PARKS CANADA AGENCY

Remediation Action and Risk Management Plan Related to Kenow Wildfire – Final Report

Waterton Lakes National Park, Alberta, Canada

August 2018 – 17-6826

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Remediation Action and Risk Management Plan – Final Report
Kenow Wildfire (Waterton Lakes National Park, Alberta, Canada)

Dear Mr. Osolo:

Dillon Consulting Limited is pleased to provide Parks Canada Agency with the Remediation Action and Risk Management Plan (RARMP) final report outlining proposed remediation and risk management strategies for seven sites in Waterton Lakes National Park, Alberta. This report addresses your comments on the draft report, which was submitted to us on May 22, 2018 and incorporates the additional sampling results from the latest field visit in June 2018.

Should you have any questions or comments, please contact me at (403) 215-8880, ext. 5035.

Yours sincerely,

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RSD:st
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Executive Summary

Dillon Consulting Limited (Dillon) was retained by Parks Canada Agency (PCA) to develop a Remediation Action and Risk Management Plan (RARMP) based on results from a hazardous material assessment and shallow soil assessment undertaken in December 2017 and January 2018 by Dillon and RJ & Associates Environmental Consulting Inc. (RJ & Associates) at nine sites within Waterton Lakes National Park (WLNP)[1]. The *Debris and Soil Assessment Related to Kenow Wildfire– Draft Report* (Dillon, March 2018) summarized laboratory results for 43 surface debris samples and 47 shallow soil samples.

After discussions with PCA in January 2018, it was decided that remediation of Site 2 - Visitor Reception Centre and Site 8 - Alpine Stables would proceed in advance of the submission of the RARMP. Detailed information regarding the remediation approach proposed for Site 2 was submitted to the client on March 27, 2018. This submission included an abatement specification, figure delineating the zone of asbestos contamination, and Hazardous Material Investigation – Final Report (RJ & Associates, January 2018). Please refer to **Appendix A** for the Site 2 – Remedial Action Plan documentation, submitted to the client in March 2018. For detailed information regarding the remediation approach proposed for Site 8, please refer to the Remedial Action Plan – Site 8: Alpine Stables - Draft Report (Dillon, March 2018), included as **Appendix B** of this report.

For the remaining seven sites, five sites require remediation; specifically:

- Site 4 - the Gatehouse;
- Site 5 – Heavy Equipment Area;
- Site 6 – Canyon Church Camp;
- Site 7 - Golf Course (Maintenance Shed); and
- Site 10 – the Salamander Barriers.

The remaining two sites – Sites 1 and 9 (Helipad and Fire Retardant Spill Site) do not require remediation. Subsequent discussions with PCA determined that PCA would address Site 10 – the Salamander Barriers and, therefore, the remedial design would only address Sites 4 through 7.

Table E- 1 summarizes the findings of the hazardous material and shallow soil assessments, identifying whether surface debris exhibited hazardous material and contaminants of potential concern (COPCs) within shallow soil.

[1] Please note that Site 3 – Horse Corral was not assessed as per the client's request.

Table E-1: Summary of Hazardous Materials and Shallow Soil Assessments

Site No.	Site Name	Site Location	Hazardous Material Identified from Surface Debris Samples	COPCs Identified from Shallow Soil Samples
1	Jet Fuel Environ Shed	Helipad	Not sampled[1]	PAHs[8]
2[2]	Visitor Reception Centre	Hwy 5 at Bears Hump Trailhead	Asbestos (Chrysotile)	None
3	Horse Corral	Upper Compound	N/A	N/A
4	Gate House	Park Entrance	None	None
5	Heavy Equipment	Park Entrance	None	BTEX[6], PAHs[8], VOCs[7], PHC[9] F2-F4, Copper
6	Canyon Church Camp[3]	Cabins + Female Washroom	None	BTEX[6], PAHs[8], VOCs[7], tin
		Cook's Residence	Asbestos (Chrysotile)	BTEX, PAHs
		Director's Residence + Hospital	None	BTEX[6], PAHs[8], lead, zinc
7	Waterton Lakes Golf Course	Maintenance Shed	VOCs (benzene and ethylbenzene)	PAHs
		Golf Cart Storage Area	Not sampled[4]	None
8[5]	Alpine Stables	Stables	VOCs[7] (benzene)	BTEX[6], PAHs, VOCs[7], zinc
		Bunkhouse	None	PAHs, copper, tin
		House	None	BTEX[6], PAHs[8]
9	Operations Compound	Fire Retardant Spill Site	Not sampled[1]	PAHs
		Fire Shed	Not sampled[1]	PHC[9] F3, PAHs[8]
10	Salamander Barriers	Slope between Operations Compound and Hwy 5	None	None

Notes:

1. Surface debris was removed from the site prior to the hazardous material assessment.
2. Remediation activities at Site 2 - Visitor Reception Centre were completed in May 2018.
3. Debris within Site 6 – Canyon Church Camp considered asbestos-containing only at the Cook's Residence.
4. Site was inaccessible in December 2017. No surface debris noted during site visit in April 2018.
5. Remediation activities at Site 8 – Alpine Stables were completed in April 2018.
6. BTEX = benzene, toluene, ethylbenzene and xylene.
7. VOCs = volatile organic compounds.
8. PAHs = polycyclic aromatic hydrocarbons.
9. PHC = petroleum hydrocarbons.

Remediation and Risk Management Strategy

Table E-2 summarizes the remediation and risk management strategy proposed at each site and/or site location. Approximate quantities of non-hazardous surface debris, hazardous surface debris, contaminated shallow soil, and foundation material to be removed and disposed of off-site are included within the table, along with a description of proposed remediation measures.

Asbestos-containing surface debris is recommended for appropriate removal and disposal off-site at Site 6 – Canyon Church Camp. It is recommended that surface debris and excavated soil containing

volatile organic compounds (VOCs) be stockpiled on a sacrificial layer of sand or gravel or be placed directly in a storage bin for off-site disposal to prevent cross-contamination with non-contaminated ground surfaces. VOCs were noted in debris and shallow soils at Site 6 – Canyon Church Camp and Site 7 – Waterton Lakes Golf Course (Location: Maintenance Shed).

Table E-2: Summary of Proposed Remediation and Risk Management Strategy

Site No.	Site Name	Site Location	Soil Sampling ID	Estimated Volume of Non-Hazardous Surface Debris (cu. m.)	Hazardous Material(s) Identified from Surface Debris Samples	Estimated Volume of Hazardous Debris (cu. m.)	COCs Identified from Shallow Soil Samples (< 0.3 m bgs[8])	Estimated Volume of Contaminated Shallow Soil (cu. m.)	Estimated Volume of Foundation Material (cu. m.)	Description of Proposed Remediation Measures
1	Helipad	Jet Fuel Environ Shed	4	0	Not sampled[1]	0	PAHs	8	N/A	• No remedial activities required, as groundwater data suggests that exposure pathway is not operable.
2[2]	Visitor Reception Centre	Hwy 5 at Bears Hump Trailhead	10	85	Asbestos (Chrysotile)	139	None	N/A	325 sq. m.	• Disposal of hazardous and non-hazardous surface debris off-site • Excavation and disposal of foundation material off-site • Removal of decorative stone wall and transport to WLNP storage facility
4	Gate House	Park Entrance	12	120	None	N/A	None	N/A	60	• Disposal of non-hazardous surface debris off-site • Excavation and disposal of foundation material off-site • Backfill/grading with clean fill and topsoil
5	Heavy Equipment	Park Entrance	11	75	None	N/A	BTEX, PAHs, VOCs, PHC F2-F4, copper	60	N/A	• Disposal of non-hazardous surface debris off-site • Removal of heavy equipment and disposal off-site[3] • Excavation and disposal of contaminated soil off-site • Confirmatory sampling of soil excavation extents • Backfill/grading with clean fill and topsoil
6	Canyon Church Camp[4]	Cabins + Female Washroom	3	235	None	30	BTEX, PAHs, VOCs, tin	220	32	• Disposal of non-hazardous and hazardous surface debris off-site • Excavation and disposal of foundation material and contaminated soil off-site • Confirmatory sampling of soil excavation extents • Backfill/grading with clean fill and topsoil
		Cook's Residence	1		Asbestos (Chrysotile)		BTEX, PAHs			
		Director's Residence + Hospital	2		None		BTEX, PAHs, lead, zinc			
7	Waterton Lakes Golf Course	Maintenance Shed	13	270	VOCs (benzene and ethylbenzene)	N/A	PAHs	53	45	• Disposal of non-hazardous surface debris off-site • Disposal of approximately 40 burnt golf carts mixed with burnt debris • Excavation and disposal of foundation material and contaminated soil off-site • Confirmatory sampling of soil excavation extents • Backfill/grading with cleanfill and topsoil
		Golf Cart Storage Area	14	0	Not sampled[6]	0	None	N/A	N/A	• Disposal of non-hazardous surface debris
8[5]	Alpine Stables	Stables	7	N/A	VOCs (benzene)	530	BTEX, PAHs, VOCs, zinc	87	53	• Disposal of hazardous surface debris off-site • Excavation and disposal of foundation material and contaminated soil off-site • Confirmatory sampling of soil excavation extents • Backfill/grading with clean topsoil
		Bunkhouse	8		None		PAHs, copper, tin			
		Residence	9		None		BTEX, PAHs			

Site No.	Site Name	Site Location	Soil Sampling ID	Estimated Volume of Non-Hazardous Surface Debris (cu. m.)	Hazardous Material(s) Identified from Surface Debris Samples	Estimated Volume of Hazardous Debris (cu. m.)	COCs Identified from Shallow Soil Samples (< 0.3 m bgs[8])	Estimated Volume of Contaminated Shallow Soil (cu. m.)	Estimated Volume of Foundation Material (cu. m.)	Description of Proposed Remediation Measures
9	Operations Compound	Fire Retardant Spill Site	5	0	Not sampled[1]	0	None	0	N/A	• No remedial activities required, as groundwater data suggests that exposure pathway is not operable.
		Fire Shed[7]	6		Not sampled[1]		None			
10[9]	Salamander Barriers	Slope between Operations Compound and Hwy 5	15	450 m of PVC pipe	None	0	None	N/A	N/A	• 450 linear metres of burnt PVC pipe to be removed and disposed of off-site

Notes:

1. Surface debris believed to contain hazardous material was removed from the site prior hazardous materials assessment.
2. Remediation activities at Site 2 - Visitor Reception Centre completed in May 2018. No further remedial work is necessary.
3. Removal of heavy equipment has been completed by PCA.
4. Debris within Site 6 – Canyon Church Camp considered asbestos containing at the cook's residence, only.
5. Remediation activities at Site 8 – Alpine Stables completed in April 2018. No further remedial work is necessary.
6. Site inaccessible in December 2017. No surface debris noted during site visit in April 2018.
7. Remediation activities at Site 9 – Fire Shed have already been completed by PCA. No further remedial work is necessary.
8. m bgs = metres below ground surface.
9. All remedial work for this site will be complete by PCA.

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A Remedial Action Plan – Site 2: Visitor Reception Centre (Dillon, March 2018)
B Remedial Action Plan – Site 8: Alpine Stables Draft Report (Dillon, March 2018)
C Site Photos (June 2018)
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1.0 Introduction

Dillon Consulting Limited (Dillon) was retained by Parks Canada Agency (PCA, the Client) to develop this Remediation Action and Risk Management Plan (RARMP), which is intended to guide short-term remediation and long-term management of identified hazardous material and contaminants of potential concern (COPCs) at nine specific sites within Waterton Lakes National Park (WLNP).

After discussions with PCA in January 2018, it was decided that remediation of Site 2 - Visitor Reception Centre and Site 8 - Alpine Stables would proceed in advance of the submission of the RARMP. Detailed information regarding the remediation approach proposed for Site 2 was submitted to the Client on March 27, 2018. This submission included an abatement specification, figure delineating the zone of asbestos contamination, and Hazardous Material Investigation – Final Report (RJ & Associates, January 2018). Please refer to **Appendix A** for the Site 2 – Remedial Action Plan documentation, submitted to the Client in March 2018. For detailed information regarding the remediation approach proposed for Site 8, please refer to the Remedial Action Plan – Site 8: Alpine Stables - Draft Report (Dillon, March 2018), included as **Appendix B** of this report.

For the remaining seven sites, five sites require remediation; specifically:

- Sites 4 - the Gatehouse;
- Site 5 – Heavy Equipment Area;
- Site 6 – Canyon Church Camp;
- Site 7 - Golf Course Areas; and
- Site 10 – the Salamander Barriers.

The remaining two sites – Sites 1 and 9 (Helipad and Fire Retardant Spill Site) do not require remediation. Subsequent discussions with PCA determined that PCA would address Site 10 – the Salamander Barriers and, therefore, the remedial design would only address Sites 4 through 7.

This RARMP provides background information related to the site, summarizes the pre-design assessment activities conducted to-date to support the development of the RARMP, describes the relevant regulatory framework, identifies environmental health and safety considerations to be considered in remediation, discusses the remediation methodology, and details the proposed remediation.

1.1 Site Background

Situated in the Rocky Mountains, WLNP is located in southwestern Alberta, approximately 260 km south of Calgary, Alberta. Totalling an area of 50,500 ha, WLNP is encompassed within Alberta Improvement District No.4 and bounded by the Alberta/British Columbia border to the west, the Canada/U.S.A. border

to the south, Municipal District of Pincher Creek No. 9 to the north, and Cardston County to the east. WLNP encompasses the Town of Waterton, Alberta.

WLNP is administered by PCA and operates year-round as a National Park. WLNP is home to glacial lakes, canyons, waterfalls, scenic trails and a wide diversity of wildlife, making it a popular visitor destination. Combined with the Glacier National Park in Montana, U.S.A., immediately south of WLNP, the two parks form the Waterton-Glacier International Peace Park, a UNESCO designated World Heritage Site. WLNP's land-use is considered to be parkland, consistent with the Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Quality *Guidelines* (CEQG) and *Canada Wide Standards (CWS) for Petroleum Hydrocarbons* (*PHCs) in Soil* and Natural Area for the *Alberta Tier 1 Soil and Groundwater Remediation Guidelines.*

During September and October 2017, 20,329 ha of WLNP were affected by the Kenow Wildfire. The Kenow Wildfire affected a total of 36 sites and 33 structures within WLNP that support park operations, including a visitor reception centre, golf course maintenance shed, a generator shed, a fuel storage shed, a fire equipment shed, and approximately 30 day-use washrooms, shelters, and cooking structures used for various purposes. From this list of sites, nine were chosen by PCA for hazardous material and shallow soil assessments covered in this report. The locations of the nine sites within WLNP are presented on **Sheet 176826-00-01: Overall Site Plan** attached.

1.2 Pre-Design Assessment Activities

A hazardous material assessment and shallow soil assessment was undertaken in December 2017 and January 2018 by Dillon and RJ & Associates Environmental Consulting Inc. (RJ & Associates) at nine sites within WLNP. The Debris and Soil Assessment – Draft Report (Dillon, March 2018) summarized laboratory results for 43 hazardous surface debris samples and 47 shallow soil samples conducted at these sites.

Due to poor weather conditions and site inaccessibility during the initial site visit in December 2017, additional sampling was undertaken at several sites, including:

- Additional shallow soil sampling was undertaken in April 2018 at two sites that were inaccessible in December 2017: Site 7 – Waterton Lakes Golf Course (Location: Golf Cart Storage Area) and Site 10 – Salamander Barriers. Summaries of these soil assessments are included in this report;
- Additional shallow soil sampling was undertaken in April 2018 at Site 2 – Visitor Reception Centre at areas that were previously inaccessible during the initial site visit in December 2017. These results have been included herein;
- Additional debris sampling was undertaken at Site 6 – Canyon Church Camp at areas that were previously inaccessible during the initial site visit in December 2017. Summaries of the debris assessments are included in this report; and

- Additional soil sampling was undertaken in June 2018 at Site 5 – Heavy Equipment Area. Samples were retrieved from under each of the trucks and trailers, which were removed prior to this site visit. Summaries of the soil assessments are included in this report.

Presently, three of the nine sites have been successfully remediated or will be addressed by PCA directly:

- Remediation activities at Site 8 – Alpine Stables were completed in April 2018 by PCA. For detailed information regarding the remediation approach proposed for Site 8, please refer to **Appendix B** for the Remedial Action Plan – Site 8: Alpine Stables Draft Report (Dillon, March 2018);
- Remediation activities at Site 2 – Visitor Reception Centre were completed in May 2018 by Remediclean Incorporated from Lethbridge, Alberta; and
- Remediation activities at Site 10 – Remediation activities will be undertaken by PCA.

Of the remaining six sites being addressed, Sites 1 and 9 – the Helipad and Operations Compound, respectively, do not require remediation as described herein; therefore, a total of four sites will require remediation and include:

- Site 4 – Gate House;
- Site 5 – Heavy Equipment Area;
- Site 6 – Canyon Church Camp; and
- Site 7 – Maintenance Shed

2.0 Objectives and Goals

The RARMP includes the following specific tasks:

- Establish the framework and, based on an evaluation of operable exposure pathways, identify applicable, site-specific remediation criteria for each site.
- Establish the remedial and risk management plan for sites exhibiting COPC concentrations above the applicable, site-specific remediation criteria;
- Develop a Risk Management Plan for locations where remediation is not feasible;
- Preparation of a Class 'C' cost estimate;
- Confirm that Pincher Creek Landfill will accept debris from these sites or, if not, identify the next-closest receiving facility and provide confirmation of acceptance, as per municipal and provincial regulations; and
- Develop a RARMP to summarize proposed remediation and risk management strategies at each site.

3.0 Regulatory Framework

3.1 Hazardous Material Assessment

The regulatory guidance documentation adhered to during the hazardous material assessment and the criteria applied to the analytical results of the assessment conducted at the sites are outlined within the Hazardous Material Investigation Report included as **Appendix A** and described below:

> *Federally regulated buildings and sites, hazardous substances in the workplace are governed by the Canada Labour Code (Part II) and regulated through the Canada Occupational Health and Safety regulations (Part X). In addition, the following standards were considered as part of meeting the objectives of the project: PSPC Asbestos Management Standard (June 5, 2017), National Joint Council Occupational Health and Safety Directive – Part XI, and the PSPC Standard on Hazardous Substances. (RJ & Associates, 2018)*

3.2 Shallow Soil Assessment

The shallow soil assessment was performed in general accordance with the Phase II ESA (CSA Z769-00 [R2013]) documents produced by the Canadian Standards Association (CSA). The assessment criteria selected for comparison of analytical results at the sites are referenced and described in detail below:

- *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health*, Canadian Council of Ministers of the Environment, 1999, updated 2016;
- *Canada Wide Standards for Petroleum Hydrocarbons (PHCs) in* Soil. CCME, 2001, updated 2008;
- *Alberta Tier 1 Soil and Groundwater Remediation Guidelines.* Alberta Environment and Parks (AEP), 2016; and
- *Alberta Tier 2 Soil and Groundwater Remediation Guidelines.* Alberta Environment and Parks (AEP), 2016.

3.2.1 Canadian Council of Ministers of the Environment

The CCME task groups were established to develop the CEQG and CWS for PHCs and other COPCs, which are nationally endorsed, science-based goals for the quality of atmospheric, aquatic, and terrestrial ecosystems. CWS for PHCs in soil have been established pursuant to the *1998 Canada-wide Accord on Environmental Harmonization of the CCME*. The CWS for PHCs are remedial standards for contaminated soil and subsoil based on the same four land uses as the CEQGs, as well as soil texture (coarse or fine-grained).

The selected guidelines are based on land use at the sites. Land use is assigned according to the following categories: Industrial, Commercial, Residential/Parkland, and Agricultural. As the sites are located within a National Park, they are classified as Parkland. The results from select sites were also compared to the other land uses depending on site-specific use.

The CCME guidelines are also dependent on soil texture. CCME defines a coarse-grained soil as having a median grain size of greater than 75 µm and fine-grained soil as having a median grain size of less than 75 µm. Grain size analysis was conducted on one soil samples from each site. The grain size analysis indicated that soil samples collected Site 2 – Visitor Reception Centre and Site 8 – Alpine Stables (House) were fine-grained. Samples collected from other locations were classified as coarse-grained. Soil analytical results are described in detail in **Section 5.0.**

3.2.2 Alberta Environment and Parks

In addition to the CCME Guidelines, AEP *Alberta Tier 1 Soil and Groundwater Remediation Guidelines* were used for reference purposes in the selection of soil guideline values for COPCs at the sites where no CCME Guidelines were available. The Alberta Tier 1 Guidelines provide conservative soil and groundwater guidelines for a given land use based on generic exposure scenarios. Land use is assigned according to the following categories: Industrial, Commercial, Residential/Parkland, Agricultural, and Natural Area.

Given current land use and dominant soil particle size of the sites and surrounding areas, the *Alberta Tier 1 Soil Remediation Guidelines for the Natural Area* land use were applied to soil results. The grain size analysis indicated that soil samples collected from Site 2 – Visitor Centre and Site 8 – Alpine Stables (House) were fine-grained. Samples collected from other locations were classified as coarse-grained.

The AEP *Alberta Tier 2 Soil and Groundwater Remediation Guidelines* were also referenced to evaluate applicable human health and ecological pathways on select sites.

4.0 Environmental Health and Safety

Proper care in relation to environmental health and safety should be followed. The below subsections provide an overview of the measures that should be considered in the implementation of the remediation works.

4.1 General Construction Site Health and Safety

Construction site health and safety during the implementation of the RARMP will be managed by the prime contractor retained to implement the work. In accordance with the associated relevant regulations, the contractor will be defined as the "constructor" for the site and shall be responsible for sub-contractors, visitors and any others (e.g., third-party stakeholder observers) attending the site. The constructor shall comply with the Canada Occupational Health and Safety Regulations (SOR/86-304), the *Occupational Health and Safety Act* (RSA 2000 cO-2), and the health and safety specifications of the remedial design package.

Some sites may possess vapours and/or particulates that may be detrimental to human and environmental health. The contractor shall develop their own health and safety plan based on the identified COPCs (and associated concentrations), site hazards, and activities to be conducted. As appropriate, the Health and Safety Plan shall incorporate provision to protect workers in the proximity of the work from potential inhalation hazards including, but not limited to, having workers be fit-tested with appropriate respiratory equipment and cartridges.

4.2 Site Access and Security

Currently, a large portion of WLNP is closed off due to the impacts of the Kenow Wildfire. However, there is a possibility that public traffic may be present during construction activities.

During remedial activities, pedestrian and vehicular access to the active construction areas shall be restricted to authorized personnel, vehicles, and other equipment involved in the site's remedial and management activities. At a minimum, construction signage should be present. Temporary construction fencing could be used to enclose the remedial areas if deemed necessary to exclude unauthorized access. Vehicular gates through the fence would be controlled during normal working hours, only allowing the entry and exit of authorized vehicles and equipment. The gates would be locked after working hours.

4.3 Equipment Decontamination

Equipment (e.g., excavators) that comes in contact with soil, ash, or debris at a specific site will require decontamination prior to exiting that site. Prior to moving equipment off-site, any visible soil, ash, and/or debris should be removed (e.g., scraped, brushed off) from the equipment undercarriages, tracks/wheels, and bodies to minimize the spread of hazardous and/or contaminated materials off-site.

Trucks (i.e., dump trucks) and/or bins used for soil removal will be loaded on non-impacted surfaces, such that the undercarriage and/or tires do not contact impacted soils; therefore, the vehicles may exit the site without requiring decontamination.

4.4 Dust Control and Monitoring

Daily site activities would be planned with weather and wind directions in mind to minimize and control dust migration at the site.

During the course of excavation and backfilling programs, the Contractor will be required to implement measures to minimize dust resulting from excavation, stockpiling, and on-site transportation operations (e.g., dust suppression via water spray application). Materials having the potential to emit dust at nuisance levels would be transported on-site and off-site in suitably-covered haulage vehicles or containers to minimize dust emissions.

Visible dust emissions from stockpiles and areas of active excavation would be controlled by various means (i.e., misting with potable water or covering with tarps) if deemed to be a health and safety concern. Daily visual dust inspections will be completed as needed. The quantity and rate of water misting (if applied) should be minimized to prevent the generation of surface run-off or the saturation of the stockpiled materials. On-site traffic on non-paved surfaces would be limited to lower speeds (e.g., 15 km/h) and paved surfaces would be regularly swept for dust control.

An organic vapor meter (i.e., RKI Eagle 2) would be used to assess air borne concentrations of volatile organic compounds (VOCs). If measured VOC concentrations exceed safe working levels, adequate contingency measures will be implemented. These measures may include, but are not limited to:

- Working up-stream of wind;
- Pause work until safe levels of VOC are confirmed;
- Mist excavation areas; and
- Reduce open excavation surface area.

4.5 Spill Response

For the purposes of this RARMP, a spill is considered to be a release of impacted soil, ash, debris, or hydraulic fluid release occurring on the site or at any location during the transportation of impacted soil originating from the site that has the potential to adversely impact the environment. This definition includes spills occurring off-site, including those on public roadways; it is noted that impacted material removed from the site is the responsibility of the construction contractor and waste transportation contractor hired by the contractor. Other site spills would include releases of fuel, oil, or other materials that could cause environmental impact from vehicles and equipment on-site.

Following a spill or unintentional release of impacted materials on-site, appropriate measures would be undertaken to contain the spill or release. However, it is noted that the contaminated materials being remediated are primarily impacted soil and fill in the solid state. Therefore, spill response will primarily consist of timely excavation and placement of the spilled materials into appropriate waste containers (trucks or bins).

The contractor is expected to develop an Environmental Protection Plan outlining appropriate measures to protect the health and safety of site personnel and local ecology with spill response and emergency response provisions. The remediation contractor will be responsible for documenting spill clean-up procedures and will be further responsible for implementation if necessary. Analytical testing may be undertaken to confirm the adequacy of the clean-up.

The contractor should have a spill response plan in place at all times while working on-site, which would cover various types of environmental spills that may be possible due to the use and refuelling of site equipment and/or handling of impacted soil and debris.

5.0 Methodology

5.1 Remediation Methodology

Each site is to be remediated and risk managed to the appropriate Tier 1 and Tier 2 guidelines and to their applicable land-use. CCME guidelines take precedence and AEP guidelines were used when no CCME guidelines were available.

The CCME CEQG *and* CWS for PHCs in Soil, as well as the AEP *Alberta Tier 1 Soil and Groundwater Remediation Guidelines* were used to establish remediation criteria to identify the need for remediation, establish the extent of remediation, and establish the basis for confirming that the remediation objective has been achieved. Soil texture (coarse/fine grained soil) and current land use at the site and surrounding properties were applied to the results of the soil assessment.

The CCME guideline value for the applicable land-use was used to determine parameters exceeding the Tier 1 Level guidelines. When CCME guideline values were not available, AEP guidelines were used. Sample results that were noted exceeding the Tier 1 guidelines were further assessed by comparing to the applicable Tier 2 pathway-specific guidelines to evaluate whether concentrations exceeded applicable pathway-specific standards for pathways determined to be operable. The purpose of identifying Tier 2 pathways was to apply site-specific guideline values and therefore determine appropriate remedial objectives for this site. The attached **Tables 1 to 7** provide a detailed comparison between soil laboratory analytical data and applicable Tier 2 guidelines.

Through this process, it was determined that several sites exhibited concentrations that exceeded the Tier 1 guidelines based on the “Aquatic Life” and/or “Potable Water” pathway. Application of Tier 1 guidelines based on these pathways may be overly conservative and may not be applicable depending on whether these pathways are operable. If either a receptor was not present or data demonstrated that COPCs in soil did not leach to groundwater, the exposure pathway was considered not operable. Specifically, for example, if there were no aquatic receptors or water wells near the site (i.e., within 500 meters), these pathways were considered non-operable and the next most stringent and applicable Tier 2 pathway was applied. Similarly, if data indicated that groundwater did not exhibit concentrations above applicable groundwater criteria for a COPC that exhibited concentrations above the soil criteria, the pathway was considered non-operable as the data demonstrated that the COPC was not present at a concentration of concern. **Table 5-1** indicates the presence of aquatic receptors and water wells for each site.

By identifying which soil samples exceeded applicable Tier 2 pathways, this also determined which locations within the site require remediation and the presumed soil excavation boundary around each contaminated soil sample. It was conservatively assumed that the contaminated soil excavation boundary should extend past the soil sample location. For sites that contain hazardous surface debris,

the contaminated soil excavation boundary was established based on the extent of the hazardous surface debris boundary.

When the soil has been properly excavated to the proposed contaminated soil excavation boundary, confirmatory soil sampling and laboratory analysis will be required to confirm that the depth and width of excavation is appropriate, by comparing the results to applicable remediation criteria. The attached **Tables 8 to 11** summarize pathway-specific guidelines and remedial objectives for each parameter per site.

Table 5-1: Shallow Soils Summary of Exceeded Pathways and Parameters

Site No.	Site Name	Site Location	Sample ID	Health Guideline Exceeded / Exceeded Pathway	Exceeded Parameter	Aquatic Receptor (Surface Water Source) within 500 m of the Site?	Water Well within 500 m of the Site?
1	Helipad	Jet Fuel Environ Shed	4-1 4-5 4-6	Environmental Health / Aquatic Life	PAHs (Anthracene, Naphthalene)	Y	Y
2[1]	Visitor Reception Centre	Hwy 5 at Bears Hump Trailhead	N/A	N/A	None	Y	N
4	Gate House	Park Entrance	12-1 12-2	N/A	None	Y	Y
5	Heavy Equipment	Park Entrance	11-3 11-5 11-6 11-8 11-9	Human Health / Potable Water, Soil Ingestion, Soil Contact, Soil Vapour Inhalation, Off-site Migration Environmental Health / Aquatic Life, Soil Contact, Soil and Food Ingestion, Nutrient Cycling, Off-site Migration, Management Limit	Metal (copper), PHC (F2-F4), BTEX (Benzene, Toluene), PAHs (Anthracene, Fluoranthene, Naphthalene, Phenanthrene, Pyrene)	Y	Y
6	Canyon Church Camp	Cabins & Female Washroom	1-2 1-4 2-2 2-3 2-4 2-5 3-1 3-3 3-5	Human Health / Potable Water, Soil Vapour Inhalation Environmental Health / Aquatic Life, Soil Contact	Metal (tin), BTEX (Benzene), VOC (Carbon Tetrachloride), PAHs (Anthracene, Fluoranthene, Pyrene)	Y	N
		Cook & Director's Residence		Human Health / Potable Water Environmental Health / Aquatic Life	BTEX (Benzene), PAHs(Anthracene, Fluoranthene, Naphthalene)		
		Hospital		Human Health / Potable Water, Soil Ingestion, Soil Contact Environmental Health/ Aquatic Life, Soil Contact, Soil and Food Ingestion, Nutrient Cycling	Metals (Lead, Zinc), BTEX (Benzene, Toluene), PAHs (Anthracene, Fluoranthene, Naphthalene, Pyrene)		
7	Waterton Lakes Golf Course	Maintenance Shed	13-2	Environmental Health / Aquatic Life	PAHs (Anthracene)	Y	N
		Golf Cart Storage Area			None	Y	N
8[1, 2]	Alpine Stables	Stables	BTEX PAHs VOCs Metals (Copper, Tin, Zinc)			N	Y
		Bunkhouse					
		Residence					
9	Operations Compound	Fire Retardant Spill Site	5-1	N/A	None	Y	Y
		Fire Shed	6-4	N/A	None		
10	Salamander Barriers	Slope between Operations Compound and Hwy 5	N/A	N/A	None	Y	N

Notes:

1. Soil type coarse for all sites except for Site 2 – Visitor Reception Centre and Site 8 – Alpine Stables (Residence), which are considered fine-grained.
2. Refer to Remedial Action Plan – Site 8: Alpine Stables Draft Report (Dillon, March 2018)

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5.2 Remedial Approach

The objective of the RARMP is to remediate the sites to applicable remediation criteria and to return the site to an operable condition for future site use and development. While the assumed contaminated soil excavation boundary was approximated by demarcating the perimeter of the contaminated debris/ash around each building during the initial site visit in December 2017, the debris and ash may have spread in the months following the site visit. As a result, the soil excavation boundary may not precisely reflect site conditions, since soil excavation is only required in areas with known soil impacts and directly underneath the contaminated debris/ash. Additional soil excavation may be required depending on the extent of contaminated debris/ash on-site at the time of remediation.

The recommended procedure for remediation is as follows:

- Remove hazardous debris/ash material and dispose off-site. If debris is potentially asbestos-containing, remove approximately 5 cm of soil underneath;
- Remove non-hazardous, contaminated debris/ash, up to a depth of 10cm and dispose off-site;
- Remove concrete slabs, foundations, walls, and piles and dispose off-site;
- Excavate known impacted (contaminated) soil, up to a depth of 30cm and dispose off-site;
- Conduct confirmatory soil sampling to measure parameters that exhibited concentrations that exceeded the applicable regulatory guidelines as per December 2017 sampling assessment in remaining soil on-site. Review analytical results and proceed as described below; and
- Once post-excavation confirmatory samples are considered acceptable, backfill with clean fill and topsoil to existing grade.

During the soil excavation process, proper care should be taken so that the excavation does not extend below building foundations without input from a geotechnical consultant. Excavations will only proceed in a safe manner that is protective of the adjacent foundations.

It should be noted that the confirmatory soil sampling process has an approximate five to seven business days turnaround period before Dillon receives the laboratory results. If the laboratory results indicate that the confirmatory soil samples are below the applicable guidelines, then backfill may commence. If the confirmatory sample results exceed the remedial objectives, further excavation will be required and confirmatory soil sampling will continue until the laboratory results are satisfactory. During the five to seven business days turnaround period, it is recommended that the contractor implement a phased remediation approach; whereby, the remediation procedures prescribed above can be conducted for other sites/locations while awaiting sample results.

Furthermore, it is at the discretion of the contractor to decide where and how contaminated ash/debris and soils will be stored prior to hauling to the selected disposal facility (e.g., Pincher Creek landfill). Proper protection between the contaminated soil and underlying clean soil will be required. The contractor may choose to use several disposal methods, including laying down a high density polyethylene geomembrane with geotextile underneath in loading areas to prevent the spread of

contaminated debris and soils. The excavated material can be immediately placed and transported to the disposal facility through the use of hauling trucks, or be stockpiled into storage bins. Should storage bins be used, tarps will be required over the bin during rainfall and windy weather to prevent the spread of contaminated soil and debris.

6.0 Proposed Remediation Activities

The following sections describes the recommended remediation activities for each site, based on the results of the hazardous material assessment (conducted by RJ & Associates) and shallow soil assessment (conducted by Dillon). Recommended remediation measures are organized by site and location.

Volumes of surface debris (hazardous and non-hazardous), contaminated soil, and foundation materials (e.g., concrete, pilings) proposed for excavation, removal, and disposal off-site are preliminary and subject to change based on site conditions. In addition, confirmatory sampling of the contaminated soil excavation areas is necessary to assess if residual soil impacts remain in place. Afterwards, clean backfill and topsoil can be placed and compacted in accordance with the specifications. If excavation is not practical, risk management measures will be implemented on a site-specific basis.

Table 6-1: Summary of Proposed Remediation and Risk Management Strategy

Site No.	Site Name	Site Location	Soil Sampling ID	Estimated Volume of Non-Hazardous Surface Debris (cu. m.)	Hazardous Material(s) Identified from Surface Debris Samples	Estimated Volume of Hazardous Debris (cu. m.)	COCs Identified from Shallow Soil Samples (< 0.3 m bgs[8])	Estimated Volume of Contaminated Shallow Soil (cu. m.)	Estimated Volume of Foundation Material (cu. m.)	Description of Proposed Remediation Measures
1	Helipad	Jet Fuel Environ Shed	4	0	Not sampled[1]	0	PAHs	8	N/A	• No remedial activities required, as groundwater data suggests that exposure pathway is not operable.
2[2]	Visitor Reception Centre	Hwy 5 at Bears Hump Trailhead	10	85	Asbestos (Chrysotile)	139	None	N/A	325 sq. m.	• Disposal of hazardous and non-hazardous surface debris off-site • Excavation and disposal of foundation material off-site • Removal of decorative stone wall and transport to WLNP storage facility
4	Gate House	Park Entrance	12	120	None	N/A	None	N/A	60	• Disposal of non-hazardous surface debris off-site • Excavation and disposal of foundation material off-site • Backfill/grading with clean fill and topsoil
5	Heavy Equipment	Park Entrance	11	75	None	N/A	BTEX, PAHs, VOCs, PHC F2-F4, copper	60	N/A	• Disposal of non-hazardous surface debris off-site • Removal of heavy equipment and disposal off-site[3] • Excavation and disposal of contaminated soil off-site • Confirmatory sampling of soil excavation extents • Backfill/grading with clean fill and topsoil
6	Canyon Church Camp[4]	Cabins + Female Washroom	3	235	None	30	BTEX, PAHs, VOCs, tin	220	32	• Disposal of non-hazardous and hazardous surface debris off-site • Excavation and disposal of foundation material and contaminated soil off-site • Confirmatory sampling of soil excavation extents • Backfill/grading with clean fill and topsoil
		Cook's Residence	1		Asbestos (Chrysotile)		BTEX, PAHs			
		Director's Residence + Hospital	2		None		BTEX, PAHs, lead, zinc			
7	Waterton Lakes Golf Course	Maintenance Shed	13	270	VOCs (benzene and ethylbenzene)	N/A	PAHs	53	45	• Disposal of non-hazardous surface debris off-site • Disposal of approximately 40 burnt golf carts mixed with burnt debris • Excavation and disposal of foundation material and contaminated soil off-site • Confirmatory sampling of soil excavation extents • Backfill/grading with cleanfill and topsoil
		Golf Cart Storage Area	14	0	Not sampled[6]	0	None	N/A	N/A	• Disposal of non-hazardous surface debris
8[5]	Alpine Stables	Stables	7	N/A	VOCs (benzene)	530	BTEX, PAHs, VOCs, zinc	87	53	• Disposal of hazardous surface debris off-site • Excavation and disposal of foundation material and contaminated soil off-site • Confirmatory sampling of soil excavation
		Bunkhouse	8		None		PAHs, copper, tin			
		Residence	9		None		BTEX, PAHs			

Site No.	Site Name	Site Location	Soil Sampling ID	Estimated Volume of Non-Hazardous Surface Debris (cu. m.)	Hazardous Material(s) Identified from Surface Debris Samples	Estimated Volume of Hazardous Debris (cu. m.)	COCs Identified from Shallow Soil Samples (< 0.3 m bgs[8])	Estimated Volume of Contaminated Shallow Soil (cu. m.)	Estimated Volume of Foundation Material (cu. m.)	Description of Proposed Remediation Measures
										extents • Backfill/grading with clean topsoil
9	Operations Compound	Fire Retardant Spill Site	5	0	Not sampled[1]	0	None	0	N/A	• No remedial activities required, as groundwater data suggests that exposure pathway is not operable.
		Fire Shed[7]	6		Not sampled[1]		None			
10[9]	Salamander Barriers	Slope between Operations Compound and Hwy 5	15	450 m of PVC pipe	None	0	None	N/A	N/A	• 450 linear metres of burnt PVC pipe to be removed and disposed of off-site

Notes:

1. Surface debris believed to contain hazardous material was removed from the site prior hazardous materials assessment.
2. Remediation activities at Site 2 - Visitor Reception Centre completed in May 2018. No further remedial work is necessary.
3. Removal of heavy equipment has been completed by PCA.
4. Debris within Site 6 – Canyon Church Camp considered asbestos containing at the cook's residence, only.
5. Remediation activities at Site 8 – Alpine Stables completed in April 2018. No further remedial work is necessary.
6. Site inaccessible in December 2017. No surface debris noted during site visit in April 2018.
7. Remediation activities at Site 9 – Fire Shed have already been completed by PCA. No further remedial work is necessary.
8. m bgs = metres below ground surface.
9. All remedial work for this site will be complete by PCA

6.1 Site 1 – Helipad (Location: Jet Fuel Environ Shed)

6.1.1 Site Observations

During a site visit in April 2018, three empty 45 gallon jet fuel drums were observed on-site that were not visible during the December 2017 sampling event. The drums do not appear to have leaked and they are intact with no visible staining was noticeable around the drums. These drums are located outside of our original work area and according to subsequent conversations with PCA, the drums have since been removed. Please refer to **Appendix C: Site Photographs – Site 1.**

6.1.2 Hazardous Material Proposed Remediation

Surface debris was removed from the site prior to RJ & Associates' site visit on December 23, 2017. No sampling was completed as part of the Debris and Soil Assessment – Draft Report and; therefore, no hazardous material debris removal is planned for Site 1.

6.1.3 Shallow Soil Proposed Remediation

The Debris and Soil Assessment Related to Kenow Wildfire– Draft Report (Dillon, 2018) documented the following results:

- The soil for this location was analyzed to be coarse-grained sandy loam;
- Anthracene concentrations exceeded AEP aquatic life guidelines for sample 4-5, located north of the shed and for sample 4-6, which is a duplicate of sample 4-5;
- Naphthalene concentration exceeded CCME aquatic life guidelines for sample 4-1, located within the fenced area of the shed; and
- As the site is approximately 100m from the Waterton Lakes, aquatic life is potentially threatened by the exceedances noted above.

Review of analytical results from a nearby water well, as shown in **Appendix D**, was provided by PCA and indicated that no PAHs were detected in groundwater. As a result, despite the elevated concentrations detected in the soil, the exposure pathway from soil to aquatic life and potable water receptors is not complete. Therefore, no unacceptable risk is present and no remediation is required. Appendix A provides a copy of the analytical results of groundwater. Review of the analytical results did identify VOCs detected in water well data but review of the data indicated that the compounds detected are typical by-products associated with disinfection/chlorination of the well and are not considered problematic.

6.2 Site 2 – Visitor Reception Centre

Detailed information regarding the remediation approach proposed for Site 2 was submitted to the client on March 27, 2018. This submission included an abatement specification, figure delineating the zone of asbestos contamination, and Hazardous Material Investigation – Final Report (RJ & Associates, January 2018). Please refer to **Appendix A** for the Site 2 – Remedial Action Plan documentation.

On April 14, 2018, two additional shallow soil samples were collected east of the former Visitor Reception Centre building for field screening of organic vapours and laboratory analysis of the following COPCs:

- BTEX;
- PHC fractions F1 to F4;
- PAHs;
- PCBs
- metals; and
- VOCs.

No exceedances of referenced guidelines for any of the COPCs tested were found in the samples. Therefore, no remediation of shallow soils is required for Site 2 – Visitor Reception Centre.

In May 2018, remediation of the Visitor Reception Center was successfully completed by Remediclean Inc and PCA. No further remedial work is required at this site.

6.3 Site 3 – Horse Corral

At PCA's request, this site was not assessed for hazardous materials or soil contamination. No further remedial work is required at this site.

6.4 Site 4 – Gate House (Location: Park Entrance)

6.4.1 Site Observations

During Dillon's site visit in April 2018, various fire-damaged household appliances were observed within the basement of the Gate House (e.g., microwave, washer, dryer, stove). These items were not visible during the December 2017 sampling event. It is recommended that these non-hazardous items be removed during remediation of the site.

In addition, it is estimated that the concrete basement walls are 2.7 m (9 ft) tall and that a concrete foundation is located within the basement area (approximate size: 9.0 m x 15.5 m). Six concrete piles were observed along the south and west sides of the Gate House and a sidewalk, concrete garage, and driveway pad (at grade) are located within the eastern half of the Gate House footprint. Please refer to **Appendix C: Site Photographs – Site 4.**

Most of the debris is captured within the building footprint and resides within the four walls of the basement. However, as there was an existing patio on the south and west face of the building, surficial debris is especially present on these two sides. Notably, two unexploded and damaged propane tanks servicing a barbecue grill are present. On the east side of the building, a seemingly-undamaged garbage bin is present.

6.4.2 Hazardous and Non-Hazardous Material Remediation

The Debris and Soil Assessment Related to Kenow Wildfire– Draft Report (Dillon, 2018) documented the following results:

- Asbestos debris samples, collected from within the footprint of the main building, tested negative for asbestos. Bulk sample 2439-AC was collected from the suspect drywall mud. Bulk sample 2442-AC was collected from the suspect caulking/mastic. Bulk sample 2440-AC was collected from debris of unknown source; and
- Bulk sample 2441-AC of various burnt metal, ash, and other debris was collected from within the foot print of the main building and submitted for laboratory analysis for total metals leachability. The material was determined to be non-leachable for metals analyzed.

No hazardous material debris removal is proposed for Site 4. Approximately 120 cu. m. of non-hazardous surface debris (which includes ash, equipment, appliances, piping, roofing, wood, and metal debris) is to be removed and disposed of off-site.

6.4.3 Shallow Soil Proposed Remediation

The Debris and Soil Assessment Related to Kenow Wildfire– Draft Report (Dillon, 2018) documented the following results:

- The soil for this location was analyzed to be coarse-grained sandy loam;
- Four soil samples were collected, one from each face of the building;
- There were trace concentrations of arsenic detected in two of the soil samples. 12-1, 12-2, which possessed 14 and 18 mg/kg of arsenic, respectively. The arsenic concentrations were above guideline values of 12 mg/kg, based on an Incremental Lifetime Cancer Risk (ILCR) of 10^{-6}; however, the province of Alberta accepts an ILCR of 10^{-5}, which results in a Tier 1 soil guideline for arsenic of 26 mg/kg. As such, the arsenic concentrations in soils at the site are not considered to exceed referenced guidelines; and
- No exceedances of applicable guidelines for remaining COPCs tested were found in the samples.

Therefore, no remediation of shallow soils is proposed for Site 4 – Gatehouse (Location: Park Entrance).

Notwithstanding the absence of contaminated soils at Site 4, up to 100mm of underlying soil may be excavated along with the non-hazardous debris, due to the debris being well-mixed in with the underlying soil. Approximately 145 tonnes of foundation material is to be removed and disposed of off-site (which includes the basement walls and foundation, piles along the south and west side of the Gate House, sidewalk, brick flooring, and garage pad slabs). Approximately 460 tonnes of clean fill is to be imported on to site for placement and compaction at the existing basement and garage footprint. 100mm of uncompacted topsoil shall be placed over the clean fill and over all areas that have been disturbed during the debris removal process and graded to match adjacent surface elevations.

The proposed contaminated soil excavation boundary, soil sampling locations and IDs are shown on **Drawing 176826-04-01: Site 4 – Park Entrance Proposed Remediation, Location: Gate House.**

6.5 Site 5 – Heavy Equipment (Location: Park Entrance)

6.5.1 Site Observations

Located approximately 25 metres east of the Gatehouse, the heavy equipment area consisted of a half-burnt vacuum truck with three fully-burnt trailers behind it, as well as a separate burnt trailer just east of the vacuum truck. The tires of trailers and water truck were partially-to-fully burnt, as well as the contents in the trailers.

During Dillon's site visit in April 2018, a generator and welding equipment were noted within the west trailer. No visible fuel stains were noted in the area. Debris consists of the trailers, heavy equipment and burnt surface debris such as old tires. It is recommended that these non-hazardous items be removed during remediation of the site. Please refer to **Appendix C: Site Photographs – Site 5.**

PCA removed the vacuum truck and trailers from site in June 2018. Non-hazardous debris remains present at the site, including tires, nails, a toolshed, generator, and other miscellaneous debris. As the soil conditions were previously unobservable and could not be assessed beneath the vehicles because of access limitations, Dillon conducted an additional site visit in late June 2018 to collect five additional shallow soil samples following the removal of the equipment. The results from this additional analysis have been presented below.

6.5.2 Hazardous and Non-Hazardous Material Remediation

The Debris and Soil Assessment Related to Kenow Wildfire– Draft Report (Dillon, 2018) documented the following results:

- Asbestos was not detected in the asbestos debris sample 2469-AC, which was collected from a fibrous debris material of an unknown source within the burnt trailers.
- Bulk sample 2468-AC of various burnt metal, ash, and debris was collected from within the burnt trailers and submitted for laboratory analysis for total metals leachability. The material was determined to be non-leachable for metals analyzed.

No hazardous material debris removal is planned for Site 5. Approximately 65 cu. m. of non-hazardous surface debris is to be removed and disposed of off-site. This includes vehicles, trailers, heavy equipment, and metal debris.

6.5.3 Shallow Soil Proposed Remediation

The Debris and Soil Assessment Related to Kenow Wildfire– Draft Report (Dillon, 2018) documented the following results:

- The soil for this location was analyzed to be coarse-grained sandy loam;

- The Heavy Equipment Area is located approximately 200 m from the nearby creek;
- Naphthalene concentration exceeded CCME aquatic life guidelines for sample 11-3;
- Two soil samples, 11-5 and 11-6, were taken directly underneath the vacuum truck. Both samples exceeded CCME guidelines for multiple human health and environmental health pathways. The samples contained exceedances for PHC (F2-F4), and PAHs (anthracene, fluoranthene, phenanthrene, pyrene);
- Sample 11-8 was taken underneath the northernmost trailer. The sample exceeded CCME human health guidelines for the potable water pathway, and multiple environmental health pathways. The sample contained exceedances for copper, BTEX (benzene, toluene), and naphthalene;
- Sample 11-9 was taken underneath the easternmost trailer. The sample exceeded CCME guidelines for aquatic life. The sample contained exceedances for PAHs (anthracene, fluoranthene, naphthalene, phenenathrene, pyrene); and
- Sample 11-7 was taken in the existing trailer footprint, located directly north of the vacuum truck. No guideline values were exceeded; however, given that the debris remnants in this area were visibly similar to the other trailers, it was assumed that the clean soil sample was unrepresentative of actual contaminated soil conditions observed at the adjacent trailers. Therefore, the soil at this location was presumed to possess similar characteristics as sample 11-5, 11-6, 11-8, and 11-9, and therefore the area is assumed to be contaminated.

As the soil has exceeded multiple human health and environmental pathway guidelines, it is recommended that approximately 133 cu. m. of contaminated soil (< 0.3 m bgs) be excavated and disposed of off-site. Approximately 190 tonnes of clean fill is to be placed and compacted in areas where contaminated soil has been removed. 100mm of uncompacted topsoil shall be placed over the clean fill and over all areas that have been disturbed during the debris removal process and graded to match adjacent surface elevations.

The proposed contaminated soil excavation boundary, soil sampling locations and IDs are shown on **Drawing 176826-05-01: Site 5 – Park Entrance Proposed Remediation, Location: Heavy Equipment.**

6.6 Site 6 – Canyon Church Camp

6.6.1 Site Observations

During Dillon's initial site visit in December 2017, several soil and debris samples were collected to characterize the potential contamination and hazardous materials on-site. Both the soil and debris samples underwent laboratory testing, where it was discovered that the site exhibited soil quality guideline exceedances and asbestos was detected in one of the debris samples.

In order to better delineate the extent of hazardous debris, Dillon collected additional debris samples from each building on-site (eight total) in May 2018. Laboratory results and analysis are presented in the following subsections.

It should be noted that a concrete septic tank was noted within the footprint of the female washroom. The tank is part of a septic system at the site which includes underground pipes and a septic field. The system was undamaged by the fire and should not be damaged during the remedial work.

6.6.2 Hazardous and Non-Hazardous Material Remediation (All Locations)

The Debris and Soil Assessment Related to Kenow Wildfire– Draft Report (Dillon, 2018) documented the following results:

- Bulk sample (2517-AC) of suspect drywall mud with burnt ash and debris on surface of soil was collected from the cook's residence located directly north of the director's residence and submitted for laboratory analysis. The material was determined to contain 1-10% Heated Chrysotile Asbestos; and
- Samples 2520-AC, 18-2a, 18-4a, 18-6a, 18-8a, 18-10a, 18-12a, and 18-16a were collected from the remaining buildings on-site (i.e., hospital, female washroom, cabins). The samples were submitted for laboratory testing and, based on the laboratory results, were determined to be non-asbestos containing. Samples were collected from a variety of sources, including burnt ash, debris, suspect drywall, suspect pipe insulation, and plaster.

Since the cook's residence located north of the director's residence was shown to possess asbestos-containing debris, asbestos abatement will be required at this location. Debris from the remaining buildings is considered non-hazardous and can be disposed of as "non-hazardous" materials.

6.6.3 Shallow Soil Results (Location: Cook & Director's Residence)

The Debris and Soil Assessment Related to Kenow Wildfire– Draft Report (Dillon, 2018) documented the following results:

- The soil for this location was analyzed to be coarse-grained sandy loam;
- Anthracene, fluoranthene, and naphthalene concentrations exceeded CCME and AEP aquatic life guidelines for sample 1-2, located west of the director's residence (see **Table 4**); and
- Sample 1-4, located within the cook's residence, contained a benzene concentration exceeding potable water guidelines, as well as naphthalene exceedances for aquatic life (see **Table 4**).

6.6.4 Shallow Soil Results (Location: Cabins & Female Washroom)

The Debris and Soil Assessment Related to Kenow Wildfire– Draft Report (Dillon, 2018) documented the following results (see **Table 5**):

- The soil for this location was analyzed to be coarse-grained loamy sand;

- Sample 3-1, located southwest of Cabin 7, exceeded benzene concentration guidelines for the potable water pathway, as well as carbon tetrachloride concentration guidelines for soil vapour inhalation;
- Tin concentration exceeded the environmental soil contact pathway under AEP guidelines for sample 3-3, located just south of Cabin 5; and
- Anthracene, fluoranthene, and pyrene concentrations exceeded the aquatic life pathway under CCME and AEP guidelines for sample 3-5, located just south of the female washroom.

6.6.5 Shallow Soil Results (Location: Hospital)

The Debris and Soil Assessment Related to Kenow Wildfire– Draft Report (Dillon, 2018) documented the following results:

- The soil characteristics for this location were analyzed to be coarse-grained sandy loam;
- Samples 2-2, 2-3, 2-4, and 2-5, which were taken from all four faces of the hospital, possessed various PAH exceedances (anthracene, fluoranthene, naphthalene, pyrene) for the aquatic life pathway;
- Additionally, sample 2-3, located west of the building, exceeded zinc, benzene, and toluene concentrations for multiple pathways; and
- Additionally, sample 2-4, located northeast of the building, exceeded lead concentrations for multiple pathways.

6.6.6 Shallow Soil Proposed Remediation for Site 6 (All Locations)

It is recommended that approximately 252 cu. m. of shallow soils (< 0.3 m bgs) be excavated and disposed of off-site. Approximately 350 tonnes of clean fill is to be placed and compacted in areas where contaminated soil has been removed. In addition, approximately 32 cu. m. of foundation material is to be removed and disposed of off-site. Clean fill is to be placed and compacted in areas where cinder block foundations have been removed. 100mm of uncompacted topsoil shall be placed over the clean fill and over all areas that have been disturbed during the debris removal process and graded to match adjacent surface elevations.

The proposed hazardous surface debris boundary, contaminated soil excavation boundary, sampling locations and IDs are shown on **Drawing 176826-06-01: Site 6 – Canyon Church Camp Proposed Remediation, Locations: Cook Residence, Director Residence, Hospital, Female Washrooms and Cabins.**

6.7 Site 7 – Waterton Lakes Golf Course (Location: Maintenance Shed)

6.7.1 Site Observations

Approximately 40 burnt golf carts mixed in with debris of the Maintenance Shed is present on the south face of the building. The majority of the golf carts were gas powered while the remainder were electric.

Debris remains north of the building footprint, extending up to 8 m past the building.

