.

I have scrutinized the aerial photos obtained for the site, in order to cross-reference the SAR for which the range overlaps with the site with the habitat that persists on the site.

Provincially Tracked Species on NHIC Database
Table 1 provides a list of provincially tracked species that have been recorded within approximately 1 km of the Old Sly site, species mapped within the range of the site by the Ontario Herpetofaunal Summary or federal Critical Habitat mapping, species that are mapped by the Department of Fisheries and Oceans near the site, as well as other species that would be highly likely to be on the site, based on the habitat. All are considered federal Species at Risk. Habitat for all these species occurs within the study area, and is present on the site or within approximately 500 m of the site.

Table 1. Potential Species at Risk and provincially rare species on the site

Common Name	Scientific Name	Federal Status	Habitat Elements on Site
Butternut	*Juglans cinerea*	END, Schedule 1	open woodlands
Little Brown Myotis	*Myotis lucifugus*	END, Schedule 1	Roosts in buildings and tree cavities; likely forage on aerial insects over the site
Northern Myotis	*Myotis septentrionalis*	END, Schedule 1	Roosts in tree cavities; likely forage on aerial insects over the site
Gray Ratsnake (Frontenac Axis population)	*Pantherophis spiloides pop. 1*	THR, Schedule 1	mosaic of forest and open habitat (fields; bedrock outcrops) with a high amount of edge; potential to hibernate in building foundations

Common Name	Scientific Name	Federal Status	Habitat Elements on Site
Barn Swallow	*Hirundo rustica*	THR, Schedule 1	Nests on human buildings and bridges; likely forage over the site
Eastern Wood-pewee	*Contopus virens*	SC, Schedule 1	Nests in trees in a variety of woodland habitats
Eastern Whip-poor-will	*Antrostomus vociferus*	THR, Schedule 1	Nests on the ground in woodland openings, generally associated with large forested areas and not found in highly disturbed areas; would not nest in parkland on the site but potentially nests along the river downstream
Western Chorus Frog	*Pseudacris triseriata*	THR, Schedule 1	Breeds in shallow flooded areas of thickets and thicket swamps; no suitable habitat on site but may breed in areas along the river downstream
Eastern Musk Turtle	*Sternotherus odoratus*	SC, Schedule 1	Forages and overwinters in well-vegetated calm waters and nests in close proximity to this habitat; suitable habitat not present on site but potentially present approximately 500 m downstream
Northern Map Turtle	*Graptemys geographica*	SC, Schedule 1	Forages and overwinters in well-vegetated calm waters and nests in close proximity to this habitat; suitable habitat not present on site but potentially present approximately 500 m downstream
Bridle Shiner	*Notropis bifrenatus*	SC, Schedule 1	quiet areas of streams and occasionally in lakes. It is usually found where there is an abundance of aquatic vegetation, where it feeds and spawns

Common Name	Scientific Name	Federal Status	Habitat Elements on Site
Grass Pickerel	*Esox americanus vermiculatus*	SC, Schedule 1	warm, slow moving streams, isolated pools of such streams, and shallow bays of lakes.

Aquatic Species at Risk mapping
Aquatic Species at Risk mapping indicates two aquatic (fish) Species at Risk, with a status of Special Concern, in the Rideau River upstream and downstream of the site, as shown in Figure 1. However, neither of these species is known to occur within the site.

Common Name*	Scientific Name	Taxon	Species at Risk Status
Bridle Shiner	*Notropis bifrenatus*	Fishes	Special Concern
Grass Pickerel	*Esox americanus vermiculatus*	Fishes	Special Concern

Tasks to be Completed on Site
Parks Canada has indicated the following tasks to be conducted on the site:

- Construction of upstream and downstream cofferdams
- Dewatering of work areas
- Removal of algae, debris and zebra mussels
- Sawcutting and raking mortar joints
- Removal of deteriorated stones/materials
- Potential for excavation behind lock/approach walls
- Masonry/grouting and
- Landscaping, site reinstatement to previous condition

Table 2 provides a summary of the works that have the potential to disrupt the habitat of Species at Risk on the site.

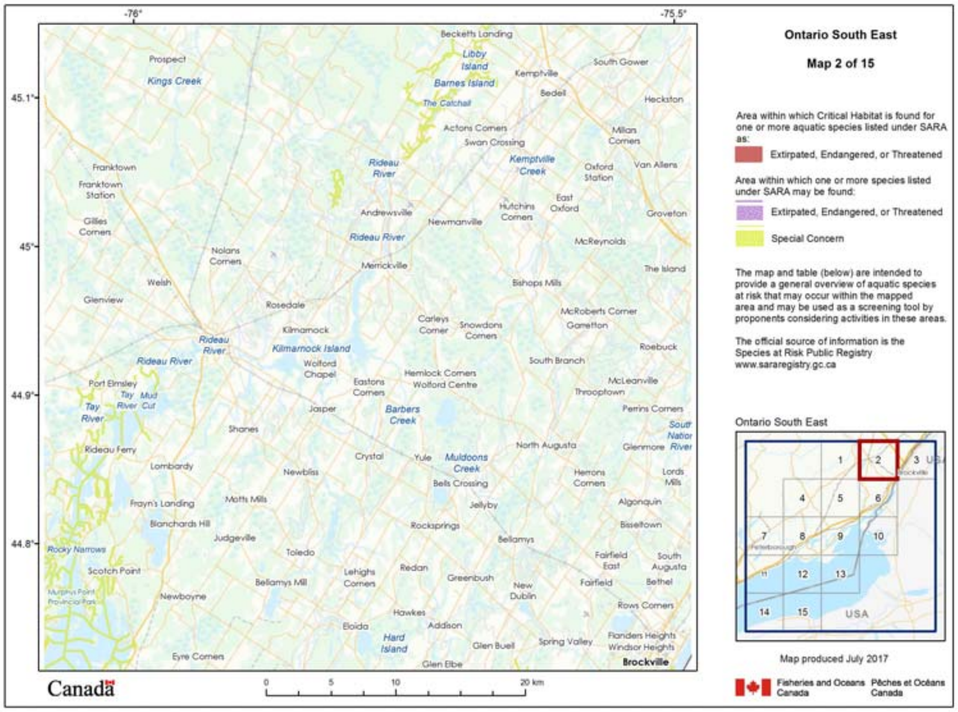


Figure 1. Aquatic Species at Risk mapping within the Smiths Falls area

Table 2. Summary of activities that have the potential to disrupt habitat for Endangered or Threatened Species at Risk with potential to occur at the Old Sly Lockstation site

Common Name	Species at Risk Status	Habitat	Potential Habitat-Disrupting Activities
Butternut	END	open woodlands	tree removal
Little Brown Myotis	END	Roost in buildings and tree cavities	tree removal; potential for impacts to nest site if repair of masonry impacts nest site or if bats' entry and exit holes into buildings are blocked
Northern Myotis	END	Roost in tree cavities	tree removal
Eastern Wood-pewee	SC	open woodlands	tree removal
Gray Ratsnake (Frontenac Axis population)	THR	mosaic of forest and open habitat (fields; bedrock outcrops) with a high amount of edge; potential to hibernate in building foundations	Short-term impacts to foraging areas from construction vehicles; potential harm to snakes from construction vehicles; disruption of hibernation habitat through removal or alteration of rock, foundations, masonry and stone
Barn Swallow	THR	nests on buildings and under bridges	Potential for impacts to habitat if repair of masonry includes nest

Common Name	Species at Risk Status	Habitat	Potential Habitat-Disrupting Activities
			site
Whip-poor-will	Antrostomus vociferus	THR, Schedule 1	none
Western Chorus Frog	Pseudacris triseriata	THR, Schedule 1	none
Eastern Musk Turtle	Sternotherus odoratus	SC, Schedule 1	none
Northern Map Turtle	Graptemys geographica	SC, Schedule 1	none
Bridle Shiner	SC	suitable habitat only in shallow marsh on east side of site	none
Grass Pickerel	SC	Suitable habitat only in shallow marsh on east side of site	none

Discussion and Conclusion

Gray Ratsnake is a Species at Risk potentially on the Old Sly Lockstation site that may use gaps, fissures and animal burrows adjacent to foundations and stone walls to access hibernation sites below the frost line in winter. No critical habitat has been identified to date in Smiths Falls in proposed critical habitat mapping (Environment Canada 2017, proposed). The Recovery Strategy for this species notes that critical habitat includes "*Critical habitat structures and features that extend below the frost line, with sufficient humidity to prevent snakes from drying out, and that provide protection from flooding (e.g., above high water mark) and predators. Such structures and features include crevices, fissures or underground ledges (naturally occurring features), old wells, septic tile beds and building foundations (non-naturally occurring features)*"

This species would likely not be at risk from site works associated with repair of lock walls, as they would be below the high water mark. The potential would be low for a hibernaculum if the soil behind the lock walls were wet, as this species hibernates in dry sites. However, if the environment behind the lock wall were high in humidity but not wet, there is the potential that this species could find a hibernaculum behind the lock wall. This snake needs hibernacula that provide sufficient humidity to protect the snake from dehydration during the winter, so if the site is humid but not wet there could still be the potential for a hibernaculum.

Gray Ratsnake hibernates communally so there is the potential for high impact if a hibernaculum were to be disturbed. This species returns to suitable hibernacula year after year. It is recommended that the environment behind the lock wall be investigated to determine if it is wet. If the habitat appears suitable for Gray Ratsnake, ot if a Gray Ratsnake is found, it is recommended that Environment Canada be contacted immediately.

It is highly unlikely that any of the other Species at Risk would be affected by repair of the lock unless large-scale tree removal takes place, in which case it could affect Species at Risk that nest or roost in trees, such as bats and Eastern Wood-pewee.

Reference: Recovery Strategy for the Gray Ratsnake (*Pantherophis spiloides*), Carolinian and Great Lakes/St. Lawrence Populations, in Canada [Proposed] – 2017. Accessed on-line September 2017 at https://www.registrelep-sararegistry.gc.ca/default.asp?lang=En&n=C4DC62FD-1&offset=2&toc=show

AELenvironment
A division of Aeon Egmond Ltd.
1705 Argentia Road, Unit 3 | Mississauga, Ontario, L5N 3A9
Tel/Fax: 416-657-2367| Toll free: 1-800-267-4797
info@aelenv.com | www.aelenv.com

APPENDIX 7
Site Closure Tool

FCSAP SCT/TRAV SPREADSHEET
Site Data Sheet

Site Name:	Old Slys Lockstation
FCSI# :	9412002
DFRP#:	5P420-17-5157
Completed By:	AEL environment
Date Completed (mm/dd/yyyy):	06/12/2018
Document #:	10888

	Question	Response	Rationale/Evidence (document any assumptions, reports, or site-specific information; provide references)	Guidance	Instructions	Flag (for review)
Site Data						
1. Sources of Contamination						
A	List main sources of contamination for this site - describe any additional sources in the rationale box:			Based on historical and current property use, areas of environmental concern identified in the Phase II ESA should be considered in the RA and/or remedial action planning. Also, consider that source areas could include off-site sources of contamination. User defined sources and associated COCs can be defined in rows 6 through 9 on the Reference-Contaminant Sources tab. If you wish to define user source / COCs, please do so before selecting the source from the dropdown box on the Site Data tab.		
	Source 1	Landfills				
	Source 2				Define Source 2 (if applicable)	
	Source 3				Define Source 3 (if applicable)	
	Source 4				Define Source 4 (if applicable)	
	Additional sources?					
B	For each source below please indicate if all typical contaminants were assessed in the Phase II ESA. Note that the list of typical contaminants is not exhaustive and professional judgement should be used to determine substances that should be assessed.					
	Source 1: Landfills					
	Typical contaminants: Metals (including iron, mercury, lead, zinc), PHCs, BTEX, PAHs, VOCs, phenols, cyanide, PCBs, PCDDs/DFs, pesticides, gases (including methane, carbon dioxide)					
	Were the typical contaminants listed above <u>considered</u> in the site assessment? If typical contaminants were considered but not assessed, answer 'y' and provide an explanation.	y				
	Source 2:					
	Were the typical contaminants listed above <u>considered</u> in the site assessment? If typical contaminants were considered but not assessed, answer 'y' and provide an explanation.					
	Source 3:					
	Were the typical contaminants listed above <u>considered</u> in the site assessment? If typical contaminants were considered but not assessed, answer 'y' and provide an explanation.					
	Source 4:					
	Were the typical contaminants listed above <u>considered</u> in the site assessment? If typical contaminants were considered but not assessed, answer 'y' and provide an explanation.					
	If Other Sources were listed					
	Were the typical contaminants listed above <u>considered</u> in the site assessment? If typical contaminants were considered but not assessed, answer 'y' and provide an explanation.					

FCSAP SCT/TRAV SPREADSHEET

Site Data Sheet

Site Name:	Old Slys Lockstation
FCSI# :	9412002
DFRP#:	5P420-17-5157
Completed By:	AEL environment
Date Completed (mm/dd/yyyy):	06/12/2018
Document #:	10888

	Question	Response	Rationale/Evidence (document any assumptions, reports, or site-specific information; provide references)	Guidance	Instructions	Flag (for review)
Site Data						
2. Media with COCs						
A	Based on sources of contamination, measured concentrations and contaminant migration, indicate if there are known COCs present above applicable guidelines (or background) in each of the media listed below. Provide rationale if COCs are not present above guidelines in a given					
i	Surface Soil (0 - 1.5 mbgs)	Considered and COCs present		**Considered and COCs present** (e.g., directly measured or calculated) - For this category, medium is known or assumed to be impacted by COCs (above guidelines) based on direct measurements or consideration of contaminant fate and transport mechanisms. **Considered and COCs not present** (e.g., by testing, modeling, barrier to migration, etc.) – If selecting this answer, it is known or assumed that the medium is NOT impacted with COCs based on direct measurements or consideration of contaminant fate and transport mechanisms. Rationale should be provided to explain why COC not present (above guidelines) in a given medium. **Not considered in assessment -** If selecting this answer, the medium was NOT considered or evaluated in the assessment and/or contaminant fate and transport mechanisms were not incorporated into the assessment. Rationale is required to explain why the medium was not considered. **na** - The medium was considered not applicable in the assessment. Rationale is required to explain why the medium was considered not applicable (e.g., sediment not applicable (na) when the site is not near a water body). Ensure that contaminant fate and transport is considered and if not that sufficient rationale is provided. Contaminant transport considerations are based on contaminant properties and site characteristics including physical setting and hydrogeology. For surface water, Expert Support recommends that contaminant See Reference Material Tab for additional information.		
ii	Subsurface Soil (> 1.5 mbgs)	Considered and COCs present				
iii	Groundwater	Considered and COCs present				
iv	Surface Water (including seawater)	Considered and COCs present				
v	Sediment	Considered and COCs present				
vi	Outdoor Air	Not considered	CoCs are not volatile, and will not impact outdoor air		If not considered, then a major deficiency is assigned unless rationale is provided.	
vii	Indoor Air	na	No buildings or structures present on site		If NA, provide rationale.	
viii	Other Media 1					
ix	Other Media 2					
B	Have all potential contaminant release and transport mechanisms been described?	y		Contaminant transport considerations are based on contaminant properties and site characteristics including physical setting and hydrogeology. See Reference Material tab for additional information by clicking the link in cell E45 above.		
C	Have all potentially impacted media been sampled?	y				

FCSAP SCT/TRAV SPREADSHEET
Site Data Sheet

Site Name:	Old Slys Lockstation
FCSI# :	9412002
DFRP#:	5P420-17-5157
Completed By:	AEL environment
Date Completed (mm/dd/yyyy):	06/12/2018
Document #:	10888

	Question	Response	Rationale/Evidence (document any assumptions, reports, or site-specific information; provide references)	Guidance	Instructions	Flag (for review)
Site Data						
3. Additional Site Data Considerations						
A	Have areas of environmental concern been delineated horizontally and vertically?	y		See CCME 1993. Guidance Manual on sampling, Analysis, and Data Management for Contaminated Sites. Volume I: Main Report.		
B	Were sufficient samples collected from areas of environmental concern to reflect maximum concentrations?	y		Is the sampling density and coverage sufficient with respect to likely maximum concentrations and site delineation? Was the dataset sufficiently large if statistical interpretation of data was conducted? See CCME 1993. Guidance Manual on sampling, Analysis, and Data Management for Contaminated Sites. Volume I: Main Report. Link in Cell E51		
C	Have QA/QC program elements been incorporated to ensure the validity of the data and scientific approach?	y		The report should detail both the sampling and analytical testing quality assurance and quality control measures employed and describe if the laboratory QA/QC program was acceptable. The laboratory analysis should be completed by an accredited laboratory (e.g., CALA). Analytical detection limits should be sufficiently low to achieve the accuracy and precision required by the RA. Additional information can be found at http://www.cala.ca/	If Yes, proceed to 3D	
i	If the answer is No, does the lack of sufficient QA/QC measures compromise the results of the assessment?			See Reference Material for QA/QC considerations.		
D	Is the site assessment testing program described, including methodology used to collect samples, number of testing locations and analytical program?	y		CCME provides guidance on sampling design in CCME (1993) Guidance Manual on sampling, Analysis, and Data Management for Contaminated Sites. Volume I: Main Report. http://www.ccme.ca/ourwork/soil.html?category_id=68 There is also guidance on sampling and analysis plans in the FCSAP ERA Guidance document.		
E	Was rationale provided for the selection of samples for analytical testing?	y				
F	Are all sampling locations identified on site plans and in data tables?	y				

FCSAP SCT/TRAV SPREADSHEET
Site Data Sheet

Site Name:	Old Slys Lockstation
FCSI# :	9412002
DFRP#:	5P420-17-5157
Completed By:	AEL environment
Date Completed (mm/dd/yyyy):	06/12/2018
Document #:	10888

	Question	Response	Rationale/Evidence (document any assumptions, reports, or site-specific information; provide references)	Guidance	Instructions	Flag (for review)
Site Data						
4. Screening COCs (applicable to risk assessments (RA) only)						
A	Was a risk assessment conducted?	y				
B	Were federal guidelines used to screen COCs? If not, provide rationale.	y		Federal guidelines (e.g., CCME, CDWQG) should be used appropriately (e.g., relevant land use). If other guidelines were used, justification should be provided.		
C	Were maximum concentrations used in the screening process?	y		Maximum concentrations should generally be used for screening purposes. The purpose of this screening step is to compile a conservative list of chemicals for further evaluation. In some cases, statistics other than maximum values can be used. Rationale should be provided in these cases.		
D	Were chemicals whose detection limit was greater than the screening guidelines retained as COCs?	y		Chemicals whose detection limits exceed guideline values should be retained for further evaluation.		
E	If chemicals were screened out because their concentrations fell within background levels, were background concentrations determined appropriately and used correctly?	y		Please refer to current guidance for methods related to establishing background or reference conditions (e.g., FCSAP ERA guidance).		
F	Was consideration given to:					
i	Substances for which there are no guidelines?	na	All substances tested for had guidelines	These substances should be retained unless the rationale for their exclusion is recorded so that the decision process is understood, transparent, easily retraced, and verifiable. If exclusion cannot be rationalized during this step, the chemical is regarded as a COC and retained for further assessment.	If NA, provide rationale.	
ii	Persistent, bioaccumulative or biomagnifying substances?	y		See Reference Material for examples of bioaccumulative substances and degradation products. Appropriate food chain considerations should be incorporated into the risk assessment for these substances.		
iii	Degradation products?	y		See Reference Material for examples of bioaccumulative substances and degradation products. Consideration should be given to degradation products when these are more toxic than their parent substances (e.g., tetrachloroethylene and its degradation products).		

FCSAP SCT/TRAV SPREADSHEET
COC Sheet

Site Name:	Old Slys Lockstation
FCSI # :	9412002
DFRP #:	5P420-17-5157
Completed By:	AEL environment
Date Completed:	06/12/2018
Document #:	10888

For each medium with contamination, list COCs. These are the COCs on the site at the time of the risk assessment and/or remedial action planning. There is enough space for 15 COCs. If the site has more than 15 COCs, consider listing the COCs that are the drivers of the risk assessment and remediation, if applicable. Additional COCs can be included in row 32 "others", which is for record keeping purposes only. For example, consider listing benzo(a)pyrene instead of all PAHs if there are more than 15 COCs, if benzo(a)pyrene is a driver for risk and remediation.

In each row of the table, enter the COC in column B. For each medium, indicate if the COC is present by selecting "y", "n" or "na" from the drop down list. In this case "y" means "yes", the parameter has been measured and is a COC; "n" means "no", the parameter has been measured and is not a COC; "na" means that the parameter has not been measured.

COCs and Media

COC #	COC	Surface Soil (0-1.5 mbgs)	Sub-surface Soil (>1.5 mbgs)	Groundwater	Surface Water	Sediment	Outdoor Air	Indoor Air
1	PHCs	y	y	y	na	n		
2	Toluene	n	y	n	n	y		
3	Xylenes	n	y	n	n	n		
4	Trichloroethylene	n	y	n	n	n		
5	PAHs	y	n	y	na	y		
6	DDD	n	y	na	na	na		
7	Metals	y	n	y	n	y		
8	Chloride	na	na	y	na	na		
9	PCBs	n	n	n	n	y		
10	Cyanide (free)	n	n	n	y	y		
11	Ammonia, unionized	na	na	na	y	na		
12	Acetone	n	n	n	na	y		
13								
14								
15								
others								
Notes	CoCs included were drivers for risk assessment							

Site Closure Tool Closure Evaluation Page

Federal Contaminated Sites Action Plan Site Closure Tool (2014)
Site Closure Evaluation Questionnaire

Site Name (per IDEA):	Old Slys Lockstation
FCSI#:	9412002
DFRP#:	5P420-17-5157
Date (MM/DD/YY):	06/12/2018
Document Number:	10888
Completed By:	AEL environment

Steps 1-6 Site Assessment and Step 7 Risk Assessment

Notes:

1. Completion of the Documentation Tab sections indicated in the Instructions column is only mandatory for sections 4.1 and 4.3, other sections are recommended to be completed at the discretion of the department or agency. However, completion of all relevant sections is highly recommended to ensure custodian documentation requirements are met currently and in the future.

2. The questions below are intended to evaluate completion of each of the Steps 1-6, 7, 8, 9 and 10 of the Federal Approach to Contaminated Sites. In general, responding 'No' will result in failure to achieve the minimum requirements for that step. In some cases, the correct response to a particular question may be 'No', but is not considered by the User to be grounds for not meeting minimum requirements. In such cases the user can select N/A and should provide a brief rational.

3. The SCT is intended to be completed for each site with a unique FCSI number. Large sites may be managed as a single project, but encompass several AECs with unique FCSI numbers, in this case the SCT should be completed for each AEC with a unique FCSI number.

4. Whenever not applicable (N/A) is selected, User should provide rationale in User Rationale column.Notes:

	Question	Response	User Rationale	Guidance	Instructions
1	Complete the Site Data and COCs Worksheets. Were any major deficiencies noted?	No		This question ensures that all Areas of Potential Environmental Concern (APECs) were addressed and their Potential Contaminants of Concern (COPCS) were tested in the supporting Environmental Site Assessments.	Automatically scored based on Site Data worksheet. If the automatic response is Yes, there is a major deficiency identified in the Site Data worksheet that needs to be addressed. Check to see that all questions on the Site Data and COC worksheets (particularly Site Data Q1 and Q2B) have been completed. If No, proceed to next question.
2	Based on the Phase II and III ESAs, did any of the COC concentrations exceed Tier 1 (generic) thresholds?	Yes		This question identifies whether the site can be closed based on a Phase II/III ESA only.	If Yes, proceed to next question. If No, SITE IS CLOSED. Complete sections 1 & 2 of Documentation worksheet (optional) to confirm. If this question is not applicable, select N/A and provide a brief explanation in the space provided
3	If following a risk management approach, was a risk assessment completed or is it in the process of being completed?	Yes		Not all risk management (RM) approaches include a risk assessment (RA). This question determines whether a RA is/was part of the RM strategy and allows bypassing of the questions about RA if an RA was not required. User must answer "yes" if a RA was completed and is part of the site closure strategy.	If Yes, proceed to next question. If No, proceed to Q8 and document risk management objectives in section 3.1 of Documentation worksheet (optional) . If N/A, provide rationale.