Please refer to **Appendix C: Site Photographs – Site 7.**

6.7.2 Hazardous Material Proposed Remediation

The Debris and Soil Assessment Related to Kenow Wildfire– Draft Report (Dillon, 2018) documented the following results:

- Asbestos debris samples tested negative for asbestos. Four samples were collected within the footprint of the building
  - Bulk sample 2446-AC was collected from a black woven material observed amongst the debris piles;
  - Bulk samples 2447-AC and 2450-AC were collected from suspect drywall board material and joint compound/skim coat material; and
  - Bulk sample 2452-AC was collected from various debris of unknown sources.
- Bulk samples 2448-AC and 2449-AC of various metal, ash, and paint debris were collected from the north and south areas of the debris piles and submitted for laboratory analysis for total metals leachability. The materials were determined non-leachable for metals analyzed; and
- Bulk samples 2445-AC and 2453-AC of various debris were collected from within the footprint of the building and from the large debris pile and submitted for laboratory analysis for VOC content. The debris material was determined to contain elevated levels of benzene (0.44 mg/kg) and ethylbenzene (0.11 mg/kg), which exceed CCME Soil Quality Guidelines for the Protection of Environmental and Human Health – Parkland/Residential Land**.**

It is recommended that approximately 270 cu. m. of non-hazardous surface debris be removed and disposed of off-site. The debris is considered impacted with VOCs and non-hazardous; it can be handled similar to contaminated soil.

6.7.3 Shallow Soil Proposed Remediation

The Debris and Soil Assessment – Draft Report noted the following results:

- The soil for this location was analyzed to be coarse-grained sandy loam;
- Anthracene concentrations exceeded aquatic life guidelines for sample 13-2, located north of the shed (see **Table 7**); and
- The site is located approximately 420 m away from the nearby creek.

It is recommended that approximately 51 cu. m. of contaminated soil (< 0.3 m bgs) be excavated and disposed of off-site. Clean fill is to be placed and compacted in areas where contaminated soil has been removed. In addition, approximately 105 tonnes of foundation material is to be removed and disposed of off-site. Clean fill is to be placed and compacted in areas where contaminated soil and foundation material have been removed. Approximately 70 tonnes of clean fill is to be imported on to site for placement and compaction. 100 mm of uncompacted topsoil shall be placed over the clean fill and over

all areas that have been disturbed during the debris removals process and graded to match adjacent surface elevations.

The proposed non-hazardous surface debris boundary, contaminated soil excavation boundary, sampling locations and IDs are shown on **Drawing 176826-07-01: Site 7 – Waterton Golf Proposed Remediation, Location: Maintenance Shed.**

6.8 Site 7 – Waterton Lakes Golf Course (Location: Golf Cart Storage Area)

6.8.1 Site Observations

The Golf Cart Storage Areas was inaccessible in December 2017. The Golf Cart Storage Areas was visited in April 2018. Please refer to **Appendix C: Site Photographs – Site 7.**

6.8.2 Hazardous Material Proposed Remediation

No hazardous materials were detected in the samples taken in December 2017. Therefore, no hazardous material debris removal is planned for Site 10. Please refer to the Debris and Soil Assessment Related to Kenow Wildfire– Draft Report (Dillon, 2018).

6.8.3 Shallow Soil Proposed Remediation

Five shallow soil samples (< 0.25 m bgs) were collected on April 19, 2018 for field screening of organic vapours and laboratory analysis of the following COPCs:

- BTEX;
- PHC fractions F1 to F4;
- PAHs;
- metals; and
- VOCs.

The Shallow Soil Assessment followed the same methodology outlined in the Debris and Soil Assessment Related to Kenow Wildfire– Draft Report (Dillon, 2018). The following result is noted:

- No exceedances of referenced guidelines for any of the COPCs tested were found in the samples.

No remediation of shallow soils is proposed for Site 7 – Waterton Lakes Golf Course (Location: Golf Cart Storage Area).

The sampling locations and IDs are shown on **Drawing 176826-07-02: Site 7 – Waterton Golf Proposed Remediation, Location: Golf Cart Storage Area.**

6.9 Site 8 – Alpine Stables (Locations: Stables, Bunkhouse and Residence)

Remediation activities at Site 8 – Alpine Stables were completed in April 2018. No further remedial work is required and this site will not be a part of the Contractor's scope of work. For detailed information

regarding the remediation approach proposed for Site 8, please refer to the Remedial Action Plan – Site 8: Alpine Stables Draft Report (Dillon, March 2018), included as **Appendix B** of this report.

Results of confirmatory sampling conducted at Site 8 will be included in a Remediation Closure Report (to be submitted to PCA under a change order following the remediation of the remainder of the sites).

6.10 Site 9 – Operations Compound (Location: Fire Shed)

6.10.1 Site Observations

During Dillon's site visit in April 2018, it was noted that remediation of the Fire Shed had already been completed by others. No additional remediation is proposed for the Fire Shed.

6.10.2 Hazardous Material Proposed Remediation (Location: Fire Shed)

The surface debris was removed from the site prior to RJ & Associates' site visit on December 23, 2017. No sampling was completed as part of the Debris and Soil Assessment Related to Kenow Wildfire– Draft Report (Dillon, 2018). Therefore, no hazardous material debris removal is planned for Site 9 - Operations Compound (Location: Fire Shed).

6.10.3 Shallow Soil Proposed Remediation (Location: Fire Shed)

The Debris and Soil Assessment – Draft Report noted the following results:

- The soil for this location was analyzed to be coarse-grained loamy sand;
- PHC F3 fraction concentration exceeded guidelines for sample 6-4, located in the southwest corner of the shed;
- Anthracene concentration exceeded guidelines for sample 6-4; and
- PFAS, nutrient, and cyanide concentrations were below the referenced guidelines.

As noted in **Section 6.10.1,** remediation of the Fire Shed has already been completed by others. No additional remediation is proposed for Site 9 – Operations Compound (Location: Fire Shed).

6.11 Site 9 – Operations Compound (Location: Fire Retardant Spill Site)

6.11.1 Site Observations

Two additional site visits were performed in April and June 2018 at the Fire Retardant Spill Site. No concerns were noted with the site, since the site had been well maintained by PCA after the wildfire.

It was noted that a potential fuel spill happened at the site before Christmas. During the latest site visit, no stains on the ground were noted, potentially due to PCA grading the site numerous times over the past months. Nevertheless, a soil sample in the general location of the suspected fuel stain was collected and submitted for laboratory analysis.

6.11.2 Hazardous and Non-Hazardous Material Remediation (Location: Fire Retardant Spill Site)

The surface debris was removed from the site prior to RJ & Associates' site visit on December 23, 2017. No sampling was completed as part of the Debris and Soil Assessment Related to Kenow Wildfire– Draft Report (Dillon, 2018). Therefore, no hazardous material debris removal is planned for Site 9 - Operations Compound (Location: Fire Retardant Spill Site).

6.11.3 Shallow Soil Proposed Remediation (Location: Fire Retardant Spill Site)

The Debris and Soil Assessment – Draft Report noted the following results:

- The soil at this location was analyzed to be coarse-grained sandy loam;
- Anthracene, benz(a)anthracene, fluoranthene, phenanthrene, and pyrene concentrations exceeded aquatic life guidelines for sample 5-1;
- PFAS, nutrient, and cyanide concentrations were below the referenced guidelines; and
- An additional soil sample (5-4) was taken in the general vicinity of the suspected fuel spillage during Dillon's June 2018 visit. No contamination was detected.

Review of analytical results from a nearby water well, provided by PCA, indicated that no PAHs were detected in groundwater, indicating that despite the elevated concentrations detected in the soil, the exposure pathway from soil to aquatic life and potable water receptors is not complete. Therefore, no unacceptable risk is present and no remediation is required. **Appendix D** provides a copy of the analytical results of groundwater.

6.12 Site 10 – Salamander Barriers

6.12.1 Site Observations

During Dillon's site visit in April 2018, the Salamander Barriers were observed to be partially to fully burnt, leaving a black trace of burnt barrier material where the Salamander Barriers used to be. Test pits were dug at five locations along the existing Salamander Barriers, where it was determined that the debris from the barriers was surficial and did not intermix with the soil.

6.12.2 Non-Hazardous Material Remediation

No hazardous materials were detected in the samples taken in December 2017. However, the existing 450 mm diameter corrugated PVC half-pipe is to be removed and disposed of off-site. The pipe, which received fire damage is U-shaped (open) and was installed along the existing ground surface. The total length of pipe to be removed is approximately 450 linear metres. PCA has indicated that they will be responsible for removing the salamander barriers.

6.12.3 Shallow Soil Proposed Remediation

Five shallow soil samples (< 0.25 m bgs) were collected on April 19, 2018 for field screening of organic vapours and laboratory analysis of the following COPCs:

- BTEX;

- PHC fractions F1 to F4;
- PAHs;
- metals; and
- VOCs.

The Shallow Soil Assessment following the same methodology outlined in the Debris and Soil Assessment Related to Kenow Wildfire– Draft Report (Dillon, 2018). The following result is noted:

- No exceedances of referenced guidelines for any of the COPCs tested were found in the samples.

No further soil remedial work is required and this site will not be a part of the Contractor's scope of work. The alignment of the 450mm diameter PVC pipe, and sampling locations and IDs are shown on **Drawing 176826-10-01: Site 10 – Salamander Barriers Proposed Remediation.**

6.13 Landfill Sampling

For soil sampling completed in December 2017, one soil sample from each site was submitted for laboratory analysis of Class II Landfill Characterization parameters to assess suitability for future landfill disposal. The following exceedances were noted in the Debris and Soil Assessment Related to Kenow Wildfire– Draft Report (Dillon, 2018):

- LF5 for Site 9 – Operations Compound, Location: Fire Retardant Spill Site had a pH of 8.49;
- LF6 for Site 9 – Operations Compound, Location: Fire Shed had a pH of 8.10; and
- LF8 for Site 8 – Alpine Stables, Location Bunkhouse, had a pH of 9.22.

Pincher Creek Landfill was contacted in March 2018 and confirmed that they would accept hazardous debris, non-hazardous debris, contaminated soil, and foundation material from the sampled sites based on the results provided.

7.0 Conclusions and Recommendations

This RARMP outlines proposed remediation activities specific to each site. Removal and disposal of hazardous surface ash/debris, non-hazardous surface ash/debris, contaminated soils, foundation material, and other materials (e.g., fuel drums, equipment) are recommended. The proposed quantities of materials to be removed and disposed of off-site are summarized in **Table 6.1.** Based on recent communication with the Pincher Creek Landfill, hazardous debris, non-hazardous debris, and contaminated soil from these sites will be accepted at the landfill.

It should be noted that remediation has completed at Site 8 – Alpine Stables and Site 2 – Visitor Reception Centre. Dillon has prepared remedial action plans for each of these sites, submitted to PCA under separate cover.

At Site 6 – Canyon Church Camp, debris samples at each of the buildings on-site were submitted for laboratory analysis. Only the cook's residence tested positive for asbestos (chrysotile), while the rest of the burnt buildings on-site tested negative for asbestos. Appropriate abatement at the cook's residence is required. Removal of hazardous surface debris from this site will require that additional health and safety measures be followed. This is recommended so that workers on -site are protected and materials are properly disposed.

Impacted surface debris and excavated contaminated soil are to be stockpiled on a sacrificial layer of sand or gravel or high density polyethylene geomembrane, unless placed directly in a storage bin to haul off-site in order to prevent cross-contamination with non-contaminated ground surfaces. VOCs were noted in debris at Site 7 – Waterton Lakes Golf Course (Location: Maintenance Shed). Contaminated soil was identified at the following sites: 1, 5, 6, 7, and 9; of which, only Sites 5, 6, and 7 still require contaminated soil remediation.

Confirmatory sampling will be required at Sites 5, 6, and 7, as contaminated soil excavation will be required. Confirmatory sampling should take place after removal of contaminated soil and prior to placement of clean fill to verify that the soil along the excavation boundary is below guideline levels for the COPCs noted in the attached **Tables 1 to 7.**

8.0 Closure

This report was prepared exclusively for the purposes, project, and site location outlined in the report. The report is based on information provided to, or obtained by Dillon as indicated in the report, and applies solely to site conditions and the regulatory and planning frameworks existing at the time of the site assessment. Although a reasonable investigation was conducted by Dillon, Dillon's assessment was by no means exhaustive and cannot be construed as a certification of the absence of any contamination from the site. Rather, Dillon's report represents a reasonable review of available information within an established work scope and schedule.

This report was prepared by Dillon for the sole benefit of the Parks Canada Agency and is not to be relied upon by any other party without Dillon's express written consent. The material in it reflects Dillon's best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibilities of such third parties. Dillon accepts no responsibility for damages, if any, suffered by any third part as a result of decisions made, or actions based on this report.

The undersigned has demonstrable experience in assessment of the types of contaminants investigated on the subject site.

Respectfully Submitted,

DILLON CONSULTING LIMITED

Andrew Thalheimer, P.Eng.
Project Manager

Richard Dieu, E.I.T.
Junior Civil Engineer

Keith Barnes, P.Eng.
Civil Engineer

9.0 References

Alberta Environment and Parks (AEP), 2016. *Alberta Tier 1 Soil and Groundwater Remediation Guidelines*. ISBN: 978-1-4601-2695-0 (On-line Edition). February 2, 2016.

Alberta Environment and Parks (AEP), 2016. *Alberta Tier 2 Soil and Groundwater Remediation Guidelines*. ISBN: 978-1-4601-2693-6 (On-line Edition). February 2, 2016.

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Dillon Consulting Limited (2018). *Remedial Action Plan – Site 8: Alpine Stables - Draft Report, Kenow Wildfire Waterton Lakes National Park***.** March 28, 2018.

Dillon Consulting Limited (2018). *Debris and Soil Assessment Related to Kenow Wildfire– Draft Report, Waterton Lakes National Park, Alberta, Canada*. March 12, 2018.

RJ & Associates Environmental Consulting Inc.(2018). *Final Report – Hazardous Materials Investigation, Waterton Lakes National Park*. January 2, 2018.

Drawings

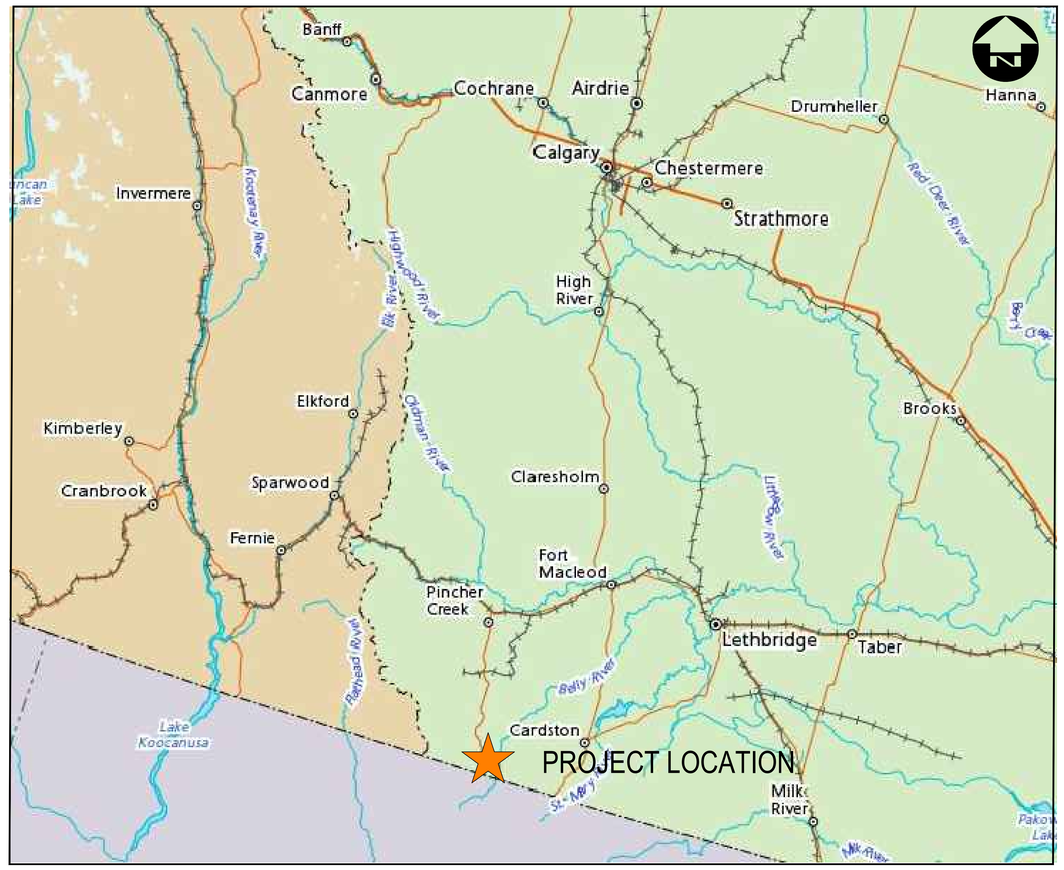
KENOW WILDFIRE ASSESSMENT AND REMEDIATION

WATERTON LAKES

VARIOUS SITES

REMEDIAL AND RISK MANAGEMENT PLAN

DRAWING INDEX	
DWG.	DESCRIPTION
176826-00-01	OVERALL SITE PLAN
176826-01-01	SITE 1 HELIPAD PROPOSED REMEDIATION, LOCATION: JET FUEL ENVIRON SHED
176826-02-01	SITE 2 VISITOR RECEPTION CENTRE PROPOSED REMEDIATION
176826-04-01	SITE 4 PARK ENTRANCE PROPOSED REMEDIATION, LOCATION: GATE HOUSE
176826-05-01	SITE 5 PARK ENTRANCE PROPOSED REMEDIATION, LOCATION: HEAVY EQUIPMENT
176826-06-01	SITE 6 CANYON CHURCH CAMP PROPOSED REMEDIATION, LOCATIONS: COOK RESIDENCE, DIRECTOR RESIDENCE, HOSPITAL, FEMALE WASHROOM AND CABINS
176826-07-01	SITE 7 WATERTON GOLF PROPOSED REMEDIATION, LOCATION: MAINTENANCE SHED
176826-07-02	SITE 7 WATERTON GOLF PROPOSED REMEDIATION, LOCATION: GOLF CART STORAGE
176826-08-01	SITE 8 ALPINE STABLES PROPOSED REMEDIATION. LOCATION: RESIDENCE
176826-08-02	SITE 8 ALPINE STABLES PROPOSED REMEDIATION, LOCATION: BUNKHOUSE
176826-08-03	SITE 8 ALPINE STABLES PROPOSED REMEDIATION, LOCATION: STABLES
176826-09-01	SITE 9 OPERATIONS COMPOUND PROPOSED REMEDIATION, LOCATION: FIRE SHED, FIRE RETARDANT SPILL SITE
176826-10-01	SITE 10 SALAMANDER PROPOSED REMEDIATION, LOCATION: BARRIERS



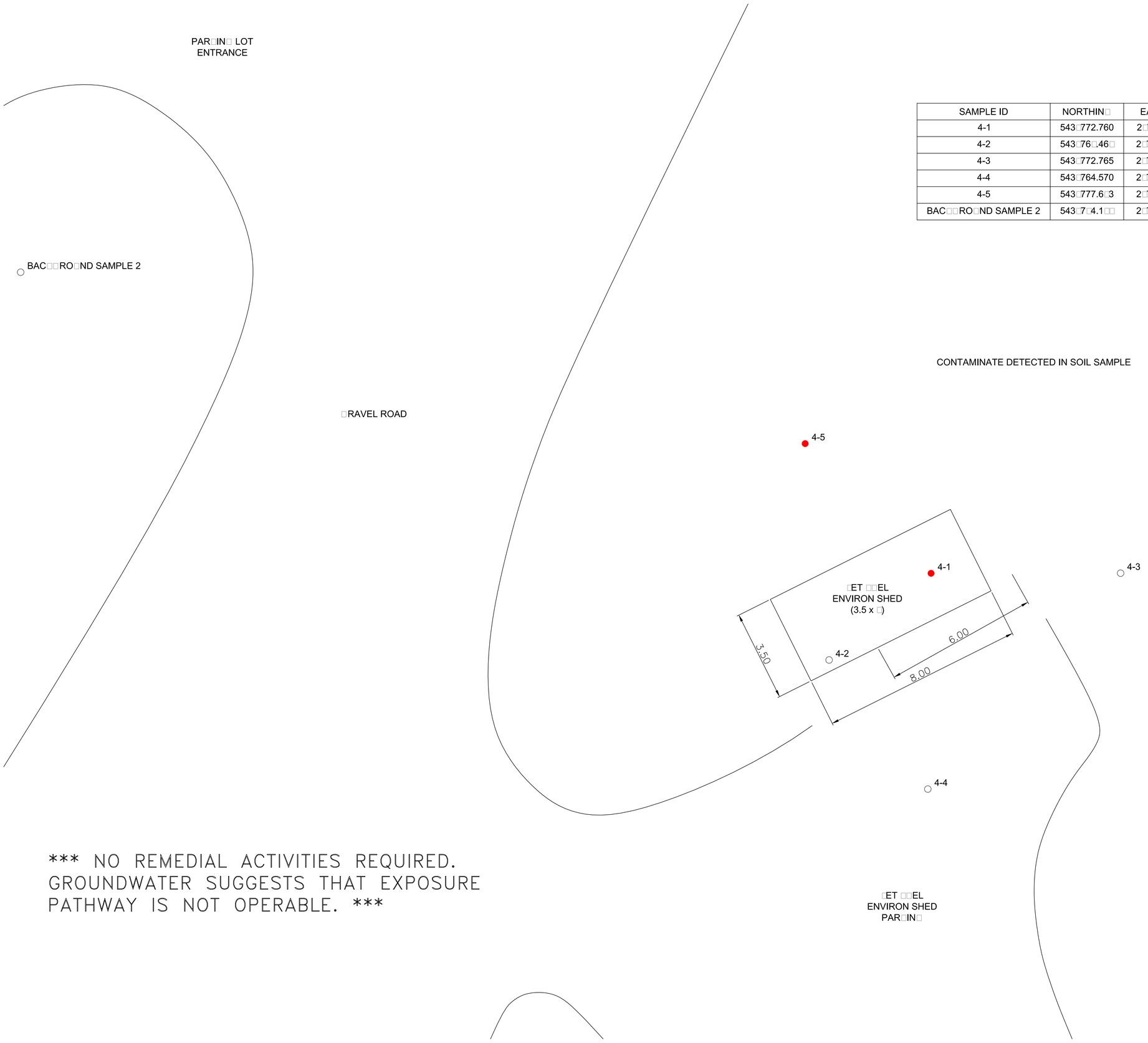
□E□ PLAN

ISSUED FOR RARMP FINAL REPORT

DILLON PROJECT: 176826
DATE: 07/18/2018

Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada
Client Services Team Southern Alberta Operations Branch / Le Client Entretient l'Équipe Alberta Méridional Branche d'Opérations
Canada
Parks Canada Agency / L'Agence Parcs Canada
Western and Northern Region / Ouest et Nord du Canada

DILLON CONSULTING



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4-3	543□772.765	2□7□54.757
4-4	543□764.570	2□7□47.43□
4-5	543□777.6□3	2□7□42.7□0
BAC□□RO□ND SAMPLE 2	543□7□4.1□□	2□7□12.□□2

CONTAMINATE DETECTED IN SOIL SAMPLE PAHs

*** NO REMEDIAL ACTIVITIES REQUIRED. GROUNDWATER SUGGESTS THAT EXPOSURE PATHWAY IS NOT OPERABLE. ***

Legend

- Soil Sample Location
- Debris Sample Location
- Soil Sample Exceeding Applicable Tier 2 Regulatory Guidelines
- Debris Sample Exceeding Regulatory Guidelines
- Contaminated Soils Excavation Boundary

Notes

1. All Dimensions are approximate
2. Surface debris removed from site prior to hazardous material assessment
3. Site is within 500m of a surface water source
4. Site is greater than 500m from a water well

ISSUED FOR RARMP FINAL REPORT

SCALE 1:50 METRES

No.	Date/Date	Description/Description	Drawn by Dessiné par	Approved Approuvé
1	07/18/18	ISSUED FOR REVIEW	RSD	AT

Revision / Revision

A detail number numéro de detail
B source drawing no. de dessin no.
C detail on drawing no. detail sur dessin no.

Consultant's Name / Nom de l'expert-conseil

Eng. Stamp / Sceau de l'ingénieur

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Client Services Team Southern Alberta Operations Branch / Le Client Entretient l'Équipe Alberta Méridional Branche d'Opérations

Canada

Client/client

Parks Canada Agency / L'Agence Parcs Canada

Western and Northern Region / Ouest et Nord du Canada

Project title/Titre du projet

KENOW WILDFIRE ASSESSMENT REMEDIATION WATERTON LAKES

Drawing title/Titre du dessin

SITE 1 – HELIPAD PROPOSED REMEDIATION
LOCATION: JET FUEL ENVIRON SHED

Surveyed by/Arpenté par	Drawn by/Dessiné par	Date/Date
BDS	BDS	04/05/18
Designed by/Concept par	Reviewed by/Revisé par	Scale/Échelle
AYS	MMH	1:50

PWGSC Project Manager/Administrateur de Projets TPSGC

Client Acceptance/Acceptation du client — Park Responsible Officer/Agent Responsable

Approved by/Approuvé par — PWGSC Project Manager/Administrateur de Projets TPSGC

Project No./No. du projet	Asset No./No. du-bien	Sheet No./No. de la feuille
176826		2 OF 13

Drawing Reference No./No. de référence du dessin
176826-01-01

AO 1189 x 841

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10-4	543□246.□00	2□7546.700
10-5	543□247.100	2□754□.000
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2511-AC	543□232.216	2□7545.2□7
2513-AC (□i□e s□m□e)	543□230.500	2□7542.□41
2514-AC (debris)	543□234.251	2□753□.703
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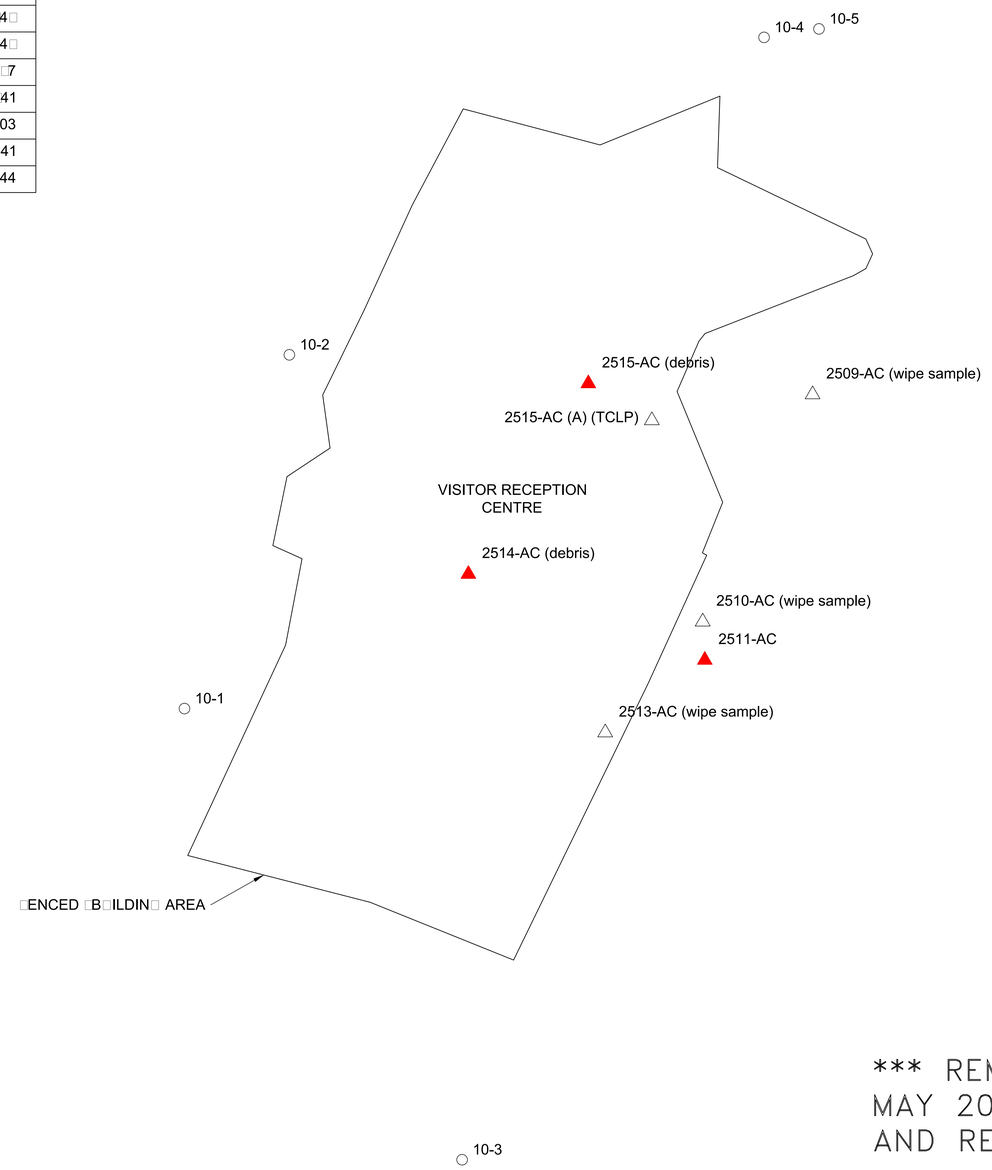

*** REMEDIATION COMPLETE MAY 2018 BY PARKS CANADA AND REMEDICLEAN ***

Legend

- Soil Sample Location
- Debris Sample Location
- Soil Sample Exceeding Applicable Tier 2 Regulatory Guidelines
- Debris Sample Exceeding Regulatory Guidelines
- Contaminated Soils Excavation Boundary
- Hazardous Surface Debris Boundary

Notes

1. All Dimensions are approximate
2. Asbestos (Chrysotile) detected in surface debris during hazardous material assessment
3. Site is within 500m of a surface water source
4. Site is greater than 500m from a water well
5. Further hazardous material sampling is recommended

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Consultant's Name Nom de l'expert-conseil

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Western and Northern Region / Ouest et Nord du Canada

Project title/Titre du projet

KENOW WILDFIRE ASSESSMENT REMEDIATION WATERTON LAKES

Drawing title/Titre du dessin

SITE 2 – VISITOR RECEPTION PROPOSED REMEDIATION LOCATION: VISITOR CENTRE

Surveyed by/Arpenté par	Drawn by/Dessiné par	Date/Date
BDS	BDS	04/05/18
Designed by/Concept par	**Reviewed by/Revisé par**	**Scale/Échelle**
AYS	MMH	1:50

PWGSC Project Manager/Administrateur de Projets TPSGC

Client Acceptance/Acceptation du client — Park Responsible Officer/Agent Responsable

Approved by/Approuvé par — PWGSC Project Manager/Administrateur de Projets TPSGC

Project No./No. du projet: 176826

Asset No./No. du-bien:

Sheet No./No. de la feuille: 3 OF 13

Drawing Reference No./No. de référence du dessin: 176826-02-01

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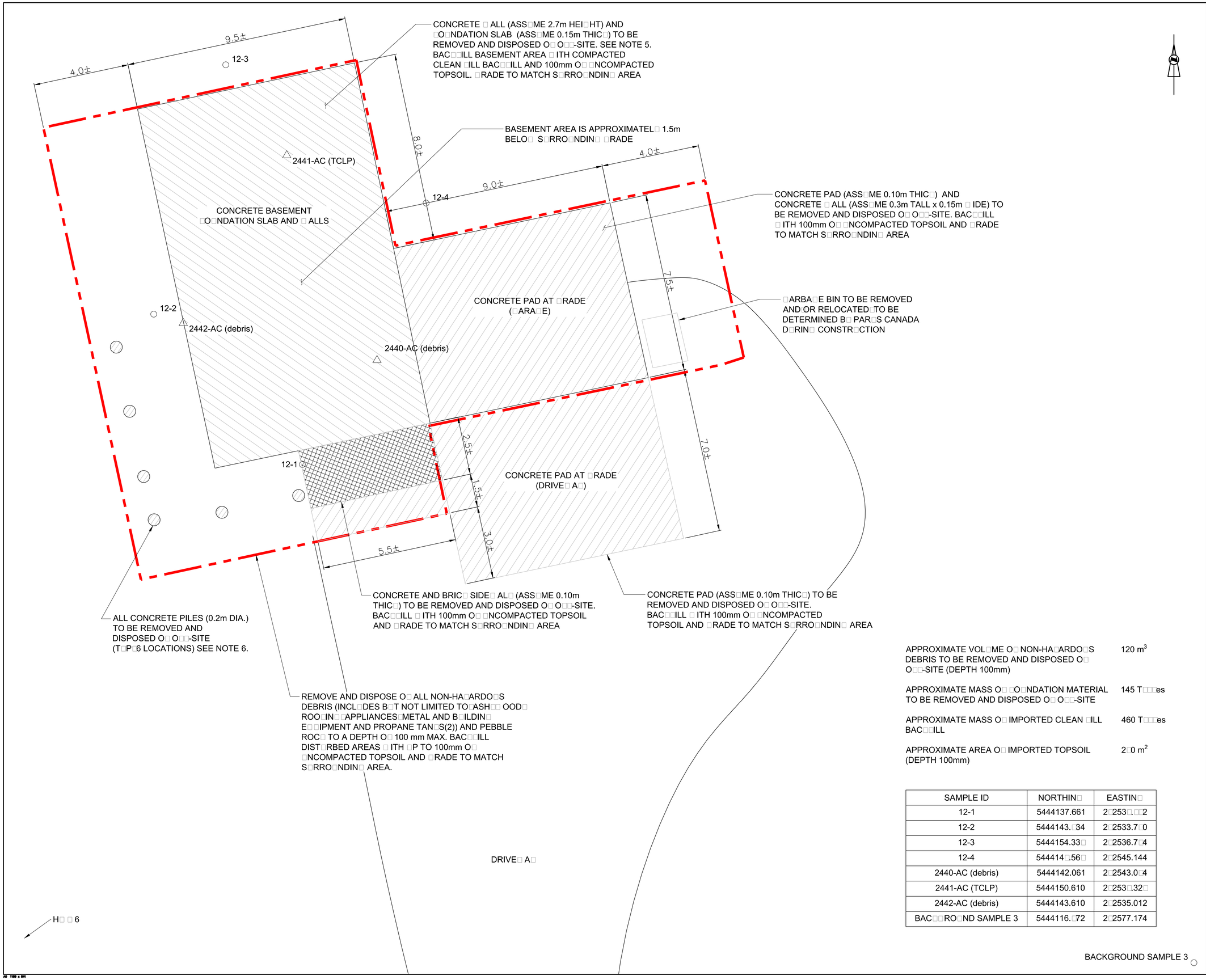

APPROXIMATE VOL□ME O□ NON-HA□ARDO□S DEBRIS TO BE REMOVED AND DISPOSED O□ O□□-SITE (DEPTH 100mm)	120 m^3
APPROXIMATE MASS O□ □O□NDATION MATERIAL TO BE REMOVED AND DISPOSED O□ O□□-SITE	145 T□□□es
APPROXIMATE MASS O□ IMPORTED CLEAN □ILL BAC□□ILL	460 T□□□es
APPROXIMATE AREA O□ IMPORTED TOPSOIL (DEPTH 100mm)	2□0 m^2

SAMPLE ID	NORTHIN□	EASTIN□
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12-3	5444154.33□	2□2536.7□4
12-4	544414□.56□	2□2545.144
2440-AC (debris)	5444142.061	2□2543.0□4
2441-AC (TCLP)	5444150.610	2□253□.32□
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BAC□□RO□ND SAMPLE 3	5444116.□72	2□2577.174

Legend

- Soil Sample Location
- Debris Sample Location
- Soil Sample Exceeding Applicable Tier 2 Regulatory Guidelines
- Debris Sample Exceeding Regulatory Guidelines
- Contaminated Soils Excavation Boundary
- Non-Hazardous Surface Debris Boundary
- Concrete
- Brick

Notes

1. All Dimensions are approximate
2. No hazardous material detected in surface debris during hazardous material assessment
3. Site is within 500m of a surface water source
4. Site is within 500m of a water well
5. Assume 2.7m (9') basement concrete wall (0.15m thick) and concrete foundation (0.15m thick) within west portion of Gate House. Buried portion of basement is 1.5m (5') below grade
6. Assume concrete piles are 0.20m^2 in area and 1m deep
7. Contractor required to cap and mark locations of water and sewer services
8. Heavy Equipment Area is approximately 25m northeast of site

ISSUED FOR RARMP FINAL REPORT

SCALE 1:50 METRES

No.	Date/Date	Description/Description	Drawn by Dessiné par	Approved Approuvé
1	07/18/18	ISSUED FOR RARMP FINAL REPORT	RSD	AT

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Consultant's Name Nom de l'expert-conseil: DILLON CONSULTING

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Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

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Canada

Client/client: Parks Canada Agency / L'Agence Parcs Canada

Western and Northern Region / Ouest et Nord du Canada

Project title/Titre du projet: KENOW WILDFIRE ASSESSMENT AND REMEDIATION WATERTON LAKES

Drawing title/Titre du dessin: SITE 4 – PARK ENTRANCE PROPOSED REMEDIATION LOCATION: GATE HOUSE

Surveyed by/Arpenté par	Drawn by/Dessiné par	Date/Date
BDS	BDS	04/05/18
Designed by/Concept par	**Reviewed by/Revisé par**	**Scale/Échelle**
AYS	MMH	1:50

PWGSC Project Manager/Administrateur de Projets TPSGC

Client Acceptance/Acceptation du client: Park Responsible Officer/Agent Responsable

Approved by/Approuvé par: PWGSC Project Manager/Administrateur de Projets TPSGC

Project No./No. du projet: 176826

Asset No./No. du-bien

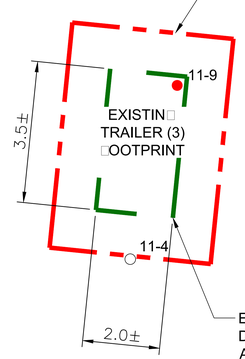
Sheet No./No. de la feuille: 4 OF 13

Drawing Reference No./No. de référence du dessin: 176826-04-01

A0 1189 x 841

REMOVE AND DISPOSE O□ ALL NON-HA□ARDO□S DEBRIS (INCL□DES B□T NOT LIMITED TO□□ENERATOR□ TIRES□METAL □B□RNT TIRE□TOOL SHED AND TAN□S) TO A DEPTH O□ 100 mm MAX. BAC□□ILL DIST□RBED AREAS □ ITH □P TO 100mm O□ □NCOMPACTED TOPSOIL AND □RADE TO MATCH S□RRO□NDIN□ AREA.

EXCAVATE CONTAMINATED SOIL TO APPROXIMATE DEPTH O□ 300mm BELO□ EXISTIN□ □RO□ND S□R□ACE AND DISPOSE O□ O□□-SITE. BAC□□ILL □ ITH 200mm O□ CLEAN BAC□□ILL AND 100mm O□ TOPSOIL. □RADE TO MATCH S□RRO□NDIN□ AREA



REMOVE AND DISPOSE O□ ALL NON-HA□ARDO□S DEBRIS TO A DEPTH O□ 100 mm MAX. BAC□□ILL DIST□RBED AREAS □ ITH □P TO 100mm O□ □NCOMPACTED TOPSOIL AND □RADE TO MATCH S□RRO□NDIN□ AREA.

EXCAVATE CONTAMINATED SOIL TO APPROXIMATE DEPTH O□ 300mm BELO□ EXISTIN□ □RO□ND S□R□ACE AND DISPOSE O□ O□□-SITE. BAC□□ILL □ ITH 200mm O□ CLEAN BAC□□ILL AND 100mm O□ □NCOMPACTED TOP SOIL. □RADE TO MATCH S□RRO□NDIN□ AREA

APPROXIMATE MASS O□ CONTAMINATED SOIL TO BE REMOVED AND DISPOSED O□□-SITE (DEPTH 300mm)	215 □□□es
CONTAMINANT DETECTED IN SOIL SAMPLE	PAHs□C□□□er□PHCs□BTEX
APPROXIMATE VOL□ME O□ NON- HA□ARDO□S DEBRIS TO REMOVED AND DISPOSED O□□-SITE (DEPTH 100mm)	65m^3
APPROXIMATE MASS O□ IMPORTED CLEAN □ILL BAC□□ILL (DEPTH 200 mm)	1□0 □□□es
APPROXIMATE AREA O□ IMPORTED TOPSOIL (DEPTH 100 mm)	660m^2

SAMPLE ID	NORTHIN□	EASTIN□
11-1	5444164.□70	2□2575.□16
11-2	5444175.360	2□2574.062
11-3	54441□7.477	2□257□.132
11-4	544416□.07□	2□25□4.405
246□-AC (TCLP)	54441□6.11□	2□2573.7□4
246□-AC (debris)	54441□0.342	2□2575.774
11-5	LOCATION APPROXIMATE	
11-6		
11-7		
11-□		
11-□		

Legend

- Soil Sample Location
- Debris Sample Location
- Soil Sample Exceeding Applicable Tier 2 Regulatory Guidelines
- Debris Sample Exceeding Regulatory Guidelines
- Contaminated Soils Excavation Boundary
- Non-Hazardous Debris Removal Boundary

Notes

1. All Dimensions are approximate
2. No hazardous material detected in surface debris during hazardous material assessment
3. Miscellaneous debris may exist within 10m immediately outside of Non-Hazardous Debris boundary. This depris shall be disposed of by the Contractor
4. Site is within 500m of a surface water source
5. Site is within 500m of a water well
6. Gate House is approximately 25m southeast of site

ISSUED FOR RARMP FINAL REPORT

1.5 0 1.5
SCALE 1:75 METRES

No.	Date/Date	Description/Description	Drawn by Dessiné par	Approved Approuvé
1	07/18/18	ISSUED FOR RARMP FINAL REPORT	RSD	AT

Revision / Revision

A detail number / numéro de detail
B source drawing no. / de dessin no.
C detail on drawing no. / detail sur dessin no.

Consultant's Name / Nom de l'expert-conseil: DILLON CONSULTING

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Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

Client Services Team Southern Alberta Operations Branch / Le Client Entretient l'Équipe Alberta Méridional Branche d'Opérations

Canada

Client/client: Parks Canada Agency / L'Agence Parcs Canada

Western and Northern Region / Ouest et Nord du Canada

Project title/Titre du projet

KENOW WILDFIRE ASSESSMENT AND REMEDIATION WATERTON LAKES

Drawing title/Titre du dessin

SITE 5 – PARK ENTRANCE PROPOSED REMEDIATION LOCATION: HEAVY EQUIPTMENT

Surveyed by/Arpenté par	Drawn by/Dessiné par	Date/Date
BDS	BDS	04/05/18
Designed by/Concept par	**Reviewed by/Revisé par**	**Scale/Échelle**
AYS	MMH	1:50

PWGSC Project Manager/Administrateur de Projets TPSGC

Client Acceptance/Acceptation du client — Park Responsible Officer/Agent Responsable

Approved by/Approuvé par — PWGSC Project Manager/Administrateur de Projets TPSGC

Project No./No. du projet: 176826

Asset No./No. du-bien:

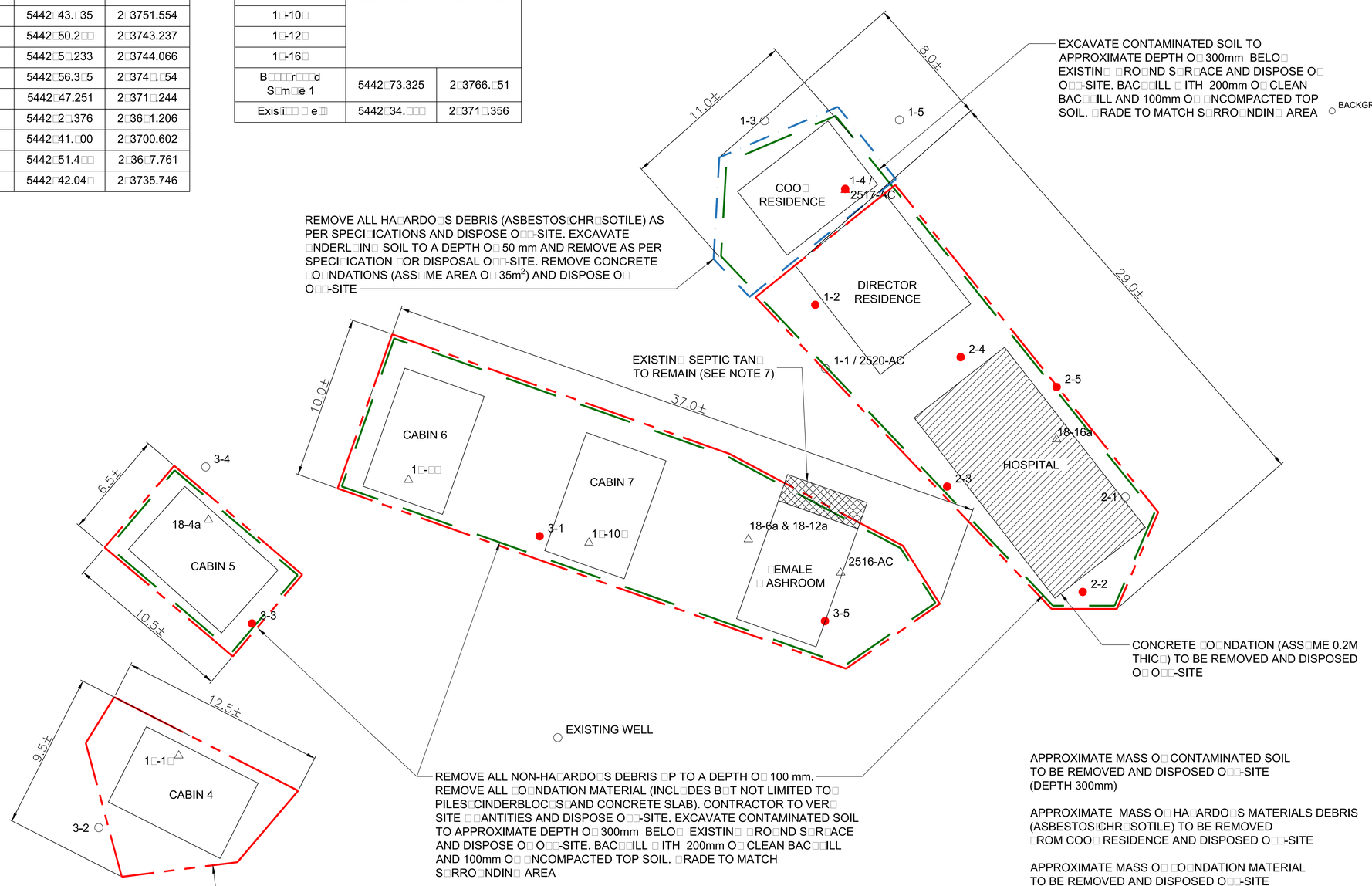
Sheet No./No. de la feuille: 5 OF 13

Drawing Reference No./No. de référence du dessin: 176826-05-01

A0 1189 x 841

SAMPLE ID	NORTHIN□	EASTIN□
1-1	5442□57.537	2□3735.772
1-2	5442□61.441	2□3735.14□
1-3	5442□72.725	2□3732.03□
1-4	5442□6□.546	2□3736.□□7
1-5	5442□72.775	2□3740.311
2-1	5442□4□.655	2□3754.163
2-2	5442□43.□35	2□3751.554
2-3	5442□50.2□□	2□3743.237
2-4	5442□5□.233	2□3744.066
2-5	5442□56.3□5	2□374□.□54
3-1	5442□47.251	2□371□.244
3-2	5442□2□.376	2□36□1.206
3-3	5442□41.□00	2□3700.602
3-4	5442□51.4□□	2□36□7.761
3-5	5442□42.04□	2□3735.746

2516-AC (debris)	5442□45.0□□	2□3736.711
2517-AC (debris)	5442□6□.546	2□3736.□□7
2520-AC (debris)	5442□57.537	2□3735.772
1□-1□	LOCATION APPROXIMATE	
1□-4□		
1□-6□		
1□-□□		
1□-10□		
1□-12□		
1□-16□		
B□□□□r□□□d S□m□e 1	5442□73.325	2□3766.□51
Exis□i□□ □ e□□	5442□34.□□□	2□371□.356



APPROXIMATE MASS O□ CONTAMINATED SOIL TO BE REMOVED AND DISPOSED O□□-SITE (DEPTH 300mm)	400 □□□□es
APPROXIMATE MASS O□ HA□ARDO□S MATERIALS DEBRIS (ASBESTOS□CHR□SOTILE) TO BE REMOVED □ROM COO□ RESIDENCE AND DISPOSED O□□-SITE	35 m^3
APPROXIMATE MASS O□ □O□NDATION MATERIAL TO BE REMOVED AND DISPOSED O□□-SITE	75 □□□□es
CONTAMINANTS DETECTED IN SOIL SAMPLES	PAHs□Me□□s□BTEX□ PHCs□VOCs
APPROXIMATE VOL□ME O□ NON- HA□ARDO□S DEBRIS TO REMOVED AND DISPOSED O□□-SITE (DEPTH 100mm)	230 m^3
APPROXIMATE MASS O□ IMPORTED CLEAN □ILL BAC□□ILL (DEPTH 200 mm)	350 □□□□es
APPROXIMATE AREA O□ IMPORTED TOPSOIL (DEPTH 100 mm)	□40 m^2

Legend

- Soil Sample Location
- Debris Sample Location
- Soil Sample Exceeding Applicable Tier 2 Regulatory Guidelines
- Debris Sample Exceeding Regulatory Guidelines
- Contaminated Soils Excavation Boundary
- Non-Hazardous Debris Removal Boundary
- Hazardous Debris Removal Boundary
- Concrete

Notes

1. All Dimensions are approximate
2. Asbestos (Chrysotile) detected in surface debris of only Female Washroom during hazardous material assessment. No asbestos was detected from any other building on-site
3. Site is within 500m of a surface water source
4. Site is within than 500m from a water well
5. Assume all buildings on cinder block foundations that cover entire building footprint
6. Contractor to assess and abate dangers posed by burnt utility poles and hazard trees in work area prior to starting work
7. One concrete septic tank is located within the footprint of Cabin 8. The tank is part of the septic system at the site which includes several underground lines and septic field. The system was undamaged by the fire. Contractor must take care not to damage any part of the septic system while completing the work
8. Site access via Canyon bridge only
9. Some sections of guardrail missing along Red Rock parkway leading to site
10. Contractor required to cap and mark locations of water and sewer services

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SCALE 1:100 METRES

No.	Date/Date	Description/Description	Drawn by Dessiné par	Approved Approuvé
1	07/18/18	ISSUED FOR RARMP FINAL REPORT	RSD	AT

Revision / Revision

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Consultant's Name / Nom de l'expert-conseil: DILLON CONSULTING

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Client Services Team Southern Alberta Operations Branch / Le Client Entretient l'Équipe Méridional Branche d'Opérations

Canada

Client/client: Parks Canada Agency / L'Agence Parcs Canada

Western and Northern Region / Ouest et Nord du Canada

Project title/Titre du projet: KENOW WILDFIRE ASSESSMENT AND REMEDIATION WATERTON LAKES

Drawing title/Titre du dessin: SITE 6 – CANYON CHURCH CAMP PROPOSED REMEDIATION

LOCATIONS: COOK RESIDENCE, DIRECTOR RESIDENCE, HOSPITAL, FEMALE WASHROOM AND CABINS

Surveyed by/Arpenté par	Drawn by/Dessiné par	Date/Date
BDS	BDS	04/05/18
Designed by/Concept par	Reviewed by/Revisé par	Scale/Échelle
AYS	MMH	1:100

PWGSC Project Manager/Administrateur de Projets TPSGC

Client Acceptance/Acceptation du client | Approved by/Approuvé par

Park Responsible Officer/Agent Responsable | PWGSC Project Manager/Administrateur de Projets TPSGC

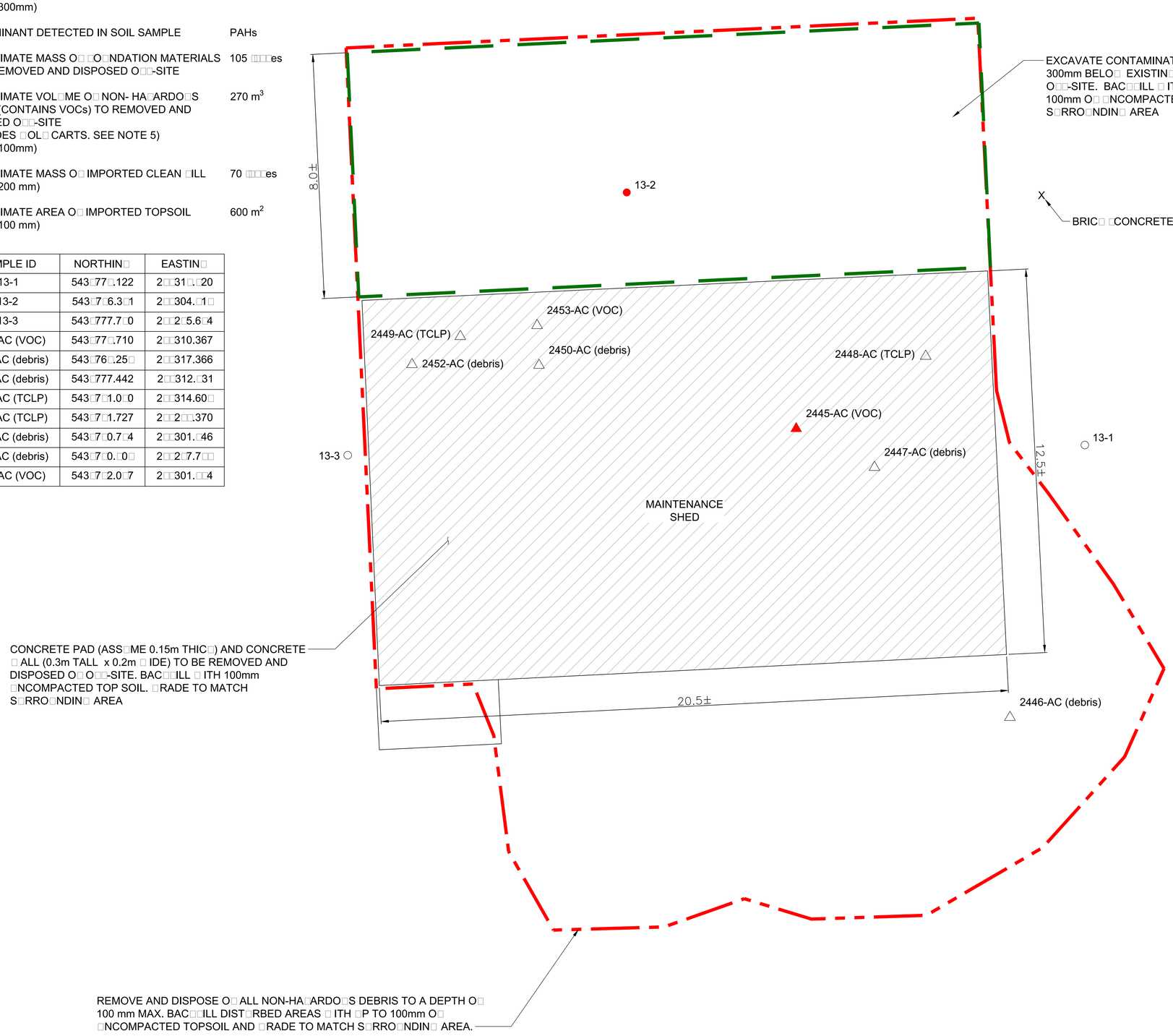
Project No./No. du projet	Asset No./No. du-bien	Sheet No./ No. de la feuille
176826		6 OF 13

Drawing Reference No./No. de référence du dessin: 176826-06-01

A0 1189 x 841

APPROXIMATE MASS O□ CONTAMINATED SOIL TO BE REMOVED AND DISPOSED O□□-SITE (DEPTH 300mm)	□5 □□□es
CONTAMINANT DETECTED IN SOIL SAMPLE	PAHs
APPROXIMATE MASS O□ □O□NDATION MATERIALS TO BE REMOVED AND DISPOSED O□□-SITE	105 □□□es
APPROXIMATE VOL□ME O□ NON- HA□ARDO□S DEBRIS (CONTAINS VOCs) TO REMOVED AND DISPOSED O□□-SITE (EXCL□DES □OL□ CARTS. SEE NOTE 5) (DEPTH 100mm)	270 m^3
APPROXIMATE MASS O□ IMPORTED CLEAN □ILL (DEPTH 200 mm)	70 □□□es
APPROXIMATE AREA O□ IMPORTED TOPSOIL (DEPTH 100 mm)	600 m^2

SAMPLE ID	NORTHIN□	EASTIN□
13-1	543□77□.122	2□□31□.□20
13-2	543□7□6.3□1	2□□304.□1□
13-3	543□777.7□0	2□□2□5.6□4
2445-AC (VOC)	543□77□.710	2□□310.367
2446-AC (debris)	543□76□.25□	2□□317.366
2447-AC (debris)	543□777.442	2□□312.□31
244□-AC (TCLP)	543□7□1.0□0	2□□314.60□
244□-AC (TCLP)	543□7□1.727	2□□2□□.370
2450-AC (debris)	543□7□0.7□4	2□□301.□46
2452-AC (debris)	543□7□0.□0□	2□□2□7.7□□
2453-AC (VOC)	543□7□2.0□7	2□□301.□□4



Legend

- Soil Sample Location
- Debris Sample Location
- Soil Sample Exceeding Applicable Tier 2 Regulatory Guidelines
- Debris Sample Exceeding Regulatory Guidelines
- Contaminated Soils Excavation Boundary
- Non-Hazardous Debris Removal Boundary
- Concrete

Notes

1. All Dimensions are approximate
2. VOCs detected in surface debris during hazardous material assessment
3. Site is within 500m of a surface water source
4. Site is greater than 500m from a water well
5. Contractor required to cap and mark locations of water and sewer services
6. Approximately 40 burnt golf carts included with the debris. Majority of carts are gas powered, remainder are electric. Contractor is required to dispose of the carts as per applicable environmental regulations

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SCALE 1:50 METRES

No.	Date/Date	Description/Description	Drawn by/Dessiné par	Approved/Approuvé
1	07/18/18	ISSUED FOR RARMP FINAL REPORT	RSD	AT

Revision / Revision

A detail number/numéro de detail
B source drawing no./de dessin no.
C detail on drawing no./detail sur dessin no.

Consultant's Name / Nom de l'expert-conseil: DILLON CONSULTING

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Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

Client Services Team Southern Alberta Operations Branch / Le Client Entretient l'Équipe Alberta Méridional Branche d'Opérations

Canada

Client/client: Parks Canada Agency / L'Agence Parcs Canada

Western and Northern Region / Ouest et Nord du Canada

Project title/Titre du projet: KENOW WILDFIRE ASSESSMENT REMEDIATION WATERTON LAKES

Drawing title/Titre du dessin: SITE 7 – WATERTON GOLF PROPOSED REMEDIATION LOCATION: MAINTENANCE SHED

Surveyed by/Arpenté par	Drawn by/Dessiné par	Date/Date
BDS	BDS	04/05/18
Designed by/Concept par	Reviewed by/Revisé par	Scale/Échelle
AYS	MMH	1:50

PWGSC Project Manager/Administrateur de Projets TPSGC

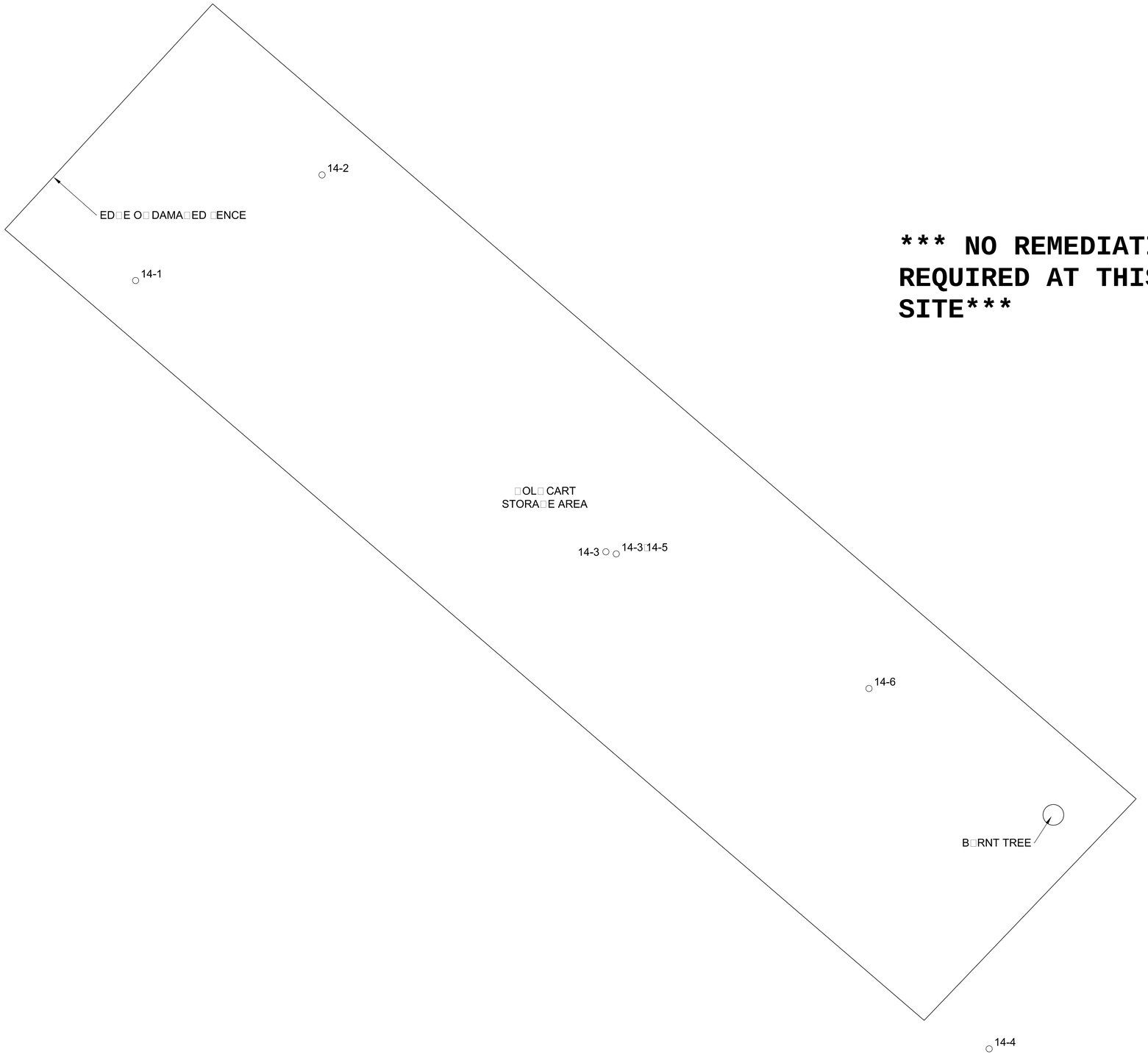
Client Acceptance/Acceptation du client — Park Responsible Officer/Agent Responsable

Approved by/Approuvé par — PWGSC Project Manager/Administrateur de Projets TPSGC

Project No./No. du projet	Asset No./No. du-bien	Sheet No./No. de la feuille
176826		7 OF 13

Drawing Reference No./No. de référence du dessin: 176826-07-01

AD 1189 x 841



***** NO REMEDIATION REQUIRED AT THIS SITE*****

Legend

- Soil Sample Location
- Debris Sample Location
- Soil Sample Exceeding Applicable Tier 2 Regulatory Guidelines
- Debris Sample Exceeding Regulatory Guidelines
- Contaminated Soils Excavation Boundary
- Non-Hazardous Debris Removal Boundary

Notes

1. All Dimensions are approximate
2. VOCs detected in surface debris during hazardous material assessment
3. Site is within 500m of a surface water source
4. Site is greater than 500m from a water well

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SCALE 1:50 METRES

No.	Date/Date	Description/Description	Drawn by Dessiné par	Approved Approuvé
1	07/18/18	ISSUED FOR RARMP FINAL REPORT	RSD	AT

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Canada

Client/client

Parks Canada Agency
L'Agence Parcs Canada

Western and Northern Region
Ouest et Nord du Canada

Project title/Titre du projet

KENOW WILDFIRE ASSESSMENT

WATERTON LAKES

Drawing title/Titre du dessin

SITE 7 – WATERTON GOLF
PROPOSED REMEDIATION
LOCATION: GOLF CART STORAGE

Surveyed by/Arpenté par	Drawn by/Dessiné par	Date/Date
BDS	BDS	04/05/18
Designed by/Concept par	**Reviewed by/Revisé par**	**Scale/Echelle**
AYS	MMH	1:50

PWGSC Project Manager/Administrateur de Projets TPSGC

Client Acceptance/Acceptation du client
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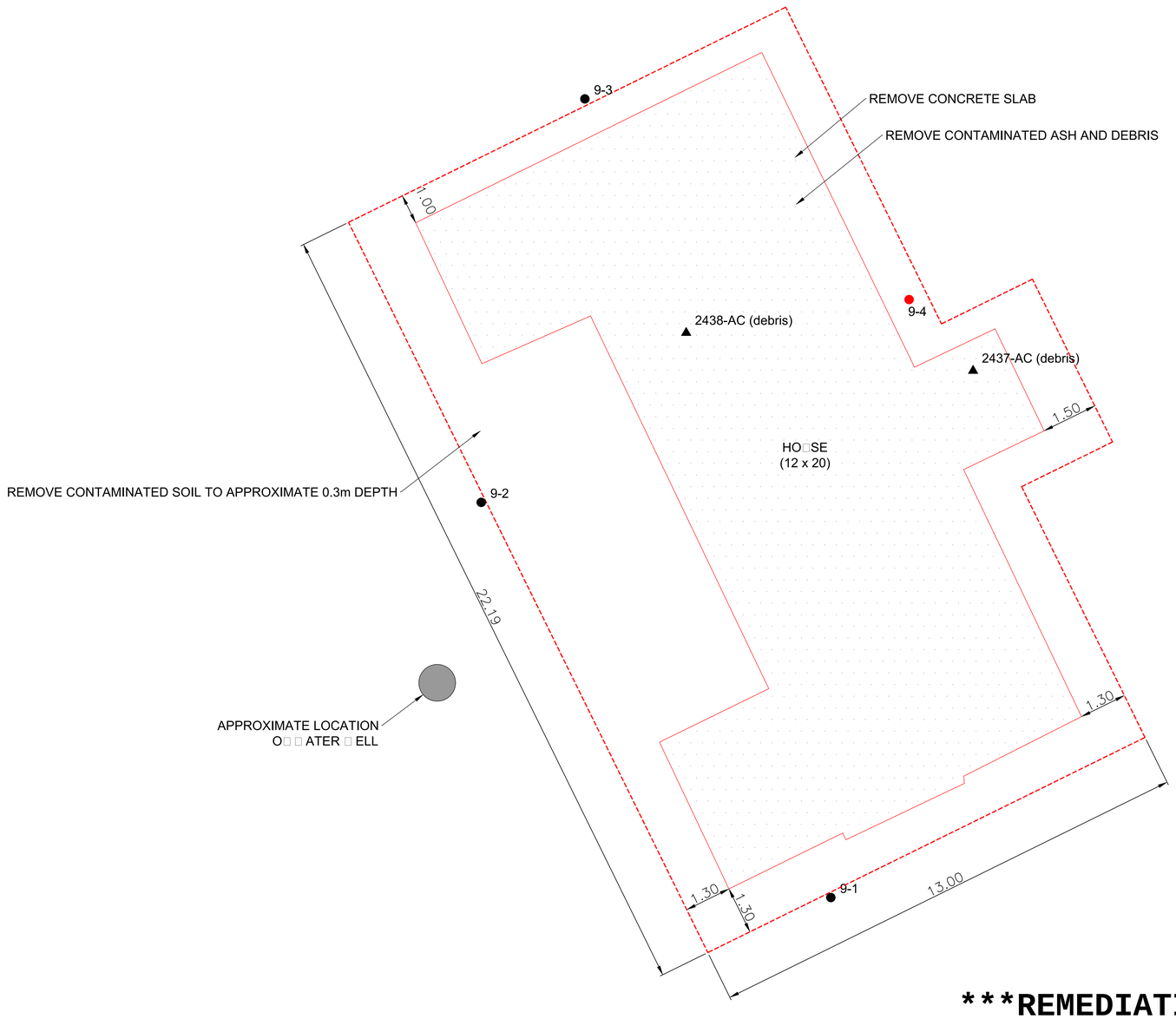
Approved by/Approuvé par
PWGSC Project Manager/Administrateur de Projets TPSGC

Project No./No. du projet	Asset No./No. du-bien	Sheet No./ No. de la feuille
176826		8 of 13

Drawing Reference No./No. de réference du dessin
176826-07-01

A0 1189 x 841



*****REMEDIATION WAS COMPLETED AT THIS SITE BY PARKS CANADA IN APRIL 2018*****

Legend

- Soil Sample Location
- Debris Sample Location
- Soil Sample Exceeding Applicable Tier 2 Regulatory Guidelines
- Debris Sample Exceeding Regulatory Guidelines
- Contaminated Soils Excavation Boundary

Notes

All Dimensions are approximate

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SCALE 1:100 METRES

No.	Date/Date	Description/Description	Drawn by Dessiné par	Approved Approuvé
1	07/18/18	ISSUED FOR RARMP FINAL REPORT	RSD	AT

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Canada

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Parks Canada Agency / L'Agence Parcs Canada

Western and Northern Region / Ouest et Nord du Canada

Project title/Titre du projet

KENOW WILDFIRE ASSESSMENT

WATERTON LAKES

Drawing title/Titre du dessin

SITE 8a – ALPINE STABLES SAMPLING LOCATIONS

Surveyed by/Arpenté par	Drawn by/Dessiné par	Date/Date
BDS	BDS	09/01/18
Designed by/Concept par	Reviewed by/Revisé par	Scale/Échelle
–		1:50

PWGSC Project Manager/Administrateur de Projets TPSGC

Client Acceptance/Acceptation du client

Park Responsible Officer/Agent Responsable

Approved by/Approuvé par

PWGSC Project Manager/Administrateur de Projets TPSGC

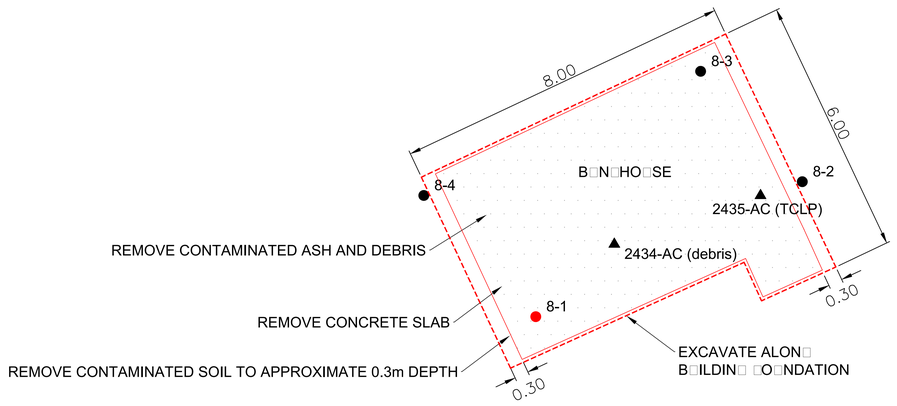
Project No./No. du projet	Asset No./No. du-bien	Sheet No./ No. de la feuille
176826		9 of 13

Drawing Reference No./No. de référence du dessin

176826-08-01

AD 1189 x 841

REMEDIATION WAS COMPLETED AT THIS SITE BY PARKS CANADA IN APRIL 2018



Legend

- Soil Sample Location
- Debris Sample Location
- Soil Sample Exceeding Applicable Tier 2 Regulatory Guidelines
- Debris Sample Exceeding Regulatory Guidelines
- Contaminated Soils Excavation Boundary

Notes

All Dimensions are approximate

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Revision / Revision

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Consultant's Name
Nom de l'expert-conseil

Eng. Stamp
Sceau de l'ingénieur

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

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Western and Northern Region
Ouest et Nord du Canada

Project title/Titre du projet

KENOW WILDFIRE ASSESSMENT

WATERTON LAKES

Drawing title/Titre du dessin

SITE 8a – ALPINE STABLES SAMPLING LOCATIONS

Surveyed by/Arpenté par	Drawn by/Dessiné par	Date/Date
BDS	BDS	09/01/18
Designed by/Concept par	Reviewed by/Revisé par	Scale/Échelle
–		1:50

PWGSC Project Manager/Administrateur de Projets TPSGC

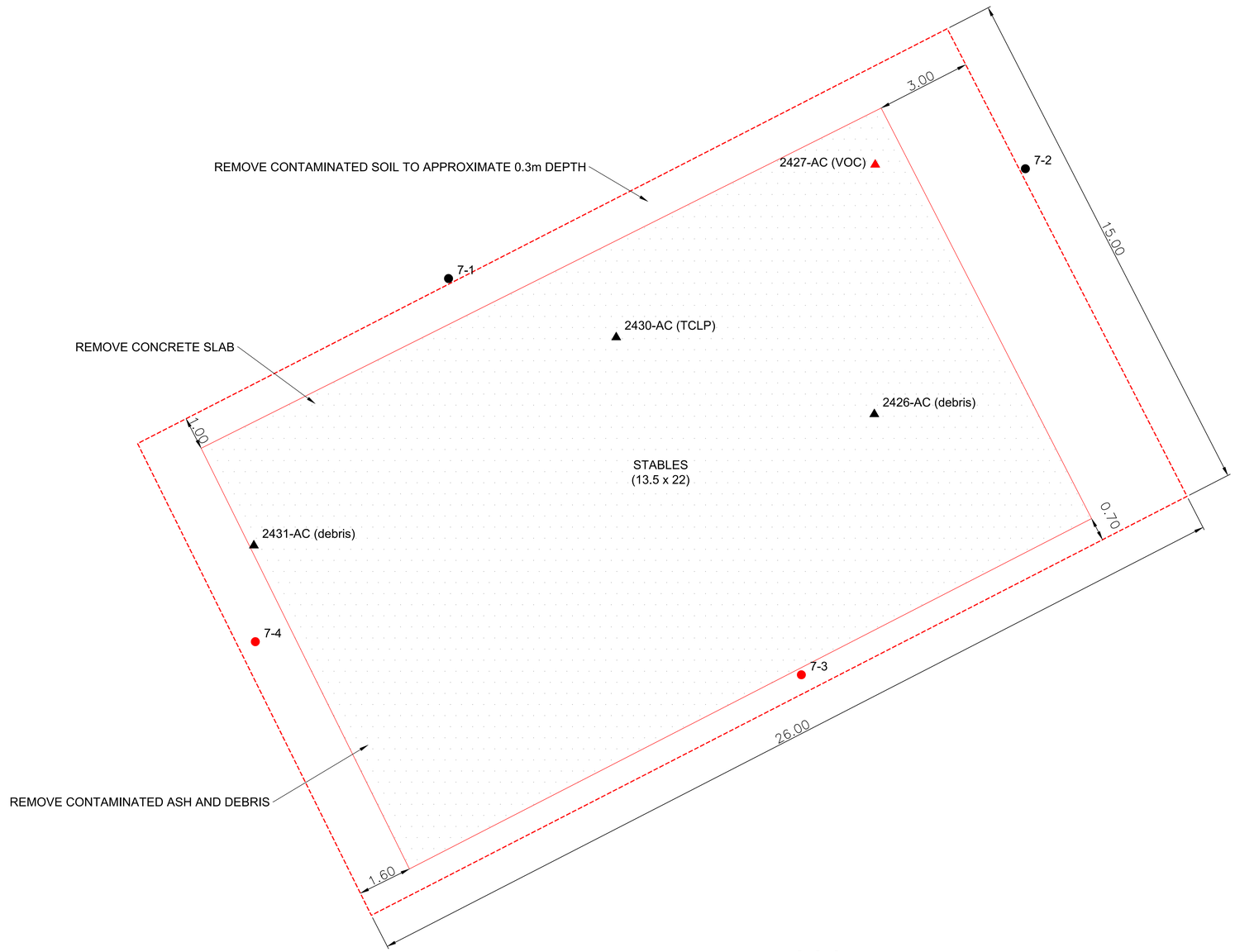
Client Acceptance/Acceptation du client
Park Responsible Officer/Agent Responsable

Approved by/Approuvé par
PWGSC Project Manager/Administrateur de Projets TPSGC

Project No./No. du projet	Asset No./No. du-bien	Sheet No./ No. de la feuille
176826		10 of 13

Drawing Reference No./No. de référence du dessin
176826-08-02

A0 1189 x 841



*****REMEDIATION WAS COMPLETED AT THIS SITE BY PARKS CANADA IN APRIL 2018*****

Legend

- Soil Sample Location
- Debris Sample Location
- Soil Sample Exceeding Applicable Tier 2 Regulatory Guidelines
- Debris Sample Exceeding Regulatory Guidelines
- Contaminated Soils Excavation Boundary

Notes

All Dimensions are approximate

ISSUED FOR RARMP FINAL REPORT

SCALE 1:100 METRES

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1	07/18/18	ISSUED FOR RARMP FINAL REPORT	RSD	AT

Revision / Revision

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Consultant's Name / Nom de l'expert-conseil

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Western and Northern Region / Ouest et Nord du Canada

Project title/Titre du projet

KENOW WILDFIRE ASSESSMENT

WATERTON LAKES

Drawing title/Titre du dessin

SITE 8a – ALPINE STABLES SAMPLING LOCATIONS

Surveyed by/Arpenté par	Drawn by/Dessiné par	Date/Date
BDS	BDS	09/01/18
Designed by/Concept par	Reviewed by/Revisé par	Scale/Échelle
–		1:50

PWGSC Project Manager/Administrateur de Projets TPSGC

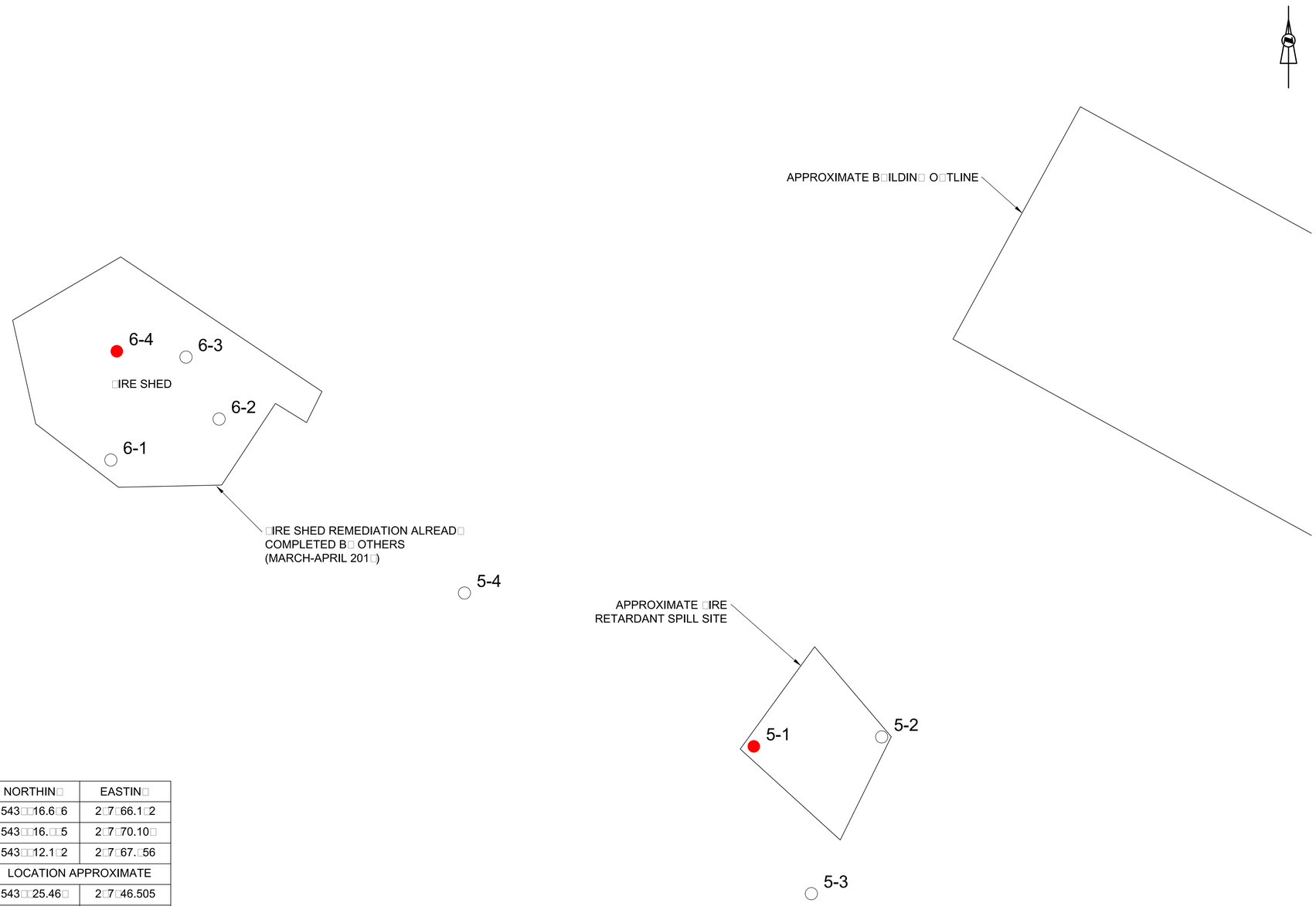
Client Acceptance/Acceptation du client — Park Responsible Officer/Agent Responsable

Approved by/Approuvé par — PWGSC Project Manager/Administrateur de Projets TPSGC

Project No./No. du projet	Asset No./No. du-bien	Sheet No./No. de la feuille
176826		11 of 13

Drawing Reference No./No. de référence du dessin: 176826-08-03

A0 1189 x 841



SAMPLE ID	NORTHIN□	EASTIN□
5-1	543□□16.6□6	2□7□66.1□2
5-2	543□□16.□□5	2□7□70.10□
5-3	543□□12.1□2	2□7□67.□56
5-4	LOCATION APPROXIMATE	
6-1	543□□25.46□	2□7□46.505
6-2	543□□26.723	2□7□4□□1□
6-3	543□□2□621	2□7□4□□04
6-4	543□□2□□01	2□7□46.6□5

CONTAMINATE DETECTED IN SOIL SAMPLE PAHs

*** NO REMEDIAL ACTIVITIES REQUIRED. GROUNDWATER SUGGESTS THAT EXPOSURE PATHWAY IS NOT OPERABLE. ***

Legend

- Soil Sample Location
- Debris Sample Location
- Soil Sample Exceeding Applicable Tier 2 Regulatory Guidelines
- Debris Sample Exceeding Regulatory Guidelines
- Contaminated Soils Excavation Boundary
- Hazardous Surface Debris Boundary

Notes

1. All Dimensions are approximate
2. Surface debris removed from site prior to hazardous material assessment
3. Site is within 500m of a surface water source
4. Site is greater than 500m from a water well

ISSUED FOR RARMP FINAL REPORT

1.5 0 1.5
SCALE 1:75 METRES

No.	Date/Date	Description/Description	Drawn by Dessiné par	Approved Approuvé
1	07/18/18	ISSUED FOR RARMP FINAL REPORT	RSD	AT

Revision / Revision

A detail number numéro de detail
B source drawing no. de dessin no.
C detail on drawing no. detail sur dessin no.

Consultant's Name / Nom de l'expert-conseil

Eng. Stamp / Sceau de l'ingénieur

Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

Client Services Team Southern Alberta Operations Branch / Le Client Entretient l'Équipe Alberta Méridional Branche d'Opérations

Canada

Client/client

Parks Canada Agency / L'Agence Parcs Canada

Western and Northern Region / Ouest et Nord du Canada

Project title/Titre du projet

KENOW WILDFIRE ASSESSMENT REMEDIATION WATERTON LAKES

Drawing title/Titre du dessin

SITE 9 – OPERATIONS COMPOUND PROPOSED REMEDIATION

LOCATION: FIRE SHED, FIRE RETARDANT SPILL SITE

Surveyed by/Arpenté par	Drawn by/Dessiné par	Date/Date
BDS	BDS	04/05/18
Designed by/Concept par	**Reviewed by/Revisé par**	**Scale/Échelle**
AYS	MMH	1:75

PWGSC Project Manager/Administrateur de Projets TPSGC

Client Acceptance/Acceptation du client — Park Responsible Officer/Agent Responsable

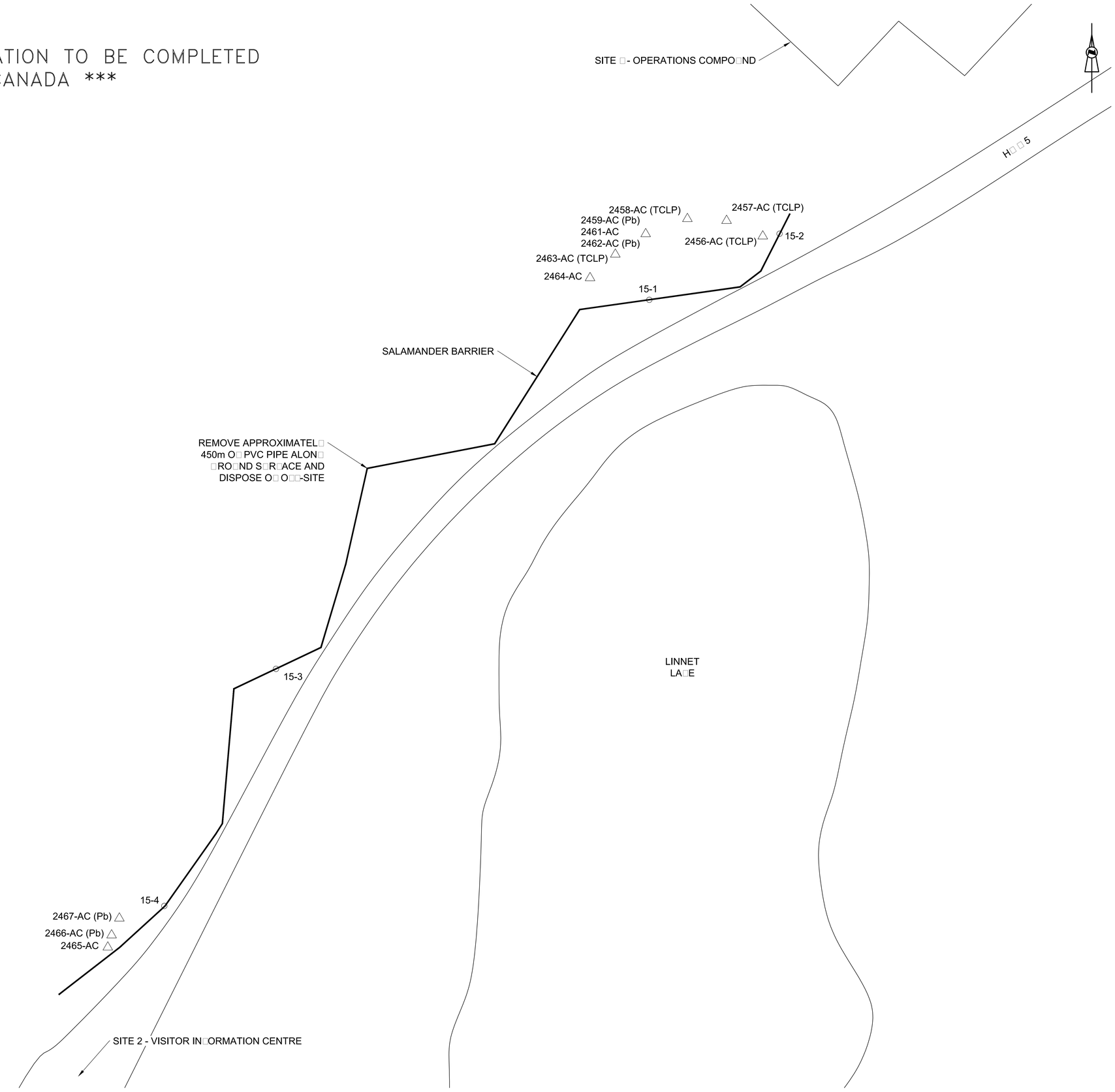
Approved by/Approuvé par — PWGSC Project Manager/Administrateur de Projets TPSGC

Project No./No. du projet	Asset No./No. du-bien	Sheet No./ No. de la feuille
176826		12 OF 13

Drawing Reference No./No. de référence du dessin: 176826-09-01

AO 1189 x 841

*** REMEDIATION TO BE COMPLETED BY PARKS CANADA ***



Legend

- Soil Sample Location
- Debris Sample Location
- Soil Sample Exceeding Applicable Tier 2 Regulatory Guidelines
- Debris Sample Exceeding Regulatory Guidelines
- Contaminated Soils Excavation Boundary
- Hazardous Surface Debris Boundary

Notes

1. All Dimensions are approximate
2. VOCs detected in surface debris during hazardous material assessment
3. Site is within 500m of a surface water source
4. Site is greater than 500m from a water well

ISSUED FOR RARMP FINAL REPORT

SCALE 1:500 METRES

No.	Date/Date	Description/Description	Drawn by Dessiné par	Approved Approuvé
1	07/18/18	ISSUED FOR RARMP FINAL REPORT	RSD	AT

Revision / Revision

A detail number / numéro de detail
B source drawing no. / de dessin no.
C detail on drawing no. / detail sur dessin no.

Consultant's Name / Nom de l'expert-conseil

Eng. Stamp / Sceau de l'ingénieur

Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

Client Services Team Southern Alberta Operations Branch / Le Client Entretient l'Équipe Alberta Méridional Branche d'Opérations

Canada

Client/client

Parks Canada Agency / L'Agence Parcs Canada

Western and Northern Region / Ouest et Nord du Canada

Project title/Titre du projet

KENOW WILDFIRE ASSESSMENT REMEDIATION WATERTON LAKES

Drawing title/Titre du dessin

SITE 10 – SALAMANDER
PROPOSED REMEDIATION
LOCATION: BARRIERS

Surveyed by/Arpenté par	Drawn by/Dessiné par	Date/Date
BDS	BDS	04/05/18
Designed by/Concept par	**Reviewed by/Revisé par**	**Scale/Échelle**
AYS	MMH	1:500

PWGSC Project Manager/Administrateur de Projets TPSGC

Client Acceptance/Acceptation du client — Park Responsible Officer/Agent Responsable

Approved by/Approuvé par — PWGSC Project Manager/Administrateur de Projets TPSGC

Project No./No. du projet	Asset No./No. du-bien	Sheet No./No. de la feuille
176826		13 OF 13

Drawing Reference No./No. de référence du dessin: 176826-10-01

AD 1189 x 841

Tables

Table 1: Site 1 - Helipad
Surface Soil SLRA Results (<3m depth) - Waterton Kenow RARMP

Parameter Group	Parameter	Highest Sample Concentration Noted During Site Assessment (mg/kg)	Sample Depth (m bgs)	Samples in Exceedance	Laboratory result (mg/kg)	Grain Size	CCME & AEP Human Health Pathway Guideline (mg/kg) Coarse-grained					CCME & AEP Environmental Health Pathway Guideline (mg/kg) Coarse-grained					Summary of Exceeded Pathways	
							Potable Water	Soil Contact	Soil Vapour Inhalation (Basement)	Soil Vapour Inhalation (Slab-on-Grade)	Off-site Migration	Aquatic Life	Soil Contact	Soil and Food Ingestion	Off-site Migration	Provisional Soil Quality	Human Health Pathways	Environmental Health Pathways
PAH	Anthracene	0.0088	0 - 0.25	4-5, 4-6	0.0082, 0.0088	Coarse	---	24,000	780,000	670,000	350,000	0.0056	2.5	61.5	36	---	---	Aquatic Life
	Naphthalene	0.019	0 - 0.25	4-1	0.019	Coarse	53	1,800	2.9	2.2	26,000	0.013	---	8.8	---	0.6	---	Aquatic Life

Notes:

Guideline values are based on CCME criteria. CCME guideline values that were unavailable used AEP guidelines instead.
The site is considered to have an industrial, residential/parkland, and natural area land-use.

m bgs - Meters below ground surface.
mg/kg - Milligram per kilogram.
CCME - Canadian Council of Ministers of the Environment.
PAH - Polycyclic aromatic hydrocarbons.
Concentration exceeds the guideline.

Guidelines:

Canadian Council of Ministers of the Environment (online), Soil Quality for the Protection of Environmental and Human Health.
Canadian Council of Ministers of the Environment (2008), Canada-wide Standards for Petroleum Hydrocarbons (PHC) in Soil.
Canadian Council of Ministers of the Environment (2010), Soil Quality for the Protection of Environmental and Human Health (Polycyclic Aromatic Hydrocarbons).
Alberta Tier 1 Soil and Groundwater Remediation Guidelines (2016)

Table 2: Site 5 - Park Entrance (Heavy Equipment)
Surface Soil SLRA Results (<3m depth) - Waterton Kenow RARMP

Parameter Group	Parameter	Highest Sample Concentration Noted During Site Assessment (mg/kg)	Sample Depth (m bgs)	Samples in Exceedance	Laboratory result (mg/kg)	Grain Size	CCME & AEP Human Health Pathway Guideline (mg/kg) Coarse-grained						CCME & AEP Environmental Health Pathway Guideline (mg/kg) Coarse-grained						Summary of Exceeded Pathways	
							Potable Water	Soil Ingestion	Soil Contact	Soil Vapour Inhalation (Basement)	Soil Vapour Inhalation (Slab-on-Grade)	Off-site Migration	Aquatic Life	Soil Contact	Soil and Food Ingestion	Nutrient Cycling	Off-site Migration	Management Limit	Human Health Pathways	Environmental Health Pathways
PHC	F2	4700	0-0.25	11-5, 11-6	4700, 2000	Coarse	320	6800	6800	190	150	30000	380	150	9800	---	2100	1000	Potable Water, Soil Vapour Inhalation	Aquatic Life, Soil Contact, Off-site Migration, Management Limit
	F3	64000	0-0.25	11-5, 11-6	64000, 24000	Coarse	---	15000	15000	---	---	30000	---	300	16000	---	4300	2500	Soil Ingestion and Contact, Off-site Migration	Soil Contact and Ingestion, Off-site Migration, Management Limit
	F4	3000	0-0.25	11-5	3000	Coarse	---	21000	21000	---	---	30000	---	2800	8400	---	30000	10000	---	Soil Contact
BTEX	Benzene	0.037	0-0.25	11-8	0.037	Coarse	0.03	110	120	0.15	0.095	1100	0.17	31	18	---	440	---	Potable Water	---
	Toluene	0.15	0-0.25	11-8	0.15	Coarse	0.37	22000	11000	200	120	9200	0.1	75	980	---	1100	---	---	Aquatic Life
Metals	Copper	720	0-0.25	11-8	720	Coarse	---	---	1100	---	---	16000	---	63	300	350	610	---	---	Soil Contact and Ingestion, Nutrient Cycling, Off-site Migration
PAHs	Anthracene	0.35	0-0.25	11-5, 11-6, 11-9	0.35, 0.16, 0.016	Coarse	---	---	24000	780000	670000	350000	0.0056	2.5	61.5	---	36	---	---	Aquatic Life
	Fluoranthene	0.088	0-0.25	11-5, 11-9	0.088, 0.067	Coarse	---	---	3500	550000	480000	50000	0.039	50	15.4	---	720	---	---	Aquatic Life
	Naphthalene	0.022	0 - 0.25	11-3, 11-8, 11-9	0.015, 0.022, 0.068	Coarse	53	---	1,800	2.9	2.2	26,000	0.013	---	8.8	---	---	---	---	Aquatic Life
	Phenanthrene	0.27	0 - 0.25	11-5, 11-6, 11-9	0.27, 0.13, 0.061	Coarse	---	---	---	---	---	---	0.046	---	43	---	---	---	---	Aquatic Life
	Pyrene	0.41	0 - 0.25	11-5, 11-6, 11-9	0.41, 0.13, 0.082	Coarse	---	---	2100	810000	730000	30000	0.04	---	7.7	---	---	---	---	Aquatic Life

Notes:

Guideline values were taken from CCME. Values that were unavailable from CCME used AEP values instead.
The site is considered to have an industrial, residential/parkland, and natural area land-use.

m bgs - Meters below ground surface.
mg/kg - Milligram per kilogram.
CCME - Canadian Council of Ministers of the Environment.
PAH - Polycyclic aromatic hydrocarbons.
Concentration exceeds the guideline.

Guidelines:

Canadian Council of Ministers of the Environment (online), Soil Quality for the Protection of Environmental and Human Health.
Canadian Council of Ministers of the Environment (2008), Canada-wide Standards for Petroleum Hydrocarbons (PHC) in Soil.
Canadian Council of Ministers of the Environment (2010), Soil Quality for the Protection of Environmental and Human Health (Polycyclic Aromatic Hydrocarbons).
Alberta Tier 1 Soil and Groundwater Remediation Guidelines (2016)

Table 3: Site 6 - Cabins and Female Washroom
Surface Soil SLRA Results (<3m depth) - Waterton Kenow RARMP

Parameter Group	Parameter	Highest Sample Concentration Noted During Site Assessment (mg/kg)	Sample Depth (m bgs)	Samples in Exceedance	Laboratory result (mg/kg)	Grain Size	CCME & AEP Human Health Pathway Guideline[1,2] (mg/kg) Coarse-grained					CCME & AEP Environmental Health Pathway Guideline[2] (mg/kg) Coarse-grained						Summary of Exceeded Pathways	
							Potable Water	Soil Ingestion	Soil Contact	Soil Vapour Inhalation (Basement)	Soil Vapour Inhalation (Slab-on-Grade)	Aquatic Life	Soil Contact	Soil and Food Ingestion	Wildlife Watering	Nutrient Cycling	Provisional Soil Quality	Human Health Pathways	Environmental Health Pathways
Metals and Inorganics	Tin	28	0 - 0.25	3-3	28	COARSE	---	---	---	---	---	---	5	---	---	---	---	---	Soil Contact
BTEX	Benzene	0.031	0 - 0.25	3-1	0.031	COARSE	0.03	110	250	0.15	0.095	0.17	31	18	0.33	---	---	Potable Water	---
VOCs	Carbon Tetrachloride	0.0019	0 - 0.25	3-1	0.0019	COARSE	0.062	---	27	0.00078	0.00057	0.062	---	---	---	---	---	Soil Vapour Inhalation	---
PAH	Anthracene	0.013	0 - 0.25	3-5	0.013	COARSE	---	---	24,000	780,000	670,000	0.0056	2.5	61.5	---	---	---	---	Aquatic Life
	Fluoranthene	0.11	0 - 0.25	3-5	0.11	COARSE	---	---	3,500	550,000	480,000	0.039	50	15.4	---	---	---	---	Aquatic Life
	Pyrene	0.1	0 - 0.25	3-5	0.1	COARSE	---	---	2,100	810,000	730,000	0.04	---	7.7	---	---	---	---	Aquatic Life

Notes:

Guideline values were taken from CCME. Values that were unavailable from CCME used AEP values instead.
The site is considered to have an residential/parkland and natural area land-use.

[1] - Guideline values for benzene are based on 1 x 10^{-5} incremental lifetime cancer risk.
[2] - Guideline values for BTEX parameters are for surface soil.
m bgs - Meters below ground surface.
mg/kg - Milligram per kilogram.
BTEX - Benzene, toluene, ethylbenzene, and xylenes.
CCME - Canadian Council of Ministers of the Environment.
PAH - Polycyclic aromatic hydrocarbons.
VOC - Volatile organic compounds.
Concentration exceeds the guideline.

Guidelines:

Canadian Council of Ministers of the Environment (online), Soil Quality for the Protection of Environmental and Human Health.
Canadian Council of Ministers of the Environment (2008), Canada-wide Standards for Petroleum Hydrocarbons (PHC) in Soil.
Canadian Council of Ministers of the Environment (2010), Soil Quality for the Protection of Environmental and Human Health (Polycyclic Aromatic Hydrocarbons).
Alberta Tier 1 Soil and Groundwater Remediation Guidelines (2016)

Table 4: Site 6 - Cook and Director's Residence
Surface Soil SLRA Results (<3m depth) - Waterton Kenow RARMP

Parameter Group	Parameter	Highest Sample Concentration Noted During Site Assessment (mg/kg)	Sample Depth (m bgs)	Samples in Exceedance	Laboratory result (mg/kg)	Grain Size	CCME & AEP Human Health Pathway Guideline[1,2] (mg/kg) Coarse-grained					CCME & AEP Environmental Health Pathway Guideline[2] (mg/kg) Coarse-grained					Summary of Exceeded Pathways	
							Potable Water	Soil Ingestion	Soil Contact	Soil Vapour Inhalation (Basement)	Soil Vapour Inhalation (Slab-on-Grade)	Aquatic Life	Soil Contact	Soil and Food Ingestion	Wildlife Watering	Provisional Soil Quality	Human Health Pathways	Environmental Health Pathways
BTEX	Benzene	0.061	0 - 0.25	1-4	0.061	COARSE	0.03	110	78	0.15	0.095	0.17	31	18	0.33	---	Potable Water	---
PAH	Anthracene	0.0068	0 - 0.25	1-2	0.0068	COARSE	---	---	24,000	780,000	670,000	0.0056	2.5	61.5	---	---	---	Aquatic Life
	Fluoranthene	0.044	0 - 0.25	1-2	0.044	COARSE	---	---	3,500	550,000	480,000	0.039	50	15.4	---	---	---	Aquatic Life
	Naphthalene	0.056	0 - 0.25	1-2, 1-4	0.047, 0.056	COARSE	53	---	1,800	2.9	2.2	0.013	---	8.8	---	0.6	---	Aquatic Life

Notes:

Guideline values were taken from CCME. Values that were unavailable from CCME used AEP values instead.
The site is considered to have an residential/parkland and natural area land-use.

[1] - Guideline values for benzene are based on 1×10^{-5} incremental lifetime cancer risk.
[2] - Guideline values for BTEX parameters are for surface soil.
m bgs - Meters below ground surface.
mg/kg - Milligram per kilogram.
BTEX - Benzene, toluene, ethylbenzene, and xylenes.
CCME - Canadian Council of Ministers of the Environment.
PAH - Polycyclic aromatic hydrocarbons.
Concentration exceeds the guideline.

Guidelines:

Canadian Council of Ministers of the Environment (online), Soil Quality for the Protection of Environmental and Human Health.
Canadian Council of Ministers of the Environment (2008), Canada-wide Standards for Petroleum Hydrocarbons (PHC) in Soil.
Canadian Council of Ministers of the Environment (2010), Soil Quality for the Protection of Environmental and Human Health (Polycyclic Aromatic Hydrocarbons).
Alberta Tier 1 Soil and Groundwater Remediation Guidelines (2016)

Table 5: Site 6 - Hospital
Surface Soil SLRA Results (<3m depth) - Waterton Kenow RARMP

Parameter Group	Parameter	Highest Sample Concentration Noted During Site Assessment (mg/kg)	Sample Depth (m bgs)	Samples in Exceedance	Laboratory result (mg/kg)	Grain Size	CCME & AEP Human Health Pathway Guideline[1,2] (mg/kg) Coarse-grained					CCME & AEP Environmental Health Pathway Guideline[2] (mg/kg) Coarse-grained						Summary of Exceeded Pathways	
							Potable Water	Soil Ingestion	Soil Contact	Soil Vapour Inhalation (Basement)	Soil Vapour Inhalation (Slab-on-Grade)	Aquatic Life	Soil Contact	Soil and Food Ingestion	Wildlife Watering	Nutrient Cycling	Provisional Soil Quality	Human Health Pathways	Environmental Health Pathways
Metals and Inorganics	Lead	200	0 - 0.25	2-4	200	COARSE	---	140	140	---	---	---	300	70	---	723	---	Soil Ingestion Soil Contact	Soil and Food Ingestion
	Zinc	210	0 - 0.25	2-3	210	COARSE	---	---	---	---	---	---	200	640	---	200	---	---	Soil Contact Nutrient Cycling
BTEX	Benzene	0.14	0 - 0.25	2-3	0.14	COARSE	0.03	110	250	0.15	0.095	0.17	31	18	0.33	---	---	Potable Water	---
	Toluene	0.27	0 - 0.25	2-3	0.27	COARSE	0.37	22,000	220000	200	120	0.10	75	980	1000	---	---	---	Aquatic Life
PAH	Anthracene	0.03	0 - 0.25	2-3, 2-4, 2-5	0.03, 0.0088, 0.0081	COARSE	---	---	24,000	780,000	670,000	0.0056	2.5	61.5	---	---	---	---	Aquatic Life
	Fluoranthene	0.14	0 - 0.25	2-3, 2-4	0.14, 0.049	COARSE	---	---	3,500	550,000	480,000	0.039	50	15.4	---	---	---	---	Aquatic Life
	Naphthalene	0.048	0 - 0.25	2-2, 2-3, 2-4	0.023, 0.048, 0.021	COARSE	53	---	1,800	2.9	2.2	0.013	---	8.8	---	---	0.6	---	Aquatic Life
	Pyrene	0.15	0 - 0.25	2-3	0.15	COARSE	---	---	2,100	810,000	730,000	0.04	---	7.7	---	---	---	---	Aquatic Life

Notes:

Guideline values were taken from CCME. Values that were unavailable from CCME used AEP values instead.
The site is considered to have an residential/parkland and natural area land-use.

[1] - Guideline values for benzene are based on 1 x 10^{-5} incremental lifetime cancer risk.
[2] - Guideline values for BTEX parameters are for surface soil.
m bgs - Meters below ground surface.
mg/kg - Milligram per kilogram.
BTEX - Benzene, toluene, ethylbenzene, and xylenes.
CCME - Canadian Council of Ministers of the Environment.
PAH - Polycyclic aromatic hydrocarbons.
Concentration exceeds the guideline.

Guidelines:

Canadian Council of Ministers of the Environment (online), Soil Quality for the Protection of Environmental and Human Health.
Canadian Council of Ministers of the Environment (2008), Canada-wide Standards for Petroleum Hydrocarbons (PHC) in Soil.
Canadian Council of Ministers of the Environment (2010), Soil Quality for the Protection of Environmental and Human Health (Polycyclic Aromatic Hydrocarbons).
Alberta Tier 1 Soil and Groundwater Remediation Guidelines (2016)

Table 6: Site 7 - Maintenance Shed
Surface Soil SLRA Results (<3m depth) - Waterton Kenow RARMP

Parameter Group	Parameter	Highest Sample Concentration Noted During Site Assessments (mg/kg)	Sample Depth (m bgs)	Samples in Exceedance	Laboratory Result (mg/kg)	Grain Size	CCME & AEP Human Health Pathway Guideline (mg/kg) Coarse-grained			CCME & AEP Environmental Health Pathway Guideline (mg/kg) Coarse-grained				Summary of Exceeded Pathways	
							Soil Contact	Soil Vapour Inhalation (Basement)	Soil Vapour Inhalation (Slab-on-Grade)	Aquatic Life	Soil Contact	Soil and Food Ingestion	Off-site Migration	Human Health Pathways	Environmental Health Pathways
PAH	Anthracene	0.0057	0 - 0.25	13-2	0.0057	Coarse	24,000	780,000	670,000	0.0056	2.5	61.5	36	---	Aquatic Life

Notes:

Guideline values were taken from CCME. Values that were unavailable from CCME used AEP values instead.
The site is considered to have a commercial, residential/parkland, and natural area land-use.

< - Concentration is less than laboratory reportable detection limit.
m bgs - Meters below ground surface.
mg/kg - Milligram per kilogram.
CCME - Canadian Council of Ministers of the Environment.
PAH - Polycyclic aromatic hydrocarbons.
Concentration exceeds the guideline.

Guidelines:

Canadian Council of Ministers of the Environment (online), Soil Quality for the Protection of Environmental and Human Health.
Canadian Council of Ministers of the Environment (2008), Canada-wide Standards for Petroleum Hydrocarbons (PHC) in Soil.
Canadian Council of Ministers of the Environment (2010), Soil Quality for the Protection of Environmental and Human Health (Polycyclic Aromatic Hydrocarbons).
Alberta Tier 1 Soil and Groundwater Remediation Guidelines (2016)

Table 7: Site 9 - Fire Retardant Spill Site
Surface Soil SLRA Results (<3m depth) - Waterton Kenow RARMP

Parameter Group	Parameter	Highest Sample Concentration Noted During Site Assessment (mg/kg)	Sample Depth (m bgs)	Samples in Exceedance	Laboratory result (mg/kg)	Grain Size	CCME & AEP Human Health Pathway Guideline (mg/kg) Coarse-grained					CCME & AEP Environmental Health Pathway Guideline (mg/kg) Coarse-grained				Summary of Exceeded Pathways	
							Potable Water	Soil Contact	Soil Vapour Inhalation (Basement)	Soil Vapour Inhalation (Slab-on-Grade)	Off-site Migration	Aquatic Life	Soil Contact	Soil and Food Ingestion	Off-site Migration	Human Health Pathways	Environmental Health Pathways
PAH	Anthracene	0.046	0 - 0.25	5-1	0.046	Coarse	---	24,000	780,000	670,000	350,000	0.0056	2.5	61.5	36	---	Aquatic Life
	Benz(a)anthracene	0.098	0 - 0.25	5-1	0.098	Coarse	3.1	---	---	---	---	0.083	---	6.2	---	---	Aquatic Life
	Fluoranthene	0.21	0 - 0.25	5-1	0.21	Coarse	---	3,500	550,000	480,000	50,000	0.039	50	15.4	720	---	Aquatic Life
	Phenanthrene	0.14	0 - 0.25	5-1	0.14	Coarse	---	---	---	---	---	0.046	---	43	---	---	Aquatic Life
	Pyrene	0.17	0 - 0.25	5-1	0.17	Coarse	---	2,100	810,000	730,000	30,000	0.04	---	7.7	---	---	Aquatic Life

Notes:

Guideline values were taken from CCME. Values that were unavailable from CCME used AEP values instead.
The site is considered to have an industrial, residential/parkland, and natural area land-use.

m bgs - Meters below ground surface.
mg/kg - Milligram per kilogram.
CCME - Canadian Council of Ministers of the Environment.
PAH - Polycyclic aromatic hydrocarbons.
Concentration exceeds the guideline.