	Question	Response	User Rationale	Guidance	Instructions
4	If you are still in Step 7 or 8 of the FACS it is recommended that you use TRAV to validate the risk assessment to ensure you are addressing all risks. Will you be using TRAV?	No		Use of the Tool for Risk Assessment Validation (TRAV) is recommended to validate any risk assessment used towards the purposes of site closure: however, it is not mandatory. By clicking on the "Open TRAV" button in the Instructions column, the TRAV worksheets will be opened and displayed.	If Yes, Open TRAV and complete Sheets III to VIII. Proceed to Q5. If No, proceed to Q7. If TRAV not used, provide rationale of how RA was reviewed and validated.
5	Based on the TRAV, were any major deficiencies in the risk assessment noted?	N/A		TRAV asks a series of questions to validate the thoroughness and soundness of a risk assessment. Major deficiencies are defined in TRAV and will be flagged within the TRAV worksheets to allow the deficiencies to be addressed. All deficiencies need to be addressed before the RA results are considered valid.	Automatically scored based on the results of the TRAV. If Yes, the risk assessment should be revised until it is acceptable based on TRAV (see bottom of (VI) Summary sheet for list of deficiencies) If No or N/A, proceed to next question.
6	Did the TRAV validated risk assessment identify any unacceptable risks posed by the site? OR	N/A		This question summarizes whether the TRAV validated risk assessment identified any potentially unacceptable risks. If answered "Yes", remedial action or risk management actions will be required to mitigate these risks. If "No", the site can be closed based on the risk assessment findings.	Automatically scored based on TRAV. If No, the site does not present any unacceptable risk based on assumptions used in risk assessment and site can be closed. Complete Documentation Tab (optional) to summarize findings. If Yes, further work is required. Establish remediation or risk management objectives and proceed to sections below. If you did not use TRAV and you completed a risk assessment, answer the next question.
7	If TRAV was not completed but a risk assessment was conducted, did the risk assessment identify any unacceptable risks posed by the site?	Yes		This question addresses those RAs which are not validated by TRAV and summarizes the RA conclusion as to whether there are any potentially unacceptable risks to be addressed through remediation or risk management. If the RA concludes that there are no unacceptable risks, the site may still remain active if additional work such as LTM is required to ensure the assumptions of the RA which determined that there were no unacceptable risks remain appplicable.	User-defined. If No, the site does not present any unacceptable risk based on assumptions used in risk assessment and site can be closed provided no further work such as LTM is required. Continue on to the next section of the Closure Evaluation. Complete Section 4 (mandatory) and other sections of Documentation Tab to summarize findings. If Yes, further R/RM work is required. Establish remediation or risk management objectives, and document them in Documentation Tab section 3.1(optional) . If a RA was not conducted select N/A
	Summary Evaluation: Do the ESAs and risk assessment meet minimum requirements?	**Minimum Requirements Met Site Active**			If "Revisions Required", revise the ESA and risk assessment until they are acceptable, and re-complete this section of the tool. If "Minimum Requirements Met, Site Closed", complete the closure evaluation tab (with "N/A" where applicable) and complete sections 1,2 (optional) & 4 of Documentation Tab (mandatory), as appropriate. If "Minimum Requirements Met, Site Active", proceed to the next section, describing remedial or risk management planning. Complete sections 1,2 & 4 of Documentation Tab, as appropriate.

	Question	Response	User Rationale	Guidance	Instructions
Step 7 Remediation / Risk Management Plan					
8	Does the R/RM Plan address all unacceptable risks as identified by a risk assessment or exceedances of CCME Tier 1 guidelines?	No		If there are exceedances of generic (Tier 1) criteria and/or a risk assessment indicates potentially unacceptable risk, a remediation (R) or risk management (RM) plan will be required. This question assumes the R/RM plan has already been completed. The R/RM plan must meet a number of minimum requirements as indicated in Questions 8 through 17.	If Yes, proceed to the next question. If No, further work must be completed on the R/RM plan before proceeding with implementation. If N/A, it is assumed R/RM Plan is not required. Rationale should be provided if selecting N/A.
9	Are the R/RM objectives clearly stated for each AEC and/or source area.	N/A	R/RM Plan has not been undertaken at this time. It is recommended that a R/RM Plan be completed for the Site.	The R/RM objectives should be clearly stated so that the R/RM approach can be assessed as to whether it will meet each of the objectives.	If Yes or N/A, complete s. 3.1 of Documentation Tab (optional) and proceed to the next question. If No, site cannot be closed and further work must be completed on the R/RM plan. Rationale should be provided if selecting N/A.
10	Have all regulatory requirements been identified (e.g. permitting) and included in the R/RM plan?	N/A	R/RM Plan has not been undertaken at this time. It is recommended that a R/RM Plan be completed for the Site.	Many R/RM strategies may involve obtaining certificates of approval for remedial technologies, permits to take water, permits to discharge to municipal sewer systems, CEAA Environmental Assessments, provincial regulatory sign off on remedial action plans, etc. These should all be identified in the R/RM Plan	If Yes or N/A, proceed to the next question. If No, site cannot be closed and further work must be completed on the R/RM plan. Rationale should be provided if selecting N/A.
11	Does the plan identify aesthetic objectives (e.g., removal of scattered surface debris) and safety-based objectives (e.g., elimination of potential trip hazards or danger related to slope stability)?	N/A	R/RM Plan has not been undertaken at this time. It is recommended that a R/RM Plan be completed for the Site.	Some R/RM plan objectives focus on cleaning up to non-numeric targets. These types of objectives need to be identified in the R/RM Plan, if applicable.	If Yes or N/A, proceed to the next question. If No, site cannot be closed and further work must be completed on the R/RM plan. Rationale should be provided if selecting N/A.
12	Have other site-specific objectives identified in a risk assessment or other ESAs been included in the R/RM plan? (e.g., prevention of off-site migration, community concerns)	N/A	R/RM Plan has not been undertaken at this time. It is recommended that a R/RM Plan be completed for the Site.	There may be other objectives such as groundwater control in the event of potential off-site migration or meeting community concerns beyond clean up to appropriate generic standards. These should be clearly stated in the R/RM Plan.	If Yes or N/A, proceed to the next question. If No, site cannot be closed and further work must be completed on the R/RM plan. Rationale should be provided if selecting N/A.

	Question	Response	User Rationale	Guidance	Instructions
13	Are all AECs as confirmed by Environmental Site Assessments addressed by the R/RM Plan?	N/A	R/RM Plan has not been undertaken at this time. It is recommended that a R/RM Plan be completed for the Site.	All confirmed Areas of Environmental Concern (AECs) should be addressed in the R/RM Plan by having clear objectives (see Question 9) and an appropriate strategy specific to that AEC, which should be documented in the R/RM Plan.	If Yes or N/A, proceed to the next question. If No, site cannot be closed and further work must be completed on the R/RM plan. Rationale should be provided if selecting N/A.
14	Does the R/RM Plan include areal extent of impact, depth interval and volumes of impacts for each AEC and for each medium?	N/A	R/RM Plan has not been undertaken at this time. It is recommended that a R/RM Plan be completed for the Site.	It is important that the extent of the contamination is known with a reasonable degree of confidence for each impacted media. This information will be required for preparing accurate liability estimates, to develop tender specifications and to limit out of scope costs in implementation.	If Yes or N/A, proceed to the next question. If No, site cannot be closed and further work must be completed on the R/RM plan. Rationale should be provided if selecting N/A.
15	Are all AECs and COCs identified on a site plan?	N/A	R/RM Plan has not been undertaken at this time. It is recommended that a R/RM Plan be completed for the Site.	Accurate site plans are very important in the R/RM Plan for communicating the location and extent of site impacts. The site plans should identify each AEC, the extent of impact horizontally and vertically, the COCs present and the magnitude of the impacts.	If Yes or N/A, proceed to the next question. If No, further work must be completed on the R/RM plan before proceeding with implementation. If N/A, it is assumed R/RM Plan is not required. Rationale should be provided if selecting N/A.
16	Was a remedial options analysis completed and documented with the preferred option identified?	N/A	R/RM Plan has not been undertaken at this time. It is recommended that a R/RM Plan be completed for the Site.	A remedial options analysis or ROA should be part of any R/RM plan. It can be a separate document. An ROA is essentially a business case for why the recommended option was selected. The criteria used for screening options and the rationale for selection for the recommended option must be documented.	If Yes or N/A, complete s. 3.2 of Documentation Tab (optional) and proceed to the next question. If No, site cannot be closed and further work must be completed on the R/RM plan. As may be the case for smaller sites, if a ROA was not completed or documented, the user can select N/A and should provide rationale.

	Question	Response	User Rationale	Guidance	Instructions
17	Is the description of the recommended option sufficiently detailed in the R/RM plan? (e.g., system components, disposal routes, facilities, overview of operational procedures, monitoring requirements, timeline for implementation, potential changes in site use, regulatory requirements, performance metrics, long-term monitoring requirements, responsibilities, communication plan, contingency measures)	N/A	R/RM Plan has not been undertaken at this time. It is recommended that a R/RM Plan be completed for the Site.	A detailed description of the scope of the recommended option is essential for planning the implementation, costing it accurately and developing a realistic schedule for implementation. The degree of detail is largely left to professional judgement.	If Yes or N/A, complete s. 3.3, 3.4, 3.5, 3.6 of Documentation Tab (optional). If No, site cannot be closed and further work must be completed on the R/RM plan. Rationale should be provided if selecting N/A.
	Summary Evaluation: Does the R/RM Plan content meet minimum requirements as indicated by answering yes to the above questions?	**Revisions Required**			If Minimum Requirements Met, proceed to the next section, describing remedial or risk management activities. If Revisions Required, revise the R/RM plan until it is acceptable, and re-complete this section of the tool. Information regarding the R/RM plan should be included in Section 3 of the Documentation section.

	Question	Response	User Rationale	Guidance	Instructions
Step 7 Long Term Monitoring (LTM) Plan					
18	Does the R/RM Plan require LTM as part of the strategy?	N/A	R/RM Plan has not been undertaken at this time. It is recommended that a R/RM Plan be completed for the Site.	The need for LTM should be considered and identified during Step 7. This question asks whether the R/RM plan includes LTM as part of the strategy. If not, this section does not need to be completed. If the R/RM Plan does not/did not explicitly require LTM, but LTM is/was determined to be required at a later date, answer Yes and proceed to the next question.	If Yes, proceed to the next question. If No, LTM is not required. Proceed to next section (Q30). If requirement for LTM is unknown, select N/A, LTM selection is then subject to change in the future. Rationale should be provided if selecting N/A.
19	Is there a LTM plan included in the R/RM Plan?			The R/RM Plan should include details on the LTM requirements, if LTM is part of the R/RM Plan. The LTM plan can be under separate cover as well.	If Yes, summarize the plan in section 6.1 of Documentation tab (optional). Proceed to next question. If No, site cannot be closed and further work must be completed on the R/RM plan to include a LTM plan. Rationale should be provided if selecting N/A.
20	Does the LTM plan identify the location and nature of residual contaminants and physical hazards to be risk managed?			It is important that the LTM requirements are linked to the residual contamination or other hazards that are being addressed by the R/RM plan. This question asks whether that has been done.	If Yes, summarize this in section 6.1 of Documentation Tab (optional). Proceed to the next question. If No, site cannot be closed and further work must be completed on the LTM plan. Rationale should be provided if selecting N/A.
21	Does the LTM plan identify the key organizations or groups involved in LTM activities for the site, including descriptions of their roles and responsibilities.			Clear roles and responsibilities of LTM implementation are one of the keys to the success of risk management. The LTM plan should identify who is responsible for what in the LTM implementation.	If Yes, summarize this in section 6.1 of Documentation Tab (optional). Proceed to the next question. If No, site cannot be closed and further work must be completed on the LTM plan. Rationale should be provided if selecting N/A.
22	Does the LTM plan describe each engineered control that is being implemented, how it is being implemented and maintained as part of LTM?			Engineered controls include barrier walls, landfill caps, fencing, groundwater control pumping, etc.. These will require on-going inspection to ensure they are working as planned. An explanation of the surveillance and maintenance activities by which effectiveness will be monitored, as well as the roles and responsibilities for maintaining the engineered controls, should be included in the discussion on the engineered controls.	If Yes, summarize this in section 6.1 of Documentation Tab (optional). Proceed to the next question. If No, site cannot be closed and further work must be completed on the LTM plan. Rationale should be provided if selecting N/A.

	Question	Response	User Rationale	Guidance	Instructions
23	If monitoring site media, does the LTM plan specify the media to be monitored along with the frequency, methodology, objectives, reporting requirements, and contingency measures in the event of non-compliance and quality assurance processes?			If monitoring activities are part of LTM at the site, a description of each of the following for each monitoring activity should be included in the LTM Plan: • Medium. Identify the medium that is being monitored (or will be monitored) and the location of the monitoring. • Method. Identify the method to be employed for monitoring activity. • Frequency. Identify the frequency of monitoring. • Objectives of Monitoring Activities. State the objectives of the monitoring activity. • Reporting Requirements. Describe reporting requirements for the results of the monitoring activities. • Emergency Response and Corrective Action. Identify linkage between monitoring and inspection observations and emergency response and/or corrective actions. • Quality Assurance. Describe the quality assurance program under which routine inspections will be conducted.	If Yes, summarize this in section 6.1 of Documentation Tab (optional). Proceed to the next question. If No, site cannot be closed and further work must be completed on the LTM plan. Rationale should be provided if selecting N/A.
24	Are trigger criteria identified that would require implementation of contingencies and are contingency actions specified in the LTM plan?			In some cases risk management measures are not working as per the RM plan as identifed by the LTM. Identify the trigger criteria that would require implementation of an alternate course of action/contingencies. This includes a description of how the data will be interpreted and what the threshold criteria is for determining when contingent actions are warranted and the procedures used to evaluate contingencies including a contingency analysis, showing the possible responses and reporting procedures including public notification requirements. If appropriate, include a discussion of onsite or offsite areas that are subject to a release (failure) and the contingency measures in place. Describe the emergency response and reporting procedures including public notification requirements.	If Yes, summarize this in section 6.1 of Documentation Tab. Proceed to the next question. If No, site cannot be closed and further work must be completed on the LTM plan. Rationale should be provided if selecting N/A.

	Question	Response	User Rationale	Guidance	Instructions
25	If institutional controls are being implemented, is there a description of how they are being implemented and maintained?			Any institutional controls being implemented should be described in the LTM Plan, including how they are being implemented and maintained. This should include a description of other use/access restrictions required to maintain protectiveness and describe the location of where these controls are in effect at the site. Refer to the FCSAP Long Term Monitoring Guidance	If Yes, summarize this in section 6.1 of Documentation Tab. Proceed to the next question. If No, site cannot be closed and further work must be completed on the LTM plan. Rationale should be provided if selecting N/A.
26	Does the LTM plan identify all of the LTM activities that are specifically required by regulation, orders, directives, policies, permits, licenses or other third party enforceable agreements and the enforcement mechanisms?			The LTM Plan should include the regulatory and institutional framework for the LTM activities. The regulatory compliance requirement(s) should be discussed along with the applicable LTM activity. Identify all of the LTM activities that: - are specifically required by regulation, permits, licenses or other third party enforceable agreements and the enforcement mechanisms. - will be conducted pursuant to regulatory orders, directives, or policies.	If Yes, summarize this in section 6.1 of Documentation Tab (optional). Proceed to the next question. If No, site cannot be closed and further work must be completed on the LTM plan. Rationale should be provided if selecting N/A.
27	Does the LTM plan identify any existing or required agreements with third parties (e.g., land use or access agreements)?			Some LTM plans require access to third party properties. The LTM should indicate what agreements are in place to facilitate this.	If Yes, summarize this in section 6.1 of Documentation Tab (optional). Proceed to the next question. If No, site cannot be closed and further work must be completed on the LTM plan. Rationale should be provided if selecting N/A.
28	Are anticipated costs of the LTM activities provided, including assumptions used to develop the cost estimates, as well as assumptions for determining when sites or portions of a site will start and stop LTM activities? Is there a description of how the LTM activities will be funded?			The LTM Plan should include the rationale for the anticipated costs of the LTM activities based on technical requirements for LTM programs and activities at the site. Include assumptions used to develop the cost estimate, as well as assumptions for determining when sites or portions of a site will start and stop LTM activities. The LTM Plan should indicate how it LTM will be funded.	If Yes, summarize this in section 6.1 of Documentation Tab (optional). Proceed to the next question. If No, site cannot be closed and further work must be completed on the LTM plan. Rationale should be provided if selecting N/A.
29	Does the LTM plan identify the purpose, methods and means by which information will be preserved, stored, maintained, and accessed?			The information documented for LTM should: • Identify information critical to implementing LTM at the site. • Identify the methods and means by which information will be preserved (this includes all types of data deemed necessary (e.g., maps, photos, reports, databases, etc.)). • Describe how and where records will be stored, the length of time they will be stored, and for what purpose the records are being maintained. • Describe how record access will be enabled and the measures necessary to ensure compatibility with information hardware and software at future dates. • Identify the means by which the public will be afforded access to records. • Identify which of the LTM records for the site are anticipated to be requested by the public and which records may be made accessible.	If Yes, summarize this in section 6.1 of Documentation Tab (optional). Proceed to the next question. If No, site cannot be closed and further work must be completed on the LTM plan. Rationale should be provided if selecting N/A.
	Summary Evaluation: Does the LTM Plan meet minimum requirements?	**Not Required**			If Minimum Requirements Met, proceed to the next section. Information regarding the LTM plan must be included in Section 3 of the Documentation section as appropriate. If Revisions Required, revise the LTM plan until it is acceptable, and re-complete this section of the tool.

	Question	Response	User Rationale	Guidance	Instructions
	Approval & Sign Off of R/RM Plan				
30	Was the R/RM Plan signed, by a P.Eng. or P.Geo. or other qualified professional? A "qualified professional" for the purposes of this question, is defined as: (a) the person holds a bachelor's degree in science, engineering or applied technology from a post-secondary institution; and (b) the person has experience in the conduct or supervision of remedial/risk management plans, as follows: (i) if the person holds a doctoral degree in science or engineering from a university, five years' experience, (ii) if the person holds a master's degree in science or engineering from a university, seven years' experience, (iii) in any other case, eight years' experience.	N/A	R/RM Plan has not been undertaken at this time. It is recommended that a R/RM Plan be completed for the Site.	A R/RM plan should be reviewed and signed off by an appropriately experienced individual to ensure sound and proven approaches are being implemented. The qualifications listed in the question are suggested minimum requirements. Ultimately each custodian will determine who is qualified to approve these types of documents.	If Yes, proceed to the next question. If No, R/RM plan should be reviewed and signed by a qualified professional. If the plan was signed off by a person not meeting the definitions of a qualified professional, "Yes" can be selected and rational can be provided. Alternatively, N/A can be selected and a rationale can be provided.
	Summary Evaluation: Was the R/RM Plan (and LTM if applicable) signed, by a P.Eng. or P.Geo. or other qualified professional?	**Not Required**			If Minimum Requirements Met, proceed to the next question. If Revisions Required, R/RM plan should be reviewed and signed by a qualified professional.

	Question	Response	User Rationale	Guidance	Instructions
Step 8 Construction Completion Note: A "construction completion" site is a contaminated site where physical construction of all remedial/risk management actions are complete, all immediate threats have been addressed, and all long-term threats are under control. This typically applies to sites where there has been completion of major capital expenditures (e.g., installation of a barrier treatment wall, construction of land treatment facility or biocell, installation of an in situ ground water treatment system, construction of a water treatment plant, etc.) but where there will be lag time of more than a year between construction completion and achievement of remedial objectives. This applies to sites requiring active operations and maintenance, including performance monitoring. This is also applies to constructed engineered controls as part of a risk management strategy, and which may or may not require long-term monitoring.					
31	Does the remedial or risk management approach include constructed or installed works representing a major capital expenditure?	No		For sites where ground or surface water remedial actions require a lengthy continuous operation phase after the system has been constructed, *construction completion* is accomplished when physical construction of the remedial works (e.g., construction of the ground water treatment plant, installation of pumps and extraction wells) is completed, a final inspection of installed systems has been undertaken, and any future modifications to the system are expected to be minimal (e.g., well replacement). The construction completion designation should also be applicable to the installation of longer term soil remediation methods such as soil vapour extraction (once extraction wells, blowers and collection units have been installed), in-situ bioremediation (after installation of injection wells and surface equipment) and ex-situ bioremediation (e.g., after construction and placement of soils in biopiles or land treatment units, with only tilling activities (O&M) to follow).	If No, this section does not need to be completed. If Yes, inspect constructed works according to requirements (e.g., inspection check list) set out in R/RM Plan and summarized in s. 3.5 of Documentation Tab (optional).
32	Is the physical construction of the remedy complete? (e.g., construction of treatment plant, pumps, extractions wells, containment structure)			The physical construction of the remedy can be considered complete when the custodian or their representative accepts the constructed works. This will typically mean a physical inspection of constructed works is required.	If Yes, proceed to the next question. If No, construction is not complete and further work is required. If N/A, rationale should be provided
33	Have the constructed works / installed system been inspected and inspection results documented, including as-built drawings?			This depends largely on professional judgement and by comparing as-built conditions against the contract requirements. Typically the supervising engineer will undertake this inspection using a checklist developed for the project. As-built drawings should also be provided to the custodian for review and sign off.	If Yes, summarize inspection activities in s. 3.5 of Documentation tab. If No, construction is not complete and further work is required. If N/A, rationale should be provided.
34	Was the inspection completed without noting major deficiencies?			Major deficiencies will typically be defined during the inspection process using a pre-approved inspection checklist.	If Yes, proceed to the next question. If no, construction is not complete and further work is required. If N/A, rationale should be provided.
35	Do constructed / installed works meet R/RM plan requirements?			This is typically accomplished by by comparing the as-built conditions with the specifications and drawings used in the tender process; however the nature of a major deficiency should be defined on a case by case basis and should be beforehand in the contract.	If Yes, proceed to the next question. If no, construction is not complete and further work is required. If N/A, rationale should be provided.
36	Is the remedy operational (e.g., is the treatment system removing/reducing contaminant concentration levels, is barrier system preventing contaminated groundwater migration, has the cap eliminated pathways to receptors) in accordance with the R/RM plan?			The question establishes whether the constructed works are operating as intended, whether it is containment or active clean up, and as per the R/RM plan.	If Yes, proceed to the next question. If no, construction is not complete and further work is required. If N/A, rationale should be provided.

Question		Response	User Rationale	Guidance	Instructions
37	Are any expected future adjustments likely to be minimal in nature? (e.g., well replacement)			Small adjustments are often necessary for constructed works in response to actual remedy performance. This question establishes whether the coststructed works are likely to require significant amendments or adjustments.	If Yes, proceed to next question. If no, construction is not complete and further work is required. If N/A, rationale should be provided
Summary Evaluation: Does the site meet minimum Construction Completion requirements as indicated by answering yes to the above questions.		**Constructed Works Not Required**			If Constructed Works Not Required, proceed to next section. If Minimum Requirements Met - Construction Complete, complete Section 3.5 of the Documentation worksheet (optional) and proceed to the next section. This will demonstrate that while the site is not closed, there has been major progress towards achieving remedial objectives. If Minimum Requirements Not Met - Construction Not Complete, correct deficiencies and re-score.