Guidelines:

Canadian Council of Ministers of the Environment (online), Soil Quality for the Protection of Environmental and Human Health.
Canadian Council of Ministers of the Environment (2008), Canada-wide Standards for Petroleum Hydrocarbons (PHC) in Soil.
Canadian Council of Ministers of the Environment (2010), Soil Quality for the Protection of Environmental and Human Health (Polycyclic Aromatic Hydrocarbons).
Alberta Tier 1 Soil and Groundwater Remediation Guidelines (2016)

Table 8: Site 4 - Gate House
Remedial Objectives - Waterton Kenow RARMP

Parameter Group	Parameter	Human Health Pathway Guideline[2,3] (mg/kg)									Environmental Health Pathway Guideline[3] (mg/kg)									Remedial Objective
		Potable Water	Soil Ingestion	Soil Contact	Soil Inhalation	Soil Vapour Inhalation (Basement)	Soil Vapour Inhalation (Slab-on-Grade)	Off-site Migration	Produce, Meat, and Milk	Provisional Soil Quality	Aquatic Life	Soil Contact	Soil and Food Ingestion	Protection of Wildlife Water	Nutrient Cycling	Protection of Livestock Water	Management Limit	Off-Site Migration	Provisional Soil Quality	
Metals and Inorganics	Antimony											20								20
	Arsenic		12	21								17	380							12
	Barium		6800	6800	6800			96000				500								6800
	Beryllium		75	75	5500			1100				5								75
	Boron	118		7500				110000			5	3.3		17				46		118
	Cadmium		14	14								10	3.8		54					14
	Chromium (VI)											0.4							0.4	0.4
	Chromium (III+VI)		220	220								64			52					220
	Cobalt											20								20
	Copper		1100	1100								63	300		350					1100
	Lead		140	140								300	70		723					140
	Mercury		6.6	6.6								12			20					6.6
	Molybdenum											4								4
	Nickel		200	200	10000			2500				45	528		171			287		200
	Selenium		80	80	80			1135				1	4.5					5		80
	Silver											20								20
	Thallium			1						1		1.4	1							1
	Tin											5								5
	Uranium		23	23	23							500	33							23
	Vanadium											130			255					130
	Zinc											200	640		200					200
BTEX	Benzene	0.03	110	250		0.15	0.095	1100			0.17	31	18	0.33				440		0.03
	Toluene	0.37	22000	220000		200	120	9200			0.1	75	980	1000				1100		0.37
	Ethylbenzene	0.082	10000	58000		88	55	24000			50	55	640	17000				790		0.082
	Xylene Total	1.9	150000	480		22	14	6900			37	95	2600	16000				930		1.9
PHC	PHC F1 (C6-C10) - BTEX	240	12000	12000	320	40	30	30000			970	210	11000	30000			700	3000		30
	PHC F2: (C10-C16)	320	6800	6800	1700	190	150	30000			380	150	9800	30000			1000	2100		150
	PHC F3: (C16-C34)		15000	15000				30000				300	16000				2500	4300		15000
	PHC F4: (C34-C50)		21000	21000				30000				2800	8400				10000	30000		21000
VOCs	1,1,1,2-tetrachloroethane																			
	1,1,1-trichloroethane																			
	1,1,2,2-tetrachloroethane																			
	1,1,2-trichloroethane																			
	1,1-dichloroethane																			
	1,1-dichloroethene	0.24		1900		0.03	0.021	27000												0.021
	1,2,3-trichlorobenzene	3.6		49		0.3	0.26	700			0.31									0.26
	1,2,4-trichlorobenzene	3.9		38		0.26	0.23	540			0.93									0.23
	1,2,4-trimethylbenzene																			
	1,2-dibromoethane																			
	1,2-dichlorobenzene	0.18		16000		14	10	0.18												0.18
	1,2-dichloroethane	0.041		2800		0.0038	0.0027	40000			0.12					0.0062				0.0027
	1,2-dichloropropane																			
	1,3,5-Trichlorobenzene	3.6		46		0.14	0.13	660												0.13
	1,3,5-trimethylbenzene																			
	1,3-dichlorobenzene																			
	1,4-dichlorobenzene	0.098		4200		0.91	0.67	59000			0.38									0.098
	Bromodichloromethane																			
	Bromoform																			
	Bromomethane																			
	Carbon Tetrachloride	0.062		27		0.00078	0.00057	380			0.062									0.00057
	Chlorobenzene	1.1		16000		0.024	0.018	230000												0.018
	Chlorodibromomethane	1.5		760		0.28	0.27	11000												0.27
	Chloroethane																			
	Chloroform	0.88		72		0.015	0.011	1000			0.003									0.011
	Chloromethane																			
	cis-1,2-dichloroethene																			
	cis-1,3-dichloropropene																			
	Dichloromethane	0.32		990		1	0.71	14000			0.095					0.048				0.32

	Methyl Methacrylate	1.8		1100		0.14	0.1	16000												0.1
	Methyl tert-Butyl Ether (MTBE)	0.062		380		0.065	0.046	5400			6.1									0.046
	Styrene	210		1000		14	10	150000			0.8									10
	Trichloroethene	0.093		35		0.017	0.012	630			0.081	3				0.14		43		0.012
	Tetrachloroethene	0.46		180		0.025	0.018	2600			0.77									0.018
	trans-1,2-dichloroethene																			
	trans-1,3-dichloropropene																			
	Trichlorofluoromethane																			
	Vinyl chloride	0.02		71		0.00049	0.00034	1000												0.00034
	Acenaphthene			5300		4800	3900	75000			0.28		21.5							3900
	Acenaphthylene										320									320
	Acridine																			
	Anthracene			24000		780000	670000	350000			0.0056	2.5	61.5					36		24000
	Benz(a)anthracene	3.1									0.083		6.2							3.1
	Benzo(a)pyrene	3.4									0.77	20	0.6					290	0.7	3.4
	Benzo[b+j]fluoranthene	1.4											6.2							1.4
	Benzo(c)phenanthrene																			
	Benzo(e)pyrene																			
	Benzo(g,h,i)perylene	63																		63
	Benzo(k)fluoranthene	0.31											6.2							0.31
PAH	Chrysene	19											6.2							19
	Dibenz(a,h)anthracene	2.1																		2.1
	Fluoranthene			3500		550000	480000	50000			0.039	50	15.4					720		3500
	Fluorene			2700		10000	86000	39000			0.25		15.4							2700
	Indeno(1,2,3-c,d)pyrene	24																		24
	Total Methylnaphthalene																			
	Naphthalene	53		1800		2.9	2.2	26000			0.013		8.8						0.6	2.2
	Perylene																			
	Phenanthrene										0.046		43							0.046
	Pyrene			2100		810000	730000	30000			0.04		7.7							2100
	Quinoline																			
	IACR	1																		1
	B(a)P Total Potency Equivalent (1x10-5 ILCR)		5.3	5.3	5.3			75												5.3
PCB	PCBs (Sum of total)			22				310				33	1.3					470		22

Notes:

Guideline values were taken from CCME. Values that were unavailable from CCME used AEP values instead.
The site is considered to have a commercial, residential/parkland, and natural area land-use
Soil and food ingestion pathway values were determined by the more stringent value for livestock and wildlife soil and food ingestion in AEP and CCME guidelines
Where applicable, AEP values superseded CCME values if CCME possessed only interim guidelines values
Guideline values for this site are based on coarse-grained soil

Guidelines:

Canadian Council of Ministers of the Environment (online), Soil Quality for the Protection of Environmental and Human Health
Canadian Council of Ministers of the Environment (2008), Canada-wide standards for Petroleum Hydrocarbons (PHC) in Soil
Canadian Council of Ministers of the Environment (2010), Soil Quality for the Protection of Environmental and Human Health (Polycyclic Aromatic Hydrocarbons).
Alberta Tier 1 Soil and Groundwater Remediation Guidelines (2016)

Table 9: Site 5 - Heavy Equipment
Remedial Objectives - Waterton Kenow RARMP

Parameter Group	Parameter	Human Health Pathway Guideline[2,3] (mg/kg)									Environmental Health Pathway Guideline[3] (mg/kg)									Remedial Objective
		Potable Water	Soil Ingestion	Soil Contact	Soil Inhalation	Soil Vapour Inhalation (Basement)	Soil Vapour Inhalation (Slab-on-Grade)	Off-site Migration	Produce, Meat, and Milk	Provisional Soil Quality	Aquatic Life	Soil Contact	Soil and Food Ingestion	Protection of Wildlife Water	Nutrient Cycling	Protection of Livestock Water	Management Limit	Off-Site Migration	Provisional Soil Quality	
Metals and Inorganics	Antimony											20								20
	Arsenic		12	21				39				17	380					140		12
	Barium		6800	6800	6800			96000				500						140000		6800
	Beryllium		75	75	5500			1100				5								75
	Boron	118		7500				110000			5	3.3		17				46		118
	Cadmium		14	14				192				10	3.8		54			132		14
	Chromium (VI)											0.4							0.4	0.4
	Chromium (III+VI)		220	220				2300				64			52			91		220
	Cobalt											20								20
	Copper		1100	1100				16000				63	300		350			610		1100
	Lead		140	140				740				300	70		723			2272		140
	Mercury		6.6	6.6				99				12			20			142		6.6
	Molybdenum											4								4
	Nickel		200	200	10000			2500				45	528		171			287		200
	Selenium		80	80	80			1135				1	4.5					5		80
	Silver											20								20
	Thallium			1						1		1.4	1					140		1
	Tin											5								5
	Uranium		23	23	23			300				500	33					7100		23
	Vanadium											130			255			830		130
	Zinc											200	640		200			1000		200
BTEX	Benzene	0.03	110	120		0.15	0.095	1100			0.17	31	18	0.33				440		0.03
	Toluene	0.37	22000	11000		200	120	9200			0.1	75	980	1000				1100		0.37
	Ethylbenzene	0.082	10000	24000		88	55	24000			50	55	640	17000				790		0.082
	Xylene Total	1.9	150000	480		22	14	6900			37	95	2600	16000				930		1.9
PHC	PHC F1 (C6-C10) - BTEX	240	12000	12000	320	40	30	30000			970	210	11000	30000			700	3000		30
	PHC F2: (C10-C16)	320	6800	6800	1700	190	150	30000			380	150	9800	30000			1000	2100		150
	PHC F3: (C16-C34)		15000	15000				30000				300	16000				2500	4300		15000
	PHC F4: (C34-C50)		21000	21000				30000				2800	8400				10000	30000		21000
VOCs	1,1,1,2-tetrachloroethane																			
	1,1,1-trichloroethane																			
	1,1,2,2-tetrachloroethane																			
	1,1,2-trichloroethane																			
	1,1-dichloroethane																			
	1,1-dichloroethene	0.24		1900		0.03	0.021	27000												0.021
	1,2,3-trichlorobenzene	3.6		49		0.3	0.26	700			0.31									0.26
	1,2,4-trichlorobenzene	3.9		38		0.26	0.23	540			0.93									0.23
	1,2,4-trimethylbenzene																			
	1,2-dibromoethane																			
	1,2-dichlorobenzene	0.18		16000		14	10	230000												0.18
	1,2-dichloroethane	0.041		2800		0.0038	0.0027	40000			0.12					0.0062				0.0027
	1,2-dichloropropane																			
	1,3,5-Trichlorobenzene	3.6		46		0.14	0.13	660												0.13
	1,3,5-trimethylbenzene																			
	1,3-dichlorobenzene																			
	1,4-dichlorobenzene	0.098		4200		0.91	0.67	59000			0.38									0.098
	Bromodichloromethane																			
	Bromoform																			
	Bromomethane																			
	Carbon Tetrachloride	0.062		27		0.00078	0.00057	380			0.062									0.00057
	Chlorobenzene	1.1		16000		0.024	0.018	230000												0.018
	Chlorodibromomethane	1.5		760		0.28	0.27	11000												0.27
	Chloroethane																			
	Chloroform	0.88		72		0.015	0.011	1000			0.003									0.011
	Chloromethane																			
	cis-1,2-dichloroethene																			
	cis-1,3-dichloropropene																			
	Dichloromethane	0.32		990		1	0.71	14000			0.095					0.048				0.32

	Methyl Methacrylate	1.8		1100		0.14	0.1	16000												0.1
	Methyl tert-Butyl Ether (MTBE)	0.062		380		0.065	0.046	5400			6.1									0.046
	Styrene	210		1000		14	10	150000			0.8									10
	Trichloroethene	0.093		35		0.017	0.012	630			0.081	3				0.14		43		0.012
	Tetrachloroethene	0.46		180		0.025	0.018	2600			0.77									0.018
	trans-1,2-dichloroethene																			
	trans-1,3-dichloropropene																			
	Trichlorofluoromethane																			
	Vinyl chloride	0.02		71		0.00049	0.00034	1000												0.00034
PAH	Acenaphthene			5300		4800	3900	75000			0.28		21.5							3900
	Acenaphthylene										320									320
	Acridine																			
	Anthracene			24000		780000	670000	350000			0.0056	2.5	61.5					36		24000
	Benz(a)anthracene	3.1									0.083		6.2							3.1
	Benzo(a)pyrene	3.4									0.77	20	0.6					290	0.7	3.4
	Benzo[b+j]fluoranthene	1.4											6.2							1.4
	Benzo(c)phenanthrene																			
	Benzo(e)pyrene																			
	Benzo(g,h,i)perylene	63																		63
	Benzo(k)fluoranthene	0.31											6.2							0.31
	Chrysene	19											6.2							19
	Dibenz(a,h)anthracene	2.1																		2.1
	Fluoranthene			3500		550000	480000	50000			0.039	50	15.4					720		3500
	Fluorene			2700		10000	86000	39000			0.25		15.4							2700
	Indeno(1,2,3-c,d)pyrene	24																		24
	Perylene																			
	Phenanthrene										0.046		43							0.046
	Pyrene			2100		810000	730000	30000			0.04		7.7							2100
	Quinoline																			
	IACR	1																		1
	B(a)P Total Potency Equivalent (1x10-5 ILCR)		5.3	5.3	5.3			75												5.3
PCB	PCBs (Sum of total)			22				310				33	1.3					470		22

Notes: Guideline values were taken from CCME. Values that were unavailable from CCME used AEP values instead.
The site is considered to have an industrial, residential/parkland, and natural area land-use
Soil and food ingestion pathway values were determined by the more stringent value for livestock and wildlife soil and food ingestion in AEP and CCME guidelines
Where applicable, AEP values superseded CCME values if CCME possessed only interim guidelines values
Guideline values for this site are based on coarse-grained soil

Guidelines: Canadian Council of Ministers of the Environment (online), Soil Quality for the Protection of Environmental and Human Health
Canadian Council of Ministers of the Environment (2008), Canada-wide standards for Petroleum Hydrocarbons (PHC) in Soil
Canadian Council of Ministers of the Environment (2010), Soil Quality for the Protection of Environmental and Human Health (Polycyclic Aromatic Hydrocarbons).
Alberta Tier 1 Soil and Groundwater Remediation Guidelines (2016)

Table 10: Site 6 - Canyon Camp
Remedial Objectives - Waterton Kenow RARMP

Parameter Group	Parameter	Human Health Pathway Guideline[2,3] (mg/kg)									Environmental Health Pathway Guideline[3] (mg/kg)									Remedial Objective
		Potable Water	Soil Ingestion	Soil Contact	Soil Inhalation	Soil Vapour Inhalation (Basement)	Soil Vapour Inhalation (Slab-on-Grade)	Off-site Migration	Produce, Meat, and Milk	Provisional Soil Quality	Aquatic Life	Soil Contact	Soil and Food Ingestion	Protection of Wildlife Water	Nutrient Cycling	Protection of Livestock Water	Management Limit	Off-Site Migration	Provisional Soil Quality	
Metals and Inorganics	Antimony											20								20
	Arsenic		12	21								17	380							12
	Barium		6800	6800	6800							500								6800
	Beryllium		75	75	5500							5								75
	Boron	118		7500							5	3.3		17						118
	Cadmium		14	14								10	3.8		54					14
	Chromium (VI)											0.4							0.4	0.4
	Chromium (III+VI)		220	220								64			52					220
	Cobalt											20								20
	Copper		1100	1100								63	300		350					1100
	Lead		140	140								300	70		723					140
	Mercury		6.6	6.6								12			20					6.6
	Molybdenum											4								4
	Nickel		200	200	10000							45	528		171					200
	Selenium		80	80	80							1	4.5							80
	Silver											20								20
	Thallium			1						1		1.4	1							1
	Tin											5								5
	Uranium		23	23	23							500	33							23
	Vanadium											130			255					130
	Zinc											200	640		200					200
BTEX	Benzene	0.03	110	250		0.15	0.095				0.17	31	18	0.33						0.03
	Toluene	0.37	22000	220000		200	120				0.1	75	980	1000						0.37
	Ethylbenzene	0.082	10000	58000		88	55				50	55	640	17000						0.082
	Xylene Total	1.9	150000	480		22	14				37	95	2600	16000						1.9
PHC	PHC F1 (C6-C10) - BTEX	240	12000	12000		40	30				970	210	11000	30000			700			30
	PHC F2: (C10-C16)	320	6800	6800		190	150				380	150	9800	30000			1000			150
	PHC F3: (C16-C34)		15000	15000								300	16000				2500			15000
	PHC F4: (C34-C50)		21000	21000								2800	8400				10000			21000
VOCs	1,1,1,2-tetrachloroethane																			
	1,1,1-trichloroethane																			
	1,1,2,2-tetrachloroethane																			
	1,1,2-trichloroethane																			
	1,1-dichloroethane																			
	1,1-dichloroethene	0.24		1900		0.03	0.021													0.021
	1,2,3-trichlorobenzene	3.6		49		0.3	0.26				0.31									0.26
	1,2,4-trichlorobenzene	3.9		38		0.26	0.23				0.93									0.23
	1,2,4-trimethylbenzene																			
	1,2-dibromoethane																			
	1,2-dichlorobenzene	0.18		16000		14	10													0.18
	1,2-dichloroethane	0.041		2800		0.0038	0.0027				0.12					0.0062				0.0027
	1,2-dichloropropane																			
	1,3,5-Trichlorobenzene	3.6		46		0.14	0.13													0.13
	1,3,5-trimethylbenzene																			
	1,3-dichlorobenzene																			
	1,4-dichlorobenzene	0.098		4200		0.91	0.67				0.38									0.098
	Bromodichloromethane																			
	Bromoform																			
	Bromomethane																			
	Carbon Tetrachloride	0.062		27		0.00078	0.00057				0.062									0.00057
	Chlorobenzene	1.1		16000		0.024	0.018													0.018
	Chlorodibromomethane	1.5		760		0.28	0.27													0.27
	Chloroethane																			
	Chloroform	0.88		72		0.015	0.011				0.003									0.011
	Chloromethane																			
	cis-1,2-dichloroethene																			
	cis-1,3-dichloropropene																			
	Dichloromethane	0.32		990		1	0.71				0.095					0.048				0.32

	Methyl Methacrylate	1.8		1100		0.14	0.1													0.1
	Methyl tert-Butyl Ether (MTBE)	0.062		380		0.065	0.046				6.1									0.046
	Styrene	210		1000		14	10				0.8									10
	Trichloroethene	0.093		35		0.017	0.012				0.081	3				0.14				0.012
	Tetrachloroethene	0.46		180		0.025	0.018				0.77									0.018
	trans-1,2-dichloroethene																			
	trans-1,3-dichloropropene																			
	Trichlorofluoromethane																			
	Vinyl chloride	0.02		71		0.00049	0.00034													0.00034
PAH	Acenaphthene			5300		4800	3900				0.28		21.5							3900
	Acenaphthylene										320									320
	Acridine																			
	Anthracene			24000		780000	670000				0.0056	2.5	61.5							24000
	Benz(a)anthracene	3.1									0.083		6.2							3.1
	Benzo(a)pyrene	3.4									0.77	20	0.6						0.7	3.4
	Benzo[b+j]fluoranthene	1.4											6.2							1.4
	Benzo(c)phenanthrene																			
	Benzo(e)pyrene																			
	Benzo(g,h,i)perylene	63																		63
	Benzo(k)fluoranthene	0.31											6.2							0.31
	Chrysene	19											6.2							19
	Dibenz(a,h)anthracene	2.1																		2.1
	Fluoranthene			3500		550000	480000				0.039	50	15.4							3500
	Fluorene			2700		10000	86000				0.25		15.4							2700
	Indeno(1,2,3-c,d)pyrene	24																		24
	Perylene																			
	Phenanthrene										0.046		43							0.046
	Pyrene			2100		810000	730000				0.04		7.7							2100
	Quinoline																			
	IACR	1																		1
	B(a)P Total Potency Equivalent (1x10-5 ILCR)		5.3	5.3	5.3															5.3
PCB	PCBs (Sum of total)			22								33	1.3							22

Notes: Guideline values were taken from CCME. Values that were unavailable from CCME used AEP values instead.
The site is considered to have a residential/parkland and natural area land-use
Soil and food ingestion pathway values were determined by the more stringent value for livestock and wildlife soil and food ingestion in AEP and CCME guidelines
Where applicable, AEP values superseded CCME values if CCME possessed only interim guidelines values
Guideline values for this site are based on coarse-grained soil

Guidelines: Canadian Council of Ministers of the Environment (online), Soil Quality for the Protection of Environmental and Human Health
Canadian Council of Ministers of the Environment (2008), Canada-wide standards for Petroleum Hydrocarbons (PHC) in Soil
Canadian Council of Ministers of the Environment (2010), Soil Quality for the Protection of Environmental and Human Health (Polycyclic Aromatic Hydrocarbons).
Alberta Tier 1 Soil and Groundwater Remediation Guidelines (2016)

Table 11: Site 7 - Golf Course
Remedial Objectives - Waterton Kenow RARMP

Parameter Group	Parameter	Human Health Pathway Guideline[2,3] (mg/kg)								Environmental Health Pathway Guideline[3] (mg/kg)									Remedial Objective
		Soil Ingestion	Soil Contact	Soil Inhalation	Soil Vapour Inhalation (Basement)	Soil Vapour Inhalation (Slab-on-Grade)	Off-site Migration	Produce, Meat, and Milk	Provisional Soil Quality	Aquatic Life	Soil Contact	Soil and Food Ingestion	Protection of Wildlife Water	Nutrient Cycling	Protection of Livestock Water	Management Limit	Off-Site Migration	Provisional Soil Quality	
Metals and Inorganics	Antimony										20								20
	Arsenic	12	21								17	380							12
	Barium	6800	6800	6800			96000				500								6800
	Beryllium	75	75	5500			1100				5								75
	Boron		7500				110000			5	3.3		17				46		7500
	Cadmium	14	14								10	3.8		54					14
	Chromium (VI)										0.4							0.4	0.4
	Chromium (III+VI)	220	220								64			52					220
	Cobalt										20								20
	Copper	1100	1100								63	300		350					1100
	Lead	140	140								300	70		723					140
	Mercury	6.6	6.6								12			20					6.6
	Molybdenum										4								4
	Nickel	200	200	10000			2500				45	528		171			287		200
	Selenium	80	80	80			1135				1	4.5					5		80
	Silver										20								20
	Thallium		1						1		1.4	1							1
	Tin										5								5
	Uranium	23	23	23							500	33							23
	Vanadium										130			255					130
	Zinc										200	640		200					200
BTEX	Benzene	110	250		0.15	0.095	1100			0.17	31	18	0.33				440		0.095
	Toluene	22000	220000		200	120	9200			0.1	75	980	1000				1100		120
	Ethylbenzene	10000	58000		88	55	24000			50	55	640	17000				790		55
	Xylene Total	150000	480		22	14	6900			37	95	2600	16000				930		14
PHC	PHC F1 (C6-C10) - BTEX	12000	12000	320	40	30	30000			970	210	11000	30000			700	3000		30
	PHC F2: (C10-C16)	6800	6800	1700	190	150	30000			380	150	9800	30000			1000	2100		150
	PHC F3: (C16-C34)	15000	15000				30000				300	16000				2500	4300		15000
	PHC F4: (C34-C50)	21000	21000				30000				2800	8400				10000	30000		21000
VOCs	1,1,1,2-tetrachloroethane																		
	1,1,1-trichloroethane																		
	1,1,2,2-tetrachloroethane																		
	1,1,2-trichloroethane																		
	1,1-dichloroethane																		
	1,1-dichloroethene		1900		0.03	0.021	27000												0.021
	1,2,3-trichlorobenzene		49		0.3	0.26	700			0.31									0.26
	1,2,4-trichlorobenzene		38		0.26	0.23	540			0.93									0.23
	1,2,4-trimethylbenzene																		
	1,2-dibromoethane																		
	1,2-dichlorobenzene		16000		14	10	0.18												0.18
	1,2-dichloroethane		2800		0.0038	0.0027	40000			0.12					0.0062				0.0027
	1,2-dichloropropane																		
	1,3,5-Trichlorobenzene		46		0.14	0.13	660												0.13
	1,3,5-trimethylbenzene																		
	1,3-dichlorobenzene																		
	1,4-dichlorobenzene		4200		0.91	0.67	59000			0.38									0.67
	Bromodichloromethane																		
	Bromoform																		
	Bromomethane																		
	Carbon Tetrachloride		27		0.00078	0.00057	380			0.062									0.00057
	Chlorobenzene		16000		0.024	0.018	230000												0.018
	Chlorodibromomethane		760		0.28	0.27	11000												0.27
	Chloroethane																		
	Chloroform		72		0.015	0.011	1000			0.003									0.011
	Chloromethane																		
	cis-1,2-dichloroethene																		

	cis-1,3-dichloropropene																		
	Dichloromethane		990		1	0.71	14000			0.095					0.048				0.71
	Methyl Methacrylate		1100		0.14	0.1	16000												0.1
	Methyl tert-Butyl Ether (MTBE)		380		0.065	0.046	5400			6.1									0.046
	Styrene		1000		14	10	150000			0.8									10
	Trichloroethene		35		0.017	0.012	630			0.081	3				0.14		43		0.012
	Tetrachloroethene		180		0.025	0.018	2600			0.77									0.018
	trans-1,2-dichloroethene																		
	trans-1,3-dichloropropene																		
	Trichlorofluoromethane																		
	Vinyl chloride		71		0.00049	0.00034	1000												0.00034
PAH	Acenaphthene		5300		4800	3900	75000			0.28		21.5							3900
	Acenaphthylene									320									320
	Acridine																		
	Anthracene		24000		780000	670000	350000			0.0056	2.5	61.5					36		24000
	Benz(a)anthracene									0.083		6.2							0.083
	Benzo(a)pyrene									0.77	20	0.6					290	0.7	0.6
	Benzo[b+j]fluoranthene											6.2							6.2
	Benzo(c)phenanthrene																		
	Benzo(e)pyrene																		
	Benzo(g,h,i)perylene																		
	Benzo(k)fluoranthene											6.2							6.2
	Chrysene											6.2							6.2
	Dibenz(a,h)anthracene																		
	Fluoranthene		3500		550000	480000	50000			0.039	50	15.4					720		3500
	Fluorene		2700		10000	86000	39000			0.25		15.4							2700
	Indeno(1,2,3-c,d)pyrene																		
	Perylene																		
	Phenanthrene									0.046		43							0.046
	Pyrene		2100		810000	730000	30000			0.04		7.7							2100
	Quinoline																		
	IACR																		
	B(a)P Total Potency Equivalent (1x10-5 ILCR)	5.3	5.3	5.3			75												5.3
PCB	PCBs (Sum of total)		22				310				33	1.3					470		22

Notes:

Guideline values were taken from CCME. Values that were unavailable from CCME used AEP values instead.
The site is considered to have a commercial, residential/parkland, and natural area land-use
Soil and food ingestion pathway values were determined by the more stringent value for livestock and wildlife soil and food ingestion in AEP and CCME guidelines
Where applicable, AEP values superseded CCME values if CCME possessed only interim guidelines values
Guideline values for this site are based on coarse-grained soil

Guidelines:

Canadian Council of Ministers of the Environment (online), Soil Quality for the Protection of Environmental and Human Health
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Canadian Council of Ministers of the Environment (2010), Soil Quality for the Protection of Environmental and Human Health (Polycyclic Aromatic Hydrocarbons).
Alberta Tier 1 Soil and Groundwater Remediation Guidelines (2016)

Appendix A

Remedial Action Plan – Site 2: Visitor Reception Centre (Dillon, March 2018)

1 GENERAL

1.01 SUMMARY

.1 Contractor to comply with requirements of this Section when performing the following work at Site 2 (Visitor Reception Centre):
- .1 Removing non-friable and/or friable asbestos-containing debris materials from the burned building site areas by manual means, if the debris material is removed without being cut, drilled, abraded, ground, sanded, or vibrated [locations indicated on drawings].
- .2 Removing non-friable and/or friable asbestos-containing debris materials from the burned building site areas, using excavator or other equipment.
- .3 Breaking, cutting, or drilling of larger non-friable asbestos-containing debris materials from the burned building site areas, using power hand tools equipped with HEPA-filtered vacuum attachment and water application device to control release of airborne dust.

1.02 RELATED REQUIREMENTS

.1 Section [_____].

1.03 REFERENCE STANDARDS

.1 Federal
- .1 Department of Justice Canada (Jus).
- .2 Canadian Environmental Protection Act, 1999 (CEPA).
- .3 Canada Labour Code Part II, SOR 86-304 - Occupational Health and Safety Regulations.
- .4 Transportation of Dangerous Goods Act, 1992 (TDGA).
- .5 Transportation of Dangerous Goods Regulation, SOR/2017-253.
- .6 Workplace Hazardous Materials Information System (WHMIS 2015), Safety Data Sheets (SDS).
- .7 Public Services and Procurement Canada (PSPC) Asbestos Management Standard, June 5, 2017.

.2 Provincial (Alberta)
- .1 Occupational Health and Safety Act (RSA 2000 cO-2).
- .2 Occupational Health and Safety Regulation, 62/2003 (amendments 182/2013).
- .3 Occupational Health and Safety Code, 2009.
- .4 Alberta Human Services - Asbestos Abatement Manual, 2009.
- .5 Alberta Environment and Sustainable Resource Development – Guidelines for the Disposal of Asbestos Waste.

.3 RJ & Associates Environmental Consultants Inc.
- .1 Hazardous Materials Assessment Report for the Kenow Wildfires at Waterton Lakes National Park, Waterton Lakes Alberta, January 2, 2018.

1.04 DEFINITIONS

- .1 HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with filter

system capable of collecting and retaining fibres greater than 0.3 microns in any direction at 99.97% efficiency.

.2 Amended Water: water with nonionic surfactant wetting agent added to reduce water tension to allow thorough wetting of fibres.

.3 Asbestos-Containing Materials (ACMs): materials that contain 1.0 percent or more asbestos by dry weight and are identified under Existing Conditions including fallen materials and settled dust.

.4 Asbestos Work Area: area where work takes place which will, or may, disturb ACMs.

.5 Authorized Visitors: Parks Canada, Engineer[s], Consultant[s], or designated representative[s], and representative[s] of regulatory agencies and any visitor approved by Parks Canada.

.6 Competent worker [person]: in relation to specific work, means a worker who:
- .1 Is qualified because of knowledge, training, and experience to perform the work.
- .2 Is familiar with applicable provincial and federal laws and with the provisions of the regulations that apply to the work.
- .3 Has knowledge of all potential or actual danger to health or safety in the work.

.7 Friable material: means material that: When dry, can be crumbled, pulverized, or powdered by hand pressure, or is crumbled, pulverized, or powdered.

.8 Non-Friable Material: material that when dry cannot be crumbled, pulverized, or powdered by hand pressure.

.9 Occupied Area: any area of the building or work site that is outside Asbestos Work Area.

.10 Polyethylene: polyethylene sheeting or rip-proof polyethylene sheeting with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide protection and isolation.

.11 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must have appropriate capacity for work.

.12 Sealant (Encapsulant): sealant or encapsulant to be used during the final clean-up operations shall be slow-drying and remain tacky on surfaces for a minimum of 8 hours for the purpose of trapping residual airborne fibres during the settling period. Products used must have flame spread and smoke development ratings both less than 50. Products shall leave no stain when dry.

.13 Bin Liner: double layered rip-proof polyethylene sheeting designed to be installed inside of disposal bins and have the ability to be sealed once filled with ACMs.

.14 Super sack: large hazardous waste bag consisting of 6mil interior liner and fabric coated outer sack with double wall stiffeners, sealable top, and lifting hooks.

1.05 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit proof satisfactory to [Departmental Representative] that suitable arrangements have been made to dispose of asbestos-containing waste in accordance with

requirements of authority having jurisdiction.

.3 Submit Provincial requirements for Notice of Project Form, as well as Exposure Control Plan and Safe Work Procedures.

.4 Submit proof of Contractor's Asbestos Liability Insurance.

.5 Submit to [Departmental Representative] necessary permits for transportation and disposal of asbestos-containing waste and proof that asbestos-containing waste has been received and properly disposed.

.6 Submit proof that all asbestos workers and supervisor have received appropriate training and education by a competent person in the hazards of asbestos exposure, good personal hygiene and work practices while working in Asbestos Work Areas, and the use, cleaning and disposal of respirators and protective clothing.

.7 Submit proof satisfactory to [Departmental Representative] that employees have respirator fitting and testing. Workers must be fit tested (qualitative test) with respirator that is personally issued.

.8 Submit proof that all HEPA-filtered equipment (vacuums and negative air units) to be used have undergone and successfully passed a DOP (Dispersed Oil Particulate) test.

1.06 QUALITY ASSURANCE

.1 Regulatory Requirements: comply with Federal, Provincial/Territorial, and local requirements pertaining to asbestos, provided that in case of conflict among these requirements or with these specifications, more stringent requirement applies. Comply with regulations in effect at time Work is performed.

.2 Health and Safety:

.1

.2 Safety Requirements: worker protection.

.1 Protective equipment and clothing to be worn by workers and machine operators while in Asbestos Work Area include:

.1 Air purifying half-mask respirator with P-100 particulate filter, personally issued to worker and marked as to efficiency and purpose, suitable for protection against asbestos and acceptable to Provincial Authority having jurisdiction. The respirator to be fitted so that there is an effective seal between the respirator and the worker's face, unless the respirator is equipped with a hood or helmet. The respirator to be cleaned, disinfected, and inspected after use on each shift, or more often if necessary, when issued for the exclusive use of one worker, or after each use when used by more than one worker. The respirator to have damaged or deteriorated parts replaced prior to being used by a worker; and, when not in use, to be stored in a convenient, clean, and sanitary location. The employer to establish written procedures regarding the selection, use, and care of respirators, and a copy of the procedures to be provided to and reviewed with each worker who is required to wear a respirator. A worker not to be assigned to an operation requiring the use of a respirator unless he or she is physically able to perform the operation while using the respirator.

.2 Disposable-type protective clothing (TYVEK coverall) that does not

readily retain or permit penetration of asbestos fibres. Protective clothing to be provided by the employer and worn by every worker or machine operator who enters the work area, and the protective clothing shall consist of a head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing to include suitable footwear, and to be repaired or replaced if torn.

.2 Eating, drinking, chewing, and smoking are not permitted in Asbestos Work Area.

.3 Before leaving Asbestos Work Area, the worker or operator can decontaminate his or her protective clothing, if observed to have visible gross contamination, by using a vacuum equipped with a HEPA filter, or by damp wiping, before removing the protective clothing and placing it in a container as asbestos waste. The container to be dust tight, suitable for asbestos waste, impervious to asbestos, identified as asbestos waste, cleaned with a damp cloth or a vacuum equipped with a HEPA filter immediately before removal from the work area, and removed from the work area frequently and at regular intervals.

.4 Facilities for washing hands and face shall be provided within or close to the Asbestos Work Area. A lined pail with clean water and wash cloths is acceptable. No more than two workers per wash out pail.

.5 Ensure workers wash hands and face when leaving Asbestos Work Area. Facilities for washing are to be located just outside the perimeter boundary of the Asbestos Work Area.

.6 Ensure that no person required to enter an Asbestos Work Area has facial hair that affects seal between respirator and face.

1.07 WASTE MANAGEMENT AND DISPOSAL

.1 Remove from site and dispose of packaging materials at appropriate recycling facilities in accordance with Parks Canada practices.

.2 Place materials defined as hazardous or toxic in designated containers.

.3 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, and Regional and Municipal regulations.

.4 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial, Territorial, and Municipal regulations. Dispose of asbestos waste in sealed double thickness [6] mils bags, lined disposal bins, super sack waste bags or leak proof drums. Label containers with appropriate warning labels.

.5 Provide manifests describing and listing waste created. Transport containers by approved means to licensed landfill for burial.

1.08 EXISTING CONDITIONS

.1 Reports and information pertaining to ACMs to be handled, removed, or otherwise disturbed and disposed of during this project are found in Appendix of this specification.

.2 Notify [Departmental Representative] of friable material discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such

material pending instructions from [Departmental Representative].

1.09 SCHEDULING

.1 Hours of Work: perform work involving asbestos abatement at each site location from typical light to light working hours.

1.10 PERSONNEL TRAINING

.1 Before beginning Work, provide [Departmental Representative] satisfactory proof that every worker and/or operator has had instruction and training in hazards of asbestos exposure, in personal hygiene and work practices, and in use, cleaning, and disposal of respirators and protective clothing.

.2 Instruction and training related to respirators includes, following minimum requirements:
- .1 Fitting of equipment.
- .2 Inspection and maintenance of equipment.
- .3 Disinfecting of equipment.
- .4 Limitations of equipment.

.3 Instruction and training must be provided by a competent, qualified person.

2 PRODUCTS

2.01 MATERIALS

.1 Drop Sheets:
- .1 Polyethylene: 0.15 mm thick.
- .2 FR polyethylene: 0.15 mm thick woven fibre reinforced fabric bonded both sides with polyethylene.

.2 Wetting Agent: 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with water in a concentration to provide thorough wetting of asbestos-containing material.

.3 Waste Containers: contain waste in two separate containers.
- .1 Inner container: 0.15 mm thick sealable polyethylene waste bag.
- .2 Outer container: sealable metal or fibre type where there are sharp objects included in waste material; otherwise outer container may be sealable metal or fibre type or second 0.15 mm thick sealable polyethylene bag.
- .3 Labelling requirements: affix pre-printed cautionary asbestos warning in both official languages that is visible when ready for removal to disposal site.

.4 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least 8 hours and designed for purpose of trapping residual asbestos fibres.

.5 Tape: fibreglass - reinforced duct tape suitable for sealing polyethylene under both dry conditions and wet conditions using amended water.

3 EXECUTION

3.1 PROCEDURES

.1 Do construction occupational health and safety in accordance with applicable Federal and Provincial Regulations.

.2 Before beginning Work, isolate Asbestos Work Area using, minimum, preprinted cautionary asbestos warning signs in both official languages that are visible at access routes to Asbestos Work Area. A work perimeter set back of 30 metres, where possible, must be established including asbestos warning signage 30 meters from the asbestos removal area. Depending on wind conditions, the downwind direction may require further set back distance.

.3 The placement of double lined disposal bins for direct transfer of asbestos debris materials should be at the upwind edge of each Asbestos Work Area.

.4 The position of excavator equipment should attempt to have the machine outside of the asbestos boundary tape line, with only the excavator arm and bucket extended inside of the Asbestos Work Area.

.5 Prevent spread of dust from Asbestos Work Area using measures appropriate to work to be done.

- .1 Use FR polyethylene sheeting, 6 mil waste bags or super sacks to double wrap and seal larger debris materials and/or objects with asbestos fiber contamination in Asbestos Work Area. Double wrapped asbestos waste materials can be placed inside of disposal bins in preparation for offsite transport and disposal.
- .2 Use excavator machine with thumb bucket to remove asbestos contaminated debris materials from the Asbestos Work Area to inside double lined waste disposal bins. Confirmed non-asbestos containing building materials and features (e.g. concrete foundations, walkways, floor slabs, etc.) remaining on site or recyclable materials such as waste metal must be HEPA vacuumed and/or wet wiped followed by the application of a slow-drying sealant (Encapsulant).
- .3 Use HEPA vacuum and/or wet cloths to remove fine debris materials from ledges and gaps of the stone wall materials (Site 2) that are to be preserved. Apply slow-drying sealant (Encapsulant) to all surfaces upon completion of cleaning.
- .4 Once all asbestos-contaminated debris materials have been removed from a burned building site, the surface layer (approx. 5 cm) of soil is to be scraped and placed into lined disposal bins as asbestos contaminated soils.
- .5 Do not use compressed air to clean up or remove asbestos contaminated debris.

.6 Wet materials containing asbestos to be cut, broken, scraped, or otherwise disturbed unless wetting creates hazard or causes damage.

- .1 Use garden reservoir type low - velocity fine - mist sprayer.
- .2 All workers inside of the Asbestos Work Area should be positioned upwind during asbestos disturbing activities to reduce exposure potential.
- .3 Perform Work to reduce dust creation to lowest levels practicable. Debris materials are to be pre-wet before disturbance.
- .4 Work will be subject to visual inspection and air monitoring.

.7 Frequently and at regular intervals during Work and immediately on completion of work:

- .1 Wet down the work site ground surface and excavator bucket to reduce dust.
- .2 Asbestos debris materials removed manually are to be placed directly into waste bags,

and not staged or piled at a secondary location.

.8 Cleanup:

.1 Place asbestos containing waste in sealed waste bags. Treat disposable protective clothing as asbestos waste; wet and fold these items to contain dust, and then place in plastic bags.

.2 Clean exterior of each waste-filled bag using damp cloths and place in second clean waste bag immediately prior to removal from Asbestos Work Area.

.3 Seal waste bags and remove from site. Dispose of in accordance with requirements of Provincial/Territorial and Federal Authority having jurisdiction. Supervise disposal and ensure that landfill operator is fully aware of hazardous nature of material to be disposed and that the appropriate guidelines and regulations for asbestos disposal are followed.

.4 Perform final thorough clean-up of all equipment and tools used inside the Work areas using damp cloths. The final clean is to include the excavator bucket, thumb attachment, and lower portion of the excavator arm.

3.2 AIR MONITORING

.1 During the work, Parks Canada may decide to take air samples at appropriate locations at the work perimeter. A third party consultant may be commissioned by Parks Canada to perform environmental oversight during abatement activities and to conduct air monitoring and testing.

.2 Ensure that respiratory safety factors are not exceeded.

END OF SECTION

Asbestos Abatement: Minimum Precautions

- Asbestos contaminated debris materials
- Asbestos contaminated soils
- Asbestos contaminated preservation stones

No.	Date/Date	Description/Description	Drawn by Dessiné par	Approved Approuvé
1	09/01/18	ISSUED FOR REVIEW	BDS	

Revision / Revision

A detail number numéro de detail
B source drawing no. de dessin no.
C detail on drawing no. detail sur dessin no.

Consultant's Name
Nom de l'expert-conseil

DILLON CONSULTING

Eng. Stamp
Sceau de l'ingénieur

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

Client Services Team Southern Alberta Operations Branch
Le Client Entretient l'Équipe Alberta Méridional Branche d'Opérations

Canada

Client/client

Parks Canada Agency
L'Agence Parcs Canada

Western and Northern Region
Ouest et Nord du Canada

Project title/Titre du projet

KENOW WILDFIRES
ASBESTOS ABATEMENT

WATERTON LAKES

Drawing title/Titre du dessin

SITE 2
VISITOR RECEPTION CENTRE

Surveyed by/Arpenté par	Drawn by/Dessiné par	Date/Date
BDS	BDS	09/01/18
Designed by/Concept par	Reviewed by/Revisé par	Scale/Echelle
–		1:75

PWGSC Project Manager/Administrateur de Projets TPSGC

Client Acceptance/Acceptation du client

Approved by/Approuvé par

Park Responsible Officer/Agent Responsable

PWGSC Project Manager/Administrateur de Projets TPSGC

Project No./No. du projet

Asset No./No. du-bien

Sheet No./No. de la feuille

3 OF 8

Drawing Reference No./No. de référence du dessin

A0 1189 x 841

"Hazardous Materials Assessment Report"

For the

Kenow Wildfires at Waterton Lakes National Park

Waterton Lakes, Alberta

Submitted to:
Public Services and Procurement Canada
Suite 1650 - 635 8 Avenue SW
Calgary, AB, T5P 3M3

Prepared by:
R.J. & Associates Environmental Consulting
Suite #407 - 604 Columbia Street
New Westminster, BC
February 26, 2018

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1 Executive Summary

R.J. & Associates Environmental Consulting Inc. (hereinafter referred to as [R.J.& A.]) was engaged by Dillon Consulting Limited, on behalf of Public Services and Procurement Canada (PSPC), to conduct a hazardous materials investigation of the nine (9) identified sites impacted by the Kenow Wildfires located at Waterton Lakes National Park in Alberta.

The subject sites were assessed by our AHERA certified Building Inspector to identify the presence of hazardous materials in areas determined accessible at the time of the investigation. These including the following, asbestos-containing bulk materials, asbestos-containing debris, VOCs, lead based paints, and leachable debris wastes that may pose an exposure threat to workers during the scheduled upcoming clean-up activities or may incur environmental liabilities to the owner. Regulations concerning workplace safety, transportation of dangerous goods and waste disposal are applicable to the investigation.

Based on the investigation findings, the following materials are considered hazardous and have the potential to pose an occupational safety and health risk:

Table 1. Summary of Identified Hazardous Materials

Hazardous Material	Material Description	Location/Building
Asbestos (Chrysotile)	Burned Debris (suspect mastic, drywall mud, insulation material)	Site 2, Visitor's Reception Centre
Asbestos (Chrysotile)	Burned Debris (suspect drywall mud)	Site 6, Canyon Church
VOCs (benzene and ethylbenzene)	Burned Debris/Soil	Site 7, Golf Course Maintenance Shed
VOCs (benzene)	Burned Debris/Soil	Site 8, Alpine Stables

The above assessed materials have the potential to pose an exposure risk or environmental liabilities and therefore, no work that may disturb these materials should proceed until they are remediated or abated following applicable regulations and guidelines.

It is estimated that there is eight hundred (800) cubic meters or more of VOCs contaminated debris/soil combined at the two site areas that exceed CCME Soil Quality Guidelines for the Protection of Environmental and Human Health – Parkland/Residential Land**.** This material should be excavated and transported offsite for final disposal to a fully permitted waste treatment facility.

2 Introduction

The purpose of this investigation is to provide (PSPC) with a detailed report of the investigation for potential hazardous materials in advance of slated restoration project efforts within the following site locations:

- Site 1: Jet Fuel Enviro Shed - Helipad
- Site 2: Visitor Reception Centre
- Site 4: Gate House- Park Entrance
- Site 5: Heavy Equipment
- Site 6: Canyon Church Camp
- Site 7: Golf Course Maintenance Shed
- Site 8: Alpine Stables
- Site 9: Operations Compound
- Site 10: Salamander Pipe

The subject sites were assessed by our AHERA certified Building Inspector to identify the presence of hazardous materials in areas determined accessible at the time of the investigation. These including the following, asbestos-containing bulk materials, asbestos-containing debris, VOCs, lead based paints and leachable debris wastes that may pose an exposure threat to workers during the scheduled upcoming clean-up activities or may incur environmental liabilities to the owner.

This report outlines the scope of the inspection, methodologies, and techniques employed in conducting the onsite investigation and environmental sampling as required. Recommendations provided in this report are based on the observations documented during the onsite investigation and the environmental sampling which were employed during the environmental inspection.

Provincial and Federal Regulations concerning workplace safety, transportation of dangerous goods and waste disposal are applicable to this investigation.

2.1 Scope of Work

The scope of work included an initial visual investigation of each site to identify and distinguish suspect hazardous materials (where possible), delineate the areas of potential contamination and obtain samples of suspect materials and debris.

The purpose of the assessments is to confirm the presence of any suspected hazardous materials within either the accumulated debris materials and/or surface soils expected to have been impacted from the wild fires experienced at the Waterton Lakes Site areas.

2.2 Site Description

The below descriptions of each site, as they were observed at the time of sampling.

2.2.1 Site 1 – Jet Fuel Enviro Shed – Helipad

Site 1 was observed to have already had all debris materials removed from the site area, leaving no visible evidence of any suspect hazardous building materials remaining at the site area.

2.2.2 Site 2 - Visitor Reception Center

Site 2 was observed to have burnt debris and ash throughout the site. The concrete/stone foundation and perimeter walls of one building were observed. Remaining stone walls and archways were observed to still be standing.

2.2.3 Site 4 - Gate House- Park Entrance

Site 4 was observed to have burnt debris and ash throughout the site, with debris mainly contained within the concrete foundation of the building. The footprint of an adjoined garage was also observed.

2.2.4 Site 5 - Heavy Equipment

Two burnt storage trailers and a service vehicle were observed on Site 5. Residual debris/ash was observed within the trailers.

2.2.5 Site 6 - Canyon Church Camp

Site 6 was not physically accessed by the [R.J. & A.] inspector due to weather conditions at the time of the site investigations.

2.2.6 Site 7 - Golf Course Maintenance

The concrete foundation of the original building was partially observed. A large pile of ash and debris which included burnt golf carts was observed adjacent to the original building foot print. Various burnt debris and ash were also observed within the original foot print of the building.

2.2.7 Site 8 - Alpine Stables

The concrete foundation walls for the “Stables”, “Bunkhouse”, and “House” were observed at Site 8. Burnt debris and ash was observed within each building footprint.

2.2.8 Site 9 - Operations Compound

Site 9 was observed to have already had all debris materials removed from the site area, leaving no visible evidence of any suspect hazardous building materials remaining at the site area.

2.2.9 Site 10 - Salamander Pipe

The Salamander pipe was observed on the north side of the main road between the Visitor Centre and the Operations Compound. The majority of the pipe was observed to be burnt/melted and only debris remaining. Select areas of the pipe were observed to be intact.

2.3 Applicable Standards and Guidelines

All work under this project was completed in strict adherence with applicable federal, provincial and local legislation, regulations, codes and standards governing hazardous materials investigation, including all associated work done in conjunction with the investigation or included within the scope of the work.

The governing of hazards and hazardous materials in the workplace to ensure worker safety in the province of Alberta is regulated under the Occupational Health and Safety Act (2012) – Parts 4.1, 12, 14, and 24, Occupational Health and Safety Regulation (62/2003, updated 2013) – Part 1, and Occupational Health and Safety Code (2009) – Parts 1, 2, 4 and 30.

Federally regulated buildings and sites, hazardous substances in the workplace are governed by the Canada Labour Code (Part II) and regulated through the Canada Occupational Health and Safety regulations (Part X). In addition, the following standards were considered as part of meeting the objectives of the project: PSPC Asbestos Management Standard (June 5, 2017), National Joint Council Occupational Health and Safety Directive – Part XI, and the PSPC Standard on Hazardous Substances.

In the event of local/provincial contractors performing work inside of a federal employed building, the most stringent asbestos management standards (federal, provincial, local) would apply.

[R.J. & A.] followed all provincial and federal guidelines and regulations applicable to the implementation and completion of the project scope of work

See Appendix A for a table outlining applicable sections of relevant guidelines and regulations.

2.4 Previous Experience in Workplace

[R.J. & A.] conducted an initial historic review of the site to establish the presence of any known asbestos materials specific to the defined area. This would include accessing original and updated drawings, review of previous building occupants and building uses, and review of previous hazard survey reports and analytical data. Drawings relating to the project scope of work areas were not provided. Limited photos of select site prior to the fires were obtained from the client and public access websites.

[R.J. & A.] was not provided with previous hazardous materials reports prior to beginning the survey.

2.5 Limitations and Exclusions Regarding Scope

This report details the regulated substances – asbestos-containing materials (ACM), lead-based paint and other lead products (Pb), and mercury materials (Hg), - that may be found within or forming part of the building materials damaged or destroyed from the wildfires.

The investigation considered issues of the structure and finishes, including mechanical equipment. Destructive sampling was performed wherever determined necessary to obtain representatives samples from the site areas.

Every effort was made to discover all regulated substances, however further suspect material may be undetermined due to the level of extreme damage and deterioration of the subject site buildings. Sampling and identification of these undetermined materials would occur as a result obtaining original details (as-built drawings and specifications) on each subject building.

2.6 Methodology

Arielle Connelly (AHERA Cert#: CABIR-17-080) of [R.J. &A.] conducted the fieldwork. The surveyor entered all sites identified by our scope of work, with the exception of Site 6 due to safety concerns and collected samples from accessible areas. A half-mask respirator equipped

with HEPA P-100 filters and a Tyvek suit were worn for personal protection. The sampling was conducted during day shift hours. Photographs were taken to document existing conditions and selected sample locations.

2.6.1 Survey and Assessment Criteria

During the survey assessments at each Site, the [R.J. & A.] technician used their best judgement to identify and distinguish suspect hazardous materials; however, with the snow cover and severely burnt conditions, identification was limited.

Representative samples were collected and/or visual observation of the hazardous materials was conducted.

Materials were assessed to determine the current condition and associated hazards that may occur in relation to occupational experiences in the workplace.

2.6.2 Asbestos Containing Materials

The methodology for completing the asbestos investigation consisted of identifying suspect asbestos-containing materials (ACM) within homogeneous sampling areas (HSAs) and then collecting samples of these suspect materials in airtight sample bags.

Bulk Sampling was performed according to AHERA procedures found in the United States Code of Federal Regulations (CFR) Part 40 Section 763.86 and British Columbia Occupational Health and Safety Regulations, Section 20.112".

Any suspect building material that was recognizable (ie: drywall joint compound) was sampled and analyzed for bulk asbestos content. When unachievable, the accumulated debris materials and/or residual materials was sampled and analyzed for asbestos and other hazardous parameters considered to be of concern for purpose of site remediation planning. Historic structures that are intended to be preserved or relocated elsewhere, have the potential to have residual debris on the surfaces. To prevent possible exposure risks, [R.J. & A.] collected surface wipe samples from such structures for asbestos fiber determination using Transmission Electron Microscopy analysis.

2.7 Quantities

The inspector(s) obtained measurements of each room entered as part of the investigation, and all suspect building materials observed within. Measurements provided in this report are to be considered as estimates, as materials were not accessible on a foot by foot basis.

Units of measurement used to report quantities of suspect building materials are: linear meter, square meter, cubic meter and each.

2.8 Sample Analysis

2.8.1 Asbestos Analysis

Bulk samples collected for asbestos analysis were labelled and submitted to Asbestos Analytical Services Ltd. for bulk asbestos analysis in accordance with NIOSH PLM Method 9002. The methodology for the analysis of asbestos in building materials is by using polarized light microscopy and dispersion staining techniques.

The detection limit of these methods is listed as 1%.

Multiple phases within samples are analyzed separately and then combined to provide a total asbestos content for each sample. The method determines the content of asbestos-containing materials by type and percent volume using a combination of polarized light microscopy, morphology, refractive index, extinction, signs of elongation, and dispersion staining colors.

2.8.2 Lead Analysis

Surface lead based paints (L.B.P.) or bulk solids collected for lead analysis were labelled and submitted to Maxxam Analytics Inc. for analysis. Representative lead bulk samples collected were digested with acids and analyzed by Inductively Coupled Plasma Spectroscopy (ICP) to confirm the presence of lead within the solid mass.

The U.S. National Institute of Occupational Safety and Health (NIOSH) have developed a number of methods for analyzing lead in paint, including Methods 7082, 7105, and 7300. The results are usually reported by the laboratory in micrograms per gram (µg/g) or milligrams per kilogram (mg/kg). If the area sampled is included, the lab may also report results in milligrams per square centimeter (mg/cm2).

2.8.3 TCLP Total Metals

Sampling of the debris materials for leachability was conducted in accordance with the US EPA Method 1311 and the Modified Leachate Extraction Procedure. The test is to confirm potential leaching ability of total metals from the waste materials and determine the method of disposal. The acceptable (TCLP) limit for disposal of lead-based paint is less than 5 mg/L (5 ppm). If an identified paint exhibits a (TCLP) result of greater than 5 ppm, the paint is considered a hazardous material and shall be disposed of as leachable lead waste material.

Representative samples from each site area were collected. Sample size of each sample contained a minimum weight of 100 grams to meet the analytical method requirement. Samples collected from Site 10 were less than 100 grams, but still were analyzed to obtain useful data. Each sample was comprised of either burnt debris material and/or substrate material. Samples were collected in large Ziploc bags and sealed.

2.8.4 VOC Analysis

During the sampling process, disposable nitrile gloves were worn by the sampler and changed after each sampling location. Samples collected were directly placed into 120mL clear glass jars and hand packed in order to prevent the loss of volatiles through headspace area. Each sampling jar was then sealed with a Teflon lined lid and labeled with a unique sample identification number.

All samples were placed into a cooler containing ice-pack with the corresponding chain-of-custody forms completed before being sent to Maxxam Analytical Laboratory in Burnaby, BC, for Volatile Organics in Soil analysis using Gas Chromatography / Mass Spectrometry.

2.8.5 Sample Retention

R.J. & Associates Environmental Consulting Inc. will store the samples for 30 days after analysis. After this time, the samples will be disposed of unless the client has requested that the samples be returned.

Refer to Appendix B for bulk sample results.

3 Hazardous Materials within each Site

This section summarizes the hazardous materials determined to be present in each site outlined in the scope of work. The quantities of identified materials are estimates.

Furthermore, reported quantities are approximate and should not be interpreted as absolute values for abatement contractor's tendering bids. Additional quantities of hazardous building materials may exist or not be identified due to inherent survey or structural limitations.

Units and numbers in the supporting tables are estimates of visible suspected or confirmed hazardous building materials and relates only to the items tested. Extrapolation by the client or others of the results is the responsibility of the client.

Risk assessment information provided for determined hazardous materials is for general purposes only, thus prior to actual abatement activities, *a formal risk assessment should be conducted by a qualified person to ensure planned restoration work activities do not result in potential increased exposure risks*.

3.1 Hazardous Materials

Table 2 outlines a summary of *samples* analyzed for the presence of hazardous materials within each site

Sample #	Sample Location	Material Description	Sample Type	Results
2509-AC	Site 2, Visitor Reception Centre	Stone Stair Edge	Asbestos Wipe	No fibres
2510-AC	Site 2, Visitor Reception Centre	Stone Archway	Asbestos Wipe	No fibres
2511-AC	**Site 2, Visitor Reception Centre**	**Mastic, ash and debris on ledge of perimeter stone wall**	**Asbestos Bulk**	**Chrysotile & Heated Chrysotile Asbestos Present**
2513-AC	Site 2, Visitor Reception Centre	Stone Perimeter Wall	Asbestos Wipe	No fibres
2514-AC	**Site 2, Visitor Reception Centre**	**Debris and ash beneath metal**	**Asbestos Bulk**	**10-30% Heated Chrysotile Asbestos**
2515-AC(A)	Site 2, Visitor Reception Centre	Metal debris with paint	TCLP- Total Metals	Non-leachable
2515-AC(B)	**Site 2, Visitor Reception Centre**	**Suspect drywall board and mud debris**	**Asbestos Bulk**	**1-10% Chrysotile Asbestos**
2516-AC	Site 6, Canyon Church Camp, Cabin	Suspect drywall board and mud debris	Asbestos Bulk	Non-asbestos
2517-AC	**Site 6, Canyon Church Camp, Cabin Adjacent to Hospital**	**Ash/debris on surface with suspect drywall mud**	**Asbestos Bulk**	**1-10% Heated Chrysotile Asbestos**
2520-AC	Site 6, Canyon Church	Ash/debris on surface	Asbestos Bulk	Non-asbestos

Sample #	Sample Location	Material Description	Sample Type	Results
	Camp, Hospital			
2426-AC	Site 8, Alpine Stables, Stable	Black and white debris with suspect mastic	Asbestos Bulk	Non-asbestos
2427-AC	**Site 8, Alpine Stables, Stable**	**Various burnt debris**	**VOCs**	**0.16 mg/kg (Benzene)**
2430-AC	Site 8, Alpine Stables, Stable	Various debris including ash and metals	TCLP- Total Metals	Non-leachable
2431-AC	Site 8, Alpine Stables, Stable	Debris found on suspect light fixture	Asbestos Bulk	Non-asbestos
2434-AC	Site 8, Alpine Stables, Bunkhouse	Suspect drywall/plaster debris	Asbestos Bulk	Non-asbestos
2435-AC	Site 8, Alpine Stables, Bunkhouse	Various debris including ash and painted metal	TCLP- Total Metals	Non-leachable
2437-AC	Site 8, Alpine Stables, House	Suspect drywall debris outside foot print of building	Asbestos Bulk	Non-asbestos
2438-AC	Site 8, Alpine Stables, House	Debris within HVAC ducting	Asbestos Bulk	Non-asbestos
2439-AC	Site 4, Gate House	Suspect drywall board and mud debris	Asbestos Bulk	Non-asbestos
2440-AC	Site 4, Gate House	Suspect exterior siding/flooring debris	Asbestos Bulk	Non-asbestos
2441-AC	Site 4, Gate House	Various metal, ash debris	TCLP-Total Metals	Non-leachable
2442-AC	Site 4, Gate House	Residual Caulking/mastic around window	Asbestos Bulk	Non-asbestos
2445-AC	**Site 7, Golf Maintenance Shed**	**Various Debris**	**VOCs**	**0.44 mg/kg (Benzene)** **0.11 mg/kg (Ethylbenzene)**
2446-AC	Site 7, Golf Maintenance Shed	Black woven material debris	Asbestos Bulk	Non-asbestos
2447-AC	Site 7, Golf Maintenance Shed	Suspect drywall/board material debris	Asbestos Bulk	Non-asbestos
2448-AC	Site 7, Golf Maintenance Shed	Various metal, ash, and paint debris	TCLP- Total Metals	Non-leachable
2449-AC	Site 7, Golf Maintenance Shed	Various metal, ash, and paint debris	TCLP- Total Metals	Non-leachable
2450-AC	Site 7, Golf Maintenance Shed	Suspect drywall/plaster material	Asbestos Bulk	Non-asbestos
2452-AC	Site 7, Golf Maintenance Shed	Suspect flooring/roofing materials	Asbestos Bulk	Non-asbestos
2453-AC	Site 7, Golf Maintenance	Various Debris	VOCs	No concerns

Sample #	Sample Location	Material Description	Sample Type	Results
	Shed			
2456-AC	Site 10, Salamander Pipe, North	Pipe ash and debris	TCLP- Total Metals	Non-leachable
2457-AC	Site 10, Salamander Pipe, North	Pipe ash and debris	TCLP-Total Metals	Non-leachable
2458-AC	Site 10, Salamander Pipe, North	Pipe ash and debris	TCLP- Total Metals	Non-leachable
2459-AC	Site 10, Salamander Pipe, North	PVC Pipe with yellow-beige coating	Lead Bulk	Non-detect
2461-AC	Site 10, Salamander Pipe, North	PVC Pipe with rubber mat material	Asbestos Bulk	Non-asbestos
2462-AC	Site 10, Salamander Pipe, North	PVC pipe with yellow-beige coating	Lead Bulk	Non-detect
2463-AC	Site 10, Salamander Pipe, North	Melted ash and debris on soil	TCLP- Total Metals	Non-leachable
2464-AC	Site 10, Salamander Pipe, North	Melted ash and debris on soil	Asbestos Bulk	Non-asbestos
2465-AC	Site 10, Salamander Pipe, South	PVC pipe with yellow-beige coating	Asbestos Bulk	Non-asbestos
2466-AC	Site 10, Salamander Pipe, South	PVC pipe with yellow-beige coating	Lead Bulk	Non-detect
2467-AC	Site 10 Salamander Pipe, South	PCV pipe with yellow-beige coating	Lead Bulk	Non-detect
2468-AC	Site 5, Heavy Equipment	Various metal, ash and debris from burnt trailers	TCLP- Total Metals	Non-leachable
2469-AC	Site 5, Heavy Equipment	Fibrous debris within trailer	Asbestos Bulk	Non-asbestos

3.1.1 Site 2- Visitor Reception Centre

Among various undistinguishable debris, suspect drywall and drywall mud was observed within the debris pile inside the foot print of the building. Bulk sample (2515-AC(B)) of the suspect drywall mud and debris was collected and submitted for laboratory analysis. The material was determined to contain **1-10% Chrysotile and Heated Chrysotile Asbestos.**

Bulk sample (2511-AC) of burnt ash, mastic, and debris was collected from the ledge of the perimeter stone wall and submitted for laboratory analysis. The material was determined to have **Chrysotile and Heated Chrysotile Asbestos Fibres present.**

Bulk sample (2514-AC) of various burnt debris and ash from an unknown source was collected from within the foot print of the building and submitted for laboratory analysis. The material was determined to contain **10-30% Chrysotile and Heated Chrysotile Asbestos.**

Wipe samples (2509-AC, 2510-AC and 2513-AC) were collected from remaining intact stone walls and archway and submitted for TEM laboratory analysis. All three samples showed no asbestos fibres present.

Based on the above results, all debris within fencing of Site 2 is considered **asbestos containing.**

Bulk sample (2515-AC(A)) of metal debris and various ash was collected from within the foot print of the building and submitted for laboratory analysis for total metals leachability. The material was determined to be non-leachable for all metals analyzed.

3.1.2 Site 4 - Gate House- Park Entrance

Suspect drywall and drywall mud debris was observed within the foot print of the building. Bulk sample (2439-AC) of the suspect drywall mud was collected and submitted for laboratory analysis. The material was determined to be non-asbestos.

Residual caulking/mastic debris was observed within window frame areas of the remaining portion of the building. Bulk sample (2442-AC) of the suspect caulking/mastic and other debris material was collected and submitted for laboratory analysis. The material was determined to be non-asbestos.

Bulk sample (2440-AC) of debris from unknown sources was collected from within the foot print of the main building and submitted for laboratory analysis. The material was determined to be non-asbestos.

Bulk sample (2441-AC) of various burnt metal, ash, and other debris was collected from within the foot print of the main building and submitted for laboratory analysis for total metals leachability. The material was determined to be non-leachable for all metals analyzed.

3.1.3 Site 5 - Heavy Equipment

Fibrous debris material of an unknown source was observed within the burnt trailers. Bulk sample (2469-AC) of the debris was collected and submitted for laboratory analysis. The material was determined to be non-asbestos.

Bulk sample (2468-AC) of various burnt metal, ash and debris was collected from within the burnt trailers and submitted for laboratory analysis for total metals leachability. The material was determined to be non-leachable for all metals analyzed.

3.1.4 Site 6- Canyon Church Camp

Due to severe weather conditions upon [R.J. & A.] arrival to Waterton, bulk samples from this site location were taken by Dillon Consulting Field Technician in advance and passed along to [R.J. & A.].

Bulk sample (2516-AC) of suspect drywall with burnt ash and debris was collected within the cabin and submitted for laboratory analysis. The material was determined to be non-asbestos.

Bulk sample (2517-AC) of suspect drywall mud with burnt ash and debris on surface of soil was collected from the cabin adjacent to the hospital and submitted for laboratory analysis. The material was determined to contain **1-10% Heated Chrysotile Asbestos.**

Bulk sample (2520-AC) of burnt ash, debris, and suspect drywall was collected from the hospital and submitted for laboratory analysis. The material was determined to be non-asbestos.

Based on the above results, all debris within the Canyon Church Camp is considered **asbestos-containing,** until further sampling is completed.

3.1.5 Site 7- Golf Course Maintenance Shed

A black woven material was observed amongst the debris piles. Bulk sample (2446-AC) of the material was collected from within the foot print of the building and submitted for laboratory analysis. The material was determined to be non-asbestos

Suspect drywall board material and joint compound/skim coat material was observed throughout the debris pile. Bulk samples (2447-AC and 2450-AC) of the material were collected from within the foot print of the building and submitted for laboratory analysis. The material was determined to be non-asbestos.

Bulk sample (2452-AC) of various debris from unknown sources was collected from within the foot print of the building and submitted for laboratory analysis. The material was determined to be non-asbestos.

Bulk samples (2448-AC and 2449-AC) of various metal, ash and paint debris were collected from the north and south areas of the debris piles and submitted for laboratory analysis for total metals leachability. The materials were determined non-leachable for all metal analyzed.

Bulk samples (2445-AC and 2453-AC) of various debris were collected from within the foot print of the building and from the large debris pile and submitted for laboratory analysis for VOC content. The debris material was determined to contain elevated levels of **benzene (0.44 mg/kg) and ethylbenzene (0.11 mg/kg),** which exceed CCME Soil Quality Guidelines for the Protection of Environmental and Human Health – Parkland/Residential Land**.**

3.1.6 Site 8- Alpine Stables

Black and white debris with suspect mastic material was observed within the foot print of the Stable. Bulk sample (2426-AC) of the material was collected and submitted for laboratory analysis. The material was determined to be non-asbestos

A burnt light fixture was observed within the north-west corner of the Stable. Bulk sample (2431-AC) of the light gasket debris was collected and submitted for laboratory analysis. The material was determined to be non-asbestos.

Large quantities of suspect drywall board and skim coat materials were observed within the Bunkhouse and House. Bulk samples (2434-AC and 2427-AC) of the material was collected and submitted for laboratory analysis. The material was determined to be non-asbestos.

Various suspect debris was observed within a large rectangular duct within the Bunkhouse. Bulk sample (2438-AC) of the debris was collected and submitted for laboratory analysis. The material was determined to be non-asbestos.

Bulk samples (2430-AC and 2435-AC) of various metal, ash, and paint debris were collected from the Stables and Bunkhouses and submitted for laboratory analysis for total metals leachability. The materials were determined non-leachable for all metals analyzed.

Bulk sample (2427-AC) of various black, loose debris was collected from within the foot print of the Stable and submitted for laboratory analysis for VOC content. The debris material was determined to contain elevated levels of **benzene (0.16 mg/kg),** which exceed CCME Soil Quality Guidelines for the Protection of Environmental and Human Health – Parkland/Residential Land**.**

3.1.7 **Site 10- Salamander Pipe**

The PVC pipe with an interior rubber mat material and an exterior yellow-beige coating was observed to either be partially burnt, with remaining large pieces of pipe, or completely burnt, with ash and debris melted onto the soil.

Bulk samples (2461-AC,2464-AC, and 2465-AC) of the PVC pipe, rubber mat material, and ash/debris were collected along the pipe line and submitted for laboratory analysis. The material was determined to be non-asbestos.

Bulk samples (2459-AC, 2462-AC, 2466-AC, and 2467-AC) of the PVC pipe and yellow-beige coating were collected along the pipe line and submitted for laboratory analysis. The material was determined to have non-detectable levels of Lead.

Bulk samples (2456-AC, 2457-AC, 2458-AC, 2463-AC, and 2468-AC) of the PVC pipe, rubber mat material, yellow-beige coating and ash/debris were collected along the pipe line and submitted for laboratory analysis for leachability. The materials were determined non-leachable.

Refer to Appendix B for laboratory results of suspect materials.

Refer to Appendix C for photo confirmation of the hazardous containing materials.

Refer to Appendix D for sample location drawings of all sampled materials.

4 Survey Limitations

4.1 Live Systems

"Live Systems" were not considered present within the Sites.

4.2 Inaccessible Spaces

The Canyon Church Camp Site was deemed unsafe for access by Parks Canada at the time of sampling. Dillon Consulting accessed the site prior to [R.J. & A.] arrival and obtained bulk samples of unknown materials.

4.3 Occupied Areas

The sites remained unoccupied during the time of sampling.

4.4 Other Factors

All sites had a layer of snow cover at the time of sampling. To the best of their ability, [R.J. & A.] cleared snow cover to observe all bulk and debris materials.

5 Recommendations for Management

Where a visual assessment or bulk sampling and subsequent laboratory analysis has determined that hazardous building materials may be present, no work that may disturb the material should proceed until a qualified professional has abated and removed the material or implemented effective management controls to prevent possible exposure.

The hazardous materials identified by this report should be considered when developing a specification for the demolition and remediation of the subject site areas.

This hazard materials survey report does not constitute as being an acceptable scope of work suitable for a hazardous materials contractor bid.

Onsite monitoring should also be provided during any abatement activities to ensure that work follows acceptable environmental practices as set out in the applicable regulations, codes of practice, and procedures.

5.1 Asbestos

All asbestos-containing materials confirmed present in a federal building or former building site area is to be managed in accordance with the recently released (June 2017) PSPC Asbestos Management Standard, which is to supplement Part II of the *Canada Labour* Code – Occupational Health and Safety, as well as the *Canada Occupational Health and Safety Regulations* (COHSR) Part X – Hazardous Substances, subsection 10.19 Control of Hazards. This directive requires each asbestos-containing material to have in place an Asbestos Management Plan (AMP).

The Asbestos Management Plan purpose is to perform a variety of functions relating to the effective control and management of ACM in a building. One main element that is required to prevent exposure to potentially harmful levels of asbestos, is to complete assessments of all identified asbestos-containing materials as a result of the survey and laboratory analysis. The assessment of the ACM is typically to consider the following:

- Type of building material (floor tile, pipe insulation, etc.)
- Location of the material,
- Asbestos type and percent content
- Friability (friable or non-friable)
- Quantity of building material
- Asbestos condition (good, fair, poor)
- Accessibility of asbestos (access A, B, C exposed, C concealed, D)

The information derived from the assessment evaluation is implemented into the action matrix used to prioritize corrective actions in terms of potential human health risk.

All units and numbers in the table below are estimates of confirmed asbestos containing materials at the time of inspection only.

Table 4 – Risk Assessment of confirmed ACMs present within the subject building.

ACM	Site	Friability	Accessibility	Condition of ACM	Percent (%) Concentration of ACM	Approx. Quantity	Overall Risk Rating
Various Ash/Debris Material	Site 2- Visitor Reception Centre	Yes	B	Poor	**1-30% Chrysotile**	139 m^3	1
Various Ash/Debris Material	Site 6- Canyon Church Camp	Yes	B	Poor	**1-10% Chrysotile**	45 m^3	1

Any items in the above table highlighted in red are considered to pose the most risk of asbestos exposure towards workers. Abatement response action is recommended to resolve and eliminate these sources of asbestos exposure.

The condition of the asbestos containing materials are recorded at the time of inspection. Thus, the condition of all asbestos containing materials may have changed since the time of inspection.

Control Action Ratings:

- ✓ *Action 1 – Immediate clean-up of debris that is likely to be disturbed.*
- ✓ *Action 2 – Entry into areas with asbestos-containing material debris requires intermediate risk precautions.*
- ✓ *Action 3 – Asbestos-containing material removal required for compliance.*
- ✓ *Action 4 – Access into areas where asbestos-containing material is present and likely to be disturbed by access requires intermediate risk precautions.*
- ✓ *Action 5 – Proactive asbestos-containing material removal.*
- ✓ *Action 6 – Asbestos-containing material repair.*
- ✓ *Action 7 – Routine surveillance.*

Accessibility Classification:

- ✓ *Access A – Areas of the building within reach (from floor level) of all building users. Includes areas such as gymnasiums, workshops, and storage areas where activities of the building users (e.g. basketball on gym ceiling) may result in disturbance of asbestos-containing material not normally within reach from floor level.*
- ✓ *Access B – Frequently entered maintenance areas within reach of maintenance staff, without the need of a ladder. Includes: frequently entered pipe chases, tunnels and service areas or areas within reach from a fixed ladder or catwalk, e.g. tops of equipment, mezzanines.*
- ✓ *Access C Exposed – Areas of the building above 8 feet where use of a ladder is required to reach the asbestos-containing material. Only refers to asbestos-containing material materials that are exposed to view, from the floor to ladder, without removing or opening other building components such as ceiling tiles, or service access doors or hatches. Does not include infrequently-accessed service areas of the building.*
- ✓ *Access C Concealed – Areas of the building which requires the removal of a building component, including lay-in ceilings and access panels into solid ceiling systems such as a ventilation plenum. Include rarely-entered crawl spaces, attic spaces, etc. Observations area limited to the extent visible from the access points.*

- ✓ *Access D – Areas of the building behind inaccessible solid ceiling systems, walls, or mechanical equipment, etc., where demolition of the ceiling, wall, or equipment, etc., is required to reach the asbestos-containing material. Evaluation of condition and extent of asbestos-containing material is limited or impossible, depending on the assessor's ability to visually examine the materials in areas rated Access (D).*

Condition Classification:

- ✓ *Poor – Sprayed materials show signs of damage, delamination or deterioration. More than one percent damage to surface of asbestos-containing material spray. (Applies to Spray-applied fireproofing, insulation and texture finishes).*
- ✓ *Poor – Original insulation jacket is missing, damaged, deteriorated or delaminated. Insulation is exposed and significant areas have been dislodged. Damage cannot be readily repaired. (Applies to Mechanical Insulation).*
- ✓ *Fair – Minor penetration damage to jacketed insulation (cuts, nicks, tears, deterioration or delamination), or undamaged insulation that has never been jacketed. Insulation is exposed but not showing surface disintegration. The extent of missing insulation should range from minor to none. (Applies to Mechanical Insulation only).*
- ✓ *Good – Insulation is completely covered in jacketing and exhibits no evidence of damage or deterioration, i.e. no insulation is exposed. Includes conditions where the jacketing has minor surface damage (i.e. scuffs or stains), but the jacketing is not penetrated. (Applies to Mechanical Insulation only).*
- ✓ *Good – Surface of material shows no significant signs of damage, deterioration or delamination. Up to one percent of the surface area having visible damage to surface is allowed within range of GOOD. Evaluation of sprayed fireproofing requires the assessor to be familiar with the irregular surface texture typical of sprayed asbestos products. GOOD condition includes un-encapsulated or unpainted fireproofing, insulation or texture finishes where no delamination or damage is observed, and encapsulated fireproofing, insulation or texture finishes where the encapsulation has been applied after the damage of fallout occurred. (Applies to Spray-applied fireproofing, insulation and texture finishes).*

In addition, any decisions regarding abatement of the materials must be forwarded in the form of N.O.P.A. (with site-specific work procedures-a proper exposure plan must be developed by a qualified person) to Work Safe Alberta.

5.2 VOCs in Debris/Soil Material

The results of the debris/soil sampling investigation have concluded that debris/soil contamination is present at Sites 7 and 8. Analytical results have determined Benzene and Ethylbenzene concentrations in the debris/soil material at these locations to be above the CCME Soil Quality Guidelines for the Protection of Environmental and Human Health – Parkland/Residential Land**.**

It is estimated that there is eight hundred (800) cubic meters or more of VOCs contaminated debris/soil combined at the two site areas. This material should be excavated and transported offsite for final disposal to a fully permitted waste treatment facility.

Table 5 - Risk Assessment of confirmed VOC s present within the scope of work.

VOCs in Debris/Soil Material	

Material Description / Location	Sample #	Concentration (mg/kg)	CCME Soil Guideline Parkland/Res. Land (mg/kg)	Approx. Quantity
Various ash and debris – Site 8	2427-AC	**0.16 (Benzene)**	0.030	530 m^3
Various black, loose burnt debris – Site 7	2445-AC	**0.44 (Benzene)**	0.030	270 m^3
		0.11 (Ethylbenzene)	0.082	

6 Closure

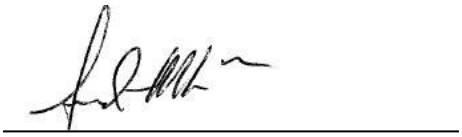
Subject to the following conditions and limitations, the investigation described in this report has been conducted in a manner consistent with adequate levels of care and skill normally exercised by members of the Health, Safety, and Environmental consulting profession currently practicing under similar conditions in the area. The investigation described in this report has been limited to the scope of work described in our contract. The scope of the investigation has been reasonable having regard for the budget constraint. The taking of samples at the site was consistent with the scope of work described in our contract; the budget for the investigation, and the information obtained concerning prior site use. Since the conditions between samples may vary, the potential remains for the presence of unknown additional contaminants.

The testing for, and analysis of compounds and materials at the site has been limited to those compounds and materials set out in our contract. Other compounds or materials not tested could be present at the site. The investigation described in this report has been made in the context of existing government regulations generally promulgated at the date of this report. The investigations did not take account of any government regulations not in effect or not generally promulgated at the date of this project. The investigation described in this report has relied upon information provided by third parties concerning the history of the site and on test results and analyses provided by independent laboratories and testing services. Except as stated in this report, we have not made an independent verification of such historical information or test results and analyses.

Where indicated, or implied in this report, or where mandated by the condition of the site and its attendant structures, the conclusions of this report are based on visual observation of the site. The conclusions of this report do not apply to any areas of the site not available for inspections. If new information is developed in future work (which may include additional sampling, testing or other investigations), [R.J. & A] should be requested to reevaluate the findings in this report, and to provide amendments as required.

This report is intended for the exclusive use of PSPC. It may not be used or relied upon in any manner whatsoever, or for any purpose whatsoever, by any other party. [R.J. & A.] makes no representation of fact or opinion of any nature whatsoever to any person or entity other than PSPC to whom this report is addressed. Any use which a third party makes of this report, or any reliance on or decisions to be made or actions based on it, are the responsibility of such third parties.

[R.J. & A.] accepts no responsibility for damages, if any suffered by a third party as a result of decisions made or actions based on this report. This report is intended solely as a reference document and cannot be used as part of a specification or tender package.



Andrew Marshall, B.Sc.
Project Manager

R.J. & Associates Environmental Consulting Inc.

Appendix A – References

Occupational Health & Safety Act – Alberta, as amended 12/2012. Occupational Health and Safety Regulation – Alberta, as amended 10/2013. Occupational Health and Safety Codes – Alberta (2009).

Canada Labour Code – Part II, as amended June 22, 2017. Canada Occupational Health and Safety Regulation, as amended June 20, 2017.

Public Services and Procurement Canada – Asbestos Management Standard, June 5, 2017.

National Joint Council – Occupational Health and Safety Directive, Part XI.

Public Services and Procurement Canada – Standard on Hazardous Substances.

Transportation of Dangerous Goods Regulations, Transport Canada, 1985, as amended August 2, 2017.

Canadian Council of Ministers of the Environment (CCME) – Soil Quality Guidelines for the Protection of Environmental and Human Health.

Guidelines for the Disposal of Asbestos Waste, Alberta Environment – Protection Services, August 1989. Environment Canada reference guide entitled "Identification of Lamp Ballasts Containing PCBs, Report EPS 2/CC/2, August 1991".

The Environment Protection and Enhancement Act, Waste Control Regulation (192/1996, amendments 62/2013) applies to the disposal of all hazardous wastes within provincial jurisdiction and is enforced by the Government of Alberta.

AHERA Procedures—United States Code of Federal Regulations (CFR) Part 40 Section 786.86

Appendix B – Bulk Sample Laboratory Results

Asbestos Analytical Services Ltd.
7 - 2883 East Kent Avenue N., Vancouver, BC, V5S 3T9

ASBESTOS ANALYSIS REPORT

AASL Report #: **B02062**
Analyst: Gabrielle Sutton
Report Date: 10JAN2018
Method: NIOSH Method 9002

Project Location: Waterton Lake National Park, Alberta
Reference #s: RH171220-01AC, RCC180105-01AC
Number of Samples: 3

# B02062	Sample	Sub-Sample	Sample Description / Location	Results	ASB
1. 1 §[1]	**2511-AC**	Phase 1 - grey, hard, metallic	Mastic, Ash, Debris, on Ledge of Perimeter Stone Wall, Visitor's Reception Centre, Site 2	Asbestos Fibres Not Detected 90 - 100 % Non-Fibrous	---
1. 2 §[2]	2511-AC	Phase 2 - weave	Mastic, Ash, Debris, on Ledge of Perimeter Stone Wall, Visitor's Reception Centre, Site 2	Asbestos Fibres Not Detected 60 - 80 % Fibrous Glass > 20 % Non-Fibrous	---
1. 3 §[3]	2511-AC	Phase 3 - black and grey loose debris / fibrous debris	Mastic, Ash, Debris, on Ledge of Perimeter Stone Wall, Visitor's Reception Centre, Site 2	Chrysotile Asbestos Present Heated Chrysotile Asbestos Present Fibrous Glass Present Insect Hair & Appendages Present	**T**
2. 1 §[4]	**2514-AC**	Phase 1 - light grey fibrous	Various Debris, Ash, Beneath Metal (Unknown Source), Visitor's Reception Centre, Site 2	Asbestos Fibres Not Detected 30 - 50 % Fibrous Glass > 50 % Non-Fibrous	---
2. 2 §[5]	2514-AC	Phase 2 - beige fibrous	Various Debris, Ash, Beneath Metal (Unknown Source), Visitor's Reception Centre, Site 2	10 - 30 % Chrysotile Asbestos & Heated Chrysotile Asbestos 10 - 30 % Fibrous Glass > 50 % Non-Fibrous	**T**
2. 3 §[6]	2514-AC	Phase 3 - off-white fibrous	Various Debris, Ash, Beneath Metal (Unknown Source), Visitor's Reception Centre, Site 2	Asbestos Fibres Not Detected 40 - 60 % Fibrous Glass > 40 % Non-Fibrous	---
2. 4 §[7]	2514-AC	Phase 4 - light brown fibrous	Various Debris, Ash, Beneath Metal (Unknown Source), Visitor's Reception Centre, Site 2	Asbestos Fibres Not Detected 70 - 90 % Cellulose Fibres > 10 % Non-Fibrous	---
3. 1 §[8]	**2515-AC(B)**	Phase 1 - white	Suspect Drywall & Mud Debris with Ash, Visitor's Reception, Site 2	Asbestos Fibres Not Detected 90 - 100 % Non-Fibrous	---
3. 2 §[9]	2515-AC(B)	Phase 2 - light grey-beige	Suspect Drywall & Mud Debris with Ash, Visitor's Reception, Site 2	1 - 10 % Chrysotile Asbestos & Heated Chrysotile Asbestos > 90 % Non-Fibrous	**T**
3. 3 §[10]	2515-AC(B)	Phase 3 - light fibrous	Suspect Drywall & Mud Debris with Ash, Visitor's Reception, Site 2	Asbestos Fibres Not Detected 90 - 100 % Fibrous Glass > 5 % Non-Fibrous	---

Comments

Samples analyzed in accordance with NIOSH Laboratory Method 9002
American Industrial Hygiene Association (AIHA) BAPAT Program Laboratory Number 204301
Estimated Limit of Detection is <0.5 %
ASB = Asbestos present/absent in material
T = Asbestos Present
AASL Asbestos Analytical Services Ltd. will not accept any responsibility as to the manner of interpretation or application of these results.

§[1] Sample B02062-1 (#2511-AC) Phase 1 is a severely fire-damaged and partially-melted metal material, and comprises the majority of the sample.

§[2] Sample B02062-1 (#2511-AC) Phase 2 is fibrous weave material, suspect to be remnants of a fire-damaged membrane material, such as a roofing felt sheeting, or ducting sheathing, or similar. Attached to the weave are two large metal screws (not reported).

§[3] Sample B02062-1 (#2511-AC) Phase 3 is loose, charred debris material, with remnants of various fibrous materials present, including: several small brown fibrous clumps suspect to be an ashed mastic or caulking material determined to contain chrysotile asbestos and heated chrysotile asbestos; a small piece of fibrous sheet material suspect to be an ashed roofing felt material determined to be composed of chrysotile asbestos; light fibrous clumps determined to be fibrous glass insulation, and pieces of black charred wood. Due to the non-homogeneous nature of debris, quantification is not practicable, thus only presence of fibres is reported, however chrysotile asbestos was determined to be present in small amounts.

§[4] Sample B02062-2 (#2514-AC) Phase 1 is a light grey fibrous material determined to contain fibrous glass and perlite, and is suspect as being an ashed insulation or ceiling tile or fibrous board material, is non-asbestos, and comprises the majority of the sample.

§[5] Sample B02062-2 (#2514-AC) Phase 2 is a beige fibrous material determined to contain chrysotile asbestos and heated chrysotile asbestos, fibrous glass and some perlite, and is suspect as being an ashed insulation material.

§[6] Sample B02062-2 (#2514-AC) Phase 3 is a fire-damaged fibrous board material, and determined to contain fibrous glass, and is suspect as being a fire-damaged non-asbestos electrical arc-panel or transite board material.

§[7] Sample B02062-2 (#2514-AC) Phase 4 is loose, tiny bits of charred printed paper material, and is determined to contain cellulose fibres.

§[8] Sample B02062-3 (#2515-AC(B)) Phase 1 is a fire-damaged drywall board material, and comprises the majority of the sample.

§[9] Sample B02062-3 (#2515-AC(B)) Phase 2 is a small portion of fire-damaged joint compound material present on the surface of one piece of drywall board material, or present as tiny loose bits and is determined to contain chrysotile asbestos and heated chrysotile asbestos.

§[10] Sample B02062-3 (#2515-AC(B)) Phase 3 is loose, tiny bits of light fibrous material determined to contain fibrous glass.

Analyst: ***Original Signed By***
Gabrielle Sutton, B.A.

Date: January 10, 2018

Original Signed By
Reviewed By: Gabrielle Sutton, B.A.

Asbestos Analytical Services Ltd.
7 - 2883 East Kent Avenue N., Vancouver, BC, V5S 3T9

ASBESTOS ANALYSIS REPORT

AASL Report #: **B02063**
Project Location: Waterton Lake National Park, Alberta
Analyst: Gabrielle Sutton
Reference #s: RH180105-01AC, RCC180105-02AC
Report Date: 11JAN2018
Number of Samples: 3
Method: NIOSH Method 9002

# B02063	Sample	Sub-Sample	Sample Description / Location	Results	ASB
1. 1 §[1]	**2516-AC**	Phase 1 - white	Suspect Drywall in Ash / Debris, Canyon Church, Cabin, Site 6	Asbestos Fibres Not Detected 90 - 100 % Non-Fibrous	---
1. 2 §[2]	2516-AC	Phase 2 - grey, hard, metallic	Suspect Drywall in Ash / Debris, Canyon Church, Cabin, Site 6	Asbestos Fibres Not Detected 90 - 100 % Non-Fibrous	---
1. 3 §[3]	2516-AC	Phase 3 - beige	Suspect Drywall in Ash / Debris, Canyon Church, Cabin, Site 6	Asbestos Fibres Not Detected 90 - 100 % Non-Fibrous	---
2. 1 §[4]	**2517-AC**	Phase 1 - black & dark brown debris	Ash / Debris on Surface, Canyon Church, Cabin Adjacent to Hospital, Site 6	Cellulose Fibres Present	---
2. 2 §[5]	2517-AC	Phase 2 - gold-brown, loose	Ash / Debris on Surface, Canyon Church, Cabin Adjacent to Hospital, Site 6	Asbestos Fibres Not Detected 90 - 100 % Non-Fibrous	---
2. 3 §[6]	2517-AC	Phase 3 - light grey & white	Ash / Debris on Surface, Canyon Church, Cabin Adjacent to Hospital, Site 6	Asbestos Fibres Not Detected 90 - 100 % Non-Fibrous	---
2. 4 §[7]	2517-AC	Phase 4 - beige, trace	Ash / Debris on Surface, Canyon Church, Cabin Adjacent to Hospital, Site 6	1 - 10 % Heated Chrysotile Asbestos > 90 % Non-Fibrous	**T**
3. 1 §[8]	**2520-AC**	Phase 1 - black & dark brown debris	Ash / Debris Residual Drywall on Surface, Canyon Church, Hospital, Site 6	Cellulose Fibres Present	---
3. 2 §[9]	2520-AC	Phase 2 - light grey & white	Ash / Debris Residual Drywall on Surface, Canyon Church, Hospital, Site 6	Asbestos Fibres Not Detected 90 - 100 % Non-Fibrous	---
3. 3 §[10]	2520-AC	Phase 3 - off-white fibrous	Ash / Debris Residual Drywall on Surface, Canyon Church, Hospital, Site 6	Asbestos Fibres Not Detected 90 - 100 % Fibrous Glass > 5 % Non-Fibrous	---
3. 4 §[11]	2520-AC	Phase 4 - thin white (paint) / beige	Ash / Debris Residual Drywall on Surface, Canyon Church, Hospital, Site 6	Asbestos Fibres Not Detected 90 - 100 % Non-Fibrous	---

Comments

Samples analyzed in accordance with NIOSH Laboratory Method 9002
American Industrial Hygiene Association (AIHA) BAPAT Program Laboratory Number 204301
Estimated Limit of Detection is <0.5 %
ASB = Asbestos present/absent in material
T = Asbestos Present
AASL Asbestos Analytical Services Ltd. will not accept any responsibility as to the manner of interpretation or application of these results.

§[1] Sample B02063-1 (#2516-AC) Phase 1 is a fire-damaged drywall board material, and comprises the majority of the sample.

§[2] Sample B02063-1 (#2516-AC) Phase 2 is two to four small pieces of severely fire-damaged and partially-melted metal material.

§[3] Sample B02063-1 (#2516-AC) Phase 3 is numerous tiny pieces of thin beige particulate layer composed of fine orange-beige particulate, and is suspected to be a skimcoat or joint compound or similar material.

§[4] Sample B02063-2 (#2517-AC) Phase 1 is loose charred debris material primarily composed of pieces of black charred wood and plant detritus including dried leaves, pine needles, pine cone pieces, plant roots, and comprises the majority of the sample. Due to the non-homogeneous nature of debris, quantification is not practicable, thus only presence of fibres is reported, however no asbestos was detected

§[5] Sample B02063-2 (#2517-AC) Phase 2 is loose, granular vermiculite insulating material mixed in with charred debris. Vermiculite is a mineral which, when it is mined, often contains other trace minerals in variable concentration, including actinolite or tremolite asbestos. However, the amount of vermiculite present in this debris is insufficient to confirm presence of any asbestos; sample was thoroughly examined for the presence of asbestos associated with the vermiculite, and no asbestos was detected.

§[6] Sample B02063-2 (#2517-AC) Phase 3 is several tiny pieces of a fire-damaged drywall board material.

§[7] Sample B02063-2 (#2517-AC) Phase 4 is a single isolated trace piece of fire-damaged joint compound material and is determined to contain heated chrysotile asbestos.

§[8] Sample B02063-3 (#2520-AC) Phase 1 is loose charred debris material primarily composed of pieces of black charred wood and plant detritus including dried leaves, pine needles, pine cone pieces, plant roots, and comprises the majority of the sample. Due to the non-homogeneous nature of debris, quantification is not practicable, thus only presence of fibres is reported, however no asbestos was detected

§[9] Sample B02063-3 (#2520-AC) Phase 2 is several tiny pieces of a fire-damaged drywall board material.

§[10] Sample B02063-3 (#2520-AC) Phase 3 is several small fibrous clumps determined to be fibrous glass insulation.

§[11] Sample B02063-3 (#2520-AC) Phase 4 is several tiny pieces of a fire-damaged painted thin beige particulate layer composed of fine orange-beige particulate, and is suspected to be a texture or joint compound material.

Analyst: ***Original Signed By***
Gabrielle Sutton, B.A.

Date: January 11, 2018

Original Signed By
Reviewed By: Gabrielle Sutton, B.A.

Appendix C – Photographs

RJ & ASSOCIATES
ENVIRONMENTAL CONSULTING

PHOTO REPORT

"WATERTON LAKE NATIONAL PARK:

SITE 2: VISITOR RECEPTION CENTRE

SITE 4: GATE HOUSE- PARK ENTRANCE

SITE 5: HEAVY EQUIPMENT

SITE 7: GOLF COURSE MAINTENANCE SHED

SITE 8: ALPINE STABLES

SITE 10: SALAMANDER PIPE"

FEBRUARY 26, 2018

Photographs – Waterton Lake National Park - Alberta

Description	Photo

Site 2	
Location Site 2, Visitor Reception Centre **Results** No Asbestos Fibres	 View of Asbestos wipe sample (2509-AC) on Stone Stair Edge.
Location Site 2, Visitor Reception Centre **Results** No Asbestos Fibres	 View of Asbestos wipe sample (2510-AC) on Stone archway .

Photographs – Waterton Lake National Park - Alberta

Description	Photo
Location Site 2, Visitor Reception Centre **Results** **Chrysotile & Heated Chrysotile Asbestos Present**	 View of mastic, ash and debris (2511-AC) on ledge of perimeter stone wall at Site 2, Visitor Reception Centre
Location Site 2, Visitor Reception Centre **Results** No Asbestos Fibres	 View of asbestos wipe sample (2513-AC) on Stone Perimeter wall at Site 2, Visitor Reception Centre

Photographs – Waterton Lake National Park - Alberta

Description	Photo
Location Site 2, Visitor Reception Centre **Results** **10-30% Heated Chrysotile Asbestos**	 View of Debris and ash (2514-AC) beneath metal at Site 2, Visitor Reception Centre.
Location Site 2, Visitor Reception Centre **Results** **1-10% Chrysotile Asbestos**	 View of suspect drywall board and mud debris (2515-AC(B)) at Site 2, Visitor Reception Centre

Photographs – Waterton Lake National Park - Alberta

Description	Photo
Location Site 2, Visitor Reception Centre **Results** Non-leachable	 View of metal debris (2515-ACA) for total metals TCLP analysis.
Site 4	
Location Site 4, Gate House **Results** Non-asbestos.	 View of suspect drywall board and mud debris (2439-AC)

Photographs – Waterton Lake National Park - Alberta

Description	Photo
Location Site 4, Gate House **Results** Non-asbestos.	 View of suspect exterior siding/ flooring debris (2440-AC) from Site 4 Gate House.
Location Site 4, Gate House **Results** Non-asbestos.	 View of residual caulking/ mastic around window (2442-AC) from Site 4 Gate House.

Photographs – Waterton Lake National Park - Alberta

Description	Photo
Location Site 4, Gate House **Results** Non-leachable	 View of various metal, ash debris (2441-AC) for total metals TCLP analysis
Site 5	
Location Site 5, Heavy Equipment **Results** Non-asbestos.	 View of debris (2469-AC) within the burnt trailer.

Photographs – Waterton Lake National Park - Alberta

Description	Photo
Location Site 5, Heavy Equipment **Results** Non-leachable	 View of various metal, ash, and debris (2468-AC) within burnt trailers for total metals TCLP analysis.
Site 7	
Location Site 7, Golf Maintenance Shed **Results** Non-asbestos	 View of black woven material debris (2446-AC).

Photographs – Waterton Lake National Park - Alberta

Description	Photo
Location Site 7, Golf Maintenance Shed **Results** Non-asbestos	 View of suspect drywall/ board material debris (2447-AC) from Site 7, Golf Maintenance Shed.
Location Site 7, Golf Maintenance Shed **Results** Non-asbestos	 View of suspect drywall/ plaster material (2450-AC) from Site 7, Golf Maintenance Shed.

Photographs – Waterton Lake National Park - Alberta

Description	Photo
Location Site 7, Golf Maintenance Shed **Results** Non-asbestos	 View of suspect flooring/ roofing material debris (2452-AC) from Site 7, Golf Maintenance Shed.
Location Site 7, Golf Maintenance Shed **Results** Non-leachable	 View of various metal, ash, and paint debris (2448-AC) from the north side for TCLP total metals analysis.

Photographs – Waterton Lake National Park - Alberta

Description	Photo
Location Site 7, Golf Maintenance Shed **Results** Non-leachable	 View of various metal, ash, and paint debris (2449-AC) from the south side for TCLP total metals analysis.
Location Site 7, Golf Maintenance Shed **Results** **0.44 mg/kg of Benzene** **0.11 mg/kg of Ethylbenzene**	 View of debris (2445-AC) for VOC analysis.

Photographs – Waterton Lake National Park - Alberta

Description	Photo
Location Site 7, Golf Maintenance Shed **Results** No elevated levels	 View of various debris (2453-AC) for VOC analysis.
Site 8	
Location Site 8, Alpine Stables, Stable **Results** Non-asbestos	 View of black and white debris with suspect mastic (2426-AC).

Photographs – Waterton Lake National Park - Alberta

Description	Photo
Location Site 8, Alpine Stables, Stable **Results** Non-asbestos	 View of debris found on suspected light fixture (2431-AC) from Site 8, Alpine Stables, Stable.
Location Site 8, Alpine Stables, Bunkhouse **Results** Non-asbestos.	 View of suspect drywall/ plaster debris (2434-AC) from Site 8, Alpine Stables, Bunkhouse.

Photographs – Waterton Lake National Park - Alberta

Description	Photo
Location Site 8, Alpine Stables, House **Results** Non-asbestos	 View of suspect drywall debris (2432-AC) outside foot print of building from Site 8, Alpine Stables, House.
Location Site 8, Alpine Stables, House **Results** Non-asbestos.	 View of debris (2438-AC) within HVAC Ducting from Site 8, Alpine Stables, House.

Photographs – Waterton Lake National Park - Alberta

Description	Photo
Location Site 8, Alpine Stables, Stable **Results** Non-leachable	 View of various debris including ash and metals (2430-AC) from Site 8, Alpine Stables, Stable, for total metals TCLP analysis.
Location Site 8, Alpine Stables, Bunkhouse **Results** Non-leachable	 View of various debris including ash and painted metal (2435-AC) from Site 8 Alpine Stables, Bunkhouse, for TCLP analysis.

Photographs – Waterton Lake National Park - Alberta

Description	Photo
Location Site 8, Alpine Stables, Stable **Results** 0.16 mg/kg of Benzene	 View of various debris (2427-AC) for VOC analysis.
Site 10	
Location Site 10, Salamander Pipe, North **Results** Non-detect level of lead.	 View of PVC pipe with yellow beige coating (2459-AC) from Site 10, Salamander Pipe.

Photographs – Waterton Lake National Park - Alberta

Description	Photo
Location Site 10, Salamander Pipe, North **Results** Non-asbestos	 View of PVC pipe with rubber mat material (2461-AC) from Site 10, Salamander Pipe.
Location Site 10, Salamander Pipe, North **Results** Non-detect level of lead.	 View of PVC pipe with yellow beige coating (2462-AC) from Site 10, Salamander Pipe.

Photographs – Waterton Lake National Park - Alberta

Description	Photo
Location Site 10, Salamander Pipe, North **Results** Non-asbestos	 View of melted ash and debris (2464-AC) on soil from Site 10, Salamander Pipe.
Location Site 10, Salamander Pipe, South **Results** Non-asbestos	 View of PVC pipe with yellow-beige coating (2465-AC) from Site 10, Salamander Pipe.

Photographs – Waterton Lake National Park - Alberta

Description	Photo
Location Site 10, Salamander Pipe, South **Results** Non-detect level of lead.	 View of PVC pipe with yellow-beige coating (2466-AC) from Site 10, Salamander Pipe.
Location Site 10, Salamander Pipe, South **Results** Non-detect level of lead.	 View of PVC with yellow-beige coating (2467-AC) from Site 10, Salamander Pipe.

Photographs – Waterton Lake National Park - Alberta

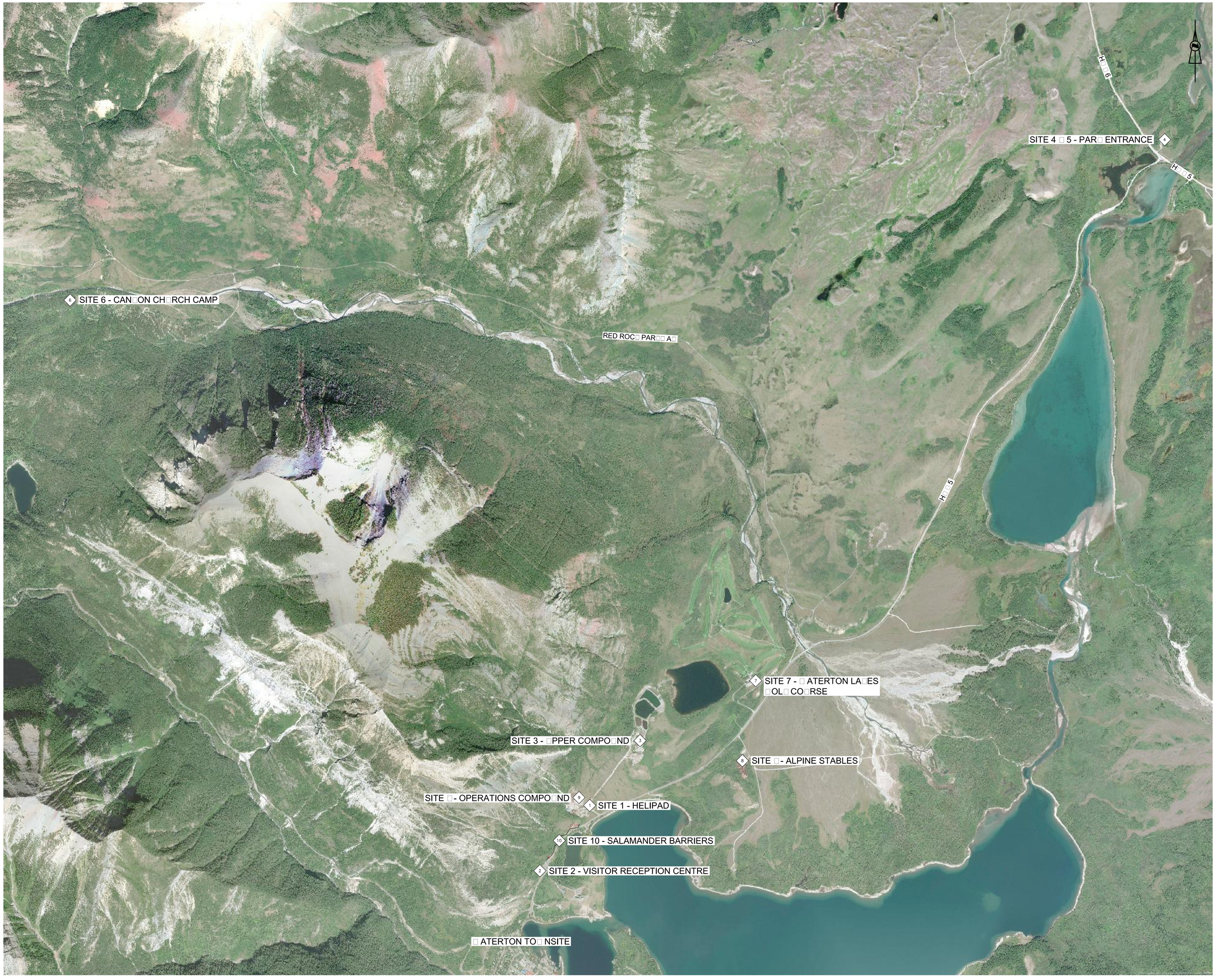
Description	Photo
Location Site 10, Salamander Pipe, South **Results** Non-leachable	 View of PVC pipe ash and debris (2456-AC) for TCLP total metals analysis.
Location Site 10, Salamander Pipe, South **Results** Non-leachable	 View of PVC pipe ash and debris (2457-AC) for TCLP total metals analysis.

Photographs – Waterton Lake National Park - Alberta

Description	Photo
Location Site 10, Salamander Pipe, South **Results** Non-leachable	 View of PVC pipe ash and debris (2458-AC) for TCLP total metals analysis.
Location Site 10, Salamander Pipe, South **Results** Non-leachable	 View of PVC pipe ash and debris (2463-AC) for TCLP total metals analysis.

Photographs – Waterton Lake National Park - Alberta	
Description	**Photo**

Appendix D – Sample Location Drawings



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SCALE 1:10,000 METRES

No.	Date/Date	Description/Description	Drawn by Dessiné par	Approved Approuvé
1	09/01/18	ISSUED FOR REVIEW	BDS	

Revision / Revision

A detail number numéro de detail
B source drawing no. de dessin no.
C detail on drawing no. detail sur dessin no.

Consultant's Name
Nom de l'expert-conseil

DILLON CONSULTING

Eng. Stamp
Sceau de l'ingénieur

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

Client Services Team Southern Alberta Operations Branch
Le Client Entretient l'Équipe Alberta Méridional Branche d'Opérations

Canada

Client/client

Parks Canada Agency
L'Agence Parcs Canada

Western and Northern Region
Ouest et Nord du Canada

Project title/Titre du projet

KENOW WILDFIRE ASSESSMENT

WATERTON LAKES

Drawing title/Titre du dessin

OVERALL SITE PLAN

Surveyed by/Arpenté par	Drawn by/Dessiné par	Date/Date
BDS	BDS	09/01/18
Designed by/Concept par	Reviewed by/Revisé par	Scale/Échelle
-		1:10000

PWGSC Project Manager/Administrateur de Projets TPSGC

Client Acceptance/Acceptation du client
Park Responsible Officer/Agent Responsable

Approved by/Approuvé par
PWGSC Project Manager/Administrateur de Projets TPSGC

Project No./No. du projet
Asset No./No. du-bien
Sheet No./No. de la feuille
1 OF 10

Drawing Reference No./No. de référence du dessin

AO 1189 x 841

Legend

- Soil Sample Location
- Debris Sample Location
- Soil Sample Exceeding Regulatory Guidelines
- Debris Sample Exceeding Regulatory Guidelines

1.5 0 1.5
SCALE 1:75 METRES

No.	Date/Date	Description/Description	Drawn by Dessiné par	Approved Approuvé
1	09/01/18	ISSUED FOR REVIEW	BDS	

Revision / Revision

A detail number numéro de detail
B source drawing no. de dessin no.
C detail on drawing no. detail sur dessin no.

Consultant's Name
Nom de l'expert-conseil

DILLON CONSULTING

Eng. Stamp
Sceau de l'ingénieur

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

Client Services Team Southern Alberta Operations Branch
Le Client Entretient l'Équipe Alberta Méridional Branche d'Opérations

Canada

Client/client

Parks Canada Agency
L'Agence Parcs Canada

Western and Northern Region
Ouest et Nord du Canada

Project title/Titre du projet

KENOW WILDFIRE ASSESSMENT

WATERTON LAKES

Drawing title/Titre du dessin

SITE 2 – VISITOR RECEPTION CENTRE SAMPLING LOCATIONS

Surveyed by/Arpenté par	Drawn by/Dessiné par	Date/Date
BDS	BDS	09/01/18
Designed by/Concept par	Reviewed by/Revisé par	Scale/Échelle
–		1:75

PWGSC Project Manager/Administrateur de Projets TPSGC

Client Acceptance/Acceptation du client

Park Responsible Officer/Agent Responsable

Approved by/Approuvé par

PWGSC Project Manager/Administrateur de Projets TPSGC

Project No./No. du projet

Asset No./No. du-bien

Sheet No./No. de la feuille

3 OF 10

Drawing Reference No./No. de référence du dessin

AO 1189 x 841

Legend

- Soil Sample Location
- Debris Sample Location
- Soil Sample Exceeding Regulatory Guidelines
- Debris Sample Exceeding Regulatory Guidelines

1.5 0 1.5
SCALE 1:75 METRES

No.	Date/Date	Description/Description	Drawn by Dessiné par	Approved Approuvé
1	09/01/18	ISSUED FOR REVIEW	BDS	

Revision / Revision

A detail number numéro de détail
B source drawing no. de dessin no.
C detail on drawing no. détail sur dessin no.