	Question	Response	User Rationale	Guidance	Instructions
Step 8 Operations and Maintenance					
38	Is/was operations and maintenance (O&M) required for R/RM measures at the site? (e.g., treatment plants, pumping systems, injection programs, performance monitoring of installed systems, tilling and fertilizing land treatment facilities)	N/A		Operation and maintenance (O&M) typically involves the operation of soil, ground water or surface water remediation measures that are meant to reduce contaminant concentrations to pre-established clean up goals within a reasonable time frame (e.g., 10 years). In the Site Closure Tool, O&M is considered to be part of Step 8 (Implement Remediation/Risk Management Strategy) in the Federal Approach to Contaminated Sites (FACS). It can include in-situ soil remediation measures such as soil vapour extraction and in-situ bioremediation, and ex-situ bioremediation. MNA should be considered as a special case of in-situ remediation strategy requiring O&M, provided it is expected to result in contaminant concentrations being reduced to clean up targets.	If Yes, this section must be completed. Summarize O&M requirements in s.3.6 of Documentation Tab (optional). If No, proceed to next section. If N/A, rationale should be provided.
39	Are maximum concentrations in all media less than established R/RM objectives or have termination criteria otherwise been met? (e.g., duration)			Once R/RM targets have been met, e.g., ground water meets pre-established target concentrations based on sampling of key monitoring wells over several events, then the site can be considered ready for closure. Other termination criteria may apply (e.g., X number of years of a stable plume): these should have been identified in the R/RM Plan.	If Yes, proceed to the next question. If No, further system operation or other changes are required to meet objectives. If N/A, rationale should be provided.
40	Have required O&M activities been completed according to the schedule outlined in the R/RM plan?			O&M activities will typically follow a set schedule developed in the R/RM plan. This question asks whether the implemented O&M is/has been following the R/RM plan. If not, user should select "N/A" and provide rationale why not, if there is a rationale.	If Yes, proceed to the next question. If No, further system operation or other changes are required. If N/A, rationale should be provided.
41	Have all O&M activities been documented?			O&M requirements should have been documented in the Consultant's Remedial Action Report and these should also be summarized in the applicable sections of the SCT Documentation tab. In many cases a separate O&M manual will have been produced. These O&M activities should now be carried out as planned until remediation or risk management targets have been met. It is common practice to have the operator of the remedial system report on system performance on a pre-established periodic basis, typically annually, although this may be more frequent in the initial stages of system ramp up.	If Yes, summarize this in s. 3.6 of Documentation Tab. If No, complete documentation to achieve construction completion. If N/A, rationale should be provided.
	Summary Evaluation: Does the site meet minimum O&M requirements as indicated by answering yes to the above questions.	**Not Required**			If Not Required or Minimum Requirements Met, complete Section 3.7 of the Documentation worksheet (optional), as appropriate, and proceed to the next section. If Minimum Requirements Not Met, correct deficiencies and re-score.
Step 9, Confirmatory Sampling and Final Report					
42	Complete Section 4.1 of Documentation (mandatory). Are maximum concentrations in all media below or meet numeric clean up targets (Tier 1 or SSTLs) identified in the R/RM plan?	No		Examples of the content of a confirmatory sampling and final remediation/risk management report, typically prepared by a consultant, should be available in previous reports on similar projects and in successful Statements of Work (available from contaminated site project delivery organizations). The consultant's report should contain final site concentrations in all remediated media and compared to applicable generic guidelines, standards (ofter referred to as Tier 1 guidelines) or site specific target levels (SSTLs).	Automatically completed from Documentation Tab. If Yes, and there are no LTM or RM measures required, site can be closed. Remaining sections do not require completion. If Yes, but LTM or RM measures are required proceed to Q43. If No, more work is required and site cannot be closed. Proceed to Q43.
	Summary Evaluation: Does the site meet minimum requirements for closure as indicated by answering yes to the above question.	**Minimum Requirements Not Met SITE IS ACTIVE**			If Minimum Requirements Met, site is closed. Ensure sections 1, 2, 3 (all optional), and 4 of the Documentation Tab (mandatory) are completed, as appropriate. Completing optional Sections 5, 7, 8 and 9 is also recommended. Skip remaining sections. If Minimum Requirements Not Met, site is active - this may mean that additional work is required at the site or that subsequent sections of the Closure Evaluation should be completed to confirm that LTM requirements have been met.

	Question	Response	User Rationale	Guidance	Instructions
Step 10 Long-Term Monitoring to Support Risk Management					
43	Are risk management (RM) measures in place to address all risks resulting from exceedances or is LTM required to confirm risk assessment assumptions?	N/A		This question assumes LTM will automatically be required if risk management (RM) measures are in place and asks whether there are any RM measures implemented to trigger the need for LTM. RM measures are assumed to be required if there any exceedances of Tier 1 and or SSTL levels. This question also allow for the case where a risk assessment might show no unacceptable risk but requires continued monitoring to demonstrate conditions are stable for the foreseeable future.	If No, RM and therefore LTM are deemed not to be required, or a risk assessment does not require confirmation of site conditions. Proceed to Q50 If Yes, summarize RM measures in s.4.2 Documentation Tab (optional). Proceed to next question. If N/A, provide rationale.
44	Based on Section 4.2 of Documentation Tab comparing implemented RM measures vs. planned RM measures (if completed), do all risk management measures implemented comply with goals of risk assessment recommendation?			While not mandatory, s. 4.2 of the Documentation Tab should be completed before answering this question. S. 4.2 identfies the COCs, media, pathways and RM activities to manage risks. Section 4.2 queries whether RM measures comply with goals, and whether LTM is required.	If Yes, Proceed to next question. If No, further work is required to fulfill actions recommended by the R/RM plan. If N/A, rationale should be provided.
45	From Section 4.2 of Documentation, is long-term monitoring required as part of the risk management plan?			In most cases LTM is required as part of risk management. Section 4.2 of the Documentation Tab identifies COCs, affected media, pathways, risk management (RM) measures planned and implemented, and queries whether RM comply with goals and whether LTM is required.	If Yes, proceed to next question. If No or N/A, site should be closed on condition remedial targets have been met. If N/A, rationale should be provided.
46	Are LTM requirements documented (i.e., LTM measures, objectives, description of measures, frequency & duration, responsibilities, etc.)?			The items listed should be standard components of any LTM plan. They should be identified the RM/LTM Plan. It is recommended they also be summarized in Section 6.1.	If Yes, complete Section 6.1 of Documentation Tab (optional). Proceed to next question. If No, document LTM requirements in RM/LTM Plan and then summarize in s. 6.1 of Documentation Tab (optional). If N/A, rationale should be provided.
47	Have you identified applicable LTM planning documents and LTM progress reports?			This question emphasizes the importance for proper documentation of LTM plannig and progress, and any key decisions in the LTM planning process.	If Yes, complete Sections 6.2 and 6.3 of Documentation document (optional). If No, identify applicable LTM planning documents and LTM progress reports and complete Sections 6.2 and 6.3 of Documentation document (optional). If N/A, rationale should be provided.
48	Are all risk management measures operating as intended (as specified in R/RM plan)?			The RM measure should be evaluated at a pre-determined frequency (subject to review of RM measures and LTM requirements) and an assessment made and documented as to whether the RM goals are still being met.	If Yes, log LTM results in Section 6.3 of Documentation worksheet (optional) and proceed to the next question. If No, further work on the remedy will be required. If N/A, rationale should be provided.
49	Is the LTM plan being reviewed and updated as required at least annually to reflect new information obtained?			The LTM plan is a living document, meaning it should be reviewed and revised as appropriate as the RM implementation evolves. If there are changes in actual site conditions or alterations to the risk management measures, these need to be reflected in updates to the LTM plans. In any event the LTM should be reviewed at least annually and updated if necessary.	If Yes, indicate updates to the LTM in Section 6.2 of Documentation Tab (optional). If No, review and update LTM as required, and update Section 6.2 of Documentation Tab (optional). If N/A, rationale should be provided.
	Summary Evaluation: Does the site meet minimum requirements for risk management as indicated by answering yes to the above questions.	**Not Required**			If "Not Required", the site is closed. If "Minimum Requirements Met", RM is operating as planned and as demonstrated by LTM. If "Minimum Requirements Not Met", revise RM/LTM plans and implementation. Update Section 6.0 of the Documentation worksheet (optional) as appropriate.

Question	Response	User Rationale	Guidance	Instructions
Risk Managed to Site Closure				
50 Have the LTM termination criteria been met?			This question assumes LTM was/is required as part of a RM strategy or to satisfy a risk assessment recommendation. Termination criteria should have been identified in previous RM or RA documentation. If not applicable the Site should have been closed with question Q42.	If Yes, complete s. 4.2 of Documentation Tab. Site is closed. If No, site is active. Continue LTM activities If N/A, rationale should be provided.
Summary Evaluation: Does the site meet minimum requirements for closure as indicated by answering yes to the above questions.	**Not Required**			If Yes, complete the remaining portions of the Documentation worksheet as required. If No, continue LTM activities until termination criteria are met.

1705 Argentia Road, Unit 3 | Mississauga, Ontario, L5N 3A9
Tel/Fax: 416-657-2367| Toll free: 1-800-267-4797
info@aelenv.com | www.aelenv.com

APPENDIX 8
Authorization and Terms

Terms of Engagement

GENERAL - Aeon Egmond Ltd. (AEL) and the Client (as described in the attached proposal) agree that any professional services, including subsequent services and charges (collectively the Services) to be provided by AEL relating to the Proposal will be subject to the following Terms and Conditions.

STANDARD OF CARE – Services provided by AEL will be conducted with a level of care ordinarily provided by the engineering and geosciences professions under similar site and time constraints. No warranty, express or implied is made. AEL's work may result in damage to surfaces, the restoration of which is not part of this agreement.

SITE ACCESS – The Client provides right of entry to AEL and their subcontractors to carry out the work.

INFORMATION – The Client warrants that it has provided AEL all information known to, or suspected by the Client relating to the past and existing condition of the Site, including but not limited to soil and groundwater data, hazardous materials and buried utilities. AEL may rely on such information.

SAFETY – AEL is responsible only for its activities and that of its employees.

PAYMENT - Charges for the service(s) rendered will be made in accordance with the Consultant's Schedule of Fees and Disbursements as the services are rendered. Invoices will be due and payable on receipt from the date of the invoice without holdback. Interest on overdue accounts is 2% per month, collection fees being extra and payable on collection (where allowed). If the account is not paid within 60 days from the date of the invoice then AEL shall have the right to suspend all work under this agreement without prejudice.

CHANGES IN WORK SCOPE – AEL and the Client agree that it may be necessary to modify the scope of work, schedule and/or cost estimate proposed in the agreement.

INSURANCE – AEL carries $1,000,000 in commercial general liability, professional liability and automobile coverage. Details on our standard coverage is available on request. AEL maintains worker's compensation coverage to statutory amounts.

LIMITATION OF LIABILITY – The Client agrees to limit the liability of AEL, its employees, officers, directors, agents, consultants and subcontractors to matters which arise directly from AEL's acts, errors or omissions and such that the total aggregate liability of AEL, whether arising in contract, tort, or otherwise, shall not exceed the greater of $50,000 or AEL's total fee for services. Any liability shall expire one year after substantial completion of the services. Neither party shall be responsible for lost revenues, profits, cost of capital, claims of customers, or other special, indirect, consequential or punitive damages.

MUTUAL INDEMNITY – AEL agrees to indemnity, defend and save harmless the Client, its officers, directors, employees, subcontractors and agents from and against all claims, damages, losses and expenses (including but not limited to legal fees) arising from personal injury, death or damage to third party property to the extent arising from the negligent acts, errors and omissions of AEL. The Client agrees to indemnity, defend and save harmless AEL, its officers, directors, employees, subcontractors and agents from and against all claims, damages, losses and expenses (including but not limited to legal fees) arising out of or resulting from the Services or work of AEL including but not limited to, claims made by third parties or any claims against AEL arising from the acts, errors, or omissions of the Client or others. To the fullest extent permitted by law, such indemnifications shall apply regardless of breach of contract or strict liability of AEL. Such indemnity shall not apply to the extent that AEL is finally determined to be negligent.

SUBSURFACE RISKS – Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive sampling and testing program may fail to detect certain conditions. The environmental, geological, geotechnical, geochemical and hydrogeological conditions that AEL interprets to exist between sampling points may differ from those that actually exist. The client agrees to waive any claim against AEL and agrees to defend, indemnify and hold AEL harmless from any claim or liability for injury or loss which may arise as a result of any damage and resulting impacts to subterranean structures, utilities or cross-contamination caused by any subsurface investigation.

DISCOVERY OF HAZARDOUS MATERIALS – The Client recognized that hazardous or suspected hazardous substances may be discovered at the site in the course of the work and that the presence of such substances are not the responsibility of AEL. All contaminated samples, materials, and field equipment that cannot be readily cleaned, shall remain the property and responsibility for the Client for proper handling and disposal. The client agrees that the discovery of any such substances shall constitute a changed condition for which AEL shall be fairly compensated. The client agrees to waive any claim against AEL and agree to defend, indemnify and hold AEL harmless from any claim or liability for injury or loss of any type arising from any alleged or actual discovery of hazardous or suspected hazardous substances.

DOCUMENTS – All reports, plans, data, notes, drawings and other documents prepared by AEL are considered its professional work product and shall remain the copyright property of AEL. The services and documents provided by AEL are intended for one time use only. At the request and expense of the Client, AEL shall provide the Client with copies of such documents. The Client acknowledges that electronic media are susceptible to unauthorised modification deterioration and incompatibility and therefore the Client cannot rely upon the electronic media version.

DELAYS – If site conditions prevent or inhibit performance of the work or unrevealed hazardous waste materials or conditions are encountered services under this Agreement may be delayed. The client shall not hold AEL responsible for damages or delays in performance caused by any such delays, or delays caused by the Client, its subcontractors, acts of God, acts and/or omissions of governmental authorities and regulatory agencies or other events which are beyond the reasonable control of AEL.

LITIGATION - The Client shall reimburse AEL for all direct expenses and time in connection with any disputes, litigation or arbitration involving representatives or documents of AEL arising out of the Services in accordance with AEL's prevailing Schedule of Fees.

PROPERTY TRANSACTIONS – In connection with any contemplated or actual purchase or sale of property related to the work, AEL will not be responsible for the independent conclusions, interpretations, interpolations and/or decisions for the Client or others arising out of data which is directly the product of AEL's services.

MISCELLANEOUS – This agreement supersedes all other agreements, oral or written and contains the entire agreement of at the parties concerning its subject matter. No cancellation, modification, amendment, deletion, addition, waiver or other change in the Agreement shall have effect unless specifically set forth in writing singed by the party to be bound thereby. **The Client acknowledges and agrees that if it accepts this engagement letter, or AEL performs the services contemplated therein, then the above Terms of Engagement shall constitute a binding agreement for the sole benefit of the Client and AEL and that no third party beneficiaries are created by this agreement.**

TOTAL SUSPENDED SOLIDS LIMIT FOR CONSTRUCTION SITE WATER

OLD SLYS LOCKSTATION, SMITHS FALL, ONTARIO

Report prepared for:

AEL Environment
1705 Argentia Road, Unit 3
Mississauga, ON
L5N 3A9

Report prepared by:

ECOMETRIX INCORPORATED
6800 Campobello Road
Mississauga, Ontario
L5N 2L8

18-2490
August 2018

TOTAL SUSPENDED SOLIDS LIMIT FOR CONSTRUCTION SITE WATER

OLD SLYS LOCKSTATION, SMITHS FALL, ONTARIO

Fei Luo, Ph.D.
Environmental Engineer

Lara Alves Beese, Ph.D. QP_{RA}
Project Manager

Don Hart, PhD.
Senior Reviewer

EXECUTIVE SUMMARY

EcoMetrix was retained by AEL Environment, on behalf of Parks Canada to develop a total suspended solids (TSS) concentration limit for releases of construction site water to surface water during planned construction work for the Old Slys Lockstation in Smiths Fall, Ontario. This TSS concentration limit will be used to trigger mitigation measures that may be needed during construction should the TSS concentration limit be exceeded in construction site water during a storm or unscheduled release.

A step-wise approach was followed to derive the TSS construction limit:

1) A mass balance equation was used to predict water concentrations of contaminants at different TSS levels in water, based on concentrations of contaminants in sediment and soil samples collected by AEL (2018) during a recent environmental site assessment.

2) Predicted water concentrations of contaminants were compared against the long-term WQGs protective of aquatic life to assess potential risks to aquatic life in the receiving environment.

3) The potential for mixture toxicity from the predicted water concentrations of contaminants was evaluated using an additive toxic unit approach and short-term WQGs or acute toxicity values.

4) A TSS limit value was selected that would be protective for both the physical effects of TSS and the effects of TSS associated contaminants.

5) An uncertainty evaluation was conducted to address potential uncertainties associated with the recommended TSS construction limit.

A TSS construction limit of 25 mg/L was recommended with an “equivalent” turbidity value of 8 NTU. It is recommended that the Contractor carrying out the planned construction work, collect site-specific data to refine the TSS turbidity-relationship, and either confirm the NTU value or set a revised site-specific NTU value corresponding to TSS of 25 mg/L.

Abbreviations

APV: Aquatic Protection Value

CCME: Canadian Council of Ministers of the Environment

CCREM: Canadian Council of Resource and Environment Ministers

CCC: Criterion Continuous Concentration

CMC: Criterion Maximum Concentration

COC: Contaminants of Concern

HWS: Hot Water-Soluble

ISQG: Interim sediment quality guideline

MECP: Ministry of Environment, Conservation and Parks

NTU: Nephelometric turbidity unit

PAH: Polycyclic Aromatic Hydrocarbon

PCB: Polychlorinated Biphenyl

PHCs: Petroleum Hydrocarbons

PWQO: Provincial Water Quality Objectives

SAR: Sodium Adsorption Ratio

SEV: Severity-of-ill-effects

TSS: Total Suspended Solids

TU: Toxicity Unit

VOCs: Volatile organic compounds

WQG: Water Quality Guideline

TABLE OF CONTENTS

LIST OF FIGURES

1.0 INTRODUCTION

EcoMetrix was retained by AEL Environment (AEL), a division of Aeon Egmond Limited, on behalf of Parks Canada, to develop/recommend a total suspended solids (TSS) construction limit for releases of construction site water to surface water during planned construction work for the Old Slys Lockstation in Smiths Fall, Ontario. The purpose of the TSS construction limit is to prevent possible exposure to concentrations of TSS or associated contaminant concentrations above safe levels for aquatic life in the receiving environment (Rideau River), by triggering mitigation measures should the TSS concentration limit be exceeded in construction site water during a storm or unscheduled release.

The Canadian Council of Ministers of the Environment (CCME) water quality guideline (WQG) for TSS of 25 mg/L above background level for any short-term exposure (e.g. 24-h period) under clear flow conditions (CCME, 2002) was initially considered as a value that is protective for physical effects. This WQG is also appropriate because a storm event and unscheduled release of TSS into the receiving environment is considered to be a short-term event. This WQG is based on an adult salmonid severity-of-ill-effects (SEV) concentration-duration-response model from Caux et al. (1997). Based on this model, a TSS concentration above a 25 mg/L for 24 hours may cause behavioural and low sublethal effects on fish.

In order to have a fixed value of TSS as a limit, we have made a conservative assumption that the background level of TSS in river water may be as low as zero. Thus, a 25 mg/L concentration of TSS is considered as the objective to avoid physical effects on aquatic life. Concentrations of other contaminants that could be associated with 25 mg/L TSS, and with lower and higher values of TSS, were explored to see if these levels would be protective in terms of potential chemical effects on aquatic life.

2.0 BACKGROUND

2.1 Objective

The objective of this work was to determine an appropriate TSS construction limit for releases of construction site water to surface water, which would trigger mitigation measures should the TSS concentration limit be exceeded in construction site water during a storm or unscheduled release, at the Old Slys Lockstation.

The planned construction work, which is managed by Parks Canada, is expected to occur in the Fall of 2018. The proposed construction work may include:

- Construction of upstream and downstream cofferdams;
- De-watering of work areas;
- Removal of algae, debris and zebra mussels;
- Saw-cutting and raking mortar joints;
- Removal of deteriorated stones/materials;
- Potential for excavation behind lock/approach walls;
- Masonry/grouting; and
- Landscaping, site reinstatement to previous condition.

2.2 Environmental Site Assessment

In 2017, AEL (2018) completed an environmental site assessment (ESA) for Old Slys Island, located south of the lock station (Figure 1). In the 1960's, the Island was used as a landfill by the Town of Smiths Falls. The landfill was not lined or capped and is of potential environmental concern due to the buried landfill materials.

AEL (2018) noted that the opening and closing of the locks causes vertical groundwater fluctuations on the Island between 1.5 m near the locks and 0.4 m away from the locks. This lock system effectively "flushes" water into the island when the locks are filled and enables groundwater to seep out when the locks are emptied.

As part of their investigation, AEL (2018) collected soil, groundwater, sediment, surface water, and/or seepage samples across the Island, and in areas along and in the lock system. These samples were submitted to an accredited laboratory for the analyses of petroleum hydrocarbons (PHCs), volatile organic compounds (VOCs), metals and inorganics, polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs). When compared to applicable federal (i.e. Canadian Council of Ministers of the Environment (CCME) and Federal Contaminated Sites Action Plan Guidance) and provincial (i.e. Ontario Regulation 153/04 and Provincial Water Quality Objectives (PWQO)) guidelines, the following contaminants were identified as contaminants of concern (COCs):

- Soil -PHCs, metals, VOCs and PAHs;
- Groundwater – PHCs, metals and inorganics, VOCs and PAHs;

- Sediment – Metals and PAHs;
- Surface Water– Inorganics; and
- Seepage – metals.

The soil, sediment, surface water and seepage results collected as part of the AEL (2018) environmental site assessment of the Island were evaluated and used for this assessment.

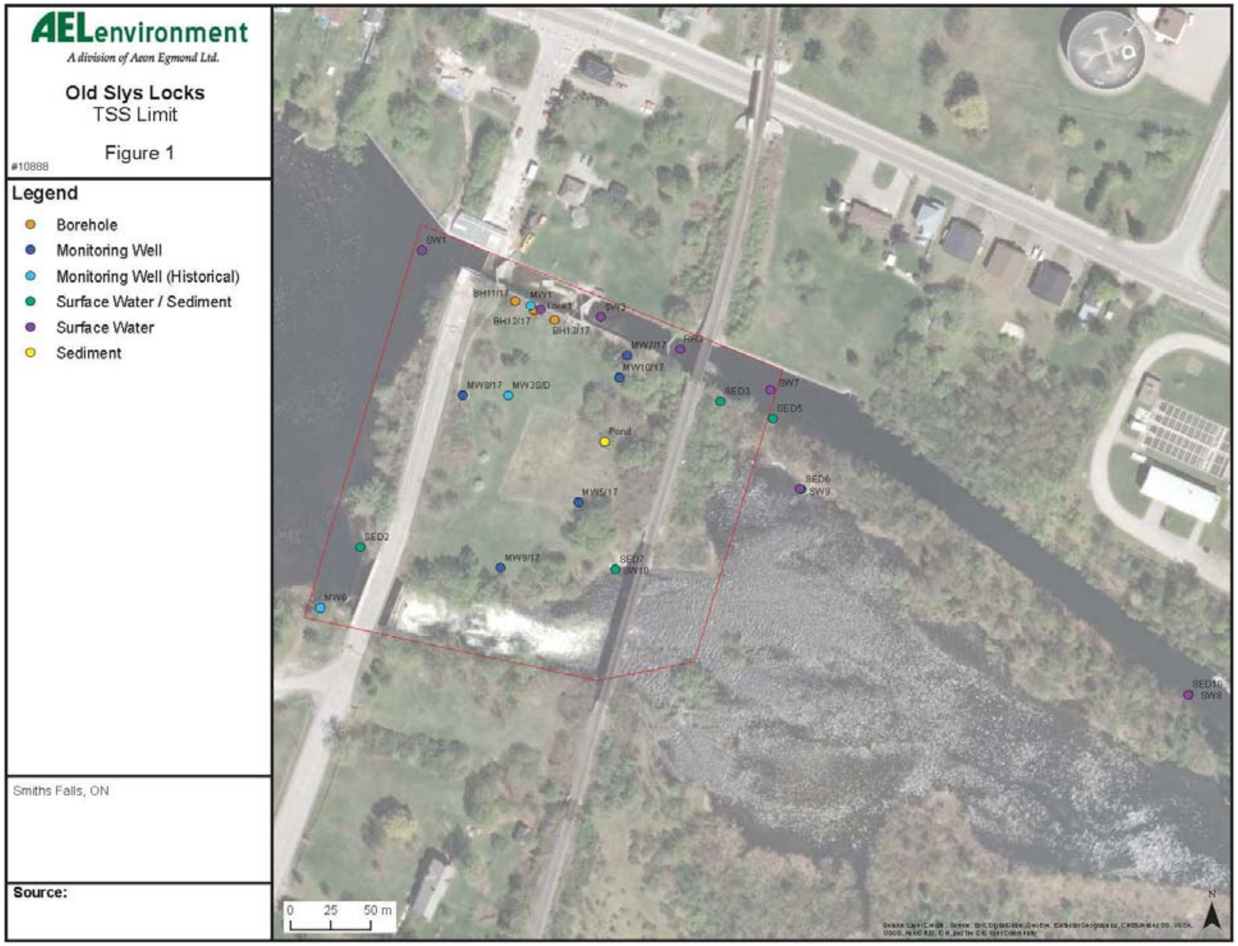


Figure 1: AEL (2018) monitoring locations, August 2017.