Consultant's Name / Nom de l'expert-conseil: DILLON CONSULTING

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Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

Client Services Team Southern Alberta Operations Branch / Le Client Entretient l'Équipe Alberta Méridional Branche d'Opérations

Canada

Client/client: Parks Canada Agency / L'Agence Parcs Canada

Western and Northern Region / Ouest et Nord du Canada

Project title/Titre du projet

KENOW WILDFIRE ASSESSMENT

WATERTON LAKES

Drawing title/Titre du dessin

SITE 4 – PARK ENTRANCE SAMPLING LOCATIONS

Surveyed by/Arpenté par	Drawn by/Dessiné par	Date/Date
BDS	BDS	09/01/18
Designed by/Concept par	Reviewed by/Revisé par	Scale/Échelle
–		1:75

PWGSC Project Manager/Administrateur de Projets TPSGC

Client Acceptance/Acceptation du client: Park Responsible Officer/Agent Responsable

Approved by/Approuvé par: PWGSC Project Manager/Administrateur de Projets TPSGC

Project No./No. du projet

Asset No./No. du-bien

Sheet No./No. de la feuille: 4 OF 10

Drawing Reference No./No. de référence du dessin

A0 1189 x 841

Legend

- Soil Sample Location
- Debris Sample Location
- Soil Sample Exceeding Regulatory Guidelines
- Debris Sample Exceeding Regulatory Guidelines

1.5 0 1.5
SCALE 1:75 METRES

No.	Date/Date	Description/Description	Drawn by Dessiné par	Approved Approuvé
1	09/01/18	ISSUED FOR REVIEW	BDS	

Revision / Revision

A detail number numéro de detail
B source drawing no. de dessin no.
C detail on drawing no. detail sur dessin no.

Consultant's Name
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Canada

Client/client

Parks Canada Agency
L'Agence Parcs Canada

Western and Northern Region
Ouest et Nord du Canada

Project title/Titre du projet

KENOW WILDFIRE ASSESSMENT

WATERTON LAKES

Drawing title/Titre du dessin

SITE 5 – PARK ENTRANCE SAMPLING LOCATIONS

Surveyed by/Arpenté par	Drawn by/Dessiné par	Date/Date
BDS	BDS	09/01/18
Designed by/Concept par	Reviewed by/Revisé par	Scale/Échelle
–		1:75

PWGSC Project Manager/Administrateur de Projets TPSGC

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Project No./No. du projet
Asset No./No. du-bien
Sheet No./No. de la feuille
5 OF 10
Drawing Reference No./No. de référence du dessin

A0 1189 x 841

Notes:

- Sample 2517-AC taken from same location as sample 1-4
- Sample 2520-AC taken from same location as sample 1-1

Legend

- Soil Sample Location
- Debris Sample Location
- Soil Sample Exceeding Regulatory Guidelines
- Debris Sample Exceeding Regulatory Guidelines

SCALE 1:100 METRES

No.	Date/Date	Description/Description	Drawn by Dessiné par	Approved Approuvé
1	09/01/18	ISSUED FOR REVIEW	BDS	

Revision / Revision

A detail number numéro de detail
B source drawing no. de dessin no.
C detail on drawing no. detail sur dessin no.

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Ouest et Nord du Canada

Project title/Titre du projet

KENOW WILDFIRE ASSESSMENT

WATERTON LAKES

Drawing title/Titre du dessin

SITE 6 – CANYON CHURCH CAMP SAMPLING LOCATIONS

Surveyed by/Arpenté par	Drawn by/Dessiné par	Date/Date
BDS	BDS	09/01/18
Designed by/Concept par	Reviewed by/Revisé par	Scale/Echelle
–		1:100

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Park Responsible Officer/Agent Responsable

Approved by/Approuvé par
PWGSC Project Manager/Administrateur de Projets TPSGC

Project No./No. du projet
Asset No./No. du-bien
Sheet No./No. de la feuille
6 OF 10
Drawing Reference No./No. de référence du dessin

AO 1189 x 841

Legend

- Soil Sample Location
- Debris Sample Location
- Soil Sample Exceeding Regulatory Guidelines
- Debris Sample Exceeding Regulatory Guidelines

1.5 0 1.5
SCALE 1:75 METRES

No.	Date/Date	Description/Description	Drawn by Dessiné par	Approved Approuvé
1	09/01/18	ISSUED FOR REVIEW	BDS	

Revision / Revision

A detail number
numéro de detail
B source drawing no.
de dessin no.
C detail on drawing no.
detail sur dessin no.

Consultant's Name
Nom de l'expert-conseil

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L'Agence Parcs Canada

Western and Northern Region
Ouest et Nord du Canada

Project title/Titre du projet

KENOW WILDFIRE ASSESSMENT

WATERTON LAKES

Drawing title/Titre du dessin

SITE 7 – WATERTON GOLF COURSE SAMPLING LOCATIONS

Surveyed by/Arpenté par	Drawn by/Dessiné par	Date/Date
BDS	BDS	09/01/18
Designed by/Concept par	**Reviewed by/Revisé par**	**Scale/Échelle**
–		1:75

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Park Responsible Officer/Agent Responsable

Approved by/Approuvé par

PWGSC Project Manager/Administrateur de Projets TPSGC

Project No./No. du projet

Asset No./No. du-bien

Sheet No./No. de la feuille

Drawing Reference No./No. de référence du dessin

7 OF 10

A0 1189 x 841

Legend

- Soil Sample Location
- Debris Sample Location
- Soil Sample Exceeding Regulatory Guidelines
- Debris Sample Exceeding Regulatory Guidelines

SCALE 1:100 METRES

No.	Date/Date	Description/Description	Drawn by Dessiné par	Approved Approuvé
1	09/01/18	ISSUED FOR REVIEW	BDS	

Revision / Revision

A detail number numéro de detail
B source drawing no. de dessin no.
C detail on drawing no. detail sur dessin no.

Consultant's Name
Nom de l'expert-conseil

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Client/client

Parks Canada Agency
L'Agence Parcs Canada

Western and Northern Region
Ouest et Nord du Canada

Project title/Titre du projet

KENOW WILDFIRE ASSESSMENT

WATERTON LAKES

Drawing title/Titre du dessin

SITE 8 – ALPINE STABLES SAMPLING LOCATIONS

Surveyed by/Arpenté par	Drawn by/Dessiné par	Date/Date
BDS	BDS	09/01/18
Designed by/Concept par	**Reviewed by/Revisé par**	**Scale/Échelle**
–		1:100

PWGSC Project Manager/Administrateur de Projets TPSGC

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PWGSC Project Manager/Administrateur de Projets TPSGC

Project No./No. du projet

Asset No./No. du-bien

Sheet No./No. de la feuille

Drawing Reference No./No. de référence du dessin

8 OF 10

A0 1189 x 841

Legend

- Soil Sample Location
- Debris Sample Location
- Soil Sample Exceeding Regulatory Guidelines
- Debris Sample Exceeding Regulatory Guidelines

10 0 10
SCALE 1:500 METRES

No.	Date/Date	Description/Description	Drawn by Dessiné par	Approved Approuvé
1	14/02/18	ISSUED FOR REVIEW	BDS	

Revision / Revision

A detail number numéro de detail
B source drawing no. de dessin no.
C detail on drawing no. detail sur dessin no.

Consultant's Name
Nom de l'expert-conseil

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Ouest et Nord du Canada

Project title/Titre du projet

KENOW WILDFIRE ASSESSMENT

WATERTON LAKES

Drawing title/Titre du dessin

SITE 10 – SALAMANDER BARRIERS SAMPLING LOCATIONS

Surveyed by/Arpenté par	Drawn by/Dessiné par	Date/Date
BDS	BDS	14/02/18
Designed by/Concept par	Reviewed by/Revisé par	Scale/Échelle
–		1:500

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Project No./No. du projet

Asset No./No. du-bien

Sheet No./No. de la feuille

10 OF 10

Drawing Reference No./No. de référence du dessin

AO 1189 x 841

Appendix B

Remedial Action Plan – Site 8: Alpine Stables Draft Report (Dillon, March 2018)

March 28, 2018

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Attention: Mr. Sacha Osolo
Project Manager

Remedial Action Plan – Site 8: Alpine Stables
Kenow Wildfire Waterton Lakes National Park
Draft Report

Dear Mr. Osolo:

Dillon Consulting Limited (Dillon) was retained by Parks Canada Agency (PCA) to conduct a Debris and Soil Assessment (draft report submitted March 16, 2018) at Waterton Lakes National Park (WLNP) from December 2017 to January 2018. The results of this assessment identified building material debris and contaminated soil at select locations that require removal, limited preservation, and disposal. This report builds on the results from the Debris and Soil Assessment report, and provides a Remedial Action Plan (RAP) for Site 8 – Alpine Stables. This letter is intended to guide the construction process to achieve remediation and restoration of the Alpine Stables (the site) by May 1, 2018. A comprehensive Remedial Action and Risk Management Plan for the remaining sites assessed during the Debris and Soil Assessment will be issued at a later date.

1.0 Background

In 2017, 20,329 ha of WLNP was affected by the Kenow wildfire that burned through the park from September 2017 to October 2017. The Kenow wildfire affected a total of 36 sites and 33 structures within WLNP that are used for the support of park operations, including the aforementioned Alpine Stables, which is shown in Figure 1.

Figure 1: Site Location

PCA intends to implement a soil remediation program at the Alpine Stables to excavate and remove contaminated soil identified during the previous assessment. Through this program, debris will also be removed and appropriately disposed off-site. The overall remediation approach to the damaged structures and/or assets at the site is outlined below:

1. Development of a RAP and Health and Safety Plan for remediation and restoration of the Alpine Stables.
2. Coordination, supervision, and monitoring by trained and experienced personnel of the removal (excavation) and off-site disposal of debris and contaminated soil identified at the site.
3. Report on site remediation and closure activities.

The Debris and Soil Assessment draft report concluded that contaminated debris and shallow soil is present on-site and therefore, requires remediation. The shallow soil and hazardous material sampling indicated that numerous contaminants exceeded soil quality guidelines, and that there is volatile organic compounds (VOCs) contamination in the debris and ash at the stables. It should be noted that sample results were compared to the Tier 1 Level regulatory guidelines (including federal and provincial guidelines).

Table 1 on the following page presents a summary of the hazardous material and shallow soil assessment (sampled from 0 – 0.25 mbgs).

Table 1: Summary of Alpine Stables Hazardous Material and Shallow Soil Assessment

Site Location	Soil Sampling ID #	Contaminated Material Detected in Surface Debris	Contamination Detected in Soil Samples (Compared to Tier 1)	Remediation Measured Required?	Description of Proposed Remediation Measures
Stables	7	VOCs (benzene)	BTEX, PAHs, VOC, zinc	Yes	Excavation and disposal of surface debris and contaminated soil, backfill/grading. Removal and disposal of concrete building foundations.
Bunkhouse	8	None	PAHs, copper, tin	Yes	
Residence	9	None	BTEX, PAHs	Yes	

The drawings provided in Appendix A illustrate the debris and soil sampling locations.

2.0 Regulatory Framework

2.1 Hazardous Materials Sampling

The regulatory guidance documentation adhered to during the hazardous material assessment and the criteria applied to the analytical results of the assessment are outlined within the Debris and Soil Assessment draft report and described below:

> *For federally regulated buildings and sites, hazardous substances in the workplace are governed by the Canada Labour Code (Part II) and regulated through the Canada Occupational Health and Safety regulations (Part X). In addition, the following standards were considered as part of meeting the objectives of the project: PSPC Asbestos Management Standard (June 5, 2017), National Joint Council Occupational Health and Safety Directive – Part XI, and the PSPC Standard on Hazardous Substances. (RJ & Associates, 2018)*

2.2 Shallow Soil Sampling

The Alpine Stables, located in WLNP, is considered to have various land uses based on current site activities, including Natural Area, Residential/Parkland, and Agricultural. Additionally, WLNP is considered federal land within the Province of Alberta. As a result, laboratory data from the shallow soil sampling assessment was compared to both federal and provincial guidelines and their respective land-uses. The applicable regulatory bodies include:

1. Canadian Council of Ministers of the Environment (CCME); and
2. Alberta Environment and Parks (AEP).

The CCME *Canadian Environmental Quality Guidelines* (CEQG) *and Canada Wide Standards* (CWS) for PHCs in Soil, as well as the AEP *Alberta Tier 1 Soil and Groundwater*

Remediation Guidelines were used to compare soil sample results. Soil texture (coarse/fine grained soil) and current land use at the site and surrounding properties were applied to the results of the soil assessment.

Sample results were initially compared to the Tier 1 Level regulatory guidelines. Pathway-specific guidelines have been reviewed in this RAP.

3.0 Environmental Health and Safety

As the site is considered contaminated, proper care in relation to environmental health and safety should be followed. The below subsections provide an overview of the measures that should be considered in the implementation of the RAP.

3.1 General Construction Site Health and Safety

Construction site health and safety during the implementation of the RAP will be managed by the prime contractor retained to implement the work. In accordance with the associated relevant regulations, the contractor will be defined as the "constructor" for the site and shall be responsible for sub-contractors, visitors and any others (e.g., third-party stakeholder observers) attending the site. The constructor shall comply with the Canada Occupational Health and Safety Regulations (SOR/86-304) and the *Occupational Health and Safety Act* (RSA 2000 cO-2).

Dillon's health and safety plan, which has been customized to incorporate aspects of both the contractor and Dillon's own employees on-site, is attached as Appendix B. This health and safety plan serves as a minimum baseline for the contractor's own health and safety plan, but it is the responsibility of the contractor to uphold and create their own health and safety plan.

3.2 Site Access and Security

Currently, a large portion of WLNP is closed off due to the impacts of the Kenow Wildfire. However, Alpine Stables is currently in the "Open Area" and there is a possibility that public traffic may be present during construction activities.

During remedial activities, pedestrian and vehicular access to the active construction areas shall be restricted to authorized personnel, vehicles, and other equipment involved in the site's remedial and management activities. At a minimum, construction signage should be present. Temporary construction fencing could be used to enclose the remedial areas if deemed necessary to exclude unauthorized access. Vehicular gates through the fence would be controlled during normal working hours, only allowing the entry and exit of authorized vehicles and equipment. The gates would be locked after working hours.

3.3 Equipment Decontamination

Equipment (i.e., excavators) that comes in contact with impacted soil, ash, and debris would require decontamination when exiting the site. Prior to moving out of the site

boundaries, the impacted material should be removed (e.g., scrapped,brushed off) from vehicle undercarriages, tracks/wheels and bodies to minimize the potential spread of impacts.

Trucks (i.e., dump trucks) and/or bins used for soil removal will be loaded on non-impacted surfaces, such that the undercarriage and/or tires do not contact impacted soils; therefore, the vehicles may exit the site without requiring decontamination.

3.4 Dust Control and Monitoring

Daily site activities would be planned with weather and wind directions in mind to minimize and control dust migration at the site.

During the course of excavation and backfilling programs, measures would be undertaken to minimize dust resulting from excavation, stockpiling and on-site transportation operations. Materials having the potential to emit dust at nuisance levels would be transported on-site and off-site in suitably covered haulage vehicles or containers to minimize dust emissions.

Visible dust emissions from stockpiles and areas of active excavation would be controlled by various means (i.e., misting with potable water or covering with tarps) if deemed to be a health and safety concern. Daily visual dust inspections would be completed. The quantity and rate of water misting (if applied) should be minimized to prevent the generation of surface run-off or the saturation of the stockpiled materials. On-site traffic on non-paved surfaces would be limited to lower speeds (e.g., 15 km/h) and paved surfaces would be regularly swept for dust control.

An organic vapor meter (i.e., RKI Eagle 2) would be used to assess air borne concentrations of VOCs. If measured VOC concentrations exceed safe working levels, adequate contingency measures will be implemented. These measures may include, but are not limited to:

- Working up-stream of wind;
- Pause work until safe levels of VOC are confirmed;
- Mist excavation areas; and
- Reduce open excavation surface area.

3.5 Spill Response

For the purposes of this plan, a spill is considered to be a release of impacted soil, ash, or debris occurring on the site or at any location during the transportation of impacted soil originating from the site that has the potential to adversely impact the environment. This definition includes spills occurring off-site, including those on public roadways; however, it is noted that impacted material once off-site would become the responsibility of the construction contractor and waste transportation contractor.

Following a spill or unintentional release of impacted materials on-site, appropriate measures would be undertaken to contain the spill or release. However, it is noted that the contaminated materials being remediated are primarily impacted soil and fill in the

solid state. Therefore spill response will primarily consist of timely excavation and placement of the spilled materials into appropriate waste containers (trucks or bins). These measures and any other appropriate measures to protect the health and safety of site personnel and local ecology would be applied as soon as practicable. The remediation contractor will be responsible for documenting spill clean-up procedures prior to the start of work and will be further responsible for implementation if necessary. Analytical testing may be undertaken to confirm the adequacy of the clean-up.

4.0 Remedial Approach

The most stringent guideline value from each land-use and the most stringent guideline value from the two regulatory bodies were applied to determine parameters exceeding the Tier 1 Level guidelines. Sample results that were noted exceeding the Tier 1 guidelines were further assessed by comparing to the applicable Tier 2 pathway-specific guidelines to determine which operable pathways had been exceeded. The purpose of identifying Tier 2 pathways was to apply site-specific guideline values and therefore determine appropriate remedial objectives for this site. The attached Tables 3 to 5 summarize sample results compared to pathway-specific guidelines.

Through this process, it was determined that although several samples had exceeded Tier 1 guideline values, the only pathway exceeded was “Aquatic Life”. There are no suspected aquatic receptors within 500 meters of the site due to the absence of nearby water bodies. Therefore, the aquatic life guidelines have been removed from further assessment of remedial objectives for the site. All other Tier 2 pathways are deemed to be applicable, including the potable water pathway due to the presence of a water well near the residence building. The water well is not currently used for human consumption; however, the potable pathway was carried-forward under the conservative assumption that water from the on-site water well may at some point be used for human consumption.

By identifying which soil samples exceeded applicable Tier 2 pathways, this also determined which locations on-site required remediation and the presumed soil excavation boundary around each of the three buildings on-site. It was conservatively assumed that the soil should be excavated up to 500 mm past the contaminated soil sampling location.

Furthermore, since VOC contamination was detected in the debris/ash sample 2427-AC located at the stables, there is a possibility that VOC concentrations in the debris/ash could have impacted the underlying soil. It is recommended that all debris/ash on-site be conservatively treated with the understanding that it is contaminated.

The assumption that all debris/ash on-site is contaminated also implies that the underlying soil could be contaminated due to cross-contamination. It is recommended that soil present underneath ash and debris, up to a depth of 300 mm, be replaced with clean fill. The only exemption from this approach is areas where there is a concrete slab

separating the debris/ash and underlying soil, as the concrete should act as an effective barrier for cross-contamination.

When the soil has been properly excavated to the proposed soil excavation boundary, confirmatory soil sampling and laboratory analysis will be required to confirm that the depth and width of excavation is appropriate, by comparing the results to applicable Tier 2 guidelines.

Table 2 below summarizes the exceeded pathways and parameters for the samples collected on-site. Tables 3 through Table 5 (attached) provide a detailed comparison between soil laboratory analytical data and applicable Tier 2 guidelines for the bunkhouse, residences, and stables, respectively.

Table 2: Summary of Exceeded Pathways and Parameters

Building	Drawing Number	Sample ID	Exceeded Parameter	Exceeded Pathway
Bunkhouse	176826-08-02	8-1	Copper	Eco Soil Contact, Eco Soil and Food Ingestion, Nutrient Cycling
			Tin	Eco Soil Contact
Residences	176826-08-01	8-5	Copper	Eco Soil Contact
		9-4	Benzene	Potable Water
			Toluene	Potable Water
Stables	176826-08-03	7-3	Zinc	Eco Soil Contact, Nutrient Cycling
			Benzene	Potable Water, Soil Vapour Inhalation (Basement)
		7-4	Benzene	Potable Water, Soil Vapour Inhalation
			Carbon Tetrachloride	Soil Vapour Inhalation

5.0 Remedial Action Plan

The objective of the RAP is to remediate the site to a level that is not detrimental to human and environmental health, as described by applicable regulatory guidelines, and to return the site to an operable condition for future site use and development. While the soil excavation boundary was determined by tracing the perimeter of the contaminated debris/ash around each building during the initial site visit in December 2017, the debris and ash may have spread in the months following the site visit. As a result, the soil excavation boundary may not completely reflect site conditions, since soil excavation is only required in areas with known soil impacts and directly underneath the contaminated debris/ash. Additional soil excavation may be required depending on the locations of contaminated debris/ash on-site.

The procedure for remediation is as follows:

1. Remove contaminated debris/ash and dispose off-site, or dispose with contaminated soil.
2. Excavate known impacted soil and soil underneath contaminated debris to a depth of 300 mm below ground surface.
3. Conduct confirmatory soil sampling to measure BTEX, metals and inorganics, and VOCs concentrations in remaining soil on-site.
4. Dispose of contaminated soil off-site.
5. Remove concrete slabs and dispose off-site.
6. Backfill with appropriate fill material and grade.

During the soil excavation process, proper care should be taken to ensure the excavation will not extend below building foundations without input from a geotechnical consultant. Excavations will only proceed in a safe manner that is protective of the adjacent foundations.

It should be noted that the confirmatory soil sampling process has an approximate 48 hour turnaround period before Dillon receives the laboratory results. If the laboratory results indicate that the confirmatory soil samples are below the selected Tier 2 guidelines, then backfill may commence. If the confirmatory sample results exceed the selected remedial objectives, further excavation will be required and confirmatory soil sampling will continue until the laboratory results are satisfactory. During the 48 hour turnaround period, it is recommended for the contractor to implement a phased remediation approach; whereby, the remediation procedures prescribed above can be conducted for the other buildings on-site while awaiting sample results.

Further, it is at the discretion of the contractor to decide where contaminated ash/debris and soils will be stored prior to hauling to the selected disposal facility (i.e., Pincher Creek landfill). Proper protection between the contaminated material and underlying clean soil will be required. Dillon recommends laying down a tarp or polyethylene membrane to contain the contaminated material before disposing the material into large storage bins that can be picked up and transported to the Pincher Creek landfill. The storage bins (~22 m^3) can be supplied and transported by Pincher Creek landfill.

6.0 Closure

This report was prepared exclusively for the purposes, project and site location outlined in the report. The report is based on information provided to, or obtained by Dillon as indicated in the report, and applies solely to site conditions and the regulatory and planning frameworks existing at the time of the site investigation. Although a reasonable investigation was conducted by Dillon, Dillon's investigation was by no means exhaustive and cannot be construed as a certification of the absence of any contaminants from the site. Rather, Dillon's report represents a reasonable review of available information within an established work scope and schedule.

This report was prepared by Dillon for the sole benefit of PCA. The material in it reflects Dillon's best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibilities of such third parties. Dillon accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

We trust that the information provided herein is satisfactory for your present requirements. If you have any questions or concerns, please do not hesitate to contact the undersigned.

Yours truly,

DILLON CONSULTING LIMITED

Richard Dieu, E.I.T.
Junior Civil Engineer

Melissa Hamilton, P.Eng
Project Manager

RSD:slg

Attachments: *Table 3: Site 8 – Bunkhouse*
Table 4: Site 8 – Residences
Table 5: Site 8 – Stables
Appendix A: Drawings
Appendix B: Dillon's Health and Safety Plan

Our file: 176826

REFERENCES

Alberta Environment and Parks (AEP), 2016. *Alberta Tier 1 Soil and Groundwater Remediation Guidelines*. ISBN: 978-1-4601-2695-0 (On-line Edition). February 2, 2016.

Canadian Council of Ministers of the Environment (CCME) (2008), *Canada-Wide Standards for Petroleum Hydrocarbons (PHC) in soil*.

CCME (2016), *Soil Quality for the Protection of Environmental and Human Health*. (online).

RJ & Associates, 2018. *"Hazardous Materials Assessment Report" For the Kenow Wildfires at Waterton Lakes National Park Waterton Lakes, Alberta.*

Tables

Parameter	Samples Exceeding Tier 1 Guidelines		Human Health Pathway-Specific Guidelines (mg/kg) Coarse-grained		Environmental Pathway-Specific Guidelines (mg/kg) Coarse-grained			Tier 2 Remedial Objective (mg/kg)
	8-1 (0 - 0.25 m bgs)	8-5 (0 - 0.25 m bgs)	Soil Ingestion	Soil Contact	Soil Contact	Soil and Food Ingestion	Nutrient Cycling	
Copper	980	260	1100	1100	63	300	350	63
Tin	5.7	4.9	---	---	5	---	---	5

Notes:

This table possesses the most stringent relevant land-use value from the most stringent federal and/or provincial guideline.
The following land uses have been considered for this table: agricultural, residential/parkland, and natural area.

< - Concentration is less than laboratory reportable detection limit.
m bgs - Meters below ground surface.
mg/kg - Milligram per kilogram.
CCME - Canadian Council of Ministers of the Environment.
Concentration exceeds one or more pathway guidelines.

Guidelines:

Canadian Council of Ministers of the Environment (online), Soil Quality for the Protection of Environmental and Human Health.
Canadian Council of Ministers of the Environment (2008), Canada-wide Standards for Petroleum Hydrocarbons (PHC) in Soil.
Canadian Council of Ministers of the Environment (2010), Soil Quality for the Protection of Environmental and Human Health (Polycyclic Aromatic Hydrocarbons).
Alberta Tier 1 Soil and Groundwater Remediation Guidelines (2016)

Sample results found in laboratory certificate of analysis included as Appendix D in *Debris and Soil Assessment Related to Kenow Wildfire - Draft Report* prepared by Dillon Consulting Limited in March 2018.

Parameter	Samples Exceeding Tier 1 Guidelines	Human Health Pathway-Specific Guidelines[1,2] (mg/kg) Fine-grained					Environmental Pathway-Specific Guidelines[2] (mg/kg) Fine-grained				Tier 2 Remedial Objective (mg/kg)
	9-4 (0 - 0.25 m bgs)	Potable Water	Soil Ingestion	Soil Contact	Soil Vapour Inhalation (Basement)	Soil Vapour Inhalation (Slab-on-Grade)	Soil Contact	Soil and Food Ingestion	Wildlife Watering	Livestock Watering	
Benzene	0.019	0.0068	110	78	0.21	1.6	60	18	15	0.2	0.0068
Toluene	0.081	0.08	22,000	640	2100	1900	110	980	1,800	26	0.08

Notes:

This table possesses the most stringent relevant land-use value from the most stringent federal and/or provincial guideline.
The following land uses have been considered for this table: agricultural, residential/parkland, and natural area.

[1] - Guideline values for benzene are based on 1 x 10^{-5} incremental lifetime cancer risk.
[2] - Guideline values for BTEX parameters are for surface soil.
m bgs - Meters below ground surface.
mg/kg - Milligram per kilogram.
BTEX - Benzene, toluene, ethylbenzene, and xylenes.
CCME - Canadian Council of Ministers of the Environment.
Concentration exceeds one or more pathway guidelines.

Guidelines:

Canadian Council of Ministers of the Environment (online), Soil Quality for the Protection of Environmental and Human Health.
Canadian Council of Ministers of the Environment (2008), Canada-wide Standards for Petroleum Hydrocarbons (PHC) in Soil.
Canadian Council of Ministers of the Environment (2010), Soil Quality for the Protection of Environmental and Human Health (Polycyclic Aromatic Hydrocarbons).
Alberta Tier 1 Soil and Groundwater Remediation Guidelines (2016)

Sample results provided in laboratory certificate of analysis included as Appendix D in *Debris and Soil Assessment Related to Kenow Wildfire - Draft Report* prepared by Dillon Consultir

Parameter	Samples Exceeding Tier 1 Guidelines		Human Health Pathway-Specific Guidelines[1,2] (mg/kg) Coarse-grained					Environmental Pathway-Specific Guidelines[2] (mg/kg) Coarse-grained					Tier 2 Remedial Objective (mg/kg)
	7-3 (0 - 0.25 m bgs)	7-4 (0 - 0.25 m bgs)	Potable Water	Soil Ingestion	Soil Contact	Soil Vapour Inhalation (Basement)	Soil Vapour Inhalation (Slab-on-Grade)	Soil Contact	Soil and Food Ingestion	Wildlife Watering	Livestock Watering	Nutrient Cycling	
Zinc	280	110	---	---	---	---	---	200	640	---	---	200	200
Benzene	0.04	0.12	0.03	110	78	0.015	0.073	31	18	0.33	0.21	---	0.015
Carbon Tetrachloride	-	0.00099	0.062	---	27	0.00078	0.00057	---	---	0.023	---	---	0.00057

Notes:

This table possesses the most stringent relevant land-use value from the most stringent federal and/or provincial guideline.
The following land uses have been considered for this table: agricultural, residential/parkland, and natural area.

[1] - Guideline values for benzene are based on 1 x 10^{-5} incremental lifetime cancer risk.
[2] - Guideline values for BTEX parameters are for surface soil.
m bgs - Meters below ground surface.
mg/kg - Milligram per kilogram.
BTEX - Benzene, toluene, ethylbenzene, and xylenes.
CCME - Canadian Council of Ministers of the Environment.
VOC - Volatile organic compounds.
Concentration exceeds the guideline.

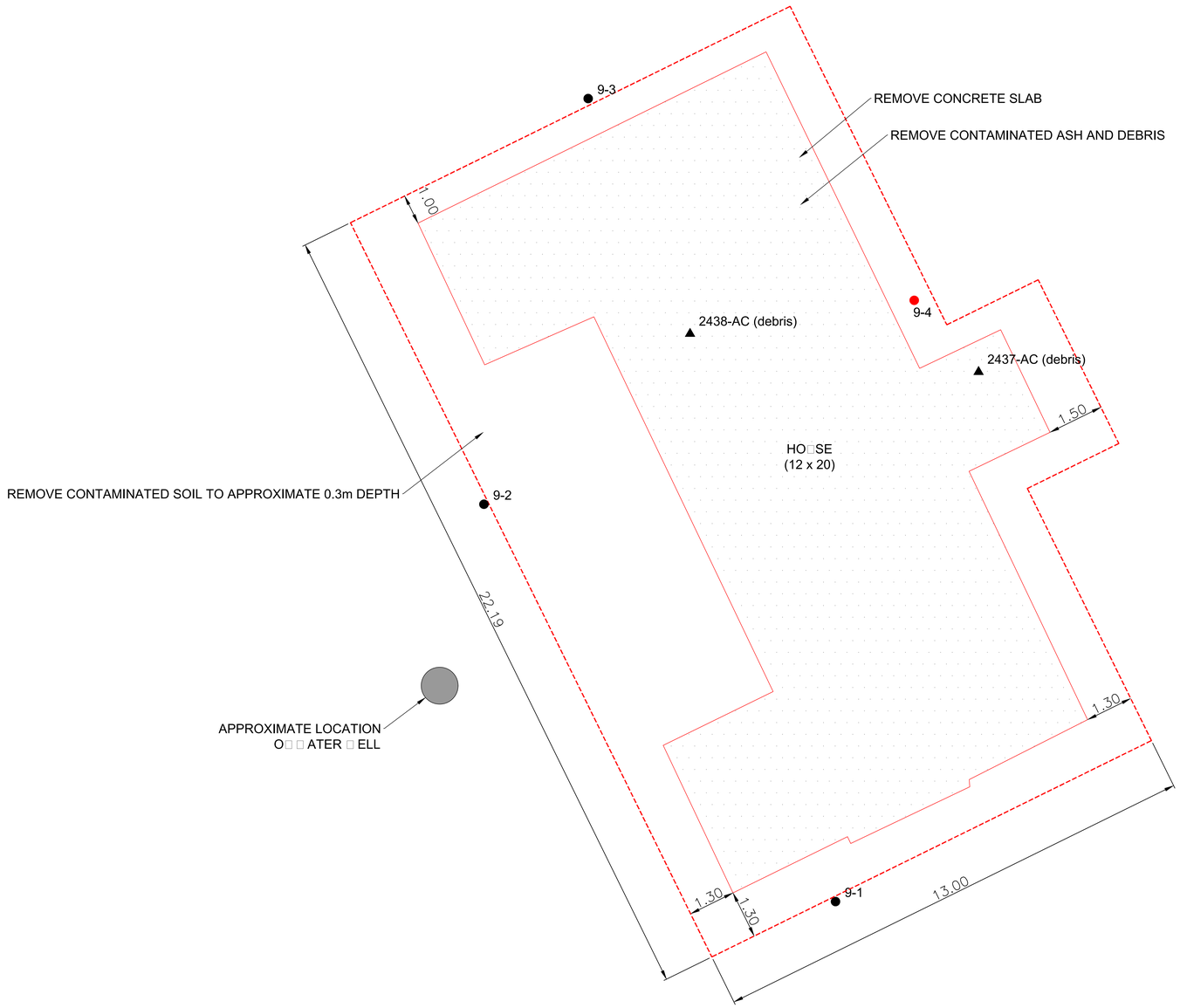
Guidelines:

Canadian Council of Ministers of the Environment (online), Soil Quality for the Protection of Environmental and Human Health.
Canadian Council of Ministers of the Environment (2008), Canada-wide Standards for Petroleum Hydrocarbons (PHC) in Soil.
Canadian Council of Ministers of the Environment (2010), Soil Quality for the Protection of Environmental and Human Health (Polycyclic Aromatic Hydrocarbons).
Alberta Tier 1 Soil and Groundwater Remediation Guidelines (2016)

Sample results provided in laboratory certificate of analysis included as Appendix D in *Debris and Soil Assessment Related to Kenow Wildfire - Draft Report* prepared by Dillon Consulting Limited in March 2018.

Appendix A

Drawings



Legend

- Soil Sample Location
- Debris Sample Location
- Soil Sample Exceeding Applicable Tier 2 Regulatory Guidelines
- Debris Sample Exceeding Regulatory Guidelines
- Contaminated Soils Excavation Boundary

Notes

All Dimensions are approximate

SCALE 1:100 METRES

No.	Date/Date	Description/Description	Drawn by Dessiné par	Approved Approuvé
1	09/01/18	ISSUED FOR REVIEW	BDS	

Revision / Revision

A detail number numéro de detail
B source drawing no. de dessin no.
C detail on drawing no. detail sur dessin no.

Consultant's Name
Nom de l'expert-conseil

Eng. Stamp
Sceau de l'ingénieur

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

Client Services Team Southern Alberta Operations Branch
Le Client Entretient l'Équipe Alberta Méridional Branche d'Opérations

Canada

Client/client

Parks Canada Agency
L'Agence Parcs Canada

Western and Northern Region
Ouest et Nord du Canada

Project title/Titre du projet

KENOW WILDFIRE ASSESSMENT

WATERTON LAKES

Drawing title/Titre du dessin

SITE 8a – ALPINE STABLES SAMPLING LOCATIONS

Surveyed by/Arpenté par	Drawn by/Dessiné par	Date/Date
BDS	BDS	09/01/18
Designed by/Concept par	**Reviewed by/Revisé par**	**Scale/Échelle**
–		1:50

PWGSC Project Manager/Administrateur de Projets TPSGC

Client Acceptance/Acceptation du client

Park Responsible Officer/Agent Responsable

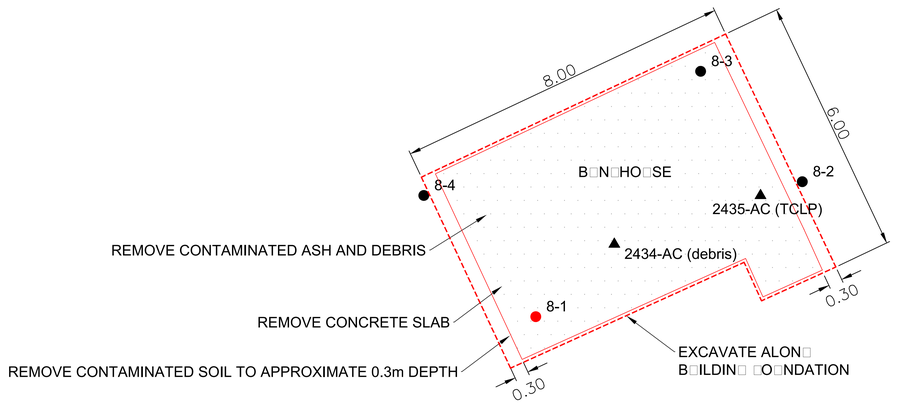
Approved by/Approuvé par

PWGSC Project Manager/Administrateur de Projets TPSGC

Project No./No. du projet	Asset No./No. du-bien	Sheet No./ No. de la feuille
176826		1 OF 3

Drawing Reference No./No. de référence du dessin
176826-08-01

A0 1189 x 841



Legend

- Soil Sample Location
- Debris Sample Location
- Soil Sample Exceeding Applicable Tier 2 Regulatory Guidelines
- Debris Sample Exceeding Regulatory Guidelines
- Contaminated Soils Excavation Boundary

Notes

All Dimensions are approximate

SCALE 1:100 METRES

No.	Date/Date	Description/Description	Drawn by Dessiné par	Approved Approuvé
1	09/01/18	ISSUED FOR REVIEW	BDS	

Revision / Revision

A detail number numéro de detail
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Consultant's Name / Nom de l'expert-conseil

Eng. Stamp / Sceau de l'ingénieur

Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

Client Services Team Southern Alberta Operations Branch / Le Client Entretient l'Équipe Alberta Méridional Branche d'Opérations

Canada

Client/client

Parks Canada Agency / L'Agence Parcs Canada

Western and Northern Region / Ouest et Nord du Canada

Project title/Titre du projet

KENOW WILDFIRE ASSESSMENT

WATERTON LAKES

Drawing title/Titre du dessin

SITE 8a – ALPINE STABLES SAMPLING LOCATIONS

Surveyed by/Arpenté par	Drawn by/Dessiné par	Date/Date
BDS	BDS	09/01/18
Designed by/Concept par	Reviewed by/Revisé par	Scale/Échelle
–		1:50

PWGSC Project Manager/Administrateur de Projets TPSGC

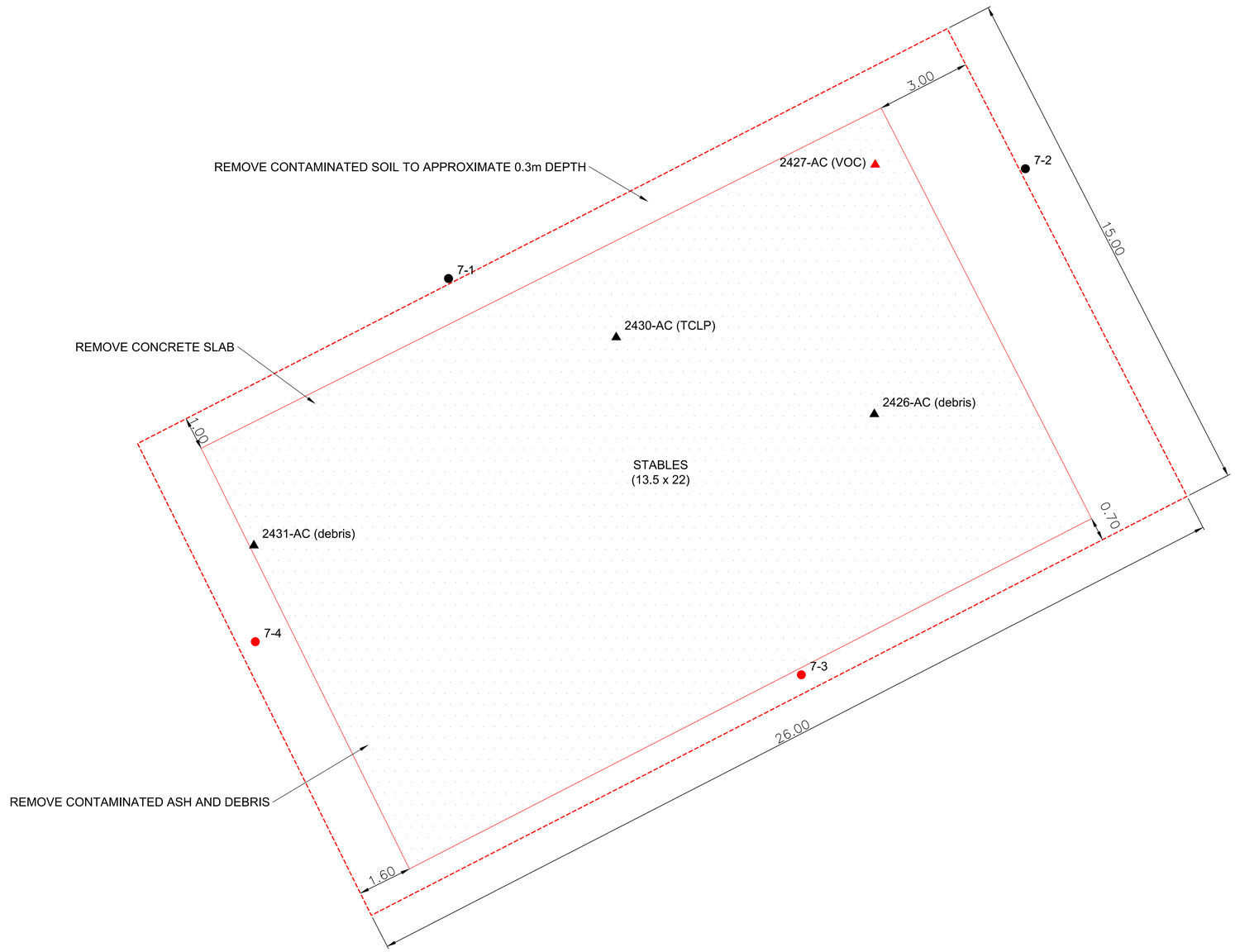
Client Acceptance/Acceptation du client — Park Responsible Officer/Agent Responsable

Approved by/Approuvé par — PWGSC Project Manager/Administrateur de Projets TPSGC

Project No./No. du projet	Asset No./No. du-bien	Sheet No./ No. de la feuille
176826		2 OF 3

Drawing Reference No./No. de référence du dessin: 176826-08-02

A0 1189 x 841



Legend

- Soil Sample Location
- Debris Sample Location
- Soil Sample Exceeding Applicable Tier 2 Regulatory Guidelines
- Debris Sample Exceeding Regulatory Guidelines
- Contaminated Soils Excavation Boundary

Notes

All Dimensions are approximate

SCALE 1:100 METRES

No.	Date/Date	Description/Description	Drawn by Dessiné par	Approved Approuvé
1	09/01/18	ISSUED FOR REVIEW	BDS	

Revision / Revision

A detail number numéro de detail
B source drawing no. de dessin no.
C detail on drawing no. detail sur dessin no.

Consultant's Name
Nom de l'expert-conseil

Eng. Stamp
Sceau de l'ingénieur

Public Works and Government Services Canada
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Client/client

Parks Canada Agency
L'Agence Parcs Canada

Western and Northern Region
Ouest et Nord du Canada

Project title/Titre du projet

KENOW WILDFIRE ASSESSMENT

WATERTON LAKES

Drawing title/Titre du dessin

SITE 8a – ALPINE STABLES SAMPLING LOCATIONS

Surveyed by/Arpenté par	Drawn by/Dessiné par	Date/Date
BDS	BDS	09/01/18
Designed by/Concept par	**Reviewed by/Revisé par**	**Scale/Echelle**
–		1:50

PWGSC Project Manager/Administrateur de Projets TPSGC

Client Acceptance/Acceptation du client
Park Responsible Officer/Agent Responsable

Approved by/Approuvé par
PWGSC Project Manager/Administrateur de Projets TPSGC

Project No./No. du projet	Asset No./No. du-bien	Sheet No./No. de la feuille
176826		3 OF 3

Drawing Reference No./No. de référence du dessin
176826-08-03

A0 1189 x 841

Appendix B

Dillon's Health and Safety Plan

Health and Safety Plan

Kenow Wildfire Assessment and Remediation

Parks Canada Agency

Dillon Project Number: 17-6826

Section 1

Hazard Assessment

Section 2

Routes to Hospital

Section 3

Guidelines and Safe Work Practices

Section 4

Tailgate Health & Safety Meeting Form

Section 5

MSDS

		Initials:
☐	I have reviewed the completed Hazard Assessment Form (Form D.1) in its entirety.	_____
☐	I have signed the completed Form D.1.	_____
☐	I have reviewed the HSP with the sub-contractor(s) and they are aware of their health and safety responsibilities.	_____
☐	I have the required PPE for today's task(s) identified in Form D.1.	_____
☐	I am familiar with the emergency route to the hospital, as well as the provided emergency measures and communications.	_____
☐	I have reviewed the relevant Guidelines and Safe Work Practices.	_____
☐	I have reviewed the required Material Safety Data Sheets (MSDS).	_____
☐	I have completed a Tailgate H&S Meeting and have completed the associated form (Form D.7), on a daily basis.	_____

Section 1
Hazard Assessment

Last issued: November, 2016
Current Revision: April, 2017

Form D.1 HAZARD ASSESSMENT/HEALTH AND SAFETY PLAN

Project Name: Waterton Kenow Wildfire Assessment and Remediation Project Number: 17-6826

Identified health and safety hazards and risks can be appropriately addressed using this form together with appended copies of relevant SWPs, guidelines and additional information (if necessary). This will provide a suitable health and safety plan for the majority of activities. If hazards and risks that cannot be appropriately addressed using this form, a custom health and safety plan must be prepared. All completed plans must be reviewed and signed off by all employees working on the project before any activities begin. Please e-mail all completed hazard assessment/health and safety plans to HSPlans@dillon.ca for tracking and auditing purposes.

Completed By: Richard Dieu Project Manager: Melissa Hamilton	Date(s): March 22, 2018 Revision Date(s):	Office: Calgary

Section A Emergency Contact Information

Key contacts (name and number):

- Sacha Osolo, P.Eng., Project Manager Federal Infrastructure Program. Parks Canada, Government of Canada, Cell: 604-789-7991
- Melissa Hamilton, P.Eng., Project Manager. Dillon Consulting. Tel: 403-215-8880. Cell: 403-471-3960
- Richard Dieu, E.I.T., Junior Civil Engineer. Dillon Consulting. Cell: 403-200-3008

First-aid qualified employees on team: Melissa Hamilton

Nearest hospital with emergency services (address and attach map): Cardston Health Centre. 144 2nd St W, Cardston, AB. T0K 0K0.

Emergency services phone number (if different than 911):

In case of emergency, are there any special instructions the team should follow:

1. Call 911
2. Call Dillon and Parks Canada Project Manager – Melissa Hamilton (403-471-3960) and Sacha Osolo (604-789-7991).

Section B Activity/Project Description

Activity, Location, Description and Background: (a detailed description of the activities as they relate to health and safety):

Visitor Center:

- Removals and relocation of decorative stone wall
- Removal of concrete slab
- Hazardous debris/ash removal (asbestos – to be removed by contractor with custom H&S plan)
- Disposal of concrete to Pincher Creek Landfill
- Soil sampling and potential hazardous materials sampling
- Construction observation

Alpine Stables:

- Removal of concrete slab
- Excavation and removals of VOC-impacted debris/ash and non-hazardous debris/ash
- Disposal of concrete and debris/ash to Pincher Creek Landfill
- Backfill with appropriate fill material
- Confirmatory soil sampling
- Construction observation

Who is managing health and safety on site (if applicable):

☒Dillon ☐Contractor hired by the client ☒Contractor hired by Dillon
☒Client ☐Other _____

How is Dillon defined on this project according to the Occupational Health and Safety Legislation? (Refer to the Act in your jurisdiction for specific duties and responsibilities.)

Form D.1 HAZARD ASSESSMENT/HEALTH AND SAFETY PLAN

Project Name: Waterton Kenow Wildfire Assessment and Remediation Project Number: 17-6826

☐Constructor or Prime Contractor ☐Supervisor ☐Employer ☒Worker/Employee

Schedule and duration of activity: April 2nd, 2018 – April 13th, 2018	Activity Supervisor: Dillon: Melissa Hamilton (403-471-3960) Parks Canada: Sacha Osolo (604-789-7991)

Dillon Personnel/Workers (Include subs working under the direction of Dillon):

- Richard Dieu, E.I.T., Field Inspector. Dillon Consulting. Cell: 403-200-3008
- Andrew Marshall, BSc., Project Manager. RJ&Associates. Cell: 778-866-2475

Section C Hazard Identification

What are the top five ways that you could get hurt while performing the assigned tasks on this project site? Think of what can foreseeably go wrong.

1. Contact with field equipment and machinery
2. Contact with hazardous materials with inadequate PPE
3. Contact with wildlife
4. Cold weather conditions
5. Slips, trips, and falls

What can you do to reduce the risk of the above mentioned potential hazards while on-site? Think of what control measures will be put in place.

1. Obtain initial eye-contact with equipment operator prior to moving into vicinity of field equipment
2. Review H&S Plan prior to work everyday and wear required PPE at all times
3. Equip appropriate gear (bear spray) and be aware of surroundings
4. Wear appropriate clothing and take warm breaks as needed
5. Be aware of surroundings at all times – especially ditches and bumps caused by excavation

For any medium/high risk items identified in this section, a space for each question has been provided to explain how these risks will be mitigated to a lower acceptable level (see guideline A.16 for additional information). Custom H&S plans will include contain details that may not be provided in the Dillon's H&S program and must be appended to this form. Any hazard identified in a custom plan also needs to be evaluated for risk.

ACTIVITY HAZARD IDENTIFICATION	Check	Risk Assessment Risk Level 1=Low, 2=Med, 3=High
Example: Will the work be adjacent to or on a road carrying public traffic?	☒ Yes ☐ No	SWP# 1 1☐ 2☒ 3☐
Mitigation Plan (for med/high risks): The project team is required to read and follow SWP# 1, wear a reflective vest, complete a traffic control plan. Participate in traffic awareness training.		
1) Will the work be adjacent to or on a road carrying public traffic?	☒ Yes ☐ No	SWP# 1 1☐ 2☒ 3☐
Mitigation Plan (for med/high risks): - Review and follow Safe Work Practice (SWP) #1 - Utilizing fencing/posts/pylons to mark-out work area - Wear high-visibility reflective vests or coveralls and be aware of oncoming traffic		
2) Will employees be working on a contamination or remediation site?	☒ Yes ☐ No	SWP# 2 1☐ 2☐ 3☒
Mitigation Plan (for med/high risks): - Review SWP #2 and Safe Job Procedure (SJP) #12 - Wear all appropriate PPE, including safety glasses, steel-toe boots, nitrile gloves (when collecting soil samples), safety glasses, high-visibility vests, and working gloves (as needed) at all times. Fitted face mask to be worn at all times during asbestos abatement. - Dispose of generated waste (i.e., nitrile gloves, paper towels, etc.) in garbage bags and remove off-site - Decontaminate sampling equipment using Liquinox and organic free water and review MSDS for liquinox		
3) Will the activity involve international business travel?	☐ Yes ☒ No	SWP# 3 1☐ 2☐ 3☐
Mitigation Plan (for med/high risks):		

4) Will employees be working on or near water?	☐ Yes ☒ No	SWP# 4 1☐ 2☐ 3☐
Mitigation Plan (for med/high risks):		
5) Will employees be working on or near ice?	☐ Yes ☒ No	SWP# 5 1☐ 2☐ 3☐
Mitigation Plan (for med/high risks):		
6) Will employees be working on a solid waste facility or site?	☐ Yes ☒ No	SWP# 6 1☐ 2☐ 3☐
Mitigation Plan (for med/high risks):		
7) Could the work result in contact with overhead /underground utilities or electrical plant? Will any ground disturbance activities be taking place (i.e., hand auguring)?	☒ Yes ☐ No	SWP# 7 1☒ 2☐ 3☐
Mitigation Plan (for med/high risks): - Review and follow SWP #12 - Perform utility locates prior to any groundworks activities and review with staff		
8) Will employees be working on or over geomembranes?	☐ Yes ☒ No	SWP# 8 1☐ 2☐ 3☐
Mitigation Plan (for med/high risks):		
9) Will employees be working around energized equipment? (Refers to machinery that would have to be de-energized or locked out.)	☒ Yes ☐ No	SWP# 9 1☒ 2☐ 3☐
Mitigation Plan (for med/high risks): - Review and follow SWP #9 - The only energized equipment on-site should be for the hand-tools when removing the decorative stone at the visitor center. Employees should be aware of surroundings at all times and note their proximity to nearby hand-tools.		
10) Will employees be working at heights or exposed to falls greater than 3m?	☐ Yes ☒ No	SWP# 10 1☐ 2☐ 3☐
Mitigation Plan (for med/high risks):		
11) Will employees be using all-terrain vehicles, snowmobiles or off-road 4X4 trucks?	☐ Yes ☒ No	SWP# 11 1☐ 2☐ 3☐
Mitigation Plan (for med/high risks):		
12) Will employees be working with ladders or scaffolding?	☐ Yes ☒ No	SWP# 12 1☐ 2☐ 3☐
Mitigation Plan (for med/high risks):		
13) Will employees be working with portable power tools?	☒ Yes	SWP# 13 1☒ 2☐ 3☐

	☐ No	
Mitigation Plan (for med/high risks): - Read and follow SWP #13 - Wear appropriate PPE - Read operator's manual of power tool used prior to activities, if needed - Ensure experienced personnel are using portable power tools, and if not, adequate supervision is provided		
14) Will there be construction equipment or other fixed / mobile equipment working at the site?	☒ Yes ☐ No	SWP# 14 1☐ 2☒ 3☐
Mitigation Plan (for med/high risks): - Read and follow SWP #14 - Obtain initial eye-contact from equipment operator prior to moving into vicinity of equipment		
15) Is the work in a remote or wilderness area? See definitions for Remote and Wilderness in SWP# 15. (Appendix 15 contains various plants & animals that are not limited to wilderness and/or in remote areas. Appendix 15 should be referenced for all field activities). Mitigation Plan (for med/high risks): - Read and follow SWP #15 - Staff should not work alone at any time; multiple people are required on-site - Bear spray will be carried by employees	☐ Yes (Remote) ☒ No ☒ Yes (Wilderness) ☐ No	SWP# 15 Complete Section E or prepare custom H&S plan Risk Level 1☐ 2☐ 3☐ SWP# 15 Custom H&S plan required Risk Level 1☒ 2☐ 3☐
16) Will the activity include electrofishing?	☐ Yes ☒ No	SWP# 16 1☐ 2☐ 3☐
Mitigation Plan (for med/high risks):		
17) Will the activity include stack testing?	☐ Yes ☒ No	SWP# 17 1☐ 2☐ 3☐
Mitigation Plan (for med/high risks):		
18) Will the activity involve the supervision of intrusive investigations, drilling or test pitting?	☒ Yes ☐ No	SWP# 18 1☒ 2☐ 3☐
Mitigation Plan (for med/high risks): - Read SWP #18 - Conduct utility locates prior to excavation - Use contamination mitigation PPE (nitrile gloves, safety glasses, disinfectants)		
19) Will the activity involve site reconnaissance?	☒ Yes ☐ No	SWP# 19 1☒ 2☐ 3☐
Mitigation Plan (for med/high risks): - Review SWP #19 - Staff will check-in and check-out with respective project managers each day when arriving at or leaving the site - Be aware of footing and surroundings and wear all PPE		
20) Could employees be exposed to any chemical or biological hazards at the site? These include: ☒ Benzene ☐ Wood or grain dust	☒ Yes	SWP# 20 1☐ 2☒ 3☐ Due to the complexity of these hazards, additional information should be provided to the

☐ H_2S ☐ Chlorinated solvents ☐ Hydrogen Cyanide ☐ Wood grain or dust ☒ Other (specify): VOC, Toluene	☐ No	employee, as safeguards will vary.
Mitigation Plan (for med/high risks): - Read and follow SWP #20 and SJP #12 - Liquinox is a liquid-based detergent used for decontaminating sampling equipment. Methanol will also be used to decontaminate sampling equipment - Wear all appropriate PPE including safety glasses and nitrile gloves while sampling soil - The Visitor Center possesses asbestos (chrysotile) in the ash/debris. Confirmatory asbestos sampling is required; should the results be negative, then mobilization in the visitor center is allowed - When in proximity to the Visitor Center, fitted face masks should be worn prior to abatement being performed		
21) Could employees be exposed to any physical agents or hazards at the site? These include: ☒ Cold Stress ☐ Heat Stress	☒ Yes ☐ No	SWP# 21 1☒ 2☐ 3☐
Mitigation Plan (for med/high risks): - Read and follow SWP #21 - Wear appropriate clothing for daily activities - Take warm breaks as needed		
22) Could employees be exposed to trench or excavation related hazards?	☒ Yes ☐ No	SWP# 22 1☒ 2☐ 3☐
Mitigation Plan (for med/high risks): - Read and follow SWP #22 - Excavation is expected to be 300mm deep, which poses a trip and fall hazard. Be aware of surroundings at all times - Ensure proper sloping and shoring, as required		
23) Will employees be working on a construction, demolition, or similar site?	☒ Yes ☐ No	SWP# 23 1☒ 2☐ 3☐
Mitigation Plan (for med/high risks): - Read and follow SWP #23 - Review H&S plan every morning prior to construction activities taking place - Ensure that you and other employees are well-informed of construction activities taking place and that adequate guidance and supervision is provided - Use construction signage and fencing, as required		
24) Will employees be working at an institutional, commercial, industrial, agricultural, or manufacturing plant?	☐ Yes ☒ No	SWP# 24 1☐ 2☐ 3☐
Mitigation Plan (for med/high risks):		
25) Could employees be exposed to any microbiological or pathological hazards at the site? These include:	☒ Yes ☐ No	SWP# 25 1☐ 2☒ 3☐
☐ Contaminated groundwater ☐ Contaminated surface water ☐ Mould ☐ Medical waste ☐ Sewage/wastewater ☐ Other (specify): ☒ Domestic waste ☐ Rodent feces		
Mitigation Plan (for med/high risks): - Read and follow SWP #25 - Staff may be exposed to pathological hazards from the debris, ash, and soil - Equip appropriate PPE at all times		

- Follow the environmental health and safety plan on the remediation action plan as well

26) Will employees be working alone?	☒ Yes	SWP# 26 1☒ 2☐ 3☐
	☐ No	

Mitigation Plan (for med/high risks):
- Read and follow SWP #26
- Staff will be near other contractors and consultants on-site at all times
- Check-in/check-out procedures

Is an additional assessment required? ☐ Yes (If yes, complete Section E or prepare custom H&S plan) ☒No

27) Could employees be exposed to any physical agents or hazards at the site? These include:	☒ Yes	SWP# 27 & 36 1☒ 2☐ 3☐
	☐ No	

☒ Noise (SWP# 36 Hearing Conservation Program) ☐ Vibration (SWP# 27) ☐ Working in the Dark (SWP# 27)

Mitigation Plan (for med/high risks):
- Read and follow SWP #27
- Wear appropriate hearing protection as required based on site activities

28) Will employees be working at an operating oil and gas site?	☐ Yes	SWP# 28 1☐ 2☐ 3☐
	☒ No	

Mitigation Plan (for med/high risks):

29) Will employees be working on/near a railway while on site?	☐ Yes	SWP# 29 1☐ 2☐ 3☐
	☒ No	

Mitigation Plan (for med/high risks):

30) Could employees be exposed to hydrogen sulfide at the site?	☐ Yes	SWP# 30 1☐ 2☐ 3☐
	☒ No	

Mitigation Plan (for med/high risks):

31) Could employees be exposed to radiation at the site?	☐ Yes	SWP# 31 1☐ 2☐ 3☐
	☒ No	

Mitigation Plan (for med/high risks):

32) Will staff be inspecting, testing or collecting hazardous substances, such as asbestos or mould?	☐ Yes	SWP# 32 1☒ 2☐ 3☐
	☒ No	

Mitigation Plan (for med/high risks):
- Read and follow SWP #32
- Staff should never be inspecting, testing, or near the visitor center. Asbestos abatement will be conducted by an experienced subcontractor. Confirmatory hazardous materials testing will be required following the abatement to test for remaining hazardous debris/ash. Following confirmation from the subcontractor that the area is decontaminated, mobilization into to the visitor center will be allowed.
- Soil sampling will be required at the visitor center prior to abatement. At a minimum, staff are required to wear fitted face-masks when near the visitor reception center and should sample in non-windy conditions and as quickly as possible.