3.0 Regulatory Context

Although the Old Slys Lockstation is under federal jurisdiction, various federal and provincial regulatory statues were considered to determine an appropriate TSS limit for construction site water to trigger mitigation measures should the TSS concentration limit be exceeded during a storm or unscheduled release. These statues include:

- Canadian Environmental Protection Act, 1999 (federal);
- Fisheries Act (federal)
- Species at Risk Act (federal);
- (Ontario) Environmental Protection Act (provincial);
- Ontario Water Resources Act (provincial); and
- (Ontario) Endangered Species Act (provincial).

4.0 Assessment Approach

Sediment may be disturbed and suspended in the surface water during the construction of the cofferdams, dewatering of work areas, removal of aquatic biota (e.g. algae and zebra mussels) and debris, and excavation activities behind the lock/approach walls. Soil along the lock/approach walls may also be disturbed and transported into the surface water through the removal of deteriorated stones and materials, land run-off, especially after a storm, or landscaping activities. Aquatic biota may be exposed to suspended solids (i.e. sediment and soils) through direct contact or ingestion of the suspended solids. Aquatic biota may also be exposed to contaminants associated with the suspended solids, or partitioning from the solids to surface water, through direct contact, incidental ingestion, and uptake through the food chain. These potential exposure pathways to aquatic biota were considered in this assessment.

4.1 Approach

The following step-wise approach was used to assess the validity of using the TSS limit of 25 mg/L or the need for a lower TSS construction limit to trigger mitigation measures should the TSS concentration limit be exceeded during a storm or unscheduled release:

1) A mass balance equation was used to predict water concentrations of contaminants at different TSS levels in water, based on concentrations of contaminants in sediments and soils collected by AEL (2018). A series of TSS concentrations between 5 and 100 mg/L were incorporated into the model. The lower TSS value is the CCME (2002) long-term (24-hours to 30 days) guideline value for clear flow conditions. The upper TSS value is intended to represent a TSS water concentration that could arise during an unscheduled release.
2) Surface water and seepage water quality data collected by AEL (2018) were used in the mass balance equation as background surface water contaminant concentrations.
3) Predicted water concentrations of contaminants (TSS-associated plus background concentrations) were compared against the long-term WQGs protective of aquatic life. Exceedance of the long-term WQGs was considered to represent potential risks to the health of aquatic life. This is conservative because most storm events would not last long enough to result in long-term exposures at contaminant concentrations associated with a storm event release. The durations of toxicity tests used in developing long-term WQGs vary with organism type: greater than 7 days for fish and plants, 96-h for invertebrates, and 24-h for algae (CCME, 2007).
4) The potential for mixture toxicity for the predicted water quality concentrations was also evaluated using an additive toxic unit approach and short-term WQGs or acute toxicity values.
5) A TSS limit value was selected that would be protective for both the physical effects of TSS and the effects of TSS associated contaminants.

6) An uncertainty assessment was also completed to address potential uncertainties associated with the recommended TSS limit for release of construction site water.

4.2 Data Selection

Sediment, soil and water chemistry data from the recent sampling effort by AEL (2018) was initially screened for inclusion in the assessment based on the location where the sample was collected in relation to the proposed construction activities and potential exposure pathways to aquatic biota. A total of seven (7) sediment/soil sampling locations and five (5) surface water/seepage sampling locations were identified:

- Sediment chemistry collected near the lock system (i.e. SED3 and SED5) was selected and used to represent sediment contaminant concentrations that may be disturbed and suspended during construction activities within the lock system;
- Soil chemistry data collected located within 30 meters (i.e. BH11/17, BH12/17, BH13/17, MW7/17 and MW10/17) from the lock system was selected and used to represent potential soil transport into the receiving environment from natural run-off or after a storm event, landscaping activities, and/or the removal of deteriorated stones and materials along the shoreline/embankment;
- Surface water chemistry (i.e. SW1, RR3, and SW7) collected within and near the lock system was selected and used to represent background water quality; and
- Seepage chemistry (i.e. SW3 and Lock 1) collected at the locks was selected and also used to represent background water quality. These samples could contribute to background water quality during the opening and closing of the locks because the lock system effectively “flushes” water into Old Slys island when the locks are filled, which enables groundwater to seep out into the receiving environment when the locks are emptied.

Figure 2 shows the locations of the sediment, soil, surface water and seepage chemistry data used for this assessment.

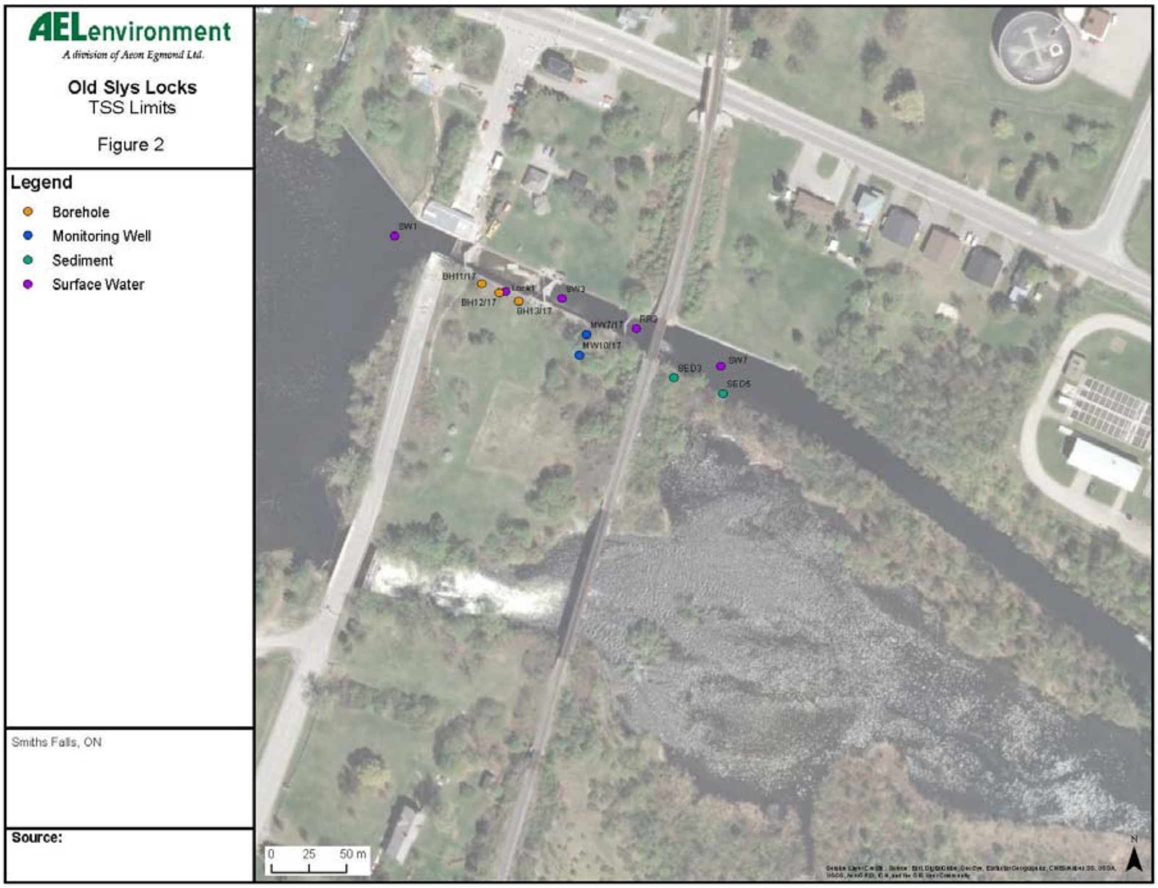


Figure 2: Sediment, Soil, Surface Water and Seepage Sample Locations Used for the Assessment.

The sediment and soil chemistry data were further screened by:

- selecting the maximum soil concentration for each contaminant for each borehole where soil samples were collected and analyzed for different soil strata;
- excluding sediment and soil chemistry parameters that were not detected in at least one (1) of the seven (7) sediment/soil samples. This approach was considered reasonable because most of the detection limits for the individual contaminants were below the applicable federal and provincial guidelines considered by AEL (2018), and it is unlikely that these non-detected contaminants will limit risks to aquatic biota exposed to suspended solids;
- excluding parameters/contaminants such as pH, conductivity, sodium adsorption ratio (SAR), and hot water-soluble boron (HWS boron) measured in sediments and soils because they are not considered to be aquatic life toxicants; potential adverse effects of conductivity, SAR, and HWS boron are limited to terrestrial plants;
- excluding PHC Fraction 3 and Fraction 4 because these fractions are sufficiently insoluble in water (CCME, 2008); and

- excluding PCBs because the environmental exposure to PCBs is predominantly via sediment, soil, and/or tissue, and the CCME (2001a) Canadian interim sediment quality guideline (ISQG) of 60 μg/g for PCBs for the protection of aquatic life is far above the maximum measured sediment/soil concentration of 0.19 μg/g.

Based on the above screen, the following sediment and soil contaminants were considered for this assessment:

PHCs

- F1 (C6-C10)
- F2 (C10-C16)

VOCs

- 1,4-Dichlorobenzene
- Ethylbenzene
- Toluene
- Trichloroethylene
- Xylene (Total)

Metals and Other Inorganics

- Antimony (Sb)
- Arsenic (As)
- Barium (Ba)
- Beryllium (Be)
- Cadmium (Cd)
- Chromium (Cr)
- Cobalt (Co)
- Copper (Cu)
- Cyanide (CN-)
- Lead (Pb)
- Mercury (Hg)
- Molybdenum (Mo)
- Nickel (Ni)
- Selenium (Se)
- Silver (Ag)
- Thallium (Tl)
- Tin (Sn)
- Uranium (U)
- Vanadium (V)
- Zinc (Zn)

PAHs

- Acenaphthene
- Acenaphthylene
- Anthracene
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b/j) fluoranthene
- Benzo(g,h,i)perylene
- Benzo(k)fluoranthene
- Chrysene
- Dibenz(a,h)anthracene
- Fluoranthene
- Fluorene
- Indeno(1,2,3-cd) pyrene
- 1-Methylnaphthalene
- 2-Methylnaphthalene
- Naphthalene
- Phenanthrene
- Pyrene

This list of sediment and soil contaminants was used to represent the contaminants potentially present in total suspended solids because measured values of contaminant concentrations in suspended solids of surface water and seepage are not available. The approach was considered to be conservative, as described in Section 6.0.

4.3 Selection of Water Quality Guidelines

4.3.1 Long-term (Chronic)

The predicted water quality concentrations were compared against the CCME long-term (chronic) water quality guidelines (WQG) for the protection of freshwater aquatic life to evaluate potential long-term risks to aquatic biota exposed to suspended solids in water. Where a CCME WQG was not available, chronic WQGs from other jurisdictions or acceptable literature, in order of preference, were selected:

- Ontario Provincial Water Quality Objectives (PWQOs; MOEE 1994);
- Ministry of Environment, Conservation and Parks (MECP) aquatic protection value (APV; MOE 2011);
- U.S. Environmental Protection Agency (U.S. EPA, 2018a) National Recommended Water Quality Criteria – Criterion Continuous Concentration (CCC); and
- Chronic benchmarks from Suter and Tsao (1996).

The PWQOs (MOEE, 1994) developed for emergency purposes were not considered for this assessment because they have not been peer reviewed.

For selenium, the U.S. EPA (2016) selenium CCC was selected over the CCME (2018; CCREM,1987) value because it is based on recent scientific knowledge.

Where a WQG was related to water hardness, a geometric mean water hardness of 113 mg/L as $CaCO_3$, estimated from the surface water and seepage samples considered in this assessment, was used.

The selected long-term WQGs and basis of the WQGs are provided in **Appendix A.**

4.3.2 Short-term (Acute)

The potential for mixture toxicity for the predicted water quality concentrations was evaluated using an additive toxic unit approach and short-term WQGs or acute toxicity values. This provides a conservative check to be sure that combined effects from multiple contaminants, all at their upper bound concentrations, are not toxic to aquatic life for a short-term event, such as a storm event or an unscheduled release. In order of preference, short-term WQGs or acute toxicity values were selected from:

- CCME short-term WQGs for the protection of freshwater aquatic life;
- The lowest acute toxicity values considered by the CCME in the derivation of their long-term WQGs for the protection of freshwater aquatic life;
- Acute endpoint considered by MECP in the derivation of their APVs (MOE, 2011);
- U.S. EPA (2018a) National Recommended Water Quality Criteria – Criterion Maximum Concentration (CMC);

- Suter and Tsao (1996) Tier II secondary acute value;
- U.S. EPA (2018b) ECOTOX database, and
- Narcosis approach from DiToro et al. (2000).

Where the selected acute value was obtained from the MECP (MOE, 2011) or Suter and Tsao (1996), the ECOTOX database (U.S. EPA, 2018b) was checked to see if more recent acute toxicity values were available. If a lower acute value was reported in the ECOTOX database (U.S. EPA, 2018b; e.g. cobalt and benzo(g,h,i)perylene), this acute value was selected for the assessment.

The endpoints considered in the ECOTOX database (U.S. EPA, 2018b) check included the lethal concentration (LC50), lethal time (LT50), effective concentration (EC50), and effective time (ET50) that produces a lethal or sublethal response to 50% of the test organisms. The test organisms considered in the ECOTOX database (U.S. EPA, 2018b) were mainly fish and invertebrates, while the effect measurements were immobility (intoxication) and survival (mortality).

For selenium, the U.S. EPA (2016) intermittent exposure formula was selected over other preferred sources because it is based on recent scientific knowledge.

Where a WQG was related to water hardness, a geometric mean water hardness of 113 mg/L as $CaCO_3$, estimated from the surface water and seepage samples considered in this assessment, was used.

The selected short-term WQGs or acute values and their basis are provided in **Appendix A**.

4.4 Water Quality Estimates

Predicted surface water quality concentrations for a series of TSS water concentrations (5, 25, 50, 75,100 mg/L) were estimated using a mass balance model (Equation 1):

$$C_W = \frac{C_{Sed/Soil} \times C_{TSS}}{1000} + C_{BKGw}$$

Equation (1)

Where:

C_w = Concentration of contaminant in water (μg/L)

$C_{Sed/Soil}$ = Concentration of contaminant in soil/sediment (μg/g)

C_{TSS} = Concentration of total suspended solid in water (mg/L)

C_{BKGw} = Concentration of background contaminant in water (μg/L)

1000 = Unit conversion factor ($mg_{sediment/soil}$ / $g_{sediment/soil}$)

The series of TSS concentrations include the CCME (2002) WQGs for suspended sediments under clear flow for a short-term (25 mg/L) and long term (5 mg/L) exposure duration, and the Department of Fisheries and Ocean's *Land Development Guidelines* (1992) value of 75 mg/L (above background) during design storm events for the protection of fish habitat (where spawning areas are not situated in the receiving environment). The upper TSS value of 100 mg/L is intended to represent a TSS water concentration during an unscheduled release.

The 75th percentile sediment/soil concentration was used for the water quality estimates. For non-detect samples, sample values were set equal to the reportable detection limit prior to calculating the 75th percentile.

The 75th percentile sediment/soil concentration was considered to be a reasonable upper bound concentration representative of suspended solids that may be present in the receiving environment during construction activities, a storm event or an unscheduled released.

The minimum, maximum, mean, median, 75th and 95th percentile sediment/soil concentrations are presented in **Appendix B.**

For consistency, the 75th percentile surface water/seepage concentrations, representative of background water, were added to the predicted surface water concentrations (Equation 1). In cases where a parameter was not detected in any of the surface water/seepage samples or where the contaminant was not analyzed by the laboratory, a background value was not added to the mass balance equation. For non-detect samples, sample values were set equal to the reportable detection limit to estimate the 75th percentile. The minimum, maximum, mean, median, 75th and 95th percentile surface water/seepage concentrations are provided in **Appendix B.**

The predicted surface water quality concentrations for the series of TSS concentrations, and the comparison to the long-term WQGs, are provided in **Appendix C**.

Seven (7) contaminants had predicted concentrations in surface water (**Appendix C**) above the long-term WQG, for at least some TSS concentrations:

- ≥ 10 mg/L TSS
    - Copper
    - Lead

- ≥ 50 mg/L TSS
    - Barium
    - Cadmium
    - Zinc

- 100 mg/L TSS
    - o Cobalt

These exceedances suggest that there may be potential risks to aquatic life for contaminants associated with the suspended solids, for different release scenarios, and that potential mitigation options may be needed to address these risks.

For a TSS concentration of 25 mg/L, predicted copper and lead concentrations in water were found to exceed the long-term WQG. This comparison is conservative, since a long-term exceedance of the TSS limit would not be permitted. The implications of short-term exceedance of the TSS limit are considered in Section 4.5.

The long-term WQG for copper (CCREM, 1987) was derived using the U.S. EPA (1985a) copper toxicity-hardness equation multiplied by an application factor of 0.2 to account for uncertainty (**Appendix A**). If this application factor were removed, this would result in a long-term WQG for copper of 13 µg/L. Comparison of this value to the predicted concentrations in surface water (**Appendix C**) indicates that a copper exceedance would still exist for the 50, 75 and 100 mg/L TSS concentrations, but not for the TSS level of 25 mg/L.

Currently the U.S. EPA (2007) has endorsed the use of the biotic ligand model to derive their long-term (CCC) freshwater criteria. This approach uses metal speciation calculations to predict metal toxicity to aquatic organisms by accounting for the toxicity-modifying effects of major ions and dissolved organic carbon in water. This approach could not be used for this assessment because major ions and dissolved organic carbon in water were not measured as part of the AEL (2018) environmental site assessment. If this approach was used it is likely that a long-term WQG for copper of more than 13 µg/L could be derived.

The long-term WQG for lead (CCREM, 1987) was derived using the U.S. EPA (1985b) lead toxicity-hardness equation. The predicted lead water quality concentration of 3.9 µg/L for a TSS concentration of 25 mg/L exceeds the long-term WQG for lead of 3.7 µg/L by 5%. However, most of the predicted concentration will be adsorbed to the suspended solids, rather than dissolved in water. The WQG is based on toxicity tests with lead mostly in dissolved form, and it is therefore conservative. Therefore, the small exceedance is unlikely to produce toxicity, particularly for a short-term event.

Based on this evaluation, setting the TSS limit for construction site water to 25 mg/L is considered to be protective of aquatic life in the Rideau River.

4.5 Mixture Toxicity

The potential for the individual contaminants in sediment and soils to mix and cause acute (short-term) toxicity during a storm event or unscheduled release was evaluated using an additive toxic unit (TU) approach. A TU for each contaminant was calculated by dividing the predicted water concentration by a short-term WQG, or where a short-term WQG was not available, by a literature-based acute value causing a 50% response in a biological endpoint (e.g. mortality or immobility). The TUs for the individual contaminants were then added together (Equation 2):

$$\sum TU = \sum_{i=1}^{n} \frac{CW_i}{WQG_i}$$

Equation (2)

Where:

TU = Toxic Unit (unitless)

C_w = Concentration of contaminant in water (µg/L)

WQG = Is the short-term WQG or acute value causing a 50% biological response (µ/L)

The model assumes a similar mode of toxicity among the contaminants included in the sum. Where $\sum TU < 1$, acute toxicity is not expected for the mixture of contaminants. Where $\sum TU > 1$, acute toxicity is possible for the mixture of contaminants.

The calculations and the $\sum TU$ values are provided in **Appendix D**. The $\sum TU < 1$ for the 5, 10 and 25 mg/L TSS concentrations, whereas the $\sum TU > 1$ for the 50, 75 and 100 mg/L TSS concentrations. The latter suggests the potential for acute toxicity.

Based on this evaluation, setting the TSS limit for construction site water to 25 mg/L is considered to be protective of aquatic life in the Rideau River.

5.0 TSS Construction Site Water Limit

Based on the above evaluations, setting the TSS limit for construction site water to 25 mg/L for a short-term duration (e.g. 24-hours) is considered to be protective of aquatic life in the Rideau River. Based on an assumed TSS-turbidity relationship of 3:1 (CCME, 2002), the equivalent turbidity value is 8 NTU. The TSS and turbidity limits are intended to be compared directly to measured values in site water prior to discharge, and not increased by river background at the time.

The TSS turbidity-relationship outlined in CCME (2002) is a generic relationship. It is recommended that the Contractor carrying out the planned construction work, collect site-specific data to refine this TSS turbidity-relationship, and either confirm the NTU value or set a revised site-specific NTU value corresponding to TSS of 25 mg/L.

6.0 Uncertainty Assessment

Although there are a number of potential uncertainties inherent in this assessment, these uncertainties are addressed by making conservative assumptions and using site-specific data. These assumptions are discussed with respect to uncertainties associated with the quality and quantity of site data used in the assessment; the use of the mass balance model; the comparison of predicted water quality concentrations to long-term WQGs; the use of the additive TU model approach to evaluate mixture toxicity; and the selection of acute values used for the additive TU model.

Data Quality and Quantity

The inclusion of soil samples in the analysis, and the use of maximum measured soil concentrations for boreholes, where soil concentrations were measured at different depths, is conservative and likely to overestimate impact because:

- contaminant concentrations in soil were often measured higher in the soil samples compared to the sediment (**Appendix B**);
- maximum measured soil concentrations were often measured in subsurface soils (>1.5 m below ground surface) (AEL, 2018) which are not likely to be introduced to TSS in surface water runoff, due to mitigation measures during construction; and
- sediments are likely to be more disturbed and suspended in water, as compared to soils, because most of the construction activity is likely to take place in water (i.e. within the lock system).

For this assessment non-detect values in sediment/soil and surface water/seepage samples were set equal to the reportable detection limit. This approach is likely to overestimate actual contaminant concentrations.

Few sediment/soil and surface water/seepage samples were collected for inclusion in the assessment. However, the samples that were used may likely overestimate contaminant concentrations because the environmental site assessment (AEL,2018) was focused on sampling areas of known or suspected contamination. Moreover, the use of the 75th percentile in this assessment is conservative.