33) Will employees be exposed to electrical equipment, should staff be aware of arc flash hazards?	☐ Yes ☒ No	SWP# 33 1☐ 2☐ 3☐
Mitigation Plan (for med/high risks):		
34) Will the project involve public consultation or working in public?	☐ Yes ☒ No	SWP#34 1☐ 2☐ 3☐
Mitigation Plan (for med/high risks):		
35) Will employees be working in and around helicopters?	☐ Yes ☒ No	SWP# 35 1☐ 2☐ 3☐
Mitigation Plan (for med/high risks):		
36) Will employees be opening and working around monitoring wells and manholes?	☐ Yes ☒ No	SWP# 37 1☐ 2☐ 3☐
Mitigation Plan (for med/high risks):		
37) Will employees act as traffic counters while working in the field?	☐ Yes ☒ No	SWP# 38 1☐ 2☐ 3☐
Mitigation Plan (for med/high risks):		
38) Will employees be required to use respiratory protection? (See Guideline A.17 Respiratory Protection Requirements)	☒ Yes ☐ No	A.17 1☒ 2☐ 3☐
Mitigation Plan (for med/high risks): - Read and follow Guideline A17 - Wear fitted face masks if near the visitor center (prior to abatement)		
39) Will heavy lifting, carrying, tasks with repetitive motions, or work that may cause an unnatural position be involved? (see Guideline A.2 Workplace Ergonomics)	☒ Yes ☐ No	A.2 1☒ 2☐ 3☐
Mitigation Plan (for med/high risks): - Read and follow Guideline A.2 - Use proper lifting techniques (lift with legs not back) - Take breaks as required		
40) Are there known issues or circumstances related to the site, personnel, or activity that creates a risk for workplace violence or harassment? (Refer to Dillon's Anti-Violence and Harassment Policies and Procedures)	☐ Yes ☒ No	Policy 1☐ 2☐ 3☐
Mitigation Plan (for med/high risks):		
41) Are there confined spaces (see Guideline A.12) at the site that employees will be entering? (If yes, custom H&S plan is required)	☐ Yes ☒ No	A.12 1☐ 2☐ 3☐

If yes, identify the type of confined space into which employees will be entering:

- ☐ Vaults, tanks, vessels, storage tanks, pipes, sumps, pits
- ☐ Settling tanks, sewers, manholes, septic tanks, digestors
- ☐ Wells, digesters, mixers, bines, flues, ducts, conveyors, elevators
- ☐ Other (specify):
- ☐ Caissons, trenches, tunnels
- ☐ Bridge girders
- ☐ Culverts

Mitigation Plan (for med/high risks):

42) Will a Sub-Consultant/Contractor be used on this project? If yes, review Guideline - A.7 Sub-Consultant/Sub-Contractor Health and Safety for additional information and instruction.	☒ Yes	Review Guideline A.7
	☐ No	
43) Is Dillon considered the Constructor on this project? If yes, review Guideline - A.21 Ontario Constructor Roles and Responsibilities.	☐ Yes	Review Guideline A.21 (Ontario)
	☒ No	
44) A custom health and safety plan is required by our client or another third party?	☒ Yes	Asbestos abatement health and safety plan will be provided by subcontractor. General environmental health and safety conditions have been listed in the Remediation Action Plan.
	☐ No	
45) In my opinion, a custom health and safety plan is necessary to assess and/or manage risk for this activity.	☐ Yes	Prepare a custom H&S plan as required
	☒ No	

Section D Identify Documentation, Equipment and Training Requirements

Documentation required:

- ☒ All identified SWP's and Guidelines by a "yes" in Section C
- ☒ Form D.7 Tailgate and Field Level Hazard Assessment (This form is required before any work commences at the site and needs to become part of all health and safety plans.)
- ☒ All supporting MSDS (list) Liquinox _____
- ☒ Other (supporting information) _____

PPE and other safety equipment required:

All employees are required to wear a hard hat, safety footwear, glasses, high visibility vest and work gloves while on-site unless otherwise directed by the project manager or their designate. Please check all PPE required for this project.	
CSA approved safety boots	☒
CSA approved hard hat	☒
CSA approved glasses	☒
High visibility safety vest	☒
Working gloves	☒
Hearing protection	☒
UV protection lotion	☐
Other (e.g., full protection body harness, respiratory protection)	☒
Other safety equipment (list)	☐
Bear Spray	☒
Other (list)	☐
No PPE required	☐

Training required (list):

- ☒ Safety Orientation
- ☒ WHMIS (all employees)
- ☐ Confined Space Awareness
- ☒ First Aid/CPR Training
- ☐ Working at Heights
- ☐ Other
- ☐ Other

Special Instructions: Staff should never be at the visitor center prior to asbestos abatement, but as soil sampling will be required, this work should be performed under non-windy conditions and as quickly as possible with a proper fitted face mask. Access to the visitor center will only be allowed when the experienced abatement contractor provides confirmation that the visitor center is decontaminated through hazardous materials sampling.

Section E Working Alone or in Remote Areas

Indicate the following: ☒ Working Alone ☐ Working in a Remote Area ☐ Both ☐ Not applicable

Additional risk and control measure to address these risks: Staff will use check-in/check-out procedures with respective Project Managers (or designated supervisor)

Emergency communications: Call 911

Check-in procedures:

Staff to check-in with respective Project Managers daily at the beginning of each field day on-site and at the end of the field day after arriving at their accommodation each night.

For work in remote areas, please provide a first aid kit and any additional supplies required to employee(s). Evaluate where you are going, and the method of transporting a person to medical emergency services if required. Include it in the project emergency procedure.

Section F Pre and Post Completion Review Sign Off

Pre-Commencement Hazard Assessment and Safety Plan Review:
I declare, that to the best of my knowledge, that the above information is complete, accurate and will be forwarded to the project team for review and comment.

Project/Submission/Office Manager: Melissa Hamilton Delegated Activity Supervisor: Richard Dieu

Employee sign-off: (Verification that the health and safety plan has been reviewed by workers/project team/subs-contractors/sub-consultants prior to commencing outlined activities).

Dillon and/or Sub Employee Name	Signature	Date

Form D.1 HAZARD ASSESSMENT/HEALTH AND SAFETY PLAN

Project Name: Waterton Kenow Wildfire Assessment and Remediation Project Number: 17-6826

Post Completion Declaration: I declare all staff associated with this project has reviewed this hazard assessment/health and safety plan.

Project/Submission/Office Manager: _____Delegated Activity Supervisor: _____

Section 2

Emergency Route to Hospital

Google Maps Cardston Health Centre to Trail Riders of the Canadian Rockies Drive 50.5 km, 37 min

Imagery ©2018 Google, DigitalGlobe, S. Alberta MD s and Counties, Province of British Columbia, Map data ©2018 Google 5 km

Cardston Health Centre

144 2 St W, Cardston, AB T0K 0K0

1. Head north on 2 St W toward 1 Ave W/AB-5 W

50 m

2. Turn left onto 1 Ave W/AB-5 W
   Continue to follow AB-5 W

44.2 km

3. Turn left to stay on AB-5 W
   Partial toll road

6.1 km

4. Turn left
   Destination will be on the right

210 m

Trail Riders of the Canadian Rockies

Waterton Lakes National Park, Marquis Rd, Waterton, AB T0K 2M0

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

Section 3

Safe Work Practices

Introduction

Ergonomics, sometimes called human factors engineering, is the design for human use to prevent injuries and accidents. It is the study of work, laws of work design, and fitting the workstation and/or task to the owner. Basic ergonomics awareness is intended to improve the health and safety of employees by reducing their exposure to the risk of musculoskeletal disorder (MSDs) in the workplace. There are many activities that may expose employees to ergonomic risk factors; however this section focuses on those exposures identified in the office environment.

The following risk factors may cause or contribute to work related MSIs and may be found in both office and field environments:

- awkward postures,
- excessive force,
- repetitive movements,
- long duration of the same activity,
- handling objects,
- contact stress,
- extreme temperatures,
- vibration,
- poor equipment/tool design, and
- poor work organization.

Guidelines

These guidelines will assist employees to choose and configure office furniture and equipment, to assess environmental conditions and to optimize job design.

Employees must understand and be aware of the early signs and symptoms of MSIs, in addition to basic ergonomics awareness, and incorporate safe ergonomic practices into the workplace and their activities. Report any ergonomic issues to your office manager or health and safety representative.

It is important to investigate potential MSIs risks to prevent their occurrence and/or reoccurrence. Risk factor identification should be integrated into workplace inspections and discussed in the Joint Health and Safety Committees meetings.

<u>Office Workstations</u>

The increased use of computers in our office environment has coincided with a rise in Musculoskeletal Disorders (MSD) and vision problems among employees who use this equipment. The primary goals are to focus on pre-emptive ergonomic assessments and recommendation in the following four areas:

- monitor location/computer monitors,
- keyboard location and support surfaces,
- seating, and
- employee education.

Computer Monitors

Hours working at a computer may place a continuous stress on the wrists, elbows and shoulders. Tendons in the arm may become inflamed, squeezing the nerves; the result is numbness and pain. Extended time in front of a computer can also cause eye fatigue, blurred vision, headaches, dizziness, and pain or stiffness in the neck, shoulders, back, arms, wrists, and hands. Short breaks away from the monitor will give eyes a rest.

Lighting

Workstations and lighting should be arranged to avoid reflections on the screen or surrounding surfaces. Light should be directed so that it does not shine into the operator's eyes when looking at the screen. Further, lighting should be adequate to enable the operator to see the text and the screen, but not bright enough to cause glare.

Normal office lighting can be supplemented by individual "task lighting" at a workstation, if necessary. Task lighting is particularly helpful for computer work especially since it enables operators to adjust lighting to their individual preferences.

Glare

Glare is defined as a harsh, uncomfortably bright light. Glare can be the result of the reflection of light on a computer screen or other reflective surfaces.

Screens that swivel horizontally and tilt or elevate vertically enable the operator to select the optimum viewing angle and help reduce glare. The monitor should be positioned so the screen's top edge is at about eye level or slightly below. This puts the head and neck in an easily maintained posture.

Posture Support

The seat and backrest of the chair should support a comfortable posture permitting occasional variations in the sitting position. Chair height and backrest angle should be easily adjustable. A footrest may be necessary for shorter individuals. **The ideal body position is the neutral position**. The chair used should have some adjustability, particularly for height and back support. The chair should allow a variety of different postures to be adopted. Chair adjustments should maintain the body's neutral positioning.

Arms

When the operator's hands are resting on the keyboard, elbow joint angle should be 90°. Hands should be in a reasonably straight line with the forearm. Long or unusually high reaches should be avoided. Armrests permit periodic support as needed, and help reduce stress on the low back.

Legs and Feet

The chair height is correct when the entire sole of the foot can rest on the floor or footrest and the back of the knee is slightly higher than the seat of the chair. Ideally, the workstation should provide about 68 cm of width and 61 cm of depth for leg space. There should not be any obstructions, such as boxes and/or shelves in the way. The tops of the legs should not be jammed up against the underside of the work surface. The thighs should be parallel to the floor. This allows the blood to circulate freely in the legs and feet, and reduces pressure on the thighs and knee joints.

Desk Surface

The table or workstation should suit the kind of task to be performed. It should be large enough for needed office items. Allow some flexibility in the positioning of your screen and keyboard. Items should be situated in a more convenient location. Place your mouse close to your keyboard.

Eye and Screen

The topmost line of the display should not be higher than the user's eyes. The screen should be the same distance from the eye (to avoid constant changes of focus) and close together so the operator can look from one to the other without excessive movement of the neck or back. All objects required for the task should be within the field of view. The field of view is the normal visual field that the head can comfortably rotate 45° to each side. The best viewing distance varies with individuals but the range tends to be about 45-60 cm.

Workstation Design

An individual workstation should provide the operator with a comfortable sitting position that is sufficiently flexible to reach, use, and observe the screen, keyboard and document. See Appendix A for workstation checklist. General guidelines to minimize fatigue include:

screen - top of screen at eye level,
keyboard - positioned to allow straight wrists,
desk or table top - think work surface to allow leg room and posture adjustments,
feet - rest comfortably on floor or foot rest,
backrest - support lower back, and
seat height, angle - allow comfortable posture.

Safe Ergonomic Practices for all Worksites

The following suggestions are examples of recommended ergonomic practices.

Awkward Postures

- minimize twisting, bending and side bending at the waist,
- avoid reaching above shoulder height,
- avoid reaching horizontally beyond 50 cm,
- use good body mechanics by turning your feet to move instead of twisting at the waist,
- keep objects close to your body and remove any obstacles between you and the object,
- remember good neutral body and joint postures, and
- consider gentle stretching while gathering and preparing equipment and supplies at the beginning of the day, as well as throughout the day.

Repetitive Movements

- use automated or mechanical equipment to minimize the repetitive body movements,
- adjust and alternate body positioning and movements to use a variety of muscles, and
- take mini-breaks to allow recovery time for the body.

Handling Objects

Note: A hazard assessment must be performed before manually lifting and handling a load.

- avoid manipulation of heavy objects whenever possible,
- use lifting and movement aids such as a cart or dolly to minimize the stress involved with handling heavy and awkward objects,
- minimize the vertical distance of the object being lifted,
- adjust the packaging of the object to a smaller weight,
- ensure the centre of the load is within 25 cm of your body and keep it tight to the body,
- keep your elbows as close to the body as possible,
- avoid arm movements that are behind the shoulder,
- use well designed handles that allow a comfortable power grip,
- balance and stabilize the load before handling,
- test the object first to see how difficult it will be before lifting,
- use mechanical equipment to assist with the lift, if available,
- lift heavier or awkward loads with another person(s),
- clear any obstacles out of the way before lifting and plan the route of the lift,
- bend at your knees, lift your head to position your back, and let your legs and knees do the work,
- keep your feet shoulder-width apart with the load placed in front of you, always point your feet in the direction of the lift,
- adjust the task so pushing can substitute for lifting,
- try to always push rather than pull as pushing is a safer activity,
- ensure the visibility is good when pushing to prevent any sudden movements,
- if pushing, use two hands to avoid any unbalanced movements or twisting,
- use extra caution when handling wet materials and equipment because of slippery coupling and the extra weight, and
- place heavier objects on middle shelves and avoid the top and bottom shelves.

Note: Employees shall not attempt to lift more than they can comfortably, and absolutely not more than 18 kg (approximately 40 pounds), without assistance from another employee or use of mechanical aids.

Contact Stress
- eliminate sharp edged objects and hard surfaces that come into constant contact with employees,
- cover sharp or hard edges with padding, and
- use personal protective equipment such as padded gloves when contacting uncomfortable objects.

Work Organization
- introduce job variation in the order of tasks and/or adjust the pace of the work,
- adjust the task to minimize the number of the times an object is handled, and
- take more frequent smaller load trips rather than one trip with a heavy load.

Equipment
- identify broken equipment right away and notify your activity supervisor instead of attempting to use it, and
- wring excess water from materials to reduce the weight.

<u>Implementation and Additional Tips</u>

Each employee is responsible for their own health and well being. To assist the employee, Dillon has prepared a workstation self-evaluation worksheet. This worksheet should be used by the employee yearly as a reminder of the proper workstation setup.

Employees must not be assigned to work activities that are beyond their physical capabilities, whether it be from physical impairment, inadequate personal protective equipment, or training.

Keep in mind that your body likes to move around. Muscles used in one position for extended periods of time get tired, affecting circulation and your joints. Change your body posture and positioning. This improves blood flow and keeps your working muscles refreshed and loose, and also relieves strain caused by awkward positioning, force and repetition. Take mini-breaks to stretch, rest your eyes and adjust your body. Other suggestions include, standing-up when taking longer phone calls and for one-on-one or small meetings, take it outside and make it a walking meeting.

Training

All employees during the health and safety orientation that may be exposed to the possibility of musculoskeletal injury are trained in specific measures to eliminate or reduce that possibility.
Training includes:

- an overview of a proper workstation set, chair adjustment and proper lifting,
- risk identification related to the work factors that could lead to a musculoskeletal injury, including the recognition of early signs and symptoms of MSDs and their potential health effects, and
- in the use of specific control measures the goal is to minimize MSDs, including safe work practices, altered work procedures, mechanical aids, equipment and personal protective equipment for the work they are assigned.

Resources

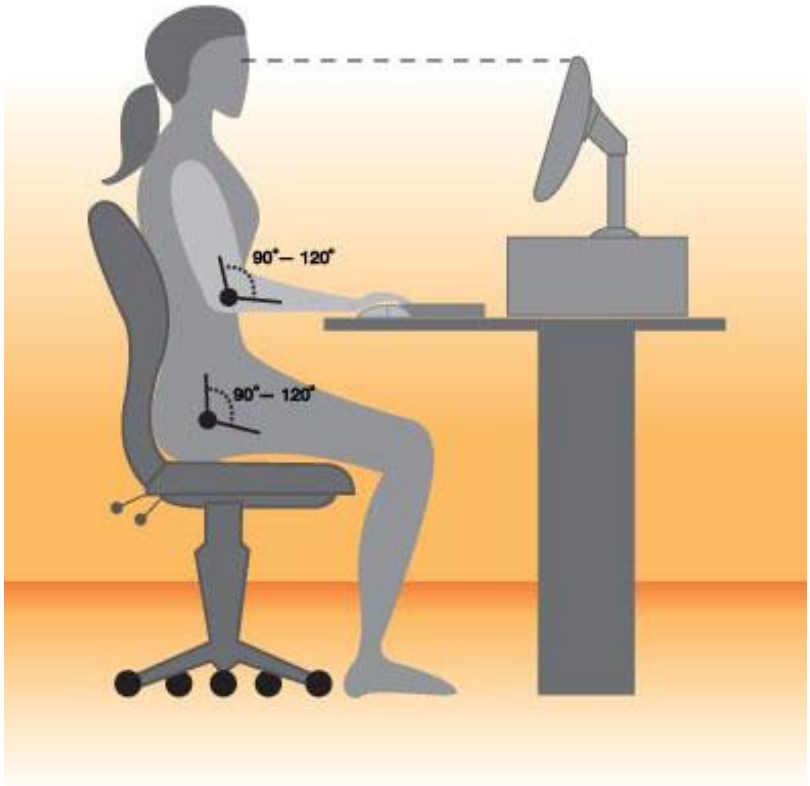
The following resources may provide additional information on workplace ergonomics:

- Provincial/Territorial health and safety agencies
- Form D.20 Workstation Ergonomic Checklist.

Basic Office Checklist

Chair and Posture
- ☐ elbows are bent slightly greater than 90°
- ☐ seat back is angled slightly back
- ☐ lower back is against the back of your chair
- ☐ feet are flat on the floor or footrest

Monitor
- ☐ the top of the screen is at eye level
- ☐ it is positioned to minimize glare
- ☐ optimal contrast and minimum brightness is achieved
- ☐ it is approximately an arm's length away from the operator
- ☐ remove eyes from the monitor hourly and focus on distant objects



Keyboard
- ☐ position keyboard so hands, wrists and elbows are parallel to floor
- ☐ position mouse close to and at the same height as the keyboard
- ☐ touch keys softly rather than pounding
- ☐ avoid resting wrists on sharp edges of work surfaces
- ☐ move hands when reaching for function keys rather than overreaching for the keys

Processes
- ☐ vary tasks; do not save keying for one long stretch
- ☐ relax your eyes by looking at least 6 meters away
- ☐ relax your shoulders
- ☐ from time to time, relax your hands
- ☐ take a brief stretch break periodically

Introduction

Dillon Consulting (Dillon) is committed to the health and safety of its employees. Sub-consultants and sub-contractors (subs) employed by Dillon are obligated to share the same commitment and meet or exceed all relevant health and safety rules and regulations. Health and safety performance will be a prime consideration in the selection process and expects subs will implement and maintain a program consistent with applicable legislation and industry best practices. Subs should demonstrate that the safe work practices are implemented and maintained current to reflect changing hazards, conditions and equipment at the work site.

Guidelines

Before acquiring sub-consultant or sub-contractor services, review P6 - Purchasing Services from Sub-Consultants, Sub-Contractors & Analytical Labs of Dillon's Business Administration Manual.

Before hiring a sub, health and safety competency must be established. A Dillon Health and Safety Sub-Consultant/Sub-Consultant Pre-Qualification form D.11, (prequalification) should be completed by the sub prior to any field activity. Timing to complete the prequalification depends on the project needs. However, it is preferred that the turnaround time stay within a 2 week period or sooner.

Subs that are used multiple times throughout year will be given a prequalification form to complete each fiscal year by the Coordinator, Health and Safety (HSC). This process will repeat yearly as long as the frequency in which the sub is hired continues. The names and addresses of regularly used subs must be communicated to the HSC by each office.

The HSC will review the returned prequalification forms using the criteria in the prequalification/evaluation/rating section provided below. Comments and other relevant information regarding returned prequalification forms will be made available to all staff once the evaluation process has been completed.

Less frequently used subs that are hired throughout the year should receive a prequalification request from the applicable Project Manager (PM). The prequalification must be completed and returned to the PM before fieldwork commences. PM's should review the completed forms using the prequalification/evaluation/rating section provided in this document. The HSC will assist with the review if requested. Copies of the completed prequalification and PM comments must be forwarded to HSC.

Note: The PM can evaluate the prequalification without the assistance of the HSC, however it is vital that a copy of the completed prequalification form be forwarded the HSC for accurate record keeping and auditing purposes.

Why is a safety prequalification needed?

Dillon has an obligation to identify if the sub meets the minimum health and safety standards as determined by law. It is an exercise to determine if and where Dillon needs to provide additional guidance on health and safety matters before field work commences. Answering 'no' to any of the questions detailed in the prequalification form does not automatically imply the sub cannot be obtained; however it does mean that Dillon should provide additional direction to ensure the safety of site employees and legislative requirements are followed. The PM can determine specific safety concerns and/or needs based on the applicable scope of work. In the event the sub does not have a health and safety manual, the sub will still be responsible for applicable policies, procedures and regulations. Therefore the sub will follow the Dillon health and safety program manual and in contents as well as a comprehensive hazard assessment/health and safety plan specific to the project at hand. The specific project health and safety plan must be signed off by all sub employees.

Note: Dillon may have other legislative responsibilities depending on jurisdiction and how Dillon is defined on the project (owner, employer, constructor, prime contractor, etc.) even if the sub is providing a supervisor and controlling the work on-site.

Evaluation Process

The evaluation is based on various criteria such as, their safety performance (i.e., lost workday cases and injury rates), existence of a health and safety program, policy, completed safety training, available safe work practices related to the scope of work and valid workers compensation insurance. Proof they follow applicable health and safety legislation and industry standards are part of ongoing site evaluations. If elements of the completed prequalification are deemed unsatisfactory an action plan must be developed by the PM. The HSC should be consulted if questions arise.

Note: Subs must be registered as an employer according to compensation legislation, and carry sufficient employees' compensation insurance that provides adequate coverage for the type of work to be performed. Depending on the length of the project, the need to provide workers compensation coverage/certificates may be requested throughout the project as insurance certificates have predetermined expiry dates. Therefore valid certificates must be made available when requested.

Prequalification Evaluation/Rating s

a. An **acceptable safety record** means the prequalification shows:

- no critical injuries have been reported in the last 3 years,
- no fatalities have been reported,
- written health and safety policies and program,
- valid health and safety training,
- competent supervisors and employees,
- valid compensation insurance,
- management involvement concerning safety,

- conducts regulate site/equipment inspections, etc.

An 'acceptable' safety record and/or evaluation indicates no further requirements are required, unless the HSC or PM deems it necessary.

b. If the prequalification is **unsatisfactory** and/ or other notable issues are found, a mitigation plan is required. More specifically, corrective actions for the inadequacies found must be prepared by the sub. The mitigation plan must detail how they plan to ensure the safety of its employees and other legislative requirements are met through the life of the project. Daily safety reports and periodic monitoring could be part of the mitigation plan.

Completed mitigation plans must be approved by the PM and the HSC are to work commencing. Dillon reserves the right to change the status of a sub, if they show insufficient progress towards a formally accepted mitigation plan. If a mitigation plan cannot be achieved to the satisfaction of the PM and/or HSC, the sub must be reconsidered. Sub employees who do not follow legislative safety requirements while on-site will be removed off the site.

c. If the returned prequalification notes any of the following points below; the sub should not be retained unless **extraordinary measures** are taken, provided in writing and approved by Dillon senior management.

- fatalities,
- multiple and reoccurring critical injuries that have not been rectified,
- multiple fines and/or orders for issues that have not been corrected,
- no documented or concern for health and safety practices, procedures or policies,
- unsatisfactory or no safety training of its employees, etc.

<u>General Sub Health and Safety Requirements and Responsibilities</u>

- Subs must have safe work practices detailing hazards specific to the job task(s) and made available to their employees. The plan should show dates of regular review by management and its employees. Ask the sub how they know safe work practices are communicated to staff?
- Subs must not report to work if their ability to perform their assigned tasks safely and efficiently is adversely impacted by drugs or alcohol. Dillon will communicate client drug and alcohol policies as applicable.
- Subs shall maintain documentation at each project site, which verifies on-going compliance with applicable federal, provincial, local regulations, and guidelines. This includes, but not limited to, reporting near misses, completing hazard assessments as required, conducting site inspections, attending pre-job meetings, and participating in daily tailgate/field level hazard assessment meetings.
- Subs must report all incidents involving their employees or other employees working on-site to Dillon as well as the client. The sub must also participate in the incident investigation.

- Subs must acknowledge, understand and follow all pertinent client/owner requirements, policies and procedures.
- Subs shall assume responsibility for complying with all applicable federal and provincial regulations.
- Each sub shall designate a competent supervisor who shall have the responsibility and full authority to enforce health and safety and report safety non-compliance matters to the Dillon PM, as required.
- All sub supervisors should have sufficient training that enables them to meet their responsibilities under applicable legislation and site health and safety. They must also ensure their employees on the project site have received safety training for all applicable work tasks. On-site employees must receive health and safety site induction before work begins.
- All personal protective equipment used by the sub and their employees shall be used in accordance with regulatory and CSA standards.
- In the event of any regulatory agency inspection, Dillon must be notified immediately. Copies of any citations, reports and corrective actions must be provided to the Dillon PM.
- Under certain circumstances, Dillon may agree in writing for a sub to conduct their activities under a Dillon project H&S plan. In these cases, Dillon will provide the plan and corresponding safe work practices to the sub and they must acknowledge receipt thereof in writing.
- Emergency evacuation plans must be developed by the sub prior to work commencing. Plans are dictated by type of work and physical environment.

Post Evaluation

Dillon PM's have an obligation to evaluate their subs once the assigned work has been completed. PM's should use the Sub-Consultant/Sub-Contractor Performance Evaluation Form D.10 found in the Dillon Health and Safety Program to document their post evaluation. Completed forms must be forwarded to HSC. A poor post sub evaluation may determine the future eligibility of the sub even if their safety prequalification has been approved.

Resources

- P6 Purchasing Services from Sub-Consultants, Sub-Contractors & Analytical Labs of Dillon's Business Administration Manual
- Health and Safety Sub-Consultant/Sub-Consultant Pre-Qualification Form D.11
- Sub-Consultant/Sub-Consultant Performance Evaluation Form D.10
- Provincial/Territorial Health and Safety Acts and Regulations.

Table A.7 – Safety Related Documentation Requirements from Sub-consultants & Sub-contractors

What	How	When	By Who
H&S safety performance (i.e., lost time days, number of injuries, fatalities etc.)	Information required on the Dillon H&S Sub Pre-Qualification	Once a year for frequently used subs	HSC
		Pre fieldwork	PM
Prior convictions or orders within the last 3 years	Information required on the Dillon H&S Sub Prequalification	Once a year for frequently used subs	HSC
		Pre fieldwork	PM
H&S policy and outline of H&S program	Information required on the Dillon H&S Sub Prequalification	Once a year for frequently used subs	HSC
		Pre fieldwork	PM
List of relevant safe work practices, employee roles and responsibilities	Information required on the Dillon H&S Sub Prequalification	Once a year for frequently used subs	HSC
		Pre fieldwork	PM or designate
Emergency procedure	Formal request	Pre fieldwork	PM or designate
Confirmation of H&S training	Information required on the Dillon H&S Sub Prequalification, Formal request, as required	Once a year for frequently used subs	HSC
		Pre fieldwork	PM or designate
Worker Compensation Insurance/Clearance Certificates	Formal request	Pre fieldwork, Throughout life of project, as required	PM or designate
Project specific hazard assessment/H&S plan	Formal request	Pre project	PM or designate
Daily safety reports (i.e., site conditions, incidents, non-conformances)	Formal request	Duration of the project, as required	PM or designate
Hazardous material lists and procedures (as applicable)	Formal request	Pre fieldwork	PM or designate
Form 1000 and/or Dillon Supervisor Designation Form (Ontario specific)	Formal request	Pre fieldwork	PM or designate
Work permits and Notice of Project (as applicable)	Formal request	Pre fieldwork	PM or designate

Introduction

Respiratory hazards are controlled using ventilation. Employees potentially exposed to airborne contaminants must wear respiratory protective devices.

Adequate ventilation shall be provided by:

- natural ventilation which introduces outside air provided by openings having a combined area equal to at least 5% of the floor area, or
- mechanical ventilation conforming to ASHRAE standard 62-1989, Ventilation for Acceptable Indoor Air Quality.

When ventilation is not practicable and it is not possible to reduce or eliminate the hazard, respirators will be utilized to help reduce potential exposure to hazardous atmospheres. Employees who are potentially exposed to airborne contaminates must wear respiratory protective devices.

Dillon must provide appropriate and approved respiratory protective devices if:

- respiratory protective equipment is required where there is potential for overexposure to an airborne hazardous substance, or an oxygen deficient atmosphere,
- an employee is or may be exposed to dust, fumes, gas, mist, aerosol or vapour that may be present in any amounts and are harmful or offensive to the employee,
- an employee is, or may be, exposed to an airborne contaminant or a mixture of airborne contaminants in a concentration exceeding occupational exposure limits, and
- ventilation is not practicable.

Guidelines

Proper Types

The proper selection, care use, maintenance, and fitting of the equipment must be selected and used in accordance with CSA Standard Z94.4 Selection, Care and Use of Respirators and CSA Standard Z180.1 Compressed Breathing Air and System, if applicable. Table 1, identifies appropriate types of respirators for different applications.

Selection

It is the intention of Dillon to provide a respirator protection guideline that meets or exceeds all standards.
The selection of respirators will be based on the findings of a hazard assessment that is performed by the project manager or their designate.
The hazard assessment should include:

- identification of actual and potential hazards to which the employee(s) may be exposed,
- determination of exposure patterns and magnitudes,
- determination of the level of exposure reduction or degree of protection necessary[1,]
- familiarization with the work operations where the respirator will be used,

[1] A table specifying the respiratory protection factors of different respirators (according to NIOSH) is available in Table 2.

- CSA Z94.4 Selection, Use and Care of Respirators requirements,
- consultation with affected personnel, and verify of the suitability of the respirator for the work operations,
- compatibility with other personal protective equipment (PPE) that the employee is required to wear, and
- maintenance, storage and care for the respirator when not in use.

Where hazard assessments are performed for purposes of specifying respiratory protection, a re-assessment should be carried out if new or altered conditions, equipment, or operating procedures could affect the safety or health of employees, or the effectiveness or suitability of specified respirator.

Additional factors to be considered when selecting an appropriate respirator:

- level of protection afforded by the respirator,
- Material Safety Data Sheet, if one is provided, refer to it and determine which respirator is recommended,
- supplier or manufacturer's specifications - the respirator user's manual will specify the conditions/hazards for which the respirator is appropriate,
- the duration or likely duration of the worker's exposure,
- ensure that respirator parts are not exchanged between brands of respirators, and
- emergency plan, if failure occurs.

Note: Dillon does not preform work in situations or conditions where there is an immediate danger to life or health (IDLH conditions) to an employee.

Fit Testing

Once an appropriate respirator has been selected, employees must be fit tested to ensure a proper seal around the face. Fit testing must be conducted by a qualified competent person. Employees being fit tested must be clean-shaven where the respirator contacts their skin. Fit test details (name, date) must be kept on record. Submit copy of the record to the Coordinator, Human Resources.

Training

Any employee required to wear respiratory protection must be provided with instruction. The employee must be able to demonstrate competence in the following subjects at the time of issuance of the equipment:

- the nature, extent and effects of the respiratory hazards to which the employee may be exposed,
- the degree of protection afforded, and limitations,
- proper selection to ensure proper fit,
- know when a proper fit test is required,
- how to properly wear the equipment,
- inspecting the equipment for condition and deficiencies,
- proper care, cleaning and storage of the equipment and other maintenance requirements,
- compatibility with other PPE, and
- how to recognize an emergency and the use of respirators during such situations.

Re-training should be provided based on usage, or when the need for re-training is indicated by deficiencies in how PPE is used, cared-for, or maintained.

A change in the employee's physical condition that could affect fit would result in the need for a new fit test. Such conditions may include facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight.

Use

The following precautions shall be taken for employees who are to use a respirator:

- each employee must ensure that he/she is medically fit to wear a respiratory prior to its use,
- where the protection afforded by a respirator depends on a tight-fitting seal between the mask and the skin of the wearer's face, the wearer should be clean-shaven,
- if a wearer objects to be clean-shaven as a condition of wearing a respirator, the activity supervisor must explain the necessity of being clean-shaven for the respirator to work effectively,
- employees required to use or wear respirators shall be issued respirators for their exclusive personal use,
- prior to using a respirator, the employee must conduct a pre-use visual check of all components for no defects,
- air-purifying cartridges with end-of-service-life indicators must be removed from service before or once they expire. Where end-of-service-life indicators are not present, the cartridges must be discarded once their service life is reached,
- after respirator use, the employee must clean and sanitize the respirator (refer to the maintenance section),
- no other PPE should interfere with the seal of the respirator to the face, and
- if a respirator fails for any reason, the employee is to immediately remove himself/herself from the area and replace the respirator.

Such failures could include:

- breathing difficulty,
- dizziness or other distress,
- smell, taste, or irritation from a contaminant,
- expiration of the cartridge, or
- damage to the respirator.

Put on and adjust the respirator as follows:

1. Clean and sanitize the respirator.
2. Put on the respirator where there is no potential for overexposure to an airborne hazardous substance or an oxygen deficient atmosphere.
3. Remove any eyewear.
4. Place the headband of the respirator in one hand and the face-piece in another.
5. Position the face-piece on the face. For half-face respirators, position the respirator across the bridge of your nose.
6. Extend the headband strap behind the head and adjust the straps to fit comfortably.

Remove the respirator as follows:

1. Go to an uncontaminated area (where there is no potential for overexposure to an airborne hazardous substance or an oxygen deficient atmosphere).
2. Wipe the face-piece and cartridge surface with a clean wipe.
3. Loosen the headbands and remove the face-piece.
4. Store clean respirator properly.

Maintenance

Users of PPE are responsible for care, cleaning and basic maintenance of the equipment they use. A user of PPE must advise his/her activity supervisor when the equipment requires any maintenance and/or replacement.

To clean and sanitize the respirator:

- remove filters, cartridges or canisters (discard or repair defective parts),
- wash in warm water with mild detergent,
- use soft bristle brush, if needed, to remove dirt,
- immerse in a disinfectant (e.g. hypochlorite solution, aqueous iodine) or other cleanser for 2 minutes, (refer to the manufacturer's manual to identify appropriate cleaning agents), and
- rinse in warm water and hand-dry with cloth then re-assemble.

Respirators should be stored in an area where they are protected from dust, sunlight, excessive moisture, damaging chemicals and extreme heat/cold.

Records

Respirator users are responsible for ensuring operator training records and proof fit testing are obtained from the trainer and submitted to the Coordinator, Human Recourses for recording purposes. Original records are to be kept in local office training files.

Resources

- CSA Z94.4, Selection, Care and Use of Respirators,
- CSA Z180.1, Compressed Breathing Air and System, and
- ASHRAE Standard 62-1989, Ventilation for Acceptable Indoor Air Quality.

Table 1 - Types of Respiratory Equipment (this table is for reference only, it does not indicate that types listed are permitted to be used)

Respirator Type	Characteristics of the Respirator	Advantages	Disadvantages	Respirator Sub-Type	Description of Sub-Type
Air-purifying respirators	• purify the air but do not replenish or increase the oxygen content of the air • use chemical, mechanical or a combination of chemical-mechanical filters	• purifies the air through a cartridge	• there is no protection in oxygen deficient atmospheres (they must not be worn in atmospheres with less than 19.5% oxygen) • they should not be used where there is a very high concentration of contaminants	Non-powered	• air is drawn through the air-purifying filter by the wearer during inhalation
				Powered	• motor-blower pushes purified air through a filter and into the face-piece
Self-contained breathing apparatus	• an atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user	• they provide an air source that is free of contaminants	• except in suit form, there is no protection against skin exposure (irritation or absorption) • the duration of use is limited by the amount of air or oxygen in the apparatus, the ambient atmospheric pressure, and the degree of physical activity of the user • the respirator is heavy and bulky	Closed-circuit	• breathing gas is re-breathed after CO2 is removed • may be demand or pressure-demand types • a face-piece or mouthpiece is provided
				Open-circuit	• may be demand or pressure-demand types • exhaled air passes through valves in the face-piece to the ambient environment • bottled air is typically from 2000 to 4500 psi • can be used for 15 - 60 minutes generally
Supplied-air respirators	• source of breathing air is not carried by the user • respirable air is supplied through a small diameter hose from a compressor of compressed air cylinders • a hose is attached to the user by a belt and can be detached rapidly in an emergency • a flow control valve sets the airflow rate • exhaled air passes to the ambient air through a valve in the enclosure • the maximum hose length available is 90 meters	• can be used for long periods of time • there is minimal breathing resistance and discomfort • they are generally light weight and not bulky	• there is no protection if the air supply fails • the air supply hose may become permeable or damaged • movement is restricted by the hose	Continuous flow airline	• provides continuous flow of breathing air to a respiratory inlet covering • requires at least 115L/min (4 cfm) of air to tight fitting face-pieces • requires at least 170 L/min (6 cfm) to loose fitting helmets, hoods and suits • used when there is ample air supply (e.g. an air compressor) • uses positive pressure to prevent inward leakage
				Pressure demand	• full and half face-piece • configured to maintain a positive pressure in the face-piece to prevent inward leakage • breathing air is admitted to the face-piece when the positive pressure inside the face-piece is reduced by inhalation
				Demand	• full and half face-piece • allows airflow only on inhalation • on exhalation the demand valve is deactivated • negative pressure device (i.e. inward leakage is possible)

Table 2 - Respiratory Protection Factors

Type of Respirator	Face-piece Style	Face-piece Pressure	Cartridge Type	Hazard Form	Protection Factor
Air-purifying	Filtering half-face-piece	N	N/A	Particle	10**
	Half-face mask	N	1	Particle, gas, vapour	10**
	Full-face mask	N	1	Particle	10
	Full-face mask	N	2	Particle	10
	Full-face mask	N	3	Gas, vapour	50**
Powered air-purifying	Loose hood helmet	C	1	Particle, gas, vapour	25**
	Tight-fitting face-piece	C	3	Gas, vapour	50**
	Tight-fitting face-piece	C	2	Particle	50
Airline	Half-face mask	N	N/A	Particle, gas, vapour	10
	Half-face mask	P	N/A	Particle, gas, vapour	1000
	Full-face mask	N	N/A	Particle, gas, vapour	50
	Full-face mask	P	N/A	Particle, gas, vapour	2000
	Hood or helmet	C	N/A	Particle, gas, vapour	25
SCBA*	Half-face mask	P	N/A	Particle, gas, vapour	1000
SCBA*	Full-face mask	N	N/A	Particle, gas, vapour	50
SCBA*	Full-face mask	P	N/A	Particle, gas, vapour	10000

* SCBA or airline with emergency air bottle for escape from the hazardous environment.
** Protection factor may be limited by the cartridge. Check with the manufacturer.

N Negative	N/A Not applicable	
C Constant Flow	P Positive Flow	
1 Any appropriate NIOSH-approved	2 HEPA	3 Appropriate NIOSH-approved gas or vapour

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A - Hazard Identification

Dillon employees are frequently involved in projects where workers are endangered by the hazard of vehicular traffic either related or unrelated to the project. Our work may involve activities that directly impact the flow of public traffic or may be adjacent to a roadway carrying public traffic. In both cases, workers face a risk of being struck by vehicles entering the work area.

Due to the variability of site conditions, a specific list of vehicular hazards and mitigation measures is required and, depending upon jurisdictional requirements, may have to be documented in writing in a traffic protection plan, prior to commencing the work.

B - Risk Assessment and Management

Some of the most common hazards encountered with respect to vehicular traffic are included in the following table.

Condition	Hazard /Concern	Mitigation Measures
Through or turning traffic adjacent to the work area	This situation can result in vehicles inadvertently entering work area	• Install traffic control devices as appropriate, based on jurisdictional requirements. • Wear PPE.
Traffic traveling on hills and curves adjacent to or approaching the work area	This can result in reduced driver visibility of workers and work area, and can result in vehicles inadvertently entering the work area	• Work downstream of signing or work vehicle so motorists are advised of your presence. • Consider addition of advanced signing warning of work operations ahead. • Wear PPE.
Construction equipment, including trucks and equipment reversing or entering the work area	Limited operator visibility out of construction vehicle. Reversing vehicles a particular concern	• See SWP 14 – Working Around Equipment. • Maintain eye contact between the equipment operator and the worker. • Establish a designated cell phone area away from moving equipment and vehicles. • Be visible to operators and drivers.

Condition	Hazard /Concern	Mitigation Measures
Work area access and egress points	Points of access and egress can create speed differentials, which can result in collisions	• Ensure that access/egress points provide ample deceleration/acceleration length. • Consider addition of advanced signing warning of work operations ahead.
High operating speeds	Increases the potential for encroachment into the work zone and increases vehicle stopping distance	• Certain speeds require higher levels of protection, such as blocker trucks. • Become familiar with the specific jurisdictional requirements.
Duration of the work	Longer durations increases level of exposure	• Install traffic control devices as appropriate, based on jurisdictional requirements.
Weather conditions	Can result in reduced visibility of both workers and drivers. Increased stopping distance can result from slippery or wet pavement surfaces	• Consider additional signing to increase the visibility of the work area. • Vacate site if weather conditions deteriorate to a point where visibility of the workers or the motorist is in question.

Traffic Protection Plans and Traffic Control Plans

The use of the term 'traffic protection plan' and 'traffic control plan' varies between jurisdictions, but generally the distinction between the two is as follows:

- A *traffic protection plan* is developed for the protection of workers. This is required for all projects where Dillon staff are working on or adjacent to a roadway carrying public traffic. The plan must contain a written description of the traffic hazards to which workers will be exposed and measures used to protect them.

- A *traffic control plan* is a detailed plan for the control of traffic during the work, including the selection and planned implementation of appropriate layouts for traffic control, signing and pavement markings. In some cases, the traffic control plan can be incorporated into the traffic protection plan, in others, a separate document with supporting plans is required to illustrate the traffic control measures.

A traffic protection plan is required for all activities where Dillon staff are working on or adjacent to a roadway carrying public traffic. Generic traffic protection plan templates are included in Appendix D of the Dillon Health & Safety Program Manual. This plan must be developed by a competent person, with the required experience through formal training, practical experience or a combination of both. **The plan must be in writing and must be available to the workers.**

Developing a Traffic Protection Plan

In developing a traffic protection plan, a site evaluation is required to assess the hazards, including consideration of:

- the proximity of the work area to the traffic
- driver visibility and stopping sight distances relative to the work area and workers
- traffic volumes and operating speeds
- existing traffic control devices (e.g. traffic signals)
- the need for temporary barriers or traffic control persons (flag persons)
- pedestrian routes and school zones
- weather conditions and visibility for night operations (if applicable)
- an assessment of the need for retaining a professional traffic control company.

General Safety Practices

- Check all beacons, signs and delineators before use to ensure that they are clean and in good operating condition. Repair or replace any faded or damaged signs and delineators.
- Conduct a survey of the work area and assess traffic patterns. Be aware of change in traffic flow and volume from that anticipated during preparation of the traffic protection plan.
- Monitor traffic patterns and effectiveness of traffic control measures during work, and adjust as necessary.
- Where our work involves affecting traffic passing through a signalized intersection, police officers with appropriate jurisdiction should be retained to control the movement of traffic through the intersection. Using flag persons in this situation is not acceptable.
- Where practical, workers should be positioned at least 3 m (or 1.5m for low speed facilities) from a live traffic lane.
- Where work vehicles are present, workers should stay ahead (downstream) of the vehicle, not behind (upstream) of the vehicle.
- Traffic movement should be interfered with or inhibited as little as possible. Roadway occupancy time and work completion time should be minimized to reduce exposure to potential hazards.
- For very short duration (30 minutes or less) field reviews where the work vehicle is parked on the shoulder and you are working more than 3m from live traffic, the use of a 360° beacon and 4-way flashers are the only traffic control devices required. Remember to work downstream of the vehicle, and wear all necessary PPE.
- Select hours of work to avoid peak traffic periods.

C – Training and Competency

Training requirements vary depending on the nature of our staff involvement and the requirements of the legislation in each jurisdiction needs to be consulted.

The staff developing the traffic protection plan and traffic control plan must be completed by someone with adequate knowledge, training and experience. As well, a worker involved in setting up the traffic control devices, must be a *competent person,* based on their experience or formal training. Flag persons require specific formal training prior to completing this work. A good resource for obtaining training related to traffic control is

with the Construction Safety Association in your specific jurisdiction.

All workers on-site must be trained on the requirements of the specific traffic protection plan and the traffic control plan developed for the work activities, prior to commencing work on that site.

D - Equipment and Personal Protective Equipment

A Dillon employee exposed to the hazard of vehicular traffic is required to wear the following personal protective equipment:

- safety vest which meets jurisdictional requirements (some areas require vests to have a tear-away feature, with Velcro or similar fastenings which release if the vest becomes entangled with equipment),
- CSA approved protective footwear;,
- CSA approved hard hat, and
- for night work, silver retro-reflective stripes encircling each arm and leg.

Note: the use of hearing protection for staff working near traffic is not appropriate, as it is important to be able to hear and be alerted by vehicular warnings and/or construction traffic.

E - Documentation

Relevant Provincial or Territorial Health and Safety Act and Regulations, including:

- Province of Manitoba Workplace Safety and Health Regulation, (Man. Reg. 217/2006) – Part 20 Vehicular and Pedestrian Traffic.
- Province of Saskatchewan, Occupational Health and Safety Regulations, 1996 (R.R.S., c. O-1,r.1) - Section 129 Protection from Traffic
- Province of Ontario, Construction Projects (O. Reg. 213/91) - Section 67-69 Traffic Control.
- Province of Newfoundland and Labrador, Occupational Health and Safety Regulations (C.N.L.R. 5/12) – Section 16 'Traffic Control' www.tw.gov.nl.ca/publications/#Manuals
- Province of British Columbia, Occupational Health and Safety Regulations – Part 18 'Traffic Control'.

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In most cases, the most significant acute hazards to which Dillon staff would be exposed at contamination and remediation sites are from the equipment operating on the sites, and associated construction and excavation activity. Much of this equipment may not be engaged in activities directly associated with contaminant characterization or remediation work. However, construction site safety and related issues are addressed in other safe work practices in this series, listed in Section E - Documentation. Additionally, the assessment of chemical and biological risk is examined in SWP 20 Exposure to Chemical or Biological Agents and SWP 25 Microbiological Hazards.

This safe work practice specifically addresses the assessment of contamination and carrying out remediation. It does not discuss the issues covered in other documents.

A - Hazard Identification

Identifying hazards on potentially contaminated sites, and identifying hazards on remediation sites, are different activities. On potentially contaminated sites the hazards may be essentially unknown until site characterization is complete, while on remediation sites the hazards should be known with a reasonable degree of confidence.

Potentially contaminated sites

Identifying potentially contaminated sites is not always easy. The existing environment may give no indication that highly contaminating uses, such as manufacture of coal gas, landfilling of waste, or metal smelting, may have taken place historically.

Furthermore, industrial processes can change over time, and processes that are now comparatively benign may have been less so in the past. In paper manufacture, for example, mercury compounds and other toxic heavy metal compounds were formerly used as anti-sliming agents, and these may contaminate former pulp mill sites.

Hazards are identified by site assessment and characterization, starting with a Phase 1 Environmental Site Assessment (ESA). This SWP does not address Phase 1 ESA preparation. However, from a safety standpoint it is important to note that contaminants can not only migrate off a site, they can also migrate onto it. Gas from landfill sites or mine workings can migrate hundreds of metres if it is not properly managed, and can present a risk of explosion or asphyxiation.

During site reconnaissance a number of indicators can suggest areas of concern, such as vegetation stress, topographic anomalies, above-ground and below-ground structures, and characteristic colours and odours. For example, blue soil discoloration or an almond smell on a coal gas site would indicate likely cyanide contamination. Such issues would normally be identified during the desk study, and addressed in the Hazard Assessment Health and Safety Plan. However, site information may be incomplete and staff should be alert for unexpected hazards.

Remediation sites

Characterization of a contaminated site should identify any significant potential exposures. Site personnel may be exposed to chemical, biological or even radioactive contaminants on the site. Remediation is done either *in-situ* or *ex-situ*, and may involve a range of activities including chemical handling; pumping of fluids and gases; heat treatment; vitrification; excavation; infilling; and other types of material handling such as windrowing. In addition to the site contaminants, remedial work will necessarily introduce associated hazards. These may include site traffic, fixed or mobile equipment, and treatment chemicals.

B - Risk Assessment and Management

Potentially contaminated sites

Assessing and managing the risk to workers assessing a site is not the same thing as assessing risk to past, current or future occupiers of the site. Because site activities and the patterns of exposure are different, different judgment criteria must be employed. However, normally a single site assessment and characterization will be done.

Once current and historical uses have been identified and located, soil and groundwater may be sampled and analyzed. The desk study and site reconnaissance should help to guide the program of sampling and analysis, by identifying the locations of potentially contaminating past uses and the types of contamination that may be expected.

On site, particular care should be used around known or suspected underground structures (such as storage tanks), sumps, pits, wells and mine shafts. These may be located by the desk study, or their presence may be indicated on site by surface depressions or other topographic anomalies. Over time, tanks and sumps may have corroded and lost structural integrity, and site workers should not travel across them.

Contact with chemicals and their containers should be avoided. Employees should record information on the label and if possible photograph the container or chemical.

If unexpected conditions occur at a site, such as unexpected and suspicious odours or liquids, Dillon staff should exercise caution. Vacate the area and contact appropriate personnel to assure the safety of people who may be on site or have access to it, including (as appropriate) the site operator, the site owner and the Dillon project manager.