Long-term Water Quality Guidelines

The use of long-term WQGs in the screening of the predicted water quality concentrations is conservative because they assume longer exposure durations than those that are likely to occur with the release of suspended solids during a storm event or unscheduled release.

The WQGs are also conservative because they are based on toxicity tests in which contaminants are mostly dissolved, whereas the contaminants transported with suspended solids will be mostly adsorbed to the solids.

Mixture Toxicity

Adding TUs from different contaminant groups (e.g. VOCs, PAHs and metals) to assess mixture toxicity may over-predict and/or under-predict mixture toxicity because the synergistic and antagonistic interactions of these chemicals have not been thoroughly studied; however, the assumption of similar modes of action for all these contaminants is likely conservative.

There are also uncertainties associated with the use of the selected acute values used to evaluate mixture toxicity. These uncertainties may include: outdated studies or limited studies; extrapolating results from laboratory tests to the field; differences in sensitivity between the test organism and resident organisms; laboratory conditions that are not representative of field conditions; the form of the contaminant used in toxicity testing is either unknown or not representative of the form found at the site.

The use of acute values from laboratory studies tends to be conservative because these studies typically use highly bioavailable forms of the contaminant. In field situations, the chemical form of the contaminant may be less bioavailable, and toxicity-modifying factors may be present that were not acting in laboratory tests. For this assessment, the lowest acute value reviewed and used by different jurisdictions in the derivation of WQGs protective of aquatic life were selected. In addition, acute values were also cross-checked with the lowest acute values reported in the ECOTOX database (U.S. EPA, 2018b) to be sure that the lowest acute value was selected for this assessment.

To have confidence in the TSS limit for construction site water of 25 mg/L, there must be a high level of certainty or an acceptable and reasonable level of conservatism. Considering the above uncertainties and how these uncertainties were addressed for this assessment, there is confidence that the TSS limit of 25 mg/L for construction site water should be protective to the aquatic life in the Rideau River, and therefore appropriate as a trigger for mitigation measures should the TSS concentration limit be exceeded during a storm event or unscheduled release.

7.0 References

Abernethy, S., A.M. Bobra, W.Y. Shiu, RG. Wells, and D. Mackay. 1986. Acute lethal toxicity of hydrocarbons and chlorinated hydrocarbons to two planktonic crustaceans: The key role of organism–water partitioning. Aquat. Toxicol. 8:163–174 (as cited in the CCME, 1999d).

AEL (AEL Environment). 2018. Risk Assessment and Environmental Monitoring Old Slys Lockstation, Smiths Falls, Ontario, PIN:052740116 and 052740097, FSCI# 09412002. Prepared for Parks Canada Agency, Gatineau, Quebec. Prepared by AEL Environment, a division of Aeon Egmond Limited., Mississauga, Ontario, June 2018.

Ahmad, N., D. Benoit, L. Brooke, D. Call, A. Carlson, D. DeFoe, J. Huot, A. Moriatry, J. Richter, P. Subat, G. Veith, and C. Wallbridge. 1984. Aquatic toxicity tests to characterize the hazard of volatile organic chemicals in water: A toxicity summary - Parts I and II. EPA-600/3-84-009. U.S. Environmental Protection Agency, Duluth MN (as cited in CCME, 1999a).

Allred, P.M., Giesy, J.P. 1985. Solar radiation-induced toxicity of anthracene to Daphnia pulex. Environmental Toxicology and Chemistry, 4: 219–226.

ATRG (Aquatic Toxicity Research Group). 1988. Aquatic toxicity of multiple organic compounds. II. Chlorinated ethanes and chlorinated ethylenes. A summary report prepared for the Ontario Ministry of the Environment by the Aquatic Toxicity Research Group, Lakehead University, Thunder Bay, ON (as cited in the CCME, 1999d).

Birge,W.J. 1978. Aquatic toxicology of trace elements of coal and fly ask, pp. 219-240. In Energy and environmental stress in aquatic systems, J.H. Thorp and J. Whitfield Gibbons [eds]. Department of Energy Symposium Series, 48. NTIS CONF-771114. Springfield, VA (as cited in MOEE, 1996).

Birge,W.J., J.A. Black, and D.M. Bruser.1979. Toxicity of Organic Chemicals to Embryo-Larval Stages of Fish. U.S.EPA, Washington, D.C.: 60 p EPA-560/11-79-007 (as cited in U.S. EPA, 2018b).

Black, J.A., W.J. Birge, W.E. McDonnell, A.G. Westerman, B.A. Ramey, and D.M. Bruser. 1982. The aquatic toxicity of organic compounds to embryo–larval stages of fish and amphibians. Research Report No. 133, University of Kentucky Water Resources Research.

Black, J.A., Birge, W.J., Westerman,A.G., Francis, P.C.. 1983. Comparative aquatic toxicology of aromatic hydrocarbons. Fundam. Appl. Toxicol. 3(9/10):353–358 (as cited in CCME, 1999h).

Borgmann,U., Couillard, Y., Doyle, P., Dixon,D.G. 2005. Toxicity of Sixty-Three Metals and Metalloids to Hyalella azteca at Two Levels of Water Hardness. Environ. Toxicol. Chem., 24: 641-652.

Brown, B.T., and B.M. Rattigan. 1979. Toxicity of soluble copper and other metal ions to Elodea canadensis. Environ. Pollut. 20:303–314 (as cited in CCME, 1999g).

Call, D.J., L.T. Brooke, S.L. Harting, S.H. Poirier, and D.J. McCauley. 1986. Toxicity of phenanthrene to several freshwater species. University of Wisconsin—Superior, Center for Lake Superior Environmental Studies, Superior, WI (as cited in CCME, 1999h).

Caux, P.-Y., Moore, D.R.J., MacDonald, D. 1997. Ambient Water Quality Guidelines (Criteria) for Turbidity, Suspended and Benthic Sediments, Technical Appendix. Prepared for: British Columbia Ministry of Environment, Lands and Park. Prepared by: Cadmus Group Inc. and MacDonald Environmental Sciences Ltd., April 1997.

CCME (Canadian Council of Ministers of the Environment). 1995. Protocol for the derivation of Canadian sediment quality guidelines for the protection of aquatic life. CCME EPC-98E. Prepared by Environment Canada, Guidelines Division, Technical Secretariat of the CCME Task Group on Water Quality Guidelines, Ottawa. [Reprinted in Canadian environmental quality guidelines, Chapter 6, Canadian Council of Ministers of the Environment, 1999, Winnipeg.]

CCME. 1999a. Canadian water quality guidelines for the protection of aquatic life: Chlorinated benzenes—1,4-Dichlorobenzene. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

CCME. 1999b. Canadian water quality guidelines for the protection of aquatic life: Ethylbenzene. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

CCME. 1999c. Canadian water quality guidelines for the protection of aquatic life: Toluene. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

CCME. 1999d. Canadian water quality guidelines for the protection of aquatic life: Chlorinated ethenes—1,1,2-Trichloroethene (trichloroethylene). In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

CCME. 1999e. Canadian water quality guidelines for the protection of aquatic life: Chromium — Hexavalent chromium and trivalent chromium. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

CCME. 1999f. Canadian water quality guidelines for the protection of aquatic life: Molybdenum. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

CCME. 1999g. Canadian water quality guidelines for the protection of aquatic life: Thallium. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

CCME. 1999h. Canadian water quality guidelines for the protection of aquatic life: Polycyclic aromatic hydrocarbons (PAHs). In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

CCME. 2001a. Canadian sediment quality guidelines for the protection of aquatic life: Polychlorinated biphenyls (PCBs). Updated. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

CCME. 2001b. Canadian water quality guidelines for the protection of aquatic life: Arsenic. Updated. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

CCME. 2002. Canadian water quality guidelines for the protection of aquatic life: Total particulate matter. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

CCME. 2003. Canadian water quality guidelines for the protection of aquatic life: Inorganic mercury and methylmercury. In: Canadian environmental quality guidelines, 1999. Canadian Council of Ministers of the Environment, Winnipeg.

Canadian Council of Ministers of the Environment. 2007. A protocol for the derivation of water quality guidelines for the protection of aquatic life 2007. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, 1999, Winnipeg.

CCME. 2008. Canada-Wide Standard for Petroleum Hydrocarbons (PHC) in Soil: Scientific Rationale, Support Technical Document, Canadian Council of Ministers of the Environment, Winnipeg, January 2008.

CCME. 2011. Canadian water quality guidelines for the protection of aquatic life: Uranium. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

CCME. 2014. Canadian water quality guidelines for the protection of aquatic life: Cadmium. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

CCME. 2015. Canadian water quality guidelines for the protection of aquatic life: Silver. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

CCME. 2018. Summary Table. Available at: http://st-ts.ccme.ca/en/index.html, retrieved July 2018.

CCREM (Canadian Council of Resource and Environment Ministers). 1987. Canadian Water Quality Guidelines. Task Force on Water Quality Guidelines of the Canadian Council of Ministers of the Environment.

DFO (Department of Fisheries and Oceans and Ministry of Environment Lands and Parks). 1992. Land development guidelines for the protection of aquatic habitat, May 1992 (first printing), September, 1993 (second printing). Available at: http://www.dfo-mpo.gc.ca/Library/165353.pdf.

Di Toro, D.M., McGrath, J.A., Hansen, D.J. 2000. Technical Basis for Narcotic Chemicals and Polycyclic Aromatic Hydrocarbon Criteria. I. Water and Tissue. Environmental Toxciology and Chemistry, 19:1951-1970.

EC (Environment Canada). 2003. Canadian Water Quality Guidelines for the Protection of Aquatic Life: Inorganic Mercury and Methylmercury. Scientific Supporting Document, Ecosystem Health: Science-based Solutions Report No. 1-7. National Guidelines and Standards Office, Water Policy and Coordination Directorate, Environment Canada, Ottawa. pp.107.

EC. 2017. Canadian Environmental Protection Act, 1999, Federal Environmental Quality Guidelines, Cobalt. Environment Canada, May 2017.

ECCC (Environment and Climate Change Canada). 2016. Canadian Environmental Protection Act, 1999, Federal Environmental Quality Guidelines, Vanadium. Environment and Climate Change Canada, May 2016.

EPA. 1993a. Water quality guidance for the Great Lakes System and correction; Proposed rules. Federal Register. 58(72):20802-21047 (as cited in Suter and Tsao, 1996).

Finger, S.E., E.F. Little, M.G. Henry, J.F. Fairchild, and T.P. Boyle. 1985. Comparison of laboratory and field assessment of fluorene. Part I. Effects of fluorene on the survival, growth, reproduction, and behavior of aquatic organisms in laboratory tests. In: Validation and predictability of laboratory methods for assessing the fate and effects of contaminants in aquatic ecosystems, ASTM STP 865. T.P. Boyle, ed. Philadelphia (as cited in the CCME, 1999h).

Fletcher T, G.L. Stephenson, B. Muncaster, C.D. Wren, and D.J. Spry. 1997. Scientific criteria document for the development of an interim provincial water quality objective for molybdenum. Ontario Ministry of Environment and Energy, Standards Development Branch, Toronto (as cited in CCME, 1999f).

Galassi,S., Mingazzini,M., Viganò, L., Cesareo,D, Tosat, M.L. 1988. Approaches to Modeling Toxic Responses of Aquatic Organisms to Aromatic Hydrocarbons. Ecotoxicology and Environmental Safety, 16: 158-169.

Heit, M. and M. Fingermann. 1977. The influence of size, sex and temperature on the toxicity of mercury to two species of crayfishes. Bull. Environ. Contam. Toxicol. 18:572-580 (as cited in EC, 2003).

Holcombe, G.W.,Phipps, G.L.,Fiandt, J.T. 1983. Toxicity of selected priority pollutants to various aquatic organisms selected priority pollutants to various aquatic organisms. Ecotoxicol. Environ. Saf. 7:400–409 (as cited in the CCME, 1999h).

Lampi,M.A., J. Gurska, K.I.C. McDonald, F. Xie, X.D. Huang, D.G. Dixon, and B.M. Greenberg. 2006. Photoinduced Toxicity of Polycyclic Aromatic Hydrocarbons to Daphnia magna: Ultraviolet-Mediated Effects and the Toxicity of Polycyclic Aromatic Hydrocarbon Photoproducts. Environmental Toxicology and Chemistry, 25: 1079-1087.

Lilius,H., Isomaa, B., Holmstrom, T. 1994. A Comparison of the Toxicity of 50 Reference Chemicals to Freshly Isolated Rainbow Trout Hepatocytes and Daphnia magna. Aquat. Toxicol.30:47-60.

Kagan, J., and E.D. Kagan. 1986. The toxicity of benzo(a)pyrene and pyrene in the mosquito Aedes aegypti, in the dark and in the presence of ultraviolet light. Chemosphere 15:243–251 (as cited in CCME, 1999h).

Kagan, J., Kagan, E.D., Kagan, I.A., Kagan, P.A., Quigley, S. 1985. The phototoxicity of non-carcinogenic polycyclic aromatic hydrocarbons in aquatic organisms. Chemosphere 14:1829–1834 (as cited in CCME, 1999h).

Kennedy, C.J. 1990. Toxicokinetic Studies of Chlorinated Phenols and Polycyclic Aromatic Hydrocarbons in Rainbow Trout (Oncorhynchus mykiss) Ph.D. Thesis, Simon Fraser University, Canada:188p; Abstr. Int. B. Sci. Eng. 53(1):18 (1992) (as cited in MOE, 2011).

Khangarot, B.S. 1991. Toxicity of metals to a freshwater tubificid worm, *Tubifex tubifex* (Muller). Bull. Environ. Contam. Toxicol. 46:906–912 (as cited in the CCME, 1999f).

Kimball, G. (n.d.). The effects of lesser known metals and one organic to fathead minnows (*Pimephales promelas*) and Daphnia magna. University of Minnesota, Department of Entomology, Fisheries and Wildlife, Minneapolis, MN (as cited in CCME, 1999h).

MADEP (Massachusetts Department of Environmental Protection). 2008. Massachusetts Contingency Plan (MCP) Numerical Standards Development Spreadsheets. Massachusetts Department of Environmental Protection. Brureau of Waste Site Cleanup (as cited in the MOE, 2011).

Mayer,F.L.,Jr., and M.R. Ellersieck. 1986. Manual of Acute Toxicity: Interpretation and Data Base for 410 Chemicals and 66 Species of Freshwater Animals. USDI Fish and Wildlife Service, Publication No.160, Washington, DC:505 p.

MOE (Ontario Ministry of the Environment). 1979. Rationale for the Establishment of Ontario's Water Quality Objectives. Ontario Ministry of the Environment, September, 1979.

MOE. 2011. Rationale for the Development of Soil and Ground Water Standards for Use at Contaminated Sites in Ontario. Standards Development Branch, Ontario Ministry of the Environment, April 2011, PIBS 7386e01.

MOEE (Ministry of Environment and Energy). 1994. Water Management. Policies, Guidelines, Provincial Water Quality Objectives of the Ministry of Environment and Energy. Ministry of Environment and Energy, Queen’s Printer for Ontario, July 1994, Reprinted February 1999, PIBS 3303e.

MOEE. 1996. Scientific Criteria Document for the Development of an Interim Provincial Water Quality Objective for Antimony. Ministry of Environment and Energy, Queen’s Printer for Ontario, January 1996, PIBS 3348E02.

Moles, A. 1981. Reduced growth of coho salmon fry exposed to two petroleum components, toluene and naphthalene in freshwater. Trans. Am. Fish. Soc. 110:430–436 (as cited in the CCME, 1999c).

Nagpal, N.K. 2004. Technical report, water quality guidelines for cobalt, Water Protection Section, Water, Air and Climate Change Branch, Ministry of Water, Land and Air Protection, Victoria, BC, July 2004.

Newcombe, C.P. 1994. Suspended sediment pollution: Dose response characteristics of various fishes. British Columbia Ministry of Environment, Lands and Parks, Habitat Protection Branch, Victoria, BC (as cited in the CCME, 2002).

Newcombe, C.P, Jensen, J.O.T. 1996. Channel Suspended Sediment and Fisheries: A Synthesis for Quantitative Assessment of Risk and Impact. North American Journal of Fisheries management, 16:693-727 (as cited in CCME, 2002).

Newsted,J.L., Giesy, J.P. 1987. Predictive Models for Photoinduced Acute Toxicity of Polycyclic Aromatic Hydrocarbons to Daphnia magna, Strauss (Cladocera, Crustacea). Environmental Toxicology and Chemistry, 6: 445-461.

Passino, D.R.M., and A.J. Novak. 1984. Toxicity of arsenate and DDT to the cladoceran Bosmina longirostris. Bull. Environ. Contam. Toxicol. 33:325–329 (as cited in CCME, 2001).

Smith, A.D., A. Bharath, C. Mallard, D. Orr, K. Smith, J.A. Sutton, J. Vukmanich, L.S. McCarty, and G.W. Ozburn. 1991. The acute and chronic toxicity of 10 chlorinated organic compounds to the American flagfish *Jordanella floridae* (Goode and Bean). Arch. Environ. Contam. Toxicol. 20:94–102 (as cited in CCME, 1999a).

Snarski, V. M. and G. F. Olson 1982. Chronic toxicity and bioaccumulation of mercuric chloride in the fathead minnow (*Pimephales promelas*). Aquat. Toxicol. 2:143-156 (as cited in CCME, 2003).

Stevens, D.G., and G.A. Chapman. 1984. Toxicity of trivalent chromium to early life stages of steelhead trout. Environ. Toxicol. Chem. 3:125–133 (as cited in the CCME, 1999e).

Suter II, G.W., Tsao, C.L. 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision. Risk Assessment Program, Health Sciences Research Division, Oak Ridge, Tennessee, June 1996.

Trucco, R.G., F.R. Engelhardt, and B. Stacey. 1983. Toxicity, accumulation and clearance of aromatic hydrocarbons in *Daphnia pulex*. Environ. Pollut. Ser. A. Ecol. Biol. 31:191–202 (as cited in CCME, 1999h).

U.S. EPA (U.S. Environmental Protection Agency). 1980. Ambient Water Quality Criteria for Nickel. U.S. Environmental Protection Agency, Office of Water, Regulations and Standards, Criteria and Standards Division, Washington, D.C.

U.S. EPA 1985a. Ambient Water Quality Criteria for Copper- 1984. U.S. Environmental Protection Agency, Office of Water, Regulations and Standards, Criteria and Standards Division, Washington, D.C., January 1985.

U.S. EPA. 1985b. Ambient Water Quality Criteria for Cyanide - 1984. U.S. Environmental Protection Agency, Office of Water, Regulations and Standards, Criteria and Standards Division, Washington, D.C., January 1985.

U.S. EPA. 1985c. Ambient Water Quality Criteria for Lead - 1984. U.S. Environmental Protection Agency, Office of Water, Regulations and Standards, Criteria and Standards Division, Washington, D.C., January 1985.

U.S. EPA. 1986. Quality Criteria for Water -1986. U.S. Environmental Protection Agency, Office of Water, Regulations and Standards, Washington, D.C., May 1986.

U.S. EPA. 1988. Draft Ambient Aquatic Life Water Quality Criteria for Antimony (III). U.S. Environmental Protection Agency, Office of Research and Development, Environmental Research Laboratories, Duluth, Minnesota, and Narragansett, Rhode Island, August 1988.

U.S. EPA. 1996. 1995 Updates: Water Quality Criteria Documents for the Protection of Aquatic Life in Ambient Water. United States Environmental Protection Agency, Office of Water, Washington, D.C.

U.S. EPA. 2007. Aquatic Life Ambient Freshwater Quality Criteria - Copper, 2007 Revision. U.S. Environmental Protection Agency, Office of Water, Washington, DC, February 2007.

U.S. EPA. 2016. Aquatic Life Ambient Water Quality Criterion for Selenium – Freshwater, 2016. U.S. Environmental Protection Agency, Office of Water, Office of Science and Technology, Washington, D.C., June 2016.

U.S. EPA. 2018a. National Recommended Water Quality Criteria – Aquatic Life Criteria Table. Available: https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria- /. Retrieved July 2018.

U.S. EPA. 2018b. ECOTOX User Guide: ECOTOXicology Knowledgebase System. Version 4.0. Available: http:/www.epa.gov/ecotox/. Retrieved July 2018.

Vigano, L. 1993. Reproductive strategy of Daphnia magna and toxicity of organic compounds. Water Res. 27:903–909 (as cited in CCME, 1999b).

Vocke, R.W., K.L. Sears, J.J. O’Toole, and R.B. Wildman. 1980. Growth responses of selected freshwater algae to trace elements and scrubber ash slurry generated by coal-fired power plants. Water Res. 14:141–150 (as cited in the CCME, 2001).

Wernersson, A.-S, Dave, G. 1997. Phototoxicity Identification by Soilid Phase Extraction and Photoinduced Toxicity to Daphnia magna. Archives of Environmental Contamination and Toxicology, 32:268-273.

Appendix A Selected Long-Term and Short-Term Water Quality Guidelines (or Acute Values)

Table A-1: Selected Long-term and Short-term Water Quality Guidelines (or Acute Values)

	Long-term			Short-term		
	Benchmark (µg/L)	Basis	Source	Benchmark (µg/L)	Basis	Source
Total Suspended Solids	5 000	Canadian water quality guidelines for suspended sediments for the protection of aquatic life for exposures lasting between 24-h and 30-days. Based on adult salmonids severity-of-ill-effects (SEV) concentration-duration-response model from Caux et al. (1997), which is based on the SEV concentration-duration response approach from Newcombe (1994) and Newcombe and Jensen, (1996). A TSS concentration above a 5000 µg/L change from background concentrations may cause minor physiological stress, and increased rates of coughing and respiration in fish (CCME, 2002).	CCME, 2002	25 000	Canadian water quality guidelines for suspended sediments for the protection of aquatic life for any short-term exposure (24-h period). 'Based on adult salmonids SEV concentration-duration-response model from Caux et al. (1997). A TSS concentration above a 25 000 µg/L change from background concentrations may cause behavioural and low sublethal effects on fish (CCME, 2002).	CCME, 2002
PHCs						
F1 (C6-C10) - BTEX	167	Surrogate approach from the CCME (2008). The geometric mean of 48-hr LC50 for Daphnia magna and 24-h LC50 for Artemia salina of 3700 µg/L divided by an uncertainty factor of 20 for n-hexane, and 48-h EC50 (immobility) for 601 µg/L Daphnia magna divided by an uncertainty factor of 5 for isopropylbenzene (cumene).	CCME, 2008	1822	a modified surrogate approach from the CCME (2008). The geometric mean of 48-hr LC50 for*Daphnia magna* and 24-h LC50 for *Artemia salin* a of 3700 µg/L for n-hexane, and 48-h EC50 (immobility) of 601 µg/L for *Daphnia magna* for isopropylbenzene (cumene).	CCME, 2008
F2 (C10-C16 Hydrocarbons)	42	Surrogate approach from the CCME (2008). The 48-h NOAEL for *Daphnia magna* of 1300 µg/L divided by an uncertainty factor of 10 for decane, and the geometric mean of rainbow trout hatchability in embryo-stage larvae of 11 µg/L for naphthalene.		53	a modified individual surrogate approach from the CCME (2008) without the inclusion of uncertainty factors. The 48-h NOAEL for *Daphnia magna* of 1300 µg/L for the surrogate parameter decane, and the geometric mean of rainbow trout hatchability in embryo-stage larvae of 11 µg/L for naphthalene.	
VOCs						
1,4-Dichlorobenzene	26	CCME (1999a) Interim Canadian water quality guideline for the protection of freshwater aquatic life. Derived by multiplying the reduction in larval survival after a 10-day exposure of 263 µg/L for the American flagfish (*Jordanella floridae*)(Smith et al., 1991) by a safety factor of 0.1 (CCME, 1999a).	CCME, 1999a	1100	96-h LC50 of 1100 µg/L for Rainbow Trout (*Oncorhynchus mykiss*) (Ahmad et al., 1984). This is the lowest acute value considered by the CCME (1999a) in the derivation of the interim 1,4-dichlorobenzene Canadian water quality guideline for the protection of freshwater aquatic life.	CCME, 1999a
Ethylbenzene	90	CCME (1999b) Interim Canadian water quality guideline for the protection of freshwater aquatic life. Derived by multiplying the 48-h EC50 (immobilization) of 1800 µg/L for *Daphnia magna* (Vigano, 1993), by a safety factor of 0.05 (CCME, 1999b).	CCME, 1999b	1800	48-h EC50 (immobilization) of 1800 µg/L for *Daphnia magna* (Vigano, 1993). This is the lowest acute value considered by the CCME (1999b) in the derivation of the interim ethylbenzene Canadian water quality guideline for the protection of freshwater aquatic life.	CCME, 1999b
Toluene	2	CCME (1999c) Interim Canadian water quality guideline for the protection of freshwater aquatic life. Derived by multiplying the 27-day LC50 of 20 µg/L for Rainbow Trout (*Oncorhynchus mykiss*) (Black et al., 1982) by a safety factor of 0.1 (CCME, 1999c).	CCME, 1999c	5460	96-h LC50 of 5460 µg/L for coho salmon (*Oncorhynchus kisutch*) (Moles, 1981). This is the lowest acute value considered by the CCME (1999c) in the derivation of the interim toluene water quality guideline for the protection of freshwater aquatic life.	CCME, 1999c
Trichloroethylene	21	CCME (1999d) Interim Canadian water quality guideline for the protection of freshwater aquatic life. Derived by multiplying the LOEC of 210 µg/L (decreased swim-up survival and 120-day fry weight and growth) for Brook Trout (Salvelinus fontinalis) (ATRG, 1988) by a safety factor of 0.1 (CCME, 1999d).	CCME, 1999d	7760	48-h EC50 of 7760 µg/L for *Daphnia magna* (Abernethy et al., 1986). This is the second lowest acute value considered by the CCME (1999c) in the derivation of the interim trichloroethylene water quality guideline for the protection of freshwater aquatic life. The lowest acute value considered by the CCME (1999d) was 5000 µg/L for the Rainbow Trout (*Oncorhynchus mykiss*). This value was based on the lowest concentration of at which a toxic condition (increased respiration rates) was developed within 24-h after exposure to trichloroethylene to the Rainbow Trout. The endpoint value was not considered appropriate for this assessment.	CCME, 1999d
Xylene Mixture (Total)	2	The interim Ontario Provincial water quality objective for xylene, m-. Although, the basis of the 2 µg/L is not known, the interim PWQO for this parameter is derived based on the lowest effect concentration reported and an uncertainty factor (MOEE, 1994).	MOEE, 1994	3300	96-h LC50 of 3300 µg/L for Rainbow Trout (Mayer and Ellersieck, 1986 from ECOTOX). This value was used by the MOE (2011) in the derivation of their aquatic protection value for the protection of aquatic biota exposed to xylene mixtures from the migration of contaminated groundwater to surface water.	MOE, 2011

Table A-1: Selected Long-term and Short-term Water Quality Guidelines (or Acute Values)

	Long-term			Short-term		
	Benchmark (µg/L)	Basis	Source	Benchmark (µg/L)	Basis	Source
Metals and other Inorganics						
Antimony (Sb)	20	An interim Ontario Provincial water quality objective derived by multiplying the 7-day LC50 of 300 µg/L for the Eastern Narrow-Mouthed Toad (*Gastrophryne carolinensis*) (Birge, 1978) by an final uncertainty factor of 14.5 (MOEE, 1996).	MOEE, 1994	175	US EPA (1988) draft final acute value.	US EPA, 1988
Arsenic (As)	5.0	CCME (2001) Canadian water quality guideline for the protection of freshwater aquatic life. Derived by multiplying the 14-d EC50 of 50 µg/L for the alga (*Scenedesmus obliquus*) (Vocke et al., 1980), by a safety factor of 0.1 (CCME, 2001).	CCME, 2001b	850	96-h EC50 (immobility) for *Bosmina longirostris* (Passino and Novak 1984). This is the lowest acute value considered by the CCME (2001) in the derivation of the arsenic Canadian water quality guideline for the protection of freshwater aquatic life.	CCME, 2001b
Barium (Ba)	4	Secondary chronic value from Suter and Tsao (1996). Derived by dividing the lowest LC50 genus mean acute value of 977 µg/L for Potamopyrgus jenkinsi by a final acute value factor of 8.6 and an secondary acute chronic ratio of 28.3 (Suter and Tsao, 1996). Although, MOE (2011) reported an aquatic protection value (APV) of 2300 µg/L based on 91.3-d LOEL (reduced growth) for *Chlorella vulgaris*, this value was higher than the short-term benchmark selected for barium. The selected chronic benchmark should not cause lethal effects.	Suter and Tsao, 1996	71	24-h EC50 (immobility) of 71 µg/L for *Daphnia magna* (Lilius et al., 1994 from ECOTOX).	ECOTOX, 2018b
Beryllium (Be)	5.3	The final chronic criterion from the U.S. EPA (1986) and the lowest chronic value for daphnids (MATC) from Sutur and Tsao (1996). Although there is a PWQO for Beryllium of 1100 µg/L for water hardness greater than 75 mg/L as $CaCO_3$, this value is higher than the short-term benchmark selected for beryllium. The selected chronic benchmark should not cause lethal effects.	MOE, 2011	35	Suter and Tsao (1996) Tier II secondary acute value. Derived by dividing the lowest LC50 genus mean acute value of 140 µg/L for *Caenorhabditis elegans* by a final acute value factor of 4.0.	Suter and Tsao, 1996
Cadmium (Cd)	0.18	CCME (2014) Canadian water quality guideline for the protection of freshwater aquatic life. Derived using the long-term toxicity-hardness relationship (based on the 5th percentile of a species sensitivity distribution (SSD)) from CCME (2014) and a geometric mean water hardness of 113 mg/L as $CaCO_3$. Hardness estimated from the surface water samples used for this assessment.	CCME, 2014	2.4	CCME (2014) Canadian water quality guideline for the protection of freshwater aquatic life. Derived using the short-term toxicity-hardness relationship (based on the 5th percentile of a SSD) from CCME (2014) and a geometric mean water hardness of 113 mg/L as $CaCO_3$. Hardness estimated from the surface water samples used for this assessment.	CCME, 2014
Chromium (Cr (III))	8.9	CCME (1999e) Interim chromium (III) water quality guideline for the protection of freshwater aquatic life. Derived by multiplying the 102-d LOEC (mortality) of 89 µg/L for Rainbow Trout (*Oncorhynchus mykiss*) (Stevens and Chapman, 1984) by a safety factor of 0.1 (CCME, 1999e).	CCME, 1999e	1200	64-h EC50 of 1200 µg/L for *Daphnia magna*. This is the lowest acute value considered by the CCME (1999e) in the derivation of the interim chromium (III) water quality guideline for the protection of freshwater aquatic life.	CCME, 1999e
Cobalt (Co)	1.1	Federal Environmental Quality Guideline (EC, 2017) to support federal environmental quality monitoring. Derived using the long-term toxicity-hardness relationship (based on the 5th percentile of SSD) from EC (2017) and a geometric mean water hardness of 113 mg/L as $CaCO_3$. Hardness estimated from the surface water samples used for this assessment.	EC, 2017	61	7-day LC50 of 61 µg/L (water hardwater of 124 mg/L as $CaCO_3$) for *Hyalella azteca* (Borgmann et al., 2005 from ECOTOX).	ECOTOX, 2018b
Copper (Cu)	2.6	CCREM (1987) Canadian water quality guideline. Derived using toxicity-hardness equation from U.S. EPA (1985a) multiplied by an application factor of 0.2. A geometric mean water hardness of 113 mg/L as CaCO3 was used in the toxicity-hardness equation. Water hardness was estimated from the surface water samples used for this assessment.	CCREM, 1987	16	Calculated using the updated toxicity- hardness equation from the U.S. EPA (1996) and a geometric mean water hardness of 113 mg/L as CaCO3 estimated from the surface water samples used for this assessment. Currently the U.S. EPA (2007) has adopted a biotic ligand model approach for derivation of their freshwater criteria. The biotic model approach could not be applied for this assessment because the measurement of surface water major ions required to run the biotic ligand model were not a measured in surface water.	U.S. EPA, 1996
Cyanide (free)	5	CCREM (1987) Canadian water quality guideline protective of freshwater aquatic life. Based on chronic effects on fish growth and reproduction (MOEE, 1994).	CCREM, 1987	22	The U.S. EPA (1985b) Criterion Maximum Concentration. Derived by dividing the final acute value of 44.73 µg/L for Rainbow Trout by 2.	U.S. EPA, 1985b
Lead (Pb)	3.7	CCREM (1987) Canadian water quality guideline. Calculated using toxicity-hardness equation from the U.S. EPA (1985b) and a geometric mean water hardness of 113 mg/L as $CaCO_3$. The water hardness was estimated from the surface water samples used for this assessment.	CCREM, 1987	95	Calculated using the U.S. EPA (1985b) toxicity-hardness equation and a geometric mean water hardness of 113 mg/L as $CaCO_3$. The water hardness was estimated from the surface water samples used for this assessment.	US EPA, 1985c

Table A-1: Selected Long-term and Short-term Water Quality Guidelines (or Acute Values)

	Long-term			Short-term		
	Benchmark (µg/L)	**Basis**	**Source**	**Benchmark (µg/L)**	**Basis**	**Source**
Mercury (Hg)	0.026	CCME (2003) Canadian water quality guideline for the protection of freshwater aquatic life. Derived by multiplying the 60-day LOAEL (growth and weight loss) of 0.26 µg/L as mercuric chloride ($HgCl_2$) for Fathead Minnow (*Pimephales promelas*) (Snarski and Olson, 1982) by a safety factor of 0.1 (CCME, 2003; EC, 2003).	CCME, 2003; EC, 2003	20	96-h LC50 of 20 µg/L (as $HgCl_2$) for crayfish (*Faxonella clypeata*) (Heit and Fingerman, 1977; EC, 2003). This was the lowest acute value considered by the CCME (2003) in the derivation of the inorganic mercury Canadian water quality guideline for the protection of freshwater aquatic life.	CCME, 2003
Molybdenum (Mo)	73	CCME (1999f) interim molybdenum Canadian water quality guideline for the protection of freshwater aquatic life. Derived by multiplying the 28-day LC50 of 730 µg/ L for Rainbow Trout (*Oncorhynchus mykiss*) (Fletcher et al. 1997), by a safety factor of 0.1 (CCME, 1999f).	CCME, 1999f	29000	96-h EC50 of 29 000 µg/L for *Tubifex tubifex* (Khangarot 1991). This is the lowest acute value considered by the CCME (1999f) in the derivation of the interim molybdenum Canadian water quality guideline for the protection of freshwater aquatic life.	CCME, 1999f
Nickel (Ni)	105	CCREM (1987) Canadian water quality guideline. Derived using the toxicity-hardness equation from U.S. EPA (1980) and a geometric mean water hardness of 113 mg/L. Water hardness estimated from the surface water samples used for this assessment.	CCREM, 1987	520	Calculated using the updated toxicity- hardness equation from the U.S. EPA (1996) and a geometric mean water hardness of 113 mg/L as $CaCO_3$. Water hardness estimated from the surface water samples used for this assessment.	U.S. EPA, 1996
Selenium (Se)	1.5	U.S. EPA (2016) final criterion (element) for lentic waters (e.g. lakes). Derived by translating the U.S. EPA (2016) egg-ovary criterion element to a distribution of water concentrations using enrichment factors (that represent the partitioning of selenium between the dissolve and particulate state), and selecting the 20th percentile of the distribution as the criterion.	U.S. EPA, 2016	45	U.S. EPA (2016) intermittent exposure calculated using the final criterion (element) of 1.5 µg/L for selenium for lentic waters divided by a 1 day fraction of any 30-day period (i.e. 0.033) during which elevated selenium concentrations occur.	U.S. EPA, 2016
Silver (Ag)	0.25	CCME (2015) Canadian water quality guideline for the protection of freshwater aquatic life. Derived using the a species sensitivity distribution (SSD) with the 5th percentile calculated from the SSD set as the long-term Canadian water quality guideline for silver protective of aquatic life (CCME, 2015).	CCME, 2015	0.25	CCME (2015) did not recommend a short-term water quality for silver because the long-term SSD 5th percentile and short-term SSD 5th percentile (0.22 µg/L) are essential equal. For the purpose of this assessment the long-term SSD 5th percentile was set as the acute value for this assessment.	CCME, 2015
Thallium (Tl)	0.80	CCME (1999g) Canadian water quality guideline for the protection of freshwater aquatic life. Derived by multiplying the 14-day EC50 of 8 µg/L for duckweed (*Lemna minor*) (Brown and Rattigan, 1979), by a safety factor of 0.1.	CCME, 1999g	680	96-h EC50 of 680 µg/L for *Daphnia magna* (Kimball n.d.). This is the lowest acute value considered by the CCME (1999g) in the derivation of the thallium Canadian water quality guideline for the protection of freshwater aquatic life.	CCME, 1999g
Tin (Sn)	73	Tier II secondary chronic value from Suter and Tsao (1996). Derived by dividing the secondary acute value of 2700 µg/L (rounded) by the secondary acute chronic ratio of 37 µg/L (rounded).	Suter and Tsao, 1996	2700	Suter and Tsao (1996) Tier II secondary acute value. Derived by diving the LC50 genus mean acute value of 55000 µg/L for *Daphnia magna* by a final acute value factor of 20.5.	Suter and Tsao, 1996
Uranium (U)	15	CCME (2011) Canadian water quality guideline for the protection of freshwater aquatic life. long-term SSD 5th percentile.	CCME, 2011	33	CCME (2011) Canadian water quality guideline for the protection of freshwater aquatic life. short-term SSD 5th percentile.	CCME, 2011
Vanadium (V)	120	Federal Environmental Quality Guideline (ECCC, 2016) to support federal environmental quality monitoring. Long-term 5th percentile for a SSD.	ECCC, 2016	280	Suter and Tsao (1996) Tier II secondary acute value. Derived by dividing the lowest LC50 genus mean acute value of 1850 µg/L for Fathead Minnow (*Pimephales promelas*) by a final acute value factor of 6.5.	Suter and Tsao, 1996
Zinc (Zn)	30	CCREM (1987) Canadian water quality guideline. Guideline tentatively recommended because it coincides with the measured "no effect" concentration for Rainbow Trout (36 µg/L) and Fathead Minnows (30 µg/L), and the beginning of growth inhibition in algae (CCREM, 1987).	CCREM, 1987	133	Calculated using the updated toxicity- hardness equation from the U.S. EPA (1996) and a geometric mean water hardness of 113 mg/L as $CaCO_3$. Water hardness estimated from the surface water samples used for this assessment.	U.S. EPA, 1996

Table A-1: Selected Long-term and Short-term Water Quality Guidelines (or Acute Values)

	Long-term			Short-term		
	Benchmark (µg/L)	**Basis**	**Source**	**Benchmark (µg/L)**	**Basis**	**Source**
PAHs						
Acenaphthene	5.8	CCME (1999h) interim Canadian water quality guideline for the protection of freshwater aquatic life. Derived by multiplying the 96-h LC50 of 580 µg/L for Brown Trout (*Salmo trutta*) (Holcombe et al. 1983) by a safety factor of 0.01 (CCME, 1999h).	CCME, 1999h	580	96-h LC50 of 580 µg/L for Brown Trout (*Salmo trutta*) (Holcombe et al. 1983). This is the lowest acute value considered by the CCME (1999h) in the derivation of the interim acenaphthene Canadian water quality guideline for the protection of freshwater aquatic life.	CCME, 1999h
Acenaphthylene	0.14	The MOE (2011) APV to protect aquatic biota exposed to contaminants from the migration of contaminated groundwater to surface water. The APV value is a median PAH phototoxicity from Massachusetts Department of Environmental Protection (MADEP, 2008)	MOE, 2011	605	Derived using the LC50 and Kow relationship for fish presented in DiToro et al. 2000 (e.g. equation 1). This relationship assumes that the most of the toxicity is associated with a narcosis/baseline-type endpoint.	Di Toro et al. 2000
Anthracene	0.012	CCME (1999h) interim Canadian water quality guideline for the protection of freshwater aquatic life. Derived by multiplying a 0.25-h LT50 (phototoxicity) of 1.2 µg/L for *Daphnia pulex* (Allred and Giesy 1985) by a safety factor of 0.01 (CCME, 1999h).	CCME, 1999h	1.2	0.25-h LT50 (phototoxicity) of 1.2 µg/L for *Daphnia pulex* (Allred and Giesy 1985). This is the lowest acute value considered by the CCME (1999h) in the derivation of the interim anthracene Canadian water quality guideline for the protection of freshwater aquatic life.	CCME, 1999h
Benzo(a)anthracene	0.018	CCME (1999h) interim Canadian water quality guideline for the protection of freshwater aquatic life. Derived by multiplying the 12.5-h LT50 (phototoxicity) of 1.8 µg/L for *Daphnia magna* (Newsted and Giesy, 1987) by a safety factor of 0.01 (CCME, 1999h).	CCME, 1999h	1.8	12.5-h LT50 (phototoxicity) of 1.8 µg/L for *Daphnia magna* (Newsted and Giesy, 1987). This is the lowest acute value considered by the CCME (1999h) in the derivation of the interim Benzo(a)anthracene Canadian water quality guideline for the protection of freshwater aquatic life.	CCME, 1999h
Benzo(a)pyrene	0.015	CCME (1999h) interim Canadian water quality guideline for the protection of freshwater aquatic life. Derived by multiplying the 4.4-h LT50 (phototoxicity) of 1.5 µg/L for *Daphnia magna* (Newsted and Giesy, 1987) by a safety factor of 0.01 (CCME, 1999h).	CCME, 1999h	1.5	4.4-h LT50 (phototoxicity) of 1.5 µg/L for *Daphnia magna* (Newsted and Giesy, 1987). This is the lowest acute value considered by the CCME (1999h) in the derivation of the interim benzo(a)pyrene Canadian water quality guideline for the protection of freshwater aquatic life.	CCME, 1999h
Benzo(b/j)fluoranthene	0.42	The MOE (2011) APV to protect aquatic biota exposed to contaminants from the migration of contaminated groundwater to surface water. Derived by dividing the a UV-24h- EC50 (following 2-h of UV irradiation) of 4.2µg/L for the *Daphnia magna* (Wernersson and Dave, 1997) by 10.	MOE, 2011	4.2	UV-EC50 (24-h EC50 values following 2-h of UV irradiation) of 4.2µg/L for the *Daphnia magna* (Wernersson and Dave, 1997).	MOE, 2011
Benzo(g,h,i)perylene	0.02	The MOE (2011) APV to protect aquatic biota exposed to contaminants from the migration of contaminated groundwater to surface water. Derived by dividing the 13.8h-LT50 (UV induced) of 0.2 µg/L for *Daphnia magna* (Newsted and Giesy, 1987) by 10.	MOE, 2011	0.13	48-hr EC50 (visible plus simulated solar radiation: UVA and UVB) of 0.13 µg/L (0.48 nm) for *Daphnia magna* (Lampi et al. 2005 from ECOTOX)	ECOTOX,2018b
Benzo(k)fluoranthene	0.14	The MOE (2011) APV to protect aquatic biota exposed to contaminants from the migration of contaminated groundwater to surface water. Derived by dividing the 13h-LT50 (UV induced) of 1.4 µg/L for *Daphnia magna* (Newsted and Giesy, 1987) by 10.	MOE, 2011	1.4	13 h-LT50 (Photoinduced) of 1.4 µg/L for *Daphnia magna* (Newsted and Giesy, 1987 from ECOTOX)	MOE, 2011
Chrysene	0.07	The MOE (2011) APV to protect aquatic biota exposed to contaminants from the migration of contaminated groundwater to surface water. Derived by dividing the 24-h LT50 (UV induced) of 0.7 µg/L for *Daphnia magna* (Newsted and Giesy, 1987) by 10.	MOE, 2011	0.7	~24-h LT50 (UV induced) of 0.7 µg/L for *Daphnia magna* (Newsted and Giesy, 1987 from CCME, 1999h)	CCME, 1999h
Dibenz(a,h)anthracene	0.04	The MOE (2011) APV to protect aquatic biota exposed to contaminants from the migration of contaminated groundwater to surface water. Derived by dividing 3h-LT50 (UV induced) of 0.4 µg/L for *Daphnia magna* (Newsted and Giesy 1987) by 10.	MOE, 2011	0.4	3h-LT50 (Photoinduced) of 0.4 µg/L in *Daphnia magna* (Newstead and Giesy, 1987 from ECOTOX).	MOE, 2011
Fluoranthene	0.04	CCME (1999h) interim Canadian water quality guideline for the protection of freshwater aquatic life. Derived by multiplying a 1-h LC_{50} of 4 µg/L for *Daphnia magna* exposed to UV light (Kagan et al. 1985) by a safety factor of 0.01 (CCME,1999h).	CCME, 1999h	4	1-h LC50 of 4 µg/L for *Daphnia magna* after 1 h irradiation with UV light (Kagan et al., 1985) This is the lowest acute value reviewed by CCME (1999h).	CCME, 1999h

Table A-1: Selected Long-term and Short-term Water Quality Guidelines (or Acute Values)

	Long-term			Short-term		
	Benchmark (µg/L)	Basis	Source	Benchmark (µg/L)	Basis	Source
Fluorene	3.0	CCME (1999h) interim Canadian water quality guideline for the protection of freshwater aquatic life. Derived by multiplying the 14-day LOEC of 125 µg/L for *Daphnia magna* (Finger et al. 1985) by a safety factor of 0.1 and a correction factor of 0.24 because the actual (or measured) fluorene concentration during chronic tests was on average of 24% of the nominal LOEC of 125 µg/L (CCME, 1999h).	CCME, 1999h	820	96-h LC50 of 820 µg/L for Rainbow Trout (*Oncorhynchus mykiss)* (Finger et al. 1985). This is one of the lowest acute value considered by the CCME (1999h) in the derivation of the interim fluorene Canadian water quality guideline for the protection of freshwater aquatic life.	CCME, 1999h
Indeno(1,2,3-cd)pyrene	0.14	The MOE (2011) APV to protect aquatic biota exposed to contaminants from the migration of contaminated groundwater to surface water. The APV value is a median PAH phototoxicity from Massachusetts Department of Environmental Protection (MADEP, 2008).	MOE, 2011	NV	No value identified	NA
1-Methylnaphthalene	2	The interim Ontario Provincial water quality objective. Although the basis of the water quality objective is no known it is derived based on the lowest effect concentration reported and an uncertainty factor (MOEE, 1994).	MOEE, 1994	37	Suter and Tsao (1996) Tier II secondary acute value. Derived by dividing the 24 to 96h-LC50 of 9000 µg/L for Fathead Minnow (*Pimephales promelas)* by a final acute factor of 242.	Suter and Tsao, 1996
2-Methylnaphthalene	146	The MOE (2011) APV to protect aquatic biota exposed to contaminants from the migration of contaminated groundwater to surface water. Derived by diving the 96-h LC50 of 1456 µg/L for Rainbow Trout (Kennedy, 1990) by 10.	MOE, 2011	982	Derived using the LC50 and Kow relationship for fish presented in Di Toro et al. (2000; e.g. equation 1). This relationship assumes that the most of the toxicity is associated with a narcosis/baseline-type endpoint	Di Toro et al.,2000
Naphthalene	1.1	CCME (1999h) interim Canadian water quality guideline for the protection of freshwater aquatic life. Derived by multiplying the chronic LOEL of 11 µg/L (geometric mean of the lowest two chronic values corresponding to the 97 (8 µg/L) and 91 (15 µg/L) survival success for Rainbow Trout embryo–larval stages (Black et al. 1983), by a safety factor of 0.1 (CCME, 1999h).	CCME, 1999h	1000	96-h LC50 of 1000 µg/L for *Daphnia pulex* (Trucco et al., 1983). This is one of the lowest acute value considered by the CCME (1999h) in the derivation of the interim naphthalene Canadian water quality guideline for the protection of freshwater aquatic life.	CCME, 1999h
Phenanthrene	0.4	CCME (1999h) interim Canadian water quality guideline for the protection of freshwater aquatic life. Derived by multiplying the chronic LOEL of 4 µg/L for Rainbow Trout (corresponding to the control-adjusted 93% survival of the trout) (Black et al. 1983) by a safety factor of 0.1 (CCME, 1999h).	CCME, 1999h	49	96-h EC50 (loss of equilibrium) of 49 µg/L for Bluegill Sunfish (*Lepomis macrochirus)* and 50 µg/L for the Rainbow Trout (*Oncorhynchus mykiss*) (Call et al., 1986). These values were two of the lowest acute value considered by the CCME (1999h) in the derivation of the interim naphthalene Canadian water quality guideline for the protection of freshwater aquatic life.	CCME, 1999h
Pyrene	0.025	CCME (1999h) interim Canadian water quality guideline for the protection of freshwater aquatic life. Derived by multiplying the LC50 of 2.5 µg/L for mosquito larvae (*Aedes aegypti*) (Kagan and Kagan 1986) by a safety factor of 0.01 (CCME, 1999h).	CCME, 1999h	2.5	LC50 of 2.5 µg/L for mosquito larvae (*Aedes aegypti*) (Kagan and Kagan 1986). This is one of the lowest acute value considered by the CCME (1999h) in the derivation of the interim Pyrene Canadian water quality guideline for the protection of freshwater aquatic life.	CCME, 1999h

Appendix B Summary of Chemistry Data

Table B-1: Summary Statistics for Sediment and Soil Samples Used in the Assessment

Location		SED3	SED5	MW7/17	MW10	BH11/17	BH12/17	BH13/17	Minimum	Mean	Standard Deviation	Median	75^{th} percentile	95^{th} percentile	Maximum
Sample ID		A0206	A0204	A0215 A0216 A0217	A219 A0221	A0228 A0229	A0223 A0224	A0230 A0232							
Sample Date		2017-08-29	2017-08-29	2017-08-30	2017-08-30	2017-08-30	2017-08-30	2017-08-30							
Depth (m)	From	0	0	0.76	0.76	1.52	0.76	0							
	To	0.1	0.1	3.81	3.81	4.57	3.05	4.51							
Contaminants	Units	Results	Results	Results	Results	Results	Results	Results							
PHCs															
F1 (C6-C10) - BTEX	µg/g	<10	<10	<10	1.50E+01	<10	<10	<10	1.00E+01	1.07E+01	1.89E+00	1.00E+01	1.00E+01	1.35E+01	1.50E+01
F2 (C10-C16 Hydrocarbons)	µg/g	<10	<10	<10	1.30E+02	3.20E+01	<10	1.10E+01	1.00E+01	3.04E+01	4.47E+01	1.00E+01	2.15E+01	1.01E+02	1.30E+02
VOCs															
1,4-Dichlorobenzene	µg/g	<0.05	<0.05	<0.05	<0.05	6.00E-02	<0.05	<0.05	5.00E-02	5.14E-02	3.78E-03	5.00E-02	5.00E-02	5.70E-02	6.00E-02
Ethylbenzene	µg/g	<0.02	<0.02	<0.01	4.40E-01	1.10E-02	<0.01	1.50E-02	1.00E-02	7.51E-02	1.61E-01	1.50E-02	2.00E-02	3.14E-01	4.40E-01
Toluene	µg/g	<0.02	<0.02	<0.02	2.40E-02	3.00E-02	<0.02	2.00E-02	2.00E-02	2.20E-02	3.83E-03	2.00E-02	2.20E-02	2.82E-02	3.00E-02
Trichloroethylene	µg/g	<0.05	<0.05	<0.01	<0.01	4.80E-01	<0.01	<0.01	1.00E-02	8.86E-02	1.74E-01	1.00E-02	5.00E-02	3.51E-01	4.80E-01
Xylene (Total)	µg/g	<0.02	<0.02	<0.02	5.00E+00	8.00E-02	1.10E-01	4.80E-02	2.00E-02	7.57E-01	1.87E+00	4.80E-02	9.50E-02	3.53E+00	5.00E+00
Metals and Inorganics															
Antimony (Sb)	µg/g	4.70E-01	7.70E-01	5.90E+00	9.80E+00	4.70E+00	1.40E+00	3.50E+00	4.70E-01	3.79E+00	3.35E+00	3.50E+00	5.30E+00	8.63E+00	9.80E+00
Arsenic (As)	µg/g	1.30E+00	2.50E+00	1.70E+01	1.20E+01	7.60E+00	4.00E+00	4.40E+00	1.30E+00	6.97E+00	5.68E+00	4.40E+00	9.80E+00	1.55E+01	1.70E+01
Barium (Ba)	µg/g	2.80E+01	7.90E+01	1.30E+02	2.80E+02	1.60E+02	1.40E+02	1.20E+02	2.80E+01	1.34E+02	7.80E+01	1.30E+02	1.50E+02	2.44E+02	2.80E+02
Beryllium (Be)	µg/g	<0.20	<0.20	5.30E-01	3.90E-01	4.70E-01	2.10E-01	3.90E-01	2.00E-01	3.41E-01	1.38E-01	3.90E-01	4.30E-01	5.12E-01	5.30E-01
Cadmium (Cd)	µg/g	<0.10	<0.10	3.40E+00	1.70E+00	1.30E+01	4.30E+00	8.60E-01	1.00E-01	3.35E+00	4.55E+00	1.70E+00	3.85E+00	1.04E+01	1.30E+01
Chromium (Cr)	µg/g	1.00E+01	5.80E+00	4.20E+01	5.10E+01	3.90E+01	2.00E+01	2.50E+01	5.80E+00	2.75E+01	1.70E+01	2.50E+01	4.05E+01	4.83E+01	5.10E+01
Cobalt (Co)	µg/g	2.60E+00	2.20E+00	8.60E+00	9.50E+00	7.00E+00	4.10E+00	5.80E+00	2.20E+00	5.69E+00	2.86E+00	5.80E+00	7.80E+00	9.23E+00	9.50E+00
Copper (Cu)	µg/g	1.40E+01	6.10E+00	3.20E+02	2.10E+02	6.20E+01	5.10E+01	7.10E+02	6.10E+00	1.96E+02	2.54E+02	6.20E+01	2.65E+02	5.93E+02	7.10E+02
Cyanide (Free)	µg/g	1.00E-02	2.00E-02	2.60E-01	2.00E-01	3.00E-02	1.00E-01	1.30E-01	1.00E-02	1.07E-01	9.62E-02	1.00E-01	1.65E-01	2.42E-01	2.60E-01
Lead (Pb)	µg/g	5.00E+01	1.10E+02	3.50E+02	5.30E+02	2.00E+02	3.30E+02	1.10E+02	5.00E+01	2.40E+02	1.71E+02	2.00E+02	3.40E+02	4.76E+02	5.30E+02
Mercury (Hg)	µg/g	<0.05	1.30E-01	6.40E-01	2.70E-01	2.10E-01	1.60E-01	1.50E-01	5.00E-02	2.30E-01	1.93E-01	1.60E-01	2.40E-01	5.29E-01	6.40E-01
Molybdenum (Mo)	µg/g	<0.50	6.10E-01	4.10E+00	6.70E+00	2.30E+00	3.20E+00	3.10E+00	5.00E-01	2.93E+00	2.14E+00	3.10E+00	3.65E+00	5.92E+00	6.70E+00
Nickel (Ni)	µg/g	5.20E+00	3.70E+00	5.50E+02	4.30E+01	2.00E+01	1.80E+01	1.40E+01	3.70E+00	9.34E+01	2.02E+02	1.80E+01	3.15E+01	3.98E+02	5.50E+02
Selenium (Se)	µg/g	<0.50	<0.50	<0.50	9.10E-01	<0.50	<0.50	<0.50	5.00E-01	5.59E-01	1.55E-01	5.00E-01	5.00E-01	7.87E-01	9.10E-01
Silver (Ag)	µg/g	<0.20	<0.20	3.60E-01	9.90E-01	3.00E-01	<0.20	8.40E-01	2.00E-01	4.41E-01	3.32E-01	3.00E-01	6.00E-01	9.45E-01	9.90E-01
Thallium (Tl)	µg/g	<0.05	8.60E-02	1.90E-01	2.10E-01	2.40E-01	1.60E-01	1.90E-01	5.00E-02	1.61E-01	6.86E-02	1.90E-01	2.00E-01	2.31E-01	2.40E-01
Tin (Sn)		-	-	2.30E+02	2.10E+02	1.30E+02	1.50E+02	5.70E+01	5.70E+01	1.55E+02	6.87E+01	1.50E+02	2.10E+02	2.26E+02	2.30E+02
Uranium (U)	µg/g	4.20E-01	1.70E-01	6.60E-01	6.60E-01	6.30E-01	6.40E-01	7.10E-01	1.70E-01	5.56E-01	1.94E-01	6.40E-01	6.60E-01	6.95E-01	7.10E-01
Vanadium (V)	µg/g	3.20E+01	5.50E+00	3.50E+01	2.90E+01	3.10E+01	1.90E+01	3.20E+01	5.50E+00	2.62E+01	1.05E+01	3.10E+01	3.20E+01	3.41E+01	3.50E+01
Zinc (Zn)	µg/g	2.70E+01	3.50E+01	5.90E+02	8.80E+02	1.50E+02	4.50E+03	3.40E+02	2.70E+01	9.32E+02	1.60E+03	3.40E+02	7.35E+02	3.41E+03	4.50E+03
PAHs															
Acenaphthene	µg/g	<0.005	9.80E-03	<0.005	9.90E-02	<0.005	<0.05	<0.005	5.00E-03	2.55E-02	3.64E-02	5.00E-03	2.99E-02	8.43E-02	9.90E-02
Acenaphthylene	µg/g	<0.005	8.60E-03	<0.005	1.80E-02	<0.005	<0.05	<0.005	5.00E-03	1.38E-02	1.67E-02	5.00E-03	1.33E-02	4.04E-02	5.00E-02
Anthracene	µg/g	<0.005	2.10E-02	<0.01	1.50E-02	1.10E-02	<0.05	1.00E-02	5.00E-03	1.74E-02	1.52E-02	1.10E-02	1.80E-02	4.13E-02	5.00E-02
Benzo(a)anthracene	µg/g	1.50E-02	7.30E-02	<0.005	3.20E-02	4.30E-02	<0.05	3.90E-02	5.00E-03	3.67E-02	2.25E-02	3.90E-02	4.65E-02	6.61E-02	7.30E-02
Benzo(a)pyrene	µg/g	1.20E-02	6.30E-02	2.90E-02	2.90E-02	4.30E-02	<0.05	3.90E-02	1.20E-02	3.79E-02	1.65E-02	3.90E-02	4.65E-02	5.91E-02	6.30E-02
Benzo(b/j)fluoranthene	µg/g	3.20E-02	9.70E-02	1.70E-02	4.40E-02	6.10E-02	<0.05	5.30E-02	1.70E-02	5.06E-02	2.51E-02	5.00E-02	5.70E-02	8.62E-02	9.70E-02
Benzo(g,h,i)perylene	µg/g	9.50E-03	4.20E-02	4.30E-02	2.00E-02	2.40E-02	<0.05	2.10E-02	9.50E-03	2.99E-02	1.50E-02	2.40E-02	4.25E-02	4.79E-02	5.00E-02
Benzo(k)fluoranthene	µg/g	7.80E-03	3.50E-02	<0.005	1.60E-02	1.90E-02	<0.05	1.70E-02	5.00E-03	2.14E-02	1.59E-02	1.70E-02	2.70E-02	4.55E-02	5.00E-02
Chrysene	µg/g	2.60E-02	7.00E-02	<0.01	3.60E-02	4.40E-02	<0.05	3.50E-02	1.00E-02	3.87E-02	1.89E-02	3.60E-02	4.70E-02	6.40E-02	7.00E-02
Dibenz(a,h)anthracene	µg/g	<0.005	1.10E-02	<0.005	<0.005	6.20E-03	<0.05	6.20E-03	5.00E-03	1.26E-02	1.66E-02	6.20E-03	8.60E-03	3.83E-02	5.00E-02
Fluoranthene	µg/g	5.60E-02	1.40E-01	5.40E-03	7.30E-02	7.60E-02	1.00E-01	6.90E-02	5.40E-03	7.42E-02	4.10E-02	7.30E-02	8.80E-02	1.28E-01	1.40E-01
Fluorene	µg/g	<0.005	9.40E-03	<0.005	2.10E-01	<0.005	<0.05	<0.005	5.00E-03	4.13E-02	7.62E-02	5.00E-03	2.97E-02	1.62E-01	2.10E-01
Indeno(1,2,3-cd)pyrene	µg/g	9.30E-03	4.60E-02	1.40E-02	2.00E-02	2.80E-02	<0.05	2.30E-02	9.30E-03	2.72E-02	1.55E-02	2.30E-02	3.70E-02	4.88E-02	5.00E-02
1-Methylnaphthalene	µg/g	<0.005	<0.005	<0.005	2.30E+00	<0.005	<0.05	5.10E-03	5.00E-03	3.39E-01	8.65E-01	5.00E-03	2.76E-02	1.63E+00	2.30E+00
2-Methylnaphthalene	µg/g	5.20E-03	<0.005	<0.005	2.90E+00	<0.005	<0.2	8.10E-03	5.00E-03	4.47E-01	1.08E+00	5.20E-03	1.04E-01	2.09E+00	2.90E+00
Naphthalene	µg/g	<0.005	<0.005	<0.005	3.70E+00	<0.005	<0.05	<0.005	5.00E-03	5.39E-01	1.39E+00	5.00E-03	2.75E-02	2.61E+00	3.70E+00
Phenanthrene	µg/g	1.90E-02	8.30E-02	8.50E-03	5.50E-02	4.20E-02	7.30E-02	4.10E-02	8.50E-03	4.59E-02	2.69E-02	4.20E-02	6.40E-02	8.00E-02	8.30E-02
Pyrene	µg/g	4.20E-02	1.10E-01	2.10E-02	7.60E-02	6.50E-02	1.00E-01	5.80E-02	2.10E-02	6.74E-02	3.12E-02	6.50E-02	8.80E-02	1.07E-01	1.10E-01

Note:

1. Data source: AEL (2018)
2. Non-detected values were set to the detection limit

EcoMetrix
INCORPORATED

Table B-2: Summary Statistics for Surface Water and Seepage Samples Used in the Assessment

Location			SW1	RR3	SW7	SW3	LOCK1	Minimum	Mean	Standard Deviation	Median	75th percentile	95th percentile	Maximum
Sample ID			A0211	A0207	A0205	A0237	A0239							
Sample Date			2017-08-29	2017-08-29	2017-08-29	2017-08-31	2017-08-31							
Chemicals	Units	RDL	Results	Results	Results	Results	Results							
PHCs														
F1 (C6-C10) - BTEX	µg/L	-	NA	NA	NA	NA	NA	-	-	-	-	-	-	-
F2 (C10-C16 Hydrocarbons)	µg/L	-	NA	NA	NA	NA	NA	-	-	-	-	-	-	-
VOCs														
1,4-Dichlorobenzene	µg/L	2.00E-01	<0.20	<0.20	<0.20	<0.20	<0.20	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	µg/L	1.00E-01	<0.10	<0.10	<0.10	<0.10	<0.10	ND	ND	ND	ND	ND	ND	ND
Toluene	µg/L	2.00E-01	<0.20	<0.20	<0.20	3.00E-01	<0.20	2.00E-01	2.20E-01	4.47E-02	2.00E-01	2.00E-01	2.80E-01	3.00E-01
Trichloroethylene	µg/L	1.00E-01	<0.10	<0.10	<0.10	<0.10	<0.10	ND	ND	ND	ND	ND	ND	ND
Xylene (Total)	µg/L	1.00E-01	<0.10	<0.10	<0.10	<0.10	<0.10	ND	ND	ND	ND	ND	ND	ND
Metals and Inorganics														
Antimony (Sb)	µg/L	5.00E-01	<0.50	<0.50	<0.50	<0.50	<0.50	ND	ND	ND	ND	ND	ND	ND
Arsenic (As)	µg/L	1.00E+00	<1.0	<1.0	<1.0	<1.0	<1.0	ND	ND	ND	ND	ND	ND	ND
Barium (Ba)	µg/L	-	NA	NA	NA	NA	NA	-	-	-	-	-	-	-
Beryllium (Be)	µg/L	5.00E-01	<0.50	<0.50	<0.50	<0.50	<0.50	ND	ND	ND	ND	ND	ND	ND
Cadmium (Cd)	µg/L	1.00E-01	<0.10	<0.10	<0.10	<0.10	<0.10	ND	ND	ND	ND	ND	ND	ND
Chromium (Cr)	µg/L	5.00E+00	<5.0	<5.0	<5.0	<5.0	<5.0	ND	ND	ND	ND	ND	ND	ND
Cobalt (Co)	µg/L	5.00E-01	<0.50	<0.50	<0.50	5.10E-01	<0.50	5.00E-01	5.02E-01	4.47E-03	5.00E-01	5.00E-01	5.08E-01	5.10E-01
Copper (Cu)	µg/L	1.00E+00	1.40E+00	<1.0	<1.0	<1.0	<1.0	1.00E+00	1.08E+00	1.79E-01	1.00E+00	1.00E+00	1.32E+00	1.40E+00
Cyanide (Free)	µg/L	1.00E+00	6.00E+00	<1	<1	<1	<1	1.00E+00	2.00E+00	2.24E+00	1.00E+00	1.00E+00	5.00E+00	6.00E+00
Lead (Pb)	µg/L	5.00E-01	<0.50	<0.50	1.50E+00	<0.50	<0.50	5.00E-01	7.00E-01	4.47E-01	5.00E-01	5.00E-01	1.30E+00	1.50E+00
Mercury (Hg)	µg/L	1.00E-01	<0.1	<0.1	<0.1	<0.1	<0.1	ND	ND	ND	ND	ND	ND	ND
Molybdenum (Mo)	µg/L	5.00E-01	<0.50	<0.50	<0.50	<0.50	<0.50	ND	ND	ND	ND	ND	ND	ND
Nickel (Ni)	µg/L	1.00E+00	<1.0	<1.0	<1.0	1.60E+00	<1.0	1.00E+00	1.12E+00	2.68E-01	1.00E+00	1.00E+00	1.48E+00	1.60E+00
Selenium (Se)	µg/L	2.00E+00	<2.0	<2.0	<2.0	<2.0	<2.0	ND	ND	ND	ND	ND	ND	ND
Silver (Ag)	µg/L	1.00E-01	<0.10	<0.10	<0.10	<0.10	<0.10	ND	ND	ND	ND	ND	ND	ND
Thallium (Tl)	µg/L	5.00E-02	<0.05	<0.05	<0.05	<0.05	<0.05	ND	ND	ND	ND	ND	ND	ND
Tin (Sn)	µg/L	-	NA	NA	NA	NA	NA	-	-	-	-	-	-	-
Uranium (U)	µg/L	1.00E-01	1.00E-01	1.10E-01	1.30E-01	<0.10	1.10E-01	1.00E-01	1.10E-01	1.22E-02	1.10E-01	1.10E-01	1.26E-01	1.30E-01
Vanadium (V)	µg/L	5.00E-01	<0.50	<0.50	<0.50	6.40E-01	8.80E-01	5.00E-01	6.04E-01	1.66E-01	5.00E-01	6.40E-01	8.32E-01	8.80E-01
Zinc (Zn)	µg/L	5.00E+00	<5.0	<5.0	<5.0	5.50E+00	<5.0	5.00E+00	5.10E+00	2.24E-01	5.00E+00	5.00E+00	5.40E+00	5.50E+00
PAHs														
Acenaphthene	µg/L	-	NA	NA	NA	NA	NA	-	-	-	-	-	-	-
Acenaphthylene	µg/L	-	NA	NA	NA	NA	NA	-	-	-	-	-	-	-
Anthracene	µg/L	-	NA	NA	NA	NA	NA	-	-	-	-	-	-	-
Benzo(a)anthracene	µg/L	-	NA	NA	NA	NA	NA	-	-	-	-	-	-	-
Benzo(a)pyrene	µg/L	-	NA	NA	NA	NA	NA	-	-	-	-	-	-	-
Benzo(b/j)fluoranthene	µg/L	-	NA	NA	NA	NA	NA	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	µg/L	-	NA	NA	NA	NA	NA	-	-	-	-	-	-	-
Benzo(k)fluoranthene	µg/L	-	NA	NA	NA	NA	NA	-	-	-	-	-	-	-
Chrysene	µg/L	-	NA	NA	NA	NA	NA	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	µg/L	-	NA	NA	NA	NA	NA	-	-	-	-	-	-	-
Fluoranthene	µg/L	-	NA	NA	NA	NA	NA	-	-	-	-	-	-	-
Fluorene	µg/L	-	NA	NA	NA	NA	NA	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	µg/L	-	NA	NA	NA	NA	NA	-	-	-	-	-	-	-
1-Methylnaphthalene	µg/L	-	NA	NA	NA	NA	NA	-	-	-	-	-	-	-
2-Methylnaphthalene	µg/L	-	NA	NA	NA	NA	NA	-	-	-	-	-	-	-
Naphthalene	µg/L	-	NA	NA	NA	NA	NA	-	-	-	-	-	-	-
Phenanthrene	µg/L	-	NA	NA	NA	NA	NA	-	-	-	-	-	-	-
Pyrene	µg/L	-	NA	NA	NA	NA	NA	-	-	-	-	-	-	-

Note:
1. Data source: AEL (2018)
RDL: Reportable Detection Limit
NA: Not Analyzed
ND: Non-detected

EcoMetrix INCORPORATED

Appendix C Water Quality Predictions

Table C-1: Predicted Surface Water Quality for a Series of TSS concentrations

Chemicals	75th Percentile Sediment and Soil (µg/g)	75th Percentile Surface Water (µg/L)	Predicted Concentrations in Surface Water (µg/L)						Long-term Water Quality Guideline (µg/L)	Reference
TSS (mg/L)			**5**	**10**	**25**	**50**	**75**	**100**	**25**	CCME, 2002
PHCs										
F1 (C6-C10) - BTEX	1.00E+01	-	5.00E-02	1.00E-01	2.50E-01	5.00E-01	7.50E-01	1.00E+00	167	CCME, 2008
F2 (C10-C16 Hydrocarbons)	2.15E+01	-	1.08E-01	2.15E-01	5.38E-01	1.08E+00	1.61E+00	2.15E+00	42	
VOCs										
1,4-Dichlorobenzene	5.00E-02	ND	2.50E-04	5.00E-04	1.25E-03	2.50E-03	3.75E-03	5.00E-03	26	CCME, 1999a
Ethylbenzene	2.00E-02	ND	1.00E-04	2.00E-04	5.00E-04	1.00E-03	1.50E-03	2.00E-03	90	CCME, 1999b
Toluene	2.20E-02	2.00E-01	2.00E-01	2.00E-01	2.01E-01	2.01E-01	2.02E-01	2.02E-01	2	CCME, 1999c
Trichloroethylene	5.00E-02	ND	2.50E-04	5.00E-04	1.25E-03	2.50E-03	3.75E-03	5.00E-03	21	CCME, 1999d
Xylene (Total)	9.50E-02	ND	4.75E-04	9.50E-04	2.38E-03	4.75E-03	7.13E-03	9.50E-03	2	MOEE, 1994
Metals and Inorganics										
Antimony (Sb)	5.30E+00	ND	2.65E-02	5.30E-02	1.33E-01	2.65E-01	3.98E-01	5.30E-01	20	MOEE, 1994
Arsenic (As)	9.80E+00	ND	4.90E-02	9.80E-02	2.45E-01	4.90E-01	7.35E-01	9.80E-01	5.0	CCME, 2001
Barium (Ba)	1.50E+02	-	7.50E-01	1.50E+00	3.75E+00	**7.50E+00**	**1.13E+01**	**1.50E+01**	4	Suter and Tsao, 1996
Beryllium (Be)	4.30E-01	ND	2.15E-03	4.30E-03	1.08E-02	2.15E-02	3.23E-02	4.30E-02	5.3	MOE, 2011
Cadmium (Cd)	3.85E+00	ND	1.93E-02	3.85E-02	9.63E-02	**1.93E-01**	**2.89E-01**	**3.85E-01**	0.18	CCME, 2014
Chromium (Cr)	4.05E+01	ND	2.03E-01	4.05E-01	1.01E+00	2.03E+00	3.04E+00	4.05E+00	8.9	CCME, 1999e
Cobalt (Co)	7.80E+00	5.00E-01	5.39E-01	5.78E-01	6.95E-01	8.90E-01	1.09E+00	**1.28E+00**	1.1	EC, 2017
Copper (Cu)	2.65E+02	1.00E+00	2.33E+00	**3.65E+00**	**7.63E+00**	**1.43E+01**	**2.09E+01**	**2.75E+01**	2.6	CCREM, 1987
Cyanide	1.65E-01	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.01E+00	1.01E+00	1.02E+00	5	CCREM, 1987
Lead (Pb)	3.40E+02	5.00E-01	2.20E+00	**3.90E+00**	**9.00E+00**	**1.75E+01**	**2.60E+01**	**3.45E+01**	3.7	CCREM, 1987
Mercury (Hg)	2.40E-01	ND	1.20E-03	2.40E-03	6.00E-03	1.20E-02	1.80E-02	2.40E-02	0.026	CCME, 2003; EC, 2003
Molybdenum (Mo)	3.65E+00	ND	1.83E-02	3.65E-02	9.13E-02	1.83E-01	2.74E-01	3.65E-01	73	CCME, 1999f
Nickel (Ni)	3.15E+01	1.00E+00	1.16E+00	1.32E+00	1.79E+00	2.58E+00	3.36E+00	4.15E+00	105	CCREM, 1987
Selenium (Se)	5.00E-01	ND	2.50E-03	5.00E-03	1.25E-02	2.50E-02	3.75E-02	5.00E-02	1.5	U.S. EPA, 2016
Silver (Ag)	6.00E-01	ND	3.00E-03	6.00E-03	1.50E-02	3.00E-02	4.50E-02	6.00E-02	0.25	CCME, 2015
Thallium (Tl)	2.00E-01	ND	1.00E-03	2.00E-03	5.00E-03	1.00E-02	1.50E-02	2.00E-02	0.80	CCME, 1999g
Tin (Sn)	2.10E+02	-	1.05E+00	2.10E+00	5.25E+00	1.05E+01	1.58E+01	2.10E+01	73	Suter and Tsao, 1996
Uranium (U)	6.60E-01	1.10E-01	1.13E-01	1.17E-01	1.27E-01	1.43E-01	1.60E-01	1.76E-01	15	CCME, 2011
Vanadium (V)	3.20E+01	6.40E-01	8.00E-01	9.60E-01	1.44E+00	2.24E+00	3.04E+00	3.84E+00	120	ECCC, 2016
Zinc (Zn)	7.35E+02	5.00E+00	8.68E+00	1.24E+01	2.34E+01	**4.18E+01**	**6.01E+01**	**7.85E+01**	30	CCREM, 1987

Table C-1: Predicted Surface Water Quality for a Series of TSS concentrations

Chemicals	75th Percentile Sediment and Soil (µg/g)	75th Percentile Surface Water (µg/L)	Predicted Concentrations in Surface Water (µg/L)						Long-term Water Quality Guideline (µg/L)	Reference
TSS (mg/L)			5	10	25	50	75	100	25	CCME, 2002
PAHs										
Acenaphthene	2.99E-02	-	1.50E-04	2.99E-04	7.48E-04	1.50E-03	2.24E-03	2.99E-03	5.8	CCME, 1999h
Acenaphthylene	1.33E-02	-	6.65E-05	1.33E-04	3.33E-04	6.65E-04	9.98E-04	1.33E-03	0.14	MOE, 2011
Anthracene	1.80E-02	-	9.00E-05	1.80E-04	4.50E-04	9.00E-04	1.35E-03	1.80E-03	0.012	CCME, 1999h
Benzo(a)anthracene	4.65E-02	-	2.33E-04	4.65E-04	1.16E-03	2.33E-03	3.49E-03	4.65E-03	0.018	CCME, 1999h
Benzo(a)pyrene	4.65E-02	-	2.33E-04	4.65E-04	1.16E-03	2.33E-03	3.49E-03	4.65E-03	0.015	CCME, 1999h
Benzo(b/j)fluoranthene	5.70E-02	-	2.85E-04	5.70E-04	1.43E-03	2.85E-03	4.28E-03	5.70E-03	0.42	MOE, 2011
Benzo(g,h,i)perylene	4.25E-02	-	2.13E-04	4.25E-04	1.06E-03	2.13E-03	3.19E-03	4.25E-03	0.02	MOE, 2011
Benzo(k)fluoranthene	2.80E-02	-	1.40E-04	2.80E-04	7.00E-04	1.40E-03	2.10E-03	2.80E-03	0.14	MOE, 2011
Chrysene	4.70E-02	-	2.35E-04	4.70E-04	1.18E-03	2.35E-03	3.53E-03	4.70E-03	0.07	MOE, 2011
Dibenz(a,h)anthracene	8.60E-03	-	4.30E-05	8.60E-05	2.15E-04	4.30E-04	6.45E-04	8.60E-04	0.04	MOE, 2011
Fluoranthene	8.80E-02	-	4.40E-04	8.80E-04	2.20E-03	4.40E-03	6.60E-03	8.80E-03	0.04	CCME, 1999h
Fluorene	2.97E-02	-	1.49E-04	2.97E-04	7.43E-04	1.49E-03	2.23E-03	2.97E-03	3.0	CCME, 1999h
Indeno(1,2,3-cd)pyrene	3.70E-02	-	1.85E-04	3.70E-04	9.25E-04	1.85E-03	2.78E-03	3.70E-03	0.14	MOE, 2011
1-Methylnaphthalene	2.76E-02	-	1.38E-04	2.76E-04	6.89E-04	1.38E-03	2.07E-03	2.76E-03	2	MOEE, 1994
2-Methylnaphthalene	1.04E-01	-	5.20E-04	1.04E-03	2.60E-03	5.20E-03	7.80E-03	1.04E-02	146	MOE, 2011
Naphthalene	2.75E-02	-	1.38E-04	2.75E-04	6.88E-04	1.38E-03	2.06E-03	2.75E-03	1.1	CCME, 1999h
Phenanthrene	6.40E-02	-	3.20E-04	6.40E-04	1.60E-03	3.20E-03	4.80E-03	6.40E-03	0.4	CCME, 1999h
Pyrene	8.80E-02	-	4.40E-04	8.80E-04	2.20E-03	4.40E-03	6.60E-03	8.80E-03	0.025	CCME, 1999h

Note:

1. Data source: AEL (2018)

Predicted contaminant concentration exceeds long-term water quality guideline

EcoMetrix INCORPORATED

Appendix D Toxic Unit Predictions

Table D-1: Sum of Toxic Units for a Series of TSS Concentrations

Chemicals	Short-term Benchmark (µg/L)	Reference	Calculated TU in Surface Water					
TSS	25	CCME, 2002	**5**	**10**	**25**	**50**	**75**	**100**
PHCs								
F1 (C6-C10) - BTEX	1822	CCME, 2008	2.7E-05	5.5E-05	1.4E-04	2.7E-04	4.1E-04	5.5E-04
F2 (C10-C16 Hydrocarbons)	53		2.0E-03	4.0E-03	1.0E-02	2.0E-02	3.0E-02	4.0E-02
VOCs								
1,4-Dichlorobenzene	1100	CCME, 1999a	2.3E-07	4.5E-07	1.1E-06	2.3E-06	3.4E-06	4.5E-06
Ethylbenzene	1800	CCME, 1999b	5.6E-08	1.1E-07	2.8E-07	5.6E-07	8.3E-07	1.1E-06
Toluene	5460	CCME, 1999c	3.7E-05	3.7E-05	3.7E-05	3.7E-05	3.7E-05	3.7E-05
Trichloroethylene	7760	CCME, 1999d	3.2E-08	6.4E-08	1.6E-07	3.2E-07	4.8E-07	6.4E-07
Xylene (Total)	3300	MOE, 2011	1.4E-07	2.9E-07	7.2E-07	1.4E-06	2.2E-06	2.9E-06
Metals and Inorganics								
Antimony (Sb)	175	US EPA, 1988	1.5E-04	3.0E-04	7.6E-04	1.5E-03	2.3E-03	3.0E-03
Arsenic (As)	850	CCME, 2001	5.8E-05	1.2E-04	2.9E-04	5.8E-04	8.6E-04	1.2E-03
Barium (Ba)	71	ECOTOX, 2018b	1.1E-02	2.1E-02	5.3E-02	1.1E-01	1.6E-01	2.1E-01
Beryllium (Be)	35	Suter and Tsao, 1996	6.1E-05	1.2E-04	3.1E-04	6.1E-04	9.2E-04	1.2E-03
Cadmium (Cd)	2.4	CCME, 2014	8.0E-03	1.6E-02	4.0E-02	8.0E-02	1.2E-01	1.6E-01
Chromium (Cr)	1200	CCME, 1999e	1.7E-04	3.4E-04	8.4E-04	1.7E-03	2.5E-03	3.4E-03
Cobalt (Co)	61	ECOTOX, 2018b	8.8E-03	9.5E-03	1.1E-02	1.5E-02	1.8E-02	2.1E-02
Copper (Cu)	16	U.S. EPA, 1996	1.5E-01	2.3E-01	4.8E-01	8.9E-01	1.3E+00	1.7E+00
Cyanide	22	U.S. EPA, 1985b	4.5E-02	4.6E-02	4.6E-02	4.6E-02	4.6E-02	4.6E-02
Lead (Pb)	95	US EPA, 1985c	2.3E-02	4.1E-02	9.5E-02	1.8E-01	2.7E-01	3.6E-01
Mercury (Hg)	20	CCME, 2003	6.0E-05	1.2E-04	3.0E-04	6.0E-04	9.0E-04	1.2E-03
Molybdenum (Mo)	29000	CCME, 1999f	6.3E-07	1.3E-06	3.1E-06	6.3E-06	9.4E-06	1.3E-05
Nickel (Ni)	520	U.S. EPA, 1996	2.2E-03	2.5E-03	3.4E-03	5.0E-03	6.5E-03	8.0E-03
Selenium (Se)	45	U.S. EPA, 2016	5.6E-05	1.1E-04	2.8E-04	5.6E-04	8.3E-04	1.1E-03
Silver (Ag)	0.25	CCME, 2015	1.2E-02	2.4E-02	6.0E-02	1.2E-01	1.8E-01	2.4E-01
Thallium (Tl)	680	CCME, 1999g	1.5E-06	2.9E-06	7.4E-06	1.5E-05	2.2E-05	2.9E-05
Tin (Sn)	2700	Suter and Tsao, 1996	3.9E-04	7.8E-04	1.9E-03	3.9E-03	5.8E-03	7.8E-03
Uranium (U)	33	CCME, 2011	3.4E-03	3.5E-03	3.8E-03	4.3E-03	4.8E-03	5.3E-03
Vanadium (V)	280	Suter and Tsao, 1996	2.9E-03	3.4E-03	5.1E-03	8.0E-03	1.1E-02	1.4E-02
Zinc (Zn)	133	U.S. EPA, 1996	6.5E-02	9.3E-02	1.8E-01	3.1E-01	4.5E-01	5.9E-01
PAHs								
Acenaphthene	580	CCME, 1999h	2.6E-07	5.2E-07	1.3E-06	2.6E-06	3.9E-06	5.2E-06
Acenaphthylene	605	Di Toro et al. 2000	1.1E-07	2.2E-07	5.5E-07	1.1E-06	1.6E-06	2.2E-06
Anthracene	1.2	CCME, 1999h	7.5E-05	1.5E-04	3.8E-04	7.5E-04	1.1E-03	1.5E-03
Benzo(a)anthracene	1.8	CCME, 1999h	1.3E-04	2.6E-04	6.5E-04	1.3E-03	1.9E-03	2.6E-03
Benzo(a)pyrene	1.5	CCME, 1999h	1.6E-04	3.1E-04	7.8E-04	1.6E-03	2.3E-03	3.1E-03
Benzo(b/j)fluoranthene	4.2	MOE, 2011	6.8E-05	1.4E-04	3.4E-04	6.8E-04	1.0E-03	1.4E-03
Benzo(g,h,i)perylene	0.13	ECOTOX,2018b	1.6E-03	3.2E-03	8.0E-03	1.6E-02	2.4E-02	3.2E-02
Benzo(k)fluoranthene	1.4	MOE, 2011	1.0E-04	2.0E-04	5.0E-04	1.0E-03	1.5E-03	2.0E-03
Chrysene	0.7	CCME, 1999h	3.4E-04	6.7E-04	1.7E-03	3.4E-03	5.0E-03	6.7E-03
Dibenz(a,h)anthracene	0.4	MOE, 2011	1.1E-04	2.2E-04	5.4E-04	1.1E-03	1.6E-03	2.2E-03
Fluoranthene	4	CCME, 1999h	1.1E-04	2.2E-04	5.5E-04	1.1E-03	1.7E-03	2.2E-03
Fluorene	820	CCME, 1999h	1.8E-07	3.6E-07	9.1E-07	1.8E-06	2.7E-06	3.6E-06
Indeno(1,2,3-cd)pyrene	NV	NA	-	-	-	-	-	-
1-Methylnaphthalene	37	Suter and Tsao, 1996	3.7E-06	7.4E-06	1.9E-05	3.7E-05	5.6E-05	7.4E-05
2-Methylnaphthalene	982	Di Toro et al.,2000	5.3E-07	1.1E-06	2.6E-06	5.3E-06	7.9E-06	1.1E-05
Naphthalene	1000	CCME, 1999h	1.4E-07	2.8E-07	6.9E-07	1.4E-06	2.1E-06	2.8E-06
Phenanthrene	49	CCME, 1999h	6.5E-06	1.3E-05	3.3E-05	6.5E-05	9.8E-05	1.3E-04
Pyrene	2.5	CCME, 1999h	1.8E-04	3.5E-04	8.8E-04	1.8E-03	2.6E-03	3.5E-03
Total Toxicity Unit			**0.3**	**0.5**	**1.0**	**1.8**	**2.7**	**3.5**

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Old Slys Lockstation at the Rideau Canal-Locks 26&27
Smiths Falls, Ontario

DATUM Approximate geodetic elevations based on Bathymetry Survey provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS Downstream of Lock 26

BORINGS BY Portable Drill

DATE November 4, 2016

FILE NO. PG3967

HOLE NO. BH 1

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
RIVERBED SURFACE						0	104.44		
River bottom sediments 0.13									
		RC	1	100	0				
		RC	2	97	35				
						1	103.44		
BEDROCK: Poor to fair quality, light grey medium-grained, quartz-rich sandstone		RC	3	92	62				
- intermittent zones of brecciation									
						2	102.44		
		RC	4	96	68				
						3	101.44		
3.35									
End of Borehole									
(River depth 1.65m)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Old Slys Lockstation at the Rideau Canal-Locks 26&27
Smiths Falls, Ontario

DATUM Approximate geodetic elevations based on Bathymetry Survey provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS Downstream of Lock 26

BORINGS BY Portable Drill

DATE November 4, 2016

FILE NO. PG3967

HOLE NO. BH 2

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
RIVERBED SURFACE						0	104.62		
River bottom sediments with cobbles and boulders									
0.51									
						1	103.62		
BEDROCK: Poor to fair quality, light grey, medium-grained, quartz-rich sandstone - intermittent zones of brecciation		RC	1	95	41				
						2	102.62		
		RC	2	100	50				
						3	101.62		
3.20									
End of Borehole (River depth 1.14m)									

Chart axis: 20 40 60 80 (Water Content %); 20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Old Slys Lockstation at the Rideau Canal-Locks 26&27
Smiths Falls, Ontario

DATUM Approximate geodetic elevations based on Bathymetry Survey provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS Upstream of Lock 27

BORINGS BY Portable Drill

DATE November 7, 2016

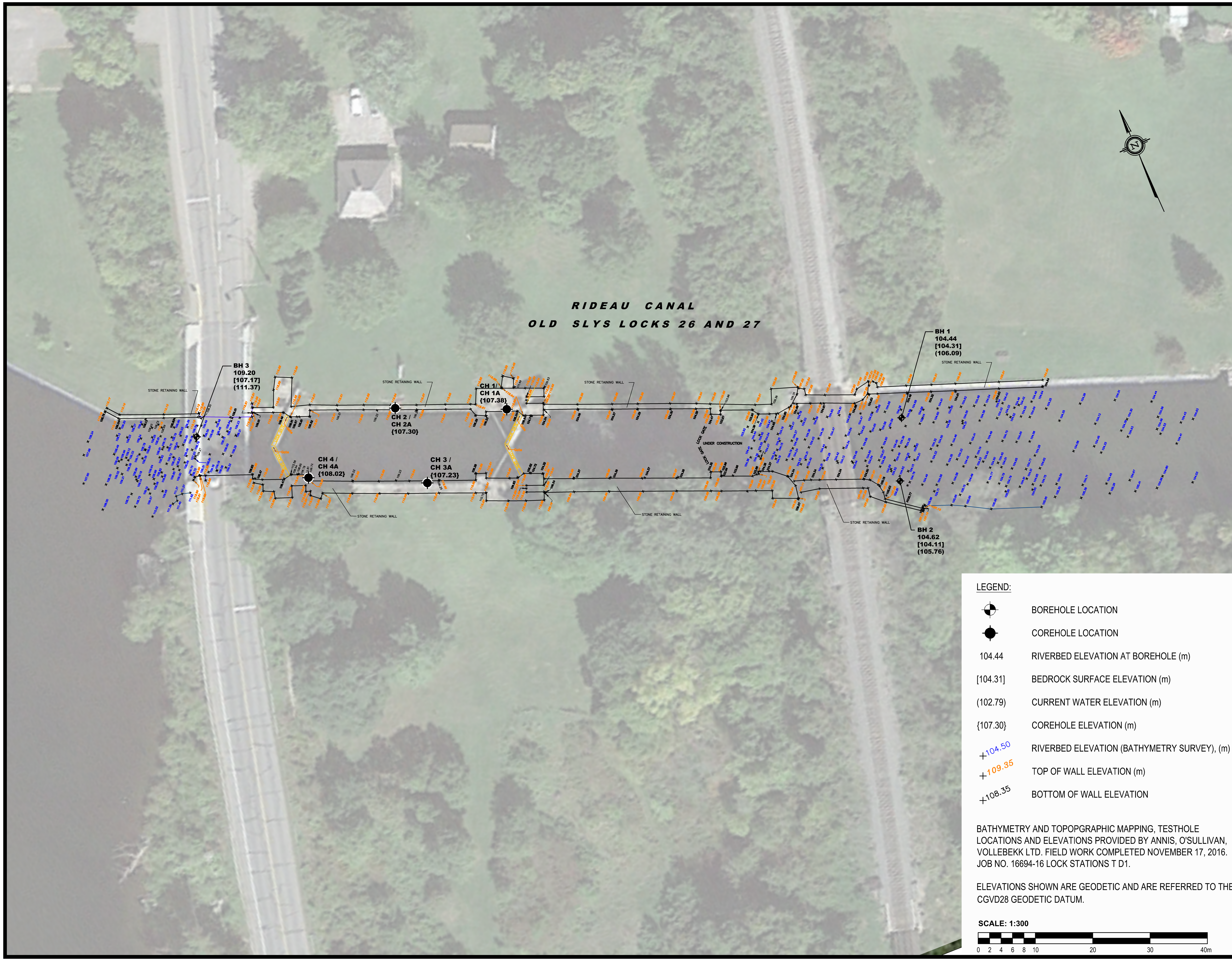
FILE NO. PG3967

HOLE NO. BH 3

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
RIVERBED SURFACE						0	109.20		
River bottom sediments - black sandy silt with organics, gravel and cobbles		SS	1	54	2				
0.81									
GLACIAL TILL: Brown silty fine to coarse sand, some gravel and cobbles, trace organics and wood pieces		SS	2	46	12	1	108.20		
		SS	3	29	20				
2.03		SS	4	100	50+	2	107.20		
BEDROCK: Poor quality, light brown medium-grained, quartz-rich sandstone		RC	1	60	0				
		RC	2	67	24				
		RC	3	55	15	3	106.20		
3.48									
End of Borehole (River depth 2.17m)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded



LEGEND:

	BOREHOLE LOCATION
	COREHOLE LOCATION
104.44	RIVERBED ELEVATION AT BOREHOLE (m)
[104.31]	BEDROCK SURFACE ELEVATION (m)
(102.79)	CURRENT WATER ELEVATION (m)
{107.30}	COREHOLE ELEVATION (m)
+104.50	RIVERBED ELEVATION (BATHYMETRY SURVEY), (m)
+109.35	TOP OF WALL ELEVATION (m)
+108.35	BOTTOM OF WALL ELEVATION

BATHYMETRY AND TOPOPGRAPHIC MAPPING, TESTHOLE LOCATIONS AND ELEVATIONS PROVIDED BY ANNIS, O'SULLIVAN, VOLLEBEKK LTD. FIELD WORK COMPLETED NOVEMBER 17, 2016. JOB NO. 16694-16 LOCK STATIONS T D1.

ELEVATIONS SHOWN ARE GEODETIC AND ARE REFERRED TO THE CGVD28 GEODETIC DATUM.

SCALE: 1:300

0 2 4 6 8 10 20 30 40m

Parcs Canada Parks Canada

Canadä

JOHN G. COOKE & ASSOCIATES LTD.
CONSULTING ENGINEERS
17 FITZGERALD ROAD SUITE 200 OTTAWA, ONT. K2H 9G1
(613) 226-8718 FAX (613) 226-7424
E-MAIL mailbox@jgcooke.com
WEB SITE www.jgcooke.com
15174

patersongroup
consulting engineers

DRAWING NO.	DRAWING NAME

REFERENCE DRAWINGS

NO.	DATE	DESCRIPTION	Drawn by / Dessine par	Approved / Approuve

REVISIONS

A Detail number — A Numero de detail
B Sheet number — B Sur feuille numero

Linear dimensions in millimeters — Dimensions lineaires en millimetres

Project title / Titre du projet

OLD SLYS LOCK 26&27
RIDEAU CANAL, SMITHS FALLS, ONTARIO

Drawing title / Titre du dessin

TEST HOLE LOCATION PLAN

Plot Scale / Echelle: 1:300	
Drawn by/ Dessine par: RCG	Date: 12/21/2016
Field Recording by / Releve-Temoin par: NZ	Date: 11/02/2016
Approved by / Approuve par: DJG	Date: 12/21/2016
Checked by/ Verifie par: DJG	Date: 12/21/2016
Project No./ No. du projet: PG3967	Asset No.: XX
Drawing Re No./No. du Dessin: PG3967-2	Sheet No./ Feuille No.: C02