Sampling will normally be done from test pits or boreholes, and the risks from these activities are addressed in safe work practices 7, 14, 18, 19 and 22 (see Section E). To some degree, the contaminants of concern should have been identified in the desk study. However, while processes and likely contaminants can sometimes be defined, it is not always possible to do so exactly. Chemicals may also transform in the environment in ways which can not be exactly predicted.

Exposure to contaminants should be minimized so far as practicable. So far as possible, potentially contaminated material should not be touched, inhaled or ingested. Sampling necessarily involves handling the material being sampled, even indirectly, and appropriate personal protective equipment should be used in accordance with H&S Program Manual Appendix A.5 Selection, Use and Maintenance of PPE. This would usually involve gloves of suitable material, and eye protection or a face mask. Aprons and coveralls may be used as appropriate. A dust mask, or more elaborate respiratory protection, may be required to control exposure to contaminated dust or hazardous gases and vapours. Dillon staff should avoid entering confined spaces, in accordance with H&S Program Manual Appendix A.12 Confined Space Awareness.

Remediation sites

Potential exposures should have been identified by the site assessment, and remediation personnel should apply protective measures in compliance with Appendix A.5 and SWP 20, 30 and 31. A site may have construction or development work going on parallel to the remediation activities, and it is important that site safety is observed.

In addition to site contaminants, remediation equipment and remediation chemicals will present risks which must be managed. Mechanical equipment will be used, perhaps involving boring or digging. Chemical or biological treatments may also be applied, and again, exposure must be managed.

Eating

In general, eating, drinking and smoking should only occur off-site. However, if the site is large, it may be appropriate to utilize a pre-defined “clean zone”. Hands should be thoroughly washed before eating, drinking or smoking. Care should be taken to avoid contact with chemicals or potentially contaminated material.

C – Training and Competency

All persons working on contamination and remediation projects must be familiar with the health and safety plan for site specific hazards, precautions, monitoring, personal protective equipment and emergency response. Health and safety awareness and WHMIS training must be completed by all staff working with contaminated site assessment and remediation. Staff trained in first aid should be available on-site. Note that many contamination or remediation sites will be classed as construction sites, where special provisions may apply.

D - Equipment and Personal Protective Equipment

CSA approved hard hats, safety footwear, eye protection, work gloves, hearing protection sunscreen and high visibility vests are considered basic PPE for all field staff. As appropriate, staff should also use dust masks, respirators, and protective overalls such as Tyvek suits. Respirators should only be used by persons trained in their use, storage, maintenance and have been fit tested.

Other training must be determined by applicable regulations as well as best practice. The Project Manager shall advise employees on other training requirements as required.

E - Documentation

Relevant Appendices of the H&S Program Manual:

- Guideline A.5 Selection, Use and Maintenance of PPE
- Guideline A.12 Confined Space Awareness
- Guideline A.2 Ergonomics and Preventing MSI's

Relevant Safe Work Practices:

- SWP 1 Working Around Traffic
- SWP 7 Working around Overhead or Underground Services
- SWP 8 Geomembranes
- SWP 12 Working with Ladders/Scaffolding
- SWP 14 Working Around Equipment
- SWP 15 Working in Remote or Wilderness Areas
- SWP 18 Supervision of Intrusive Investigations, Drilling, Test Pitting
- SWP 19 Site Reconnaissance
- SWP 20 Exposure to Chemical or Biological Agents
- SWP 21 Physical Hazards (Heat, Cold)
- SWP 22 Working Around Trenches and Excavations
- SWP 23 General Site Hazards (Construction or Demolition Sites)
- SWP 25 Microbiological Hazards
- SWP 27 Physical Hazards (Vibration and Working in the Dark)
- SWP 32 Hazardous Material Inspection, Testing and Collection
- SWP 6 Solid Waste Facilities
- SWP 13 Potable Power Tools
- SWP 26 Working Alone
- SWP 30 Hydrogen Sulfide
- SWP 31 Radiation Exposure and Safety
- SWP 36 Hearing Conservation Program

This safe work practice is intended to provide common sense guidance on managing hazards that are typically encountered in common activities. It should be used in conjunction with any other guidelines or safe work practices that may be relevant. Where there is a conflict, the more onerous advice should be followed. In any case where Dillon safe work practices do not match local jurisdictional requirements, the jurisdictional requirements take precedence. If there is any doubt, consult with the project manager or the Coordinator, Health and Safety.

A - Hazard Identification

Overhead and underground utilities can pose severe hazards when contacted by overhead equipment such as ladders or underground equipment such as drills or augers.

Overhead utilities of special concern are power lines which, if contacted, can result in electrical shock ranging in effect from a tingling sensation to death. A shock that may not be enough to kill or even injure can nevertheless startle a worker and cause a fall from a ladder or work platform.

Underground utilities such as pressured gas/oil/watermains can cause severe injury or death if punctured by equipment, due to explosion, fire or high pressure impact. Underground electrical conduit or cable can result in the same serious injuries or death as overhead hydro lines.

Underground oil and gas infrastructure can be present where wells or processing plant are nearby. Oil and gas are sometimes “sour”, or contaminated with hydrogen sulphide. Hydrogen sulphide is a heavier-than-air, highly toxic gas which can affect a wide area following an uncontrolled release.

Another underground hazard is hidden landscape fabric or geomembrane which is being used in increasing applications. If struck by a power auger, the material can pull the equipment operator into the auger.

Ground Disturbance – is considered to be any work, operation, or activity that results in a disturbance of the earth or that result in a reduction of the initial installation cover over a buried facility. This includes hand auguring, hand shoveling, pounding tree stakes etc.

B - Risk Assessment and Management

Prior to Commencing Field Work

The following risk management procedures should be followed during the planning and design phase, prior to completing field work:

- When planning a project that includes ground disturbance field activities, make contact with all utility companies and the owner of the site to determine the presence and location of existing infrastructure.
- Consult with oil and gas companies that may have infrastructure in the area. This is extremely important in the vicinity of sour gas wells or processing plant.
- Complete a site visit to observe overhead plant and surface evidence of underground utilities, such as valves, chamber lids or manhole covers.

- Consider the existing plant on the site plan or the investigation drawings, and when planning or designing the work, avoid areas of existing plant, where possible.
- In critical areas of potential conflict, the use of vacuum excavation should be considered to confirm the presence and location of existing plant, prior to intrusive field work such as drilling.
- Consider the potential for underground landscaping fabric or other types of geomembrane in areas of drilling or auguring, and note this on the drawings or investigation plan.
- Where the field work is being completed by the owner, by a contractor working for the owner or by a sub-contractor working for Dillon, ensure that they are aware of their responsibility to arrange for utility field locates prior to completing any intrusive work.
- Confirm all underground locates (verbal acknowledgment to proceed with excavating is not acceptable if utilities are on site and not positively located). This is to include all types of underground locates (i.e. hydro, water, sewage [storm and sanitary], gas, cable, phone, etc.).

<u>During Field Work</u>

The following risk management procedures should be followed as part of the field work, where Dillon has a contract administration or construction observer role:

- The contractor is responsible for obtaining field locates and implementing plans for the protection of existing utilities, underground oil or gas lines. Dillon field staff should be familiar with the contractor's health and safety plan as it applies to Dillon's activities. On construction projects, it is recommended that representatives from utility companies, oil/gas companies where appropriate, and municipal staff be invited to the pre-work meeting.
- When using ladders, scaffolding, lift trucks, zoom-booms, cranes, and similar equipment near power lines, use a signaler to warn the operators when any part of the equipment or load approaches the minimum allowable distances, as defined by the regulations. Have power lines moved, insulated, or de-energized where necessary.
- Before moving ladders, rolling scaffolds, or elevating work platforms, always check for overhead wires. The placement of warning signs at ground level should be done to alert workers of the overhead utilities.

In addition to the above procedures, the following additional measures should be followed for field work where Dillon is completing the work or the investigation:

- Contact utility companies to complete field locates of all underground and overhead services before starting work. Ensure our field staff are aware of utility company locates and requirements for working around the site. During the course of the work, obtain additional locates if locate marks are lost or the locate sheets expire. It is preferred that the client maintain contractual responsibility for infrastructure locates. If Dillon is completing the intrusive work, it is our responsibility to ensure that utility locates have been completed.
- In all cases, confirm all underground and overhead locates are marked as shown on the locate documentation that is provided by the utility companies.
- Contact oil and gas companies, which have operations or infrastructure in the area to ensure underground pipes are located and marked. Do not enter setbacks or exclusion zones.

- Many utility companies will not locate underground utilities on private property, in which case private utility locators should be engaged to complete this work.
- Avoid storing material or equipment under power lines. If it must be stored there, hang warning flags and signs to prevent other workers from using hoisting equipment to move or lift it.
- If work is to occur within the minimum separation distance for overhead lines as defined by some provincial legislation, a work permit may be obtained by the utility company.

C – Training and Competency

Personnel must be familiar with Dillon's project health and safety plan, as well as health and safety requirements of the owner and the contractor. They must also be familiar with the relevant regulations made pursuant to the Occupational Health and Safety Act, with regard to working around utilities.

Personnel must be familiar with the contractual and legal responsibilities of all parties involved in a project related to locating and protection existing utilities and services.

Ground Disturbance training may be a regulatory or a client requirement.
Please Note: Each jurisdiction has its own requirements governing ground disturbance and damage prevention. The specific requirements may vary, and sometimes conflict, between municipal, provincial, and federal requirements related to buried facilities and ground disturbance practices. Ground disturbance activities around petroleum pipelines have specific regulatory requirements.

D - Equipment and Personal Protective Equipment

Refer to Dillon Guideline in the H&S Program Manual, Appendix A.5 Selection, Use and Maintenance of PPE.

As a minimum standard, no Dillon employee should enter a site unless they are wearing suitable CSA-approved safety footwear, high visibility vest, eye protection, and hard hat.

E - Documentation

Where Dillon is completing the work or investigation on site, it is important that the field locate sheets be kept on site in the possession of our activity supervisor.

Additional Resources:

- Click before you dig is a helpful web-site that provides information across the country. www.clickbeforeyoudig.com.
- Technical Standards &Safety Authority (TSSA) Guidelines for Excavations in the Vicinity of Utility Lines. 2008
- Enform - Ground Disturbance and Damage Prevention (An Industry Recommended Practice for Canadian Oil and Gas Industry)

Relevant Provincial or Territorial Health and Safety Regulations:

- Province of Manitoba Workplace Safety and Health Regulation, (Man. Reg. 217/2006) – Part 25 'Work in the Vicinity of Overhead Electrical Lines'.
- Province of Alberta, Occupational Health and Safety Code, 2006 - Part 17 'Overhead Power Lines'.
- Province of Saskatchewan, Occupational Health and Safety Regulations, 1996 (R.R.S., c. O-1,r.1) - Section 259 'Locating Underground Pipelines etc.'.
- Province of Ontario, Construction Projects (O. Reg. 213/91) - Section 181, 'Electrical Hazards'.
- Province of British Columbia, Occupational Health and Safety Regulations – Part 20 - 33 (B.C. Reg. 296/97), Section 20.79 Underground Utilities'.
- Province of Newfoundland and Labrador, Occupational Health and Safety Regulations- Section 396, under Part 17, Construction, Excavation and Demolition for Underground Utilities.
- Province of Newfoundland and Labrador, Occupational Health and Safety Regulations – Section 498 and 499, under Part 26 – Electrical operations for Overhead Utilities.

This Safe Work Practice is intended to provide common sense guidance on managing hazards that are typically encountered in common activities. It should be used in conjunction with any other guidelines or safe work practices that may be relevant. Where there is a conflict, the more onerous advice should be followed. In any case where Dillon safe work practices do not match local jurisdictional requirements, the jurisdictional requirements take precedence. If there is any doubt, consult with the project manager or the Coordinator, Health and Safety.

A - Hazard Identification

Working at a construction site or third party facility can present a wide range of safety and health hazards. Prior to commencing work on any site or at any facility, Dillon staff should familiarize themselves with the site health and safety plan and undergo an orientation at their first visit to the facility. The site health and safety plan and orientation should identify any equipment to be locked-out and the relevant procedures.

Sites operated by Dillon would typically have a health and safety plan written under Form D-1 of the Health and Safety Program Manual, although exceptionally a site-specific risk assessment may be done. This safe work practice supports these documents, and provides a brief overview of the major hazards that should be locked-out prior to commencing work.

There are many types of potentially hazardous energy forms that need to be identified prior to beginning work on any site. Examples are shown in the table below.

Category	Hazards
Electrical Energy	Shocks or electrocution from contact with live power lines or electrical services.
	Shocks or electrocution from contact with buried power sources during excavation.
	Shocks or electrocution from contact with energy source when working around wiring, cabling, and control panels.
	Shocks or electrocution from contact with a grounded electrical device such as welding equipment.
	Shocks or electrocution from contact with equipment or electronics with stored power supplies. Contact includes where you walk.
Thermal Energy	Skin burns from contact with hot heating equipment such as boilers, furnaces, radiators, associated piping and metal housing on equipment. Other items such as exhaust systems for vehicles and engine driven equipment also pose thermal hazards. Skin burns from contact with steam, gas supplies (broken pipe, pressure relief valves, stack gases), open flames, boiling liquids and hot coils.
Chemicals	Skin burn, inhalation and physical injury. See SWP 20 (Exposure to Chemical or Biological Agents) for further information.

Category	Hazards
Pneumatic	Pneumatic equipment and systems present several hazards including noise and physical injury due to equipment malfunction, or injury from exposure to high pressure air streams. See SWP 14 Working Around Equipment, SWP 21 Physical Hazards (Heat, Cold) and SWP 27 Physical Hazards (Noise, Vibration and Working in the Dark).
Liquids (hydraulic)	Sewers, pipes, tanks and other "hydraulic" systems pose a variety of hazards depending on the operation, configuration and use of the system/equipment. Examples of some hazards include: • drowning • chemical exposure • trips and falls. See SWP 20 Exposure to Chemical or Biological Agents, SWP 14 Working Around Equipment, SWP 21 Physical Hazards (Heat, Cold) and SWP 27 Physical Hazards (Noise, Vibration and Working in the Dark).
Mechanical	Live mechanical equipment poses several hazards including trapping, slicing, noise, burns (friction), and other physical injuries. See SWP 14, Working Around equipment, SWP 21 Physical Hazards (Heat, Cold) and SWP 27 Physical Hazards (Noise, Vibration and Working in the Dark).
Gravitational	Unsecured objects (e.g., ice, tools, equipment) can pose physical hazards to employees working at lower elevations.

B - Risk Assessment and Management

All hazardous potential energy sources must be identified and locked-out or isolated before work in/on equipment begins. Possible energy sources include, but are not limited to, those identified in Part A above.

Lockout of equipment is typically not carried out by Dillon staff. Lockout should only be done by those adequately trained in lockout procedures and equipment.

Dillon staff should familiarize themselves with the lockout procedures being followed on each site.

Dillon personnel shall not commence work in any areas until the hazard assessment has been completed and all identified hazards have been locked-out by adequately trained personnel.

All affected people must be notified that a lockout system is going to be implemented and the reason for it. The locations of the equipment, the lockouts, and the person performing the work should all be discussed.

Do not attempt to operate any switch, valve or other energy isolating device where it is locked or tagged-out, or where it is unclear as to whether it is locked-out.

Do not cut or remove a lock that is not yours.

Dillon personnel should not work on locked-out equipment unless they have personally locked it out. This is in addition to others (i.e. facility electrician) also locking the same equipment out.

Some facilities will issue a 'guest' lock or have a 'sign out and return' lockout program. This should be verified prior to conducting the work.

A test must be conducted to ensure the equipment has been locked-out properly. The test must take place prior to commencing any work.

Electrical Lockout
No Dillon personnel shall work on live electrical circuits.

For machinery that utilizes an electrical cord:
- ensure machine controls are in the "off" position
- disconnect the plug and place the male end of the plug on the machine in a location readily visible to the person performing the work, and
- ensure the machinery will not start by attempting to start it.

For machinery supplied with power from an electrical panel circuit breaker or disconnect:
- ensure the machine controls are in the "off" position
- determine the correct breaker and switch it to the "off" position
- ensure the individual circuit breaker has been locked-out by appropriate personnel, and
- ensure the machinery will not start by attempting to start it.

Thermal/Hydraulic/Chemical/Pneumatic Lock-Out
Determine the location of valves, power sources and interlocks required to isolate the system by speaking with the system operators, reviewing drawings of the system if available, and the lockout procedure worksheet for the equipment.

Switches, valves or other similar control devices for energy sources shall be isolated or disconnected from the equipment by adequately qualified personnel. Confirm that locks and/or blanks and blinds have been applied to lockout the source.

Double check all components by attempting to start the system to verify that it has been de-energized.

Mechanical/Gravitational Lockout Procedures
All sources of mechanical/gravitational energy which may be hazardous to workers must be secured by the use of locks, chains, blocks, pins, etc. Although the equipment may be locked-out from electrical or hydraulic energy, some equipment parts may still need to be secured from movement.
All such forms of energy must be locked-out, blocked or released to ensure that machinery or equipment does not turn on or move during installation, repair or maintenance.

C – Training and Competency

- Staff must obtain appropriate lockout training and safety orientation prior to commencing work site.
- Staff operating equipment or machinery, such as mechanical lifts, at project sites must be trained in the safe use of that equipment.
- Personnel will be expected to demonstrate familiarity with any project health and safety plan or site-specific health and safety plan at any time.

D - Equipment and Personal Protective Equipment

Personal protective equipment may be necessary for even the most rudimentary tasks at operating facilities. Work clothing and PPE required at most operating facilities include, as a minimum:

- safety glasses
- hard hat
- protective footwear, and
- long-sleeved shirts, long pants and work gloves.

Loose clothing, hanging items and jewellery can become entangled in machinery and should not be worn. Additional PPE that may be required at operating facilities includes hearing protection, high-visibility tear-away safety vest, half-face respirator and special outer wear such as Nomex coveralls. In some chemical or pulp & paper processing facilities, where respirators must be kept on your person at all times, a no facial hair policy will be enforced and respirator fit-test documentation will be required.

Supplied-air respirators must only be used by staff properly trained in their storage, maintenance and use.

E - Documentation

Sources of relevant health and safety information will include:

- facility health and safety manuals
- facility operating manuals
- machinery/equipment operating manuals
- material safety data sheets
- provincial/territorial occupational health and safety regulations.

Dillon Health and Safety Program Manual should be consulted as appropriate. Sections to be consulted may include, but are not limited to:

- Appendix A.5 Selection, Use and Maintenance of PPE
- Appendix A.12 Confined Space Awareness
- SWP 14 Working Around Equipment
- SWP 20 Exposure to Chemical or Biological Agents
- SWP 21 Physical Hazards (Heat, Cold)
- SWP 27 Physical Hazards (Noise, Vibration and Working in the Dark).

This safe work practice is intended to provide common sense guidance on managing hazards that are typically encountered in common activities. It should be used in conjunction with any other guidelines or safe work practices that may be relevant. Where there is a conflict, the more onerous advice should be followed. In any case where Dillon safe work practices do not match local jurisdictional requirements, the jurisdictional requirements take precedence. If there is any doubt, consult with the project manager or the Coordinator, Health and Safety.

A - Hazard Identification

A wide range of types of power tools are used in numerous applications in today's work sites, it is important to understand the hazards posed by each. The hazards posed by a power tool are largely determined by two basic facts about the tool in question: the type of power source, and the nature of operation.

Power sources fall into four main categories:

- electric (e.g. electric drill)
- pneumatic (e.g. compressed air jack-hammer)
- hydraulic (e.g. jaws of life)
- internal combustion (e.g. chainsaw)
- powder-actuated (e.g. nail gun).

Most common power tools fall into two main categories:

- reciprocating (e.g. jack-hammer)
- rotating (e.g. handheld circular saw).

When the power source and nature of operation are considered, it is possible to determine the likely hazards that may be associated with a particular tool.

Portable power tools present much the same range of physical hazards as fixed power tools, specifically:

- entanglement with rotating parts
- friction or abrasion from contact with abrasive surfaces or smooth surfaces moving at high speed
- cutting or severing by saws or moving edges
- drawing-in or trapping at pinch points or in-running nips
- impact or puncture by projectile, e.g. from cutting or grinding machines
- impact from kickback
- noise and vibration.

They also present additional hazards, associated with the power source.

Electric Tools

Electric tools present the possibility of electrocution. Other hazards of working with electric powered tools are burns and slight shocks which can lead to injuries or even heart failure. Under certain conditions, even a small amount of current can result in fibrillation of the heart and eventual death. A shock also can cause the user to fall off a ladder or other elevated work surface.

Gasoline Powered Tools

Some commonly used gasoline powered tools are the chainsaw, stand-alone jack-hammer/breaker, cut-off saw, and string trimmer (weed wacker). These tools have a number of hazards associated with them including cutting, heat, projectile throwing, and noise. The gasoline fuel is also highly flammable and must be treated with caution, particularly when the machine is being fuelled.

Pneumatic Tools

Pneumatic tools are powered by compressed air and include breakers (aka jack-hammers), chippers, drills, hammers, impact wrenches, and grinders. There are several hazards encountered in the use of pneumatic tools. The main one is the danger of getting hit by one of the tool's attachments or by some kind of fastener the worker is using with the tool.

Hydraulic Power Tools

As with pneumatic tools, hydraulic systems are pressurized. Hazards relate to being hit by attachments, or loss from containment of fluids under pressure.

Powder-Actuated Tools

Powder-actuated tools, such as nail guns (Hilti guns), operate like a loaded gun and should be treated with the same respect and precautions.

B - Risk Assessment and Management

NEVER USE A POWER TOOL UNLESS YOU ARE FAMILIAR WITH IT. TOOLS MAY ONLY BE USED FOR THE PURPOSES FOR WHICH THEY WERE DESIGNED. READ THE MANUFACTURER'S INSTRUCTIONS AND WARNINGS BEFORE USE.

Hazardous moving parts of a power tool need to be guarded. For example, belts, gears, shafts, pulleys, sprockets, spindles, drums, fly wheels, chains, or other reciprocating, rotating, or moving parts of equipment must be guarded if such parts could come into contact with the operator. Beware of pinch points and being struck by moving parts of reciprocating tools such as power pumps.

Safety guards must never be removed when a tool is being used. For example, portable circular saws must be equipped with guards. An upper guard must cover the entire blade of the saw. A retractable lower guard must cover the teeth of the saw, except where it makes contact with the work material. The lower guard must automatically return to the covering position when the tool is withdrawn from the work.

The following general precautions should be observed by power tool users:

- All observers should be kept at a safe distance away from the work area.
- Secure work with clamps or a vice, freeing both hands to operate the tool.
- Avoid accidental starting. The worker should not hold a finger on the switch button while carrying a powered or energized tool.
- Tools should be maintained with care. They should be kept sharp and clean for the best performance. Follow instructions in the user's manual for lubricating and changing accessories.
- Be sure to keep good footing and maintain good balance.
- All tools that are damaged must be removed from service and tagged "Do Not Use."

Applying five basic safety rules can help to manage risks associated with portable power tools:

- Keep all tools in good condition with regular maintenance.
- Use the right tool for the job.
- Examine each tool for damage before use.
- Training should be taken where appropriate and the tool should be operated according to the manufacturer's instructions.
- Provide and use the proper protective equipment. Loose clothing, ties, or jewellery can become caught in moving parts.

Further precautions are required for different types of tools.

Electric Tools

To protect the user from shock, tools must either have a three wire cord with ground and be grounded, be double insulated, or be powered by a low-voltage isolation transformer. Three-wire cords contain two current-carrying conductors and a grounding conductor. One end of the grounding conductor connects to the tool's metal housing. The other end is grounded through a prong on the plug. Anytime an adapter is used to accommodate a two-hole receptacle, the adapter wire must be attached to a known ground. The third prong should never be removed from the plug.

Double insulation may also be used. The user and the tools are protected in two ways: by normal insulation on the wires inside, and by a housing that cannot conduct electricity to the operator in the event of a malfunction.

These general practices should be followed when using electric tools:

- electric tools should be operated within their design limitations
- when not in use, tools should be stored in a dry place
- where water or other conducting fluids are present, ensure the system is powered through a ground fault circuit interrupter.

Furthermore, the cord should be protected from damage by:

- never carrying a tool by the cord or hose
- never yanking the cord or the hose to disconnect it from the receptacle
- keeping cords and hoses away from heat, oil, and sharp edges
- disconnecting tools when not in use, before servicing, and when changing accessories such as blades, bits and cutters.

Gasoline Powered Tools

When using gasoline powered tools:

- ensure that all moving parts are safely attached and do not have excessive free play (e.g. make sure a chain saw chain is properly adjusted)
- make sure that all the controls work correctly including the shut off switch
- test that any safety devices, such as the chain brake on a chain saw, are working correctly
- allow the tool to cool before refuelling
- transport the gasoline in an approved container

- check to see if the tool requires mixed or unmixed gasoline -- if it uses 2 stroke motor oil, ensure that it is mixed correctly with the gasoline
- have a fire extinguisher on site.

Pneumatic Tools

- Eye protection is required and face protection is recommended for employees working with pneumatic tools.
- Noise is another hazard. Working with noisy tools such as jack-hammers requires proper, effective use of hearing protection.
- When using pneumatic tools, employees must check to see that they are fastened securely to the hose to prevent them from becoming disconnected. A short wire or positive locking device attaching the air hose to the tool will serve as an added safeguard.
- A safety clip or retainer must be installed to prevent attachments, such as chisels on a chipping hammer, from being unintentionally shot from the barrel.
- Screens must be set up to protect nearby workers from being struck by flying fragments around chippers, riveting guns, staplers, or air drills.

Compressed air guns should never be pointed toward anyone. Users should never "dead-end" it against themselves or anyone else. Discharge of the compressed air against the skin could cause injury, possibly injecting air bubbles into the blood stream.

Hydraulic Power Tools

The fluid used in hydraulic power tools must be an approved fire-resistant fluid and must retain its operating characteristics at the most extreme temperatures to which it will be exposed. The manufacturer's recommended safe operating pressure for hoses, valves, pipes, filters, and other fittings must not be exceeded.

Powered Cutting Wheel Tools

Powered cutting, and grinding discs and wheels create special safety problems because they may throw off flying fragments.

Before a cutting or grinding disk or wheel is mounted, it should be inspected closely to be sure that it is free from cracks or defects. If they are cracked or damaged, they could fly apart in operation and so must not be used.

To prevent damage to the disc/wheel the user should be sure it fits freely on the spindle. The spindle nut must be tightened enough to hold the wheel in place, without distorting the flange. Follow the manufacturer's recommendations. Care must be taken to assure that the disc/wheel is rated for the rpm that the tool will spin it at.

Due to the possibility of a wheel disintegrating (exploding) during start-up, the employee should never stand directly in front of the wheel as it accelerates to full operating speed.
Portable grinding tools need to be equipped with safety guards to protect workers not only from the moving wheel surface, but also from flying fragments in case the wheel breaks.

In addition, when using a powered grinder:

- always use eye, hand, hearing, and foot protection
- turn off the power when not in use
- never clamp a hand-held grinder in a vice.

Powder-Actuated Tools

Powder-actuated tools must be operated only by specially trained personnel. No Dillon employee should use a powder-activated tool unless they have been trained in its use.

Personal protective equipment, notably hearing protection, may be required by staff working in the vicinity of powder-actuated tools used by others.

C – Training and Competency

Employees should not use power tools unless they are competent in their use, either by training or experience.

D - Equipment and Personal Protective Equipment

The following personal protective equipment is required for safe use of common hand and/or power tools:

- eye protection, face shield, goggles, or safety glasses
- hard hat
- hearing protection
- safety boots
- sturdy gloves
- long pants and long sleeved shirt (minimum)
- leg chaps and knee pads can provide protection when using a chain saw.

There are many ergonomic concerns associated with the incorrect or excessive use of powered tools. When selecting a tool, ensure manufacturer's recommendations and the correct method of use are followed to avoid unnecessary injuries.

E - Documentation

Employees using equipment must check maintenance records against the manufacturer's recommended maintenance schedule (instructions and warnings). Refer to the Dillon Business Administration Manual P11: Equipment Management for more information about record retention and storage.

Refer the Provincial/Territorial health and safety regulations, as applicable.

This safe work practice is intended to provide common sense guidance on managing hazards that are typically encountered in common activities. It should be used in conjunction with any other guidelines or safe work practices that may be relevant. Where there is a conflict, the more onerous advice should be followed. In any case where Dillon safe work practices do not match local jurisdictional requirements, the jurisdictional requirements take precedence. If there is any doubt, consult with the project manager or the Coordinator, Health and Safety.

This safe work practice will examine safety around equipment in industrial, commercial or institutional facilities or on construction sites. It does not deal with portable power tools.

Dillon staff may work alongside equipment in a number of situations, and it is important to be able to recognize the associated hazards and manage the associated risks. For example, an escorted site or plant visit may be a pre-approved activity under the Health and Safety Program Manual, Appendix B. Under these circumstances, Dillon would not do a task-specific safety assessment. While staff should familiarize themselves with relevant parts of the facility safety plan before entering the site, equipment safety may not be adequately addressed in that plan. Therefore, it is important to be familiar with the principles of equipment safety.

A - Hazard Identification

Hazards from machinery and equipment can be caused by many factors. Communication and awareness of potential hazards are key elements when working around equipment.

For equipment to be hazardous, it must have components that are moving, or energized.

Typical hazards include:

Fixed Equipment

Hazard	Causes
Mechanical Hazards	
Entanglement	• rotating surfaces and spindles • projections and gaps
Friction and Abrasion	• contact with moving abrasive surfaces • contact with high speed smooth surfaces
Cutting or Severing	• contact with knives, saws, or moving edges
Impact or Stabbing/Puncturing	• penetration by projectile, e.g. from chipping, cutting or grinding machines
Drawing-in or Trapping	• in-running nips (pinch points) between counter-rotating parts • in-running nips between a rotating surface and a tangentially moving part (e.g. chain and sprocket, or belt wheel)

Hazard	Causes
Fluids	
Tissue damage	• exposure to gases or liquids released from high-pressure containment – hydraulic and pneumatic systems, compressed air, pressurized gases or liquids
Slipping, Tripping and Falling	
Falling into moving or energized part, or falling onto another person (e.g. operator).	• uneven surface • poor housekeeping
Electrical Hazards	
Electricity can cause a direct hazard of shock or burn, or an indirect hazard as an ignition source in the vicinity of flammable or explosive materials.	• damaged insulation • poorly wired equipment • wrongly wired or damaged outlet
Thermal Hazards	
It may not be apparent that surfaces will be hot or cold, for example where welding is being done inside a vessel.	• burn or scald from contact with hot surface or material • burn from contact with cold material
Noise and vibration	
Both noise and vibration are transmitted through matter as waves. Noise exposure can result in hearing loss. Vibration exposure can produce acute fatigue and chronic physical effects, notably “white finger”.	• impact, e.g. hammer piling • friction, e.g. worn or poorly lubricated bearings • fluid cavitation in pipe systems • reciprocal motion (e.g. pistons) • explosions
Radiation - ionizing	
Staff should not be exposed to ionizing radiation from occupational sources except where a full health and safety assessment has been carried out.	• radioactive sources emit alpha (α), beta (β) particles, and gamma (γ) rays • x-rays
Radiation - non-ionizing	
Includes near ultraviolet, visible, infrared, microwave, radio frequency and laser radiation.	• exposure to lasers can produce corneal and retinal injury

Mobile Equipment

Hazard	Causes
Vehicle Hazards	
Impact from moving vehicle	Drivers and vehicle operators will be focused on their task, and may reverse without looking. Also, many industrial machines provide only limited visibility to the operator. Talking on a cell phone or texting is also a major distraction to vehicle drivers and operators.
Exhaust from mobile construction equipment	Toxic gases and vapours may emit from various types of mobile equipment.
Projectiles from materials being handled/loaded	During loading and unloading of material, projectiles may issue, for example where material being compacted bursts under pressure.

B - Risk Assessment and Management

It is essential that any person operating equipment or machinery is properly trained in its use. This is especially the case where guards, interlocks and other safeguards must be by-passed for repair or maintenance. Under those circumstances, written safe procedures generally involving lockout should be applied.

Fixed Equipment

Mechanical hazards

- Use caution around equipment. Make sure operators are aware of your presence, by notifying them of your arrival, and upon your departure.
- Determine what equipment is in use, or is likely to be used, in your vicinity.
- Note revolving or moving parts such as belts, chains, flywheels, sprockets, gears, pulleys, shafts, spindles, couplings and screws. All such components should be guarded to prevent contact. Guards should be substantial, adequately supported, securely fastened and in good repair. It should not be possible to overcome the guard in normal operation. The guard should be secured, for example by bolts or a lock, or it should be interlocked to the power supply.
- Under no circumstances should Dillon personnel approach unguarded machinery under power.
- Precautions against kickback are necessary on certain types of cutting and abrasive machinery, particularly where work pieces are manipulated by hand.
- Precautions against bursting abrasive wheels generally involve ensuring that associated equipment has been marked clearly with their speeds. Worn or damaged abrasive wheels should be replaced.
- Where possible, limit your closeness of approach near a machine's traverse.
- Use appropriate manual handling devices, such as tings for forging work, push sticks for circular saws, or push blocks for planning machines.
- Loose clothing, neckties, gloves, rings and other jewelry, long hair (unless tied back and/or covered), and fabric dressings and bandages should not be worn around machinery. Close-fitting clothing with close-fitting cuffs and no external pockets should be worn.
- Wear required personal protective equipment (PPE). This would include CSA-approved hard hat, safety footwear and eye protection as a minimum.

Fluids
Use caution around pressurized systems. Ensure adherence to written procedures. Pressure testing of equipment, including pressure relief valves, must be up to date.

Slipping, Tripping and Falling
There should be safe, unobstructed access, with firm handholds where necessary, around machinery. Such access should be free of material likely to cause slipping, tripping or falling, such as swarf, rags and other debris, oil or water.

Electrical Hazards
- Electrical equipment and wiring should be maintained in good condition. Inspect tools, power cords, and electrical fittings for damage or wear prior to each use. Repair or replace damaged equipment immediately.
- Unusually warm or hot outlets may be a sign that unsafe wiring conditions exists. Unplug any cords to these outlets and do not use until a qualified electrician has checked the wiring.
- Where water or other conducting fluids are present, ensure the system is powered through a ground fault circuit interrupter.

Do not touch a person or electrical apparatus in the event of an electrical accident. Always disconnect the current first. Also, refer to SWP 33 Arc Flash for more information.

Thermal Hazards
Avoid handling equipment unnecessarily. Check whether surfaces are likely to be hot or cold. Hot/cold surfaces should be identified by a label, but do not rely on this being done. Use PPE as appropriate.

Noise and Vibration
Exposure time to noise and vibration should be avoided where possible, and minimized where unavoidable. Where entry into a noisy area is required, wear suitable and adequate hearing protection see SWP 27 Physical Hazards (Noise, Vibration and Working in the Dark) and SWP 36 Hearing Conservation Program for more information.

Radiation – ionizing
Dillon staff should not normally be exposed to ionizing radiation in an occupational setting. Where there is potential exposure, a full risk assessment should be done and written safe work procedures put in place.

Radiation – non-ionizing
The most significant occupational exposure to non-ionizing radiation would be where lasers are in use. Visible laser light can be so intense that it can do damage faster than a blink of an eye. The invisible, infrared laser beam such as carbon dioxide laser beam does not produce a bright light that would cause the blinking reflex or the pupil to constrict.

Lasers must be labeled by class. Class 1, 1M, 2, 2M, 3R, 3B or 4. People working around lasers should be instructed in the associated hazards. Eye protection is needed while using Class 3B or Class 4 type lasers to prevent harmful exposure from reflected and scattered laser beams.

Mobile Equipment

- Familiarize yourself with operator's work plan.
- Be aware of basic hand signals to "stop".
- Advise operators of your presence.
- Be aware of the location and direction of moving equipment. Never assume that an operator sees you. Maintain distance from equipment equal to at least overall length of the equipment x2.
- Do not walk behind heavy equipment.
- Avoid proximity to equipment when dark or in poor weather.
- On construction or waste sites, stay at least 100 feet away from roll-off trucks or semis in case they tip over on uneven or subsiding ground.
- 2-way radios, cell phones, horns and hand signals are all used at sites to communicate hazards, directions, and information. Learn and obey communication procedures at the facility.
- Never walk under a load supported by a crane or forklift. Never use a forklift as a person lift. Never operate unless trained.
- Ensure that the equipment operator is aware of your location at all times. Maintain eye contact with drivers where possible. Wear a high visibility vest. At some locations, this may require to be "tear-off" (attached at key points with Velcro) as a precaution against entanglement with equipment.
- Never use a cell phone near operating mobile equipment. The operator must see you. If cell phone use is required, remove yourself to a safe location away from moving traffic in a space where operating mobile equipment cannot reach you. Do not put yourself in harms way.

C – Training and Competency

All persons working around machinery should be familiar with the hazards associated with that equipment. The site operator should be able to assist in these areas. Industrial facilities should provide a safety orientation for all persons entering the facility. Visitors should be continuously escorted by facility personnel.

If there is any doubt, consult with the Project Manager or the Coordinator, Health and Safety.

D - Equipment and Personal Protective Equipment

Any selection of a wide range of personal protective equipment may be required when working around equipment. This can include, but is not limited to:

- hard hat
- eye protection
- hearing protection (Note: hearing protection must be approved by the project manager or general manager of the site. Hearing protection can put you in more danger if earing is impaired)
- protective footwear (suitable treads)

- high visibility vest
- respiratory protection
- electrical shock protection
- chemical protection.

E - Documentation

Canadian Standards Association Standard CSA-Z432-04 – safeguarding of machinery applies to the protection of persons from the hazards arising from the use of mobile or stationary machinery. It provides the criteria to be observed and the description, selection, and application of guards and safety devices. Where a CSA standard exists for a specific type of machinery, it is to be used in conjunction with that standard to provide the most effective protection to the situation. This standard does not apply to portable hand tools.

Health and Safety Program Manual Guidelines:

- A.5 Selection, Use and Maintenance of PPE.

Health and Safety Program Manual Safe Work Practices:

- SWP 13 Portable Power Tools.
- SWP 20 Exposure to Chemical or Biological Agents
- SWP 21 Physical Hazards (Heat, Cold)
- SWP 27 Physical Hazards (Noise, Vibration, Working in the Dark)
- SWP 31 Radiation Exposure and Safety Program
- SWP 33 Arc Flash
- SWP 36 Hearing Conservation Program
- Young Worker Program.

This safe work practice is intended to provide common sense guidance on managing hazards that are typically encountered in common activities. It should be used in conjunction with any other guidelines or safe work practices that may be relevant. Where there is a conflict, the more onerous advice should be followed. In any case where Dillon safe work practices do not match local jurisdictional requirements, the jurisdictional requirements take precedence. If there is any doubt, consult with the project manager or the Coordinator, Health and Safety.

A - Hazard Identification

Remote area is variously defined in Canadian jurisdictions, and even the term "remote" is not applied universally. The basic criterion used in defining a remote location is the travel time from emergency medical care or fixed medical facilities, or the ambulance response time. The travel time is usually specified as either 20 or 30 minutes. Note the criterion that defines remoteness is time, not distance.

Different jurisdictions require that different standards of first aid or medical training be met at near and remote locations, and that different levels of first aid or medical provision must be in place. These requirements are generally both specific and detailed, and it is important to comply with local regulations and codes. Accordingly, this Safe Work Practice should be used in conjunction with the relevant local regulations. For your reference, these are listed below, in Part E – Documentation, with a link to on-line resources for each.

Wilderness is not defined in health and safety legislation, although the term is used in the Canada Occupational Health and Safety Regulations. It is defined in the Compact Oxford Canadian Dictionary as "a wild, uncultivated, and uninhabited region" and by the BC Ministry of Forests as an area "…that predominantly retains its natural character … where human impact is transitory, minor, and in the long run, substantially unnoticeable". Senior Dillon biologists advise that, depending on factors such as the extent of resource development infrastructure (e.g. logging or oilfield access roads or operations) in the area or the presence or absence of dangerous wildlife in the area (e.g. bears or cougars), both of these definitions of "wilderness" should be subject to area-specific interpretation by a competent person.

Remote Areas, under above definitions, is a location that can be remote and may or may not be inhabited. Emergency medical assistance is not readily available, so the consequences of being injured or falling ill may be greater than if an employee is close to a large settlement.

The hazards associated with crashing a vehicle or getting lost while travelling to or from the site may also be greater than when an employee is near habitation. There may be no assistance nearby, and employees may be forced to spend some time without proper shelter.

Wilderness areas are not necessarily remote. However, they usually are, and they present similar hazards to remote locations. The chances of becoming lost, and the potential adverse consequences, are both greater. It may take longer to locate an injured or sick person in the wilderness. Because a wilderness location by definition is uninhabited (or human impact is transitory), fixed shelter is less likely to be available, so employees are more exposed to adverse weather. Finally, employees may share wilderness areas with dangerous animals and plants. These present hazards from direct exposure, and during hunting seasons, indirectly attract the hazard of hunters.

B - Risk Assessment and Management

Remote areas

Refer to Part E for local requirements for necessary first aid training and equipment. Where a worker visits a remote area alone, the activity also must be assessed under lone worker provisions; see SWP 26, Working Alone.

Remote location plan

A remote location safety plan must be incorporated in the project health and safety plan. This should include:

- a communications plan,
- a list of personnel trained in first aid, with their qualifications,
- a list of first aid supplies, and
- the method of transporting injured or ill persons to medical support services.

Where remote areas are uninhibited, consider the following additional guidance, as appropriate:

Navigation

Adequate equipment should be carried to allow employees to navigate, and determine their location. Maps, and aerial photographs where available, covering the entire proposed route and a compass should be carried as a minimum. Global Positioning System (GPS) is a useful aid to navigation but is not entirely reliable. It can be affected by mechanical breakdown, and batteries can fail. Interference can introduce errors, especially among trees and in gullies, which become more pronounced as you move north. It is important to have a good understanding of the amount of error that may affect a GPS system, and it is essential that traditional map and compass are carried as back-up.

Note that any compass must be set with the local declination. This may be quite large. As well as the magnetic deviation east or west, compasses show a vertical "dip". This dip varies in different parts of the world and compasses are calibrated for it. A compass made for South America would be inaccurate in Canada. Furthermore, close to the magnetic pole compasses behave erratically, and in areas in the north of NWT and Yukon, compasses are largely worthless. For hundreds of miles around that, compasses can be erratic.

Travel plan

Leave a travel plan including your proposed route, destination, and schedule, and stick to it. If the field work is for an extended period, call in a travel plan each day. Include the make, model, colour and licence number of your vehicle. It is much easier to locate a vehicle than a person.

Evacuation procedures for injured persons should comply with the relevant local provisions listed in Section E.

Emergency supplies
Pack emergency supplies listed in Section D – Equipment and PPE.

Check-in procedures
The means of communication and contact frequency will be determined by the nature of the work site, and its remoteness.

The check-in procedure should:
- specify the mechanism and time intervals for checking on the workers,
- specify the person responsible for contacting the worker and recording the results of the contact, and
- outline the procedure to be followed if the workers cannot be contacted, including provisions for an emergency rescue.

For most situations, regular phone check-in contact would be expected. In most cases a cell phone is adequate for check-in. However, if cell phone reception is unavailable or unreliable in the area, alternative methods of communication should be used. Satellite phones, two-way radios or a lone worker monitoring system are normally suitable. In some northern locations it is necessary to use Iridium satellite phones, this requirement should be verified prior to use.

The following may be used as a guide to suitable check intervals:

Activity risk level	Check interval
High	30 minutes
Medium	60 to 120 minutes
Low	Beginning and end of shift

Note: that automated check-in systems (e.g."safetyline") and lone worker monitoring systems are available, and these can reduce the chance of human error**.**

If employees do not respond within a defined amount of time to an employee check, the situation will be treated as an emergency until the employee has been located or the employee finally responds. The following procedures should be followed:
- if possible, respond immediately to the work area and assess the situation or
- if necessary, call for emergency assistance (e.g., first aid, 911, search & rescue).

Wilderness areas
In general, Dillon staff should not work alone in wilderness locations. The risk of injury is greater than in cultivated or developed areas, both from trips and falls, and from contact with harmful plants or animals. If a person is injured or becomes ill, they may be vulnerable to adverse weather, and animal attack. Furthermore, locating and extracting that person may be difficult in a wilderness location. Employing a "buddy" system helps to manage all of these risks.

Navigation and driving can both require special techniques. The risk that a vehicle may become stuck or disabled is higher in wilderness areas, and staff needs to be prepared for that.

Where lone wilderness work is contemplated, the risks must be assessed carefully by a competent person, with reference to SWP 26 (Working Alone) and any other relevant SWPs, and the assessment must be approved by the Coordinator, Health and Safety. Factors to consider may include accessibility of the work site; proximity to other people; emergency service response time; visibility around and through the work site; and the experience and training of the worker. Where a worker is not expected to leave the cabin of a vehicle, it would not normally be necessary for them to be accompanied.

Plants and animals

An advisory note on potentially harmful plants and animals is attached as an appendix to this SWP. It lists the organisms assessed to present the greatest risk to field staff, describes them and their preferred habitats, describes the threat they pose, and summarizes recommended control measures. It is clearly not a complete list and local hazards can be assessed on a site specific basis, if necessary with reference to local environmental and wildlife agencies.

Hunting season

Hunting seasons vary across the country, and for different species of animal. During the season, hunters across the country recognize blaze (hunter) orange, even in provinces where it is not a legal requirement, and field staff in wilderness areas must comply with this dress code. Across most of Canada the rule is to wear a hat, and a vest or jacket of which not less than 2580 square centimetres (400 square inches) in aggregate should be exposed to view from all directions. Avoid wearing light brown or grey, and especially avoid wearing any white. A glimpse of white clothing through the trees can resemble a deer's tail. White mittens and hats are especially bad choices during hunting season.

General safe practices

- Upon discovering any condition or situation which may be more risky than anticipated, work should be suspended and the condition or situation reported to the activity supervisor or project manager.
- Do not allow yourself to become fatigued. Pace yourself, do not leave too much until the end of the day, and always leave enough time to get out of the woods at least 30 minutes before sunset.
- Avoid steep slopes, boggy or unstable ground, fast running water and do not take short-cuts.
- Always carry a basic survival kit with you – See Section D.
- Before entering woods, check the distance and direction back to the site and to surrounding roads. If the trail is unclear, use flagging tape to mark it.
- If you become lost, stop, stay in one location, stay as warm and dry as possible, and signal for help with a ground signal or fire.
- On logging roads, where possible check with the forestry company about presence of trucks and the times gates are open.
- Contact the local authority if the fire hazard is high and abide by travel restrictions. Do not smoke or light fires if there is a fire hazard.
- Check the weather forecast and dress for the conditions. Apply sunscreen as appropriate.

Working in the dark

Working in the dark can also make working conditions more difficult. Insufficient lighting can be resolved by the following:

- posting reflective signs at/around hazards,
- carrying devices (radios or other means) to communicate with other teams and with emergency personnel,
- devising an emergency evacuation plan,
- providing additional lighting when working with powered equipment to prevent exposure to additional hazards (i.e. boom contact with aerial wires),
- wearing reflective vests,
- being familiar with the work area in the daylight,
- working in teams of at least two people,
- if necessary, wearing a personal audible alarm,
- being familiar with other hazards in the area (i.e. confined space, construction, water, rail lines, ice, wilderness, etc.). Refer to appropriate SWPs for further information, and
- paying attention to the signs of exhaustion and fatigue, and stop working.

C – Training and Competency

- First aid training as required by provincial or territorial legislation – this may need to include wilderness first aid training.
- Training or instruction in the symptoms and treatment of temperature-related health conditions (hypothermia, dehydration, heat stress, sunstroke).
- Familiarity or instruction with wilderness navigation and wilderness survival techniques.

D - Equipment and Personal Protective Equipment

First aid and medical provision in remote areas is defined in the legislation referenced in Appendix E.

Required in wilderness locations:	
communication device (phone or radio)	flashlight
emergency blanket (space blanket)	waterproof matches or lighter
GPS, map, and compass set with proper declination	knife
whistle	signal mirror
first aid kit in a waterproof container meeting current First Aid Regulations	

Recommended in wilderness locations, depending on site assessment:	
bear bangers, bear spray or armed “bear monitor”(if applicable)	sun protection
flagging tape	pocket signal flares (emergency use only)
spare batteries for GPS, flashlight	emergency food and water
candle	spare clothes

E - Documentation

Alberta
Occupational Health and safety Code, 2006, Part 11 and Schedule 2
http://work.alberta.ca/documents/WHS-LEG_ohsc_2009.pdf

British Columbia
OHS Guidelines Part 3, Sections G3,14 to G3.21
http://www2.worksafebc.com/Publications/OHSRegulation/GuidelinePart3.asp#SectionNumber:LevelsFirstAid

Canada
Canada Occupational Health and Safety Regulations, SOR/86-304
http://www.ccohs.ca/legislation/documents/canada/caeclc/caroshe0.htm#PartNumber:XVI

Manitoba
Workplace Safety and Health Regulation, Man. Reg. 217/2006, Part 5
http://www.ccohs.ca/legislation/documents/man/mbewsa/mbrwshe0.htm#PartNumber:5

New Brunswick
First Aid Regulation – Occupational Health and Safety Act, N.B. Reg. 2004-130
http://www2.worksafebc.com/Topics/FirstAid/RegulationAndGuidelines.asp?ReportID=33602

Newfoundland and Labrador
Occupational Health and Safety First Aid Regulations, C.N.L.R 1148/96
http://www.ccohs.ca/legislation/documents/nfld/nfeoha/nfrfare0.htm#SectionNumber:8

Northwest Territories
General Safety Regulations, R.R.N.W.T. 1990, c. S-1, Part III
http://www.ccohs.ca/legislation/documents/nwt/ntesa/ntrgene0.htm

Nova Scotia
Occupational Health and Safety First Aid Regulations, N.S. Reg. 155/96
http://www.ccohs.ca/legislation/documents/ns/nseoha/nsrfrae0.htm

Nunavut
General Safety Regulations, R.R.N.W.T. 1990, c. S-1, Part III
http://www.ccohs.ca/legislation/documents/nunavut/nuesa/nurgene0.htm

Ontario
Worker's Compensation Act, First Aid Requirements, R.R.O. 1990, Reg. 1101
http://www.ccohs.ca/legislation/documents/ont/onewsi/onrfare0.htm

Prince Edward Island
Occupational Health and Safety Act General Regulations, EC180/87, Part 9, First Aid
http://www.ccohs.ca/legislation/documents/pei/peeoha/perohse0.htm#PartNumber:9

Quebec
First Aid Minimum Standards Regulation, R.R.Q., c. A-3, r.8.2 O.C. 1922-84
http://www.ccohs.ca/legislation/documents/que/pqearo/pqrmpse0.htm#PartTitle:

Saskatchewan
Occupational Health and Safety Regulations, 1996, R.R%.S. c. 0-1, r. 1, Part V, First Aid
http://www.ccohs.ca/legislation/documents/sask/skeoha/skroshe0.htm

Yukon
Minimum First-Aid Regulations, O.I.C. 1986/164
http://www.ccohs.ca/legislation/documents/yukon/yteoha/ytrohse5.htm

Applicable Health and Safety Program Manual Safe Work Practices:

- SWP 4 Working on or Over Water
- SWP 5 Working on or Over Ice
- SWP 11 All Terrain Vehicles (Quads, Snowmobiles, etc.)
- SWP 13 Portable Power Tools
- SWP 16 Electrofishing
- SWP 21 Physical Hazards (Heat, Cold)
- SWP 26 Working Alone
- SWP 27 Physical Hazards (Noise, Vibration and Working in the Dark).

- DVDs on bear safety include *Staying Safe in Bear Country* and *Working in Bear Country* (Published by Distribution Access) and a Bear Safety power point presentation on Inside Dillon.

Dillon staff across Canada have the potential to encounter a variety of biological hazards ranging from “low” to “severe”. To prepare and educate Dillon staff about these risks, this appendix has been prepared detailing plant and animal species that have been identified as potentially harmful to Dillon field staff. The species identified include those that are either likely to be encountered and fairly benign (e.g., black flies and mosquitoes) to those that are rarely encountered, but present a serious risk of injury or death (e.g., polar bears). The types of injuries that can be caused include the physical injury, poisonous bites or stings, and transfer of disease or allergens.

This list is not exhaustive and many other plants and animals have the potential to injure if not approached properly. This appendix is only intended to identify and introduce biological risks present across Canada. This appendix applies only to work within Canada, Dillon staff working abroad are encouraged to consult local plant and wildlife species lists and become familiar with any potential biological threats. For further information and area specific avoidance and management tactics, consult local guidebooks on human interaction with plants and wildlife.

Species	Biology	Habitat Preferences	Threat	Prevention/Avoidance
LARGE MAMMALS				
Grizzly Bear (*Ursus arctos horriblis*)  Range: Western Canada (BC, Alberta, Yukon and NWT)	Can reach weights of 120–520 kg and stand 2.44 m tall on its hind legs. Has a large hump over the shoulders. Their coloring ranges widely across geographic areas, from blond to deep brown or black.	In coastal areas the grizzly congregates alongside streams and rivers during the salmon spawn. Home range generally includes areas of tree and shrub cover.	Type: Potentially aggressive animal capable of killing human beings. When: Spring to fall; window of activity reduced in colder climates. Warning! Stay away from and avoid at all times a sow grizzly bear with cubs and a grizzly bear on or near a kill.	• Do not travel alone. • Look for recent reports of activity and bear sign. • Make noise while traveling. • Use caution at dusk, night or dawn. • Be aware of wind direction. • Avoid prey carcasses and cubs. • Retain a “bear monitor” if possible. • Carry a firearm if comfortable doing so and appropriately qualified. Obtain permission of Coordinator, H&S prior to carrying a firearm. • Keep dogs under control. • Use good food storage/ preparation practices. • Keep bear spray/bangers easily accessible.

Species	Biology	Habitat Preferences	Threat	Prevention/Avoidance
Black Bear (*Ursus americanus*)  Range: Occurs in all Canadian provinces except Prince Edward Island.	Adult has small eyes, rounded ears, a long snout, a large body, and a short tail. Females weigh between 40 and 180 kg; males weigh between 114 and 274 kg; cubs usually weigh 200 to 450 g at birth.	In many areas they prefer forested and shrubby areas, but use wet meadows, high tidelands, ridge tops, burned areas, riparian areas, agricultural fields, and avalanche chutes. Often found near landfills.	Type: Potentially aggressive animal capable of killing human beings. When: Potentially year-round in warmer climates with abundant food supply. Warning! Stay away from and avoid at all times a sow black bear with cubs and a black bear on or near a kill.	• Do not travel alone. • Look for recent reports of activity and bear sign. • Make noise while traveling. • Use caution at dusk, night or dawn. • Be aware of wind direction. • Avoid prey carcasses and cubs. • Retain a “bear monitor” if possible. • Carry a firearm if comfortable doing so and appropriately qualified. Obtain permission of Coordinator, H&S prior to carrying a firearm. • Keep dogs under control. • Use good food storage/ preparation practices. Keep bear spray/bangers easily accessible.

Species	Biology	Habitat Preferences	Threat	Prevention/Avoidance
Polar Bear (*Ursus maritimus*)  Range: Found in the Canadian Arctic archipelago, Hudson Bay and James Bay.	Adults weigh 150-680 kgs. Fur appears as white or cream colored, short tail, small round ears, as well as a small head and long tapered body.	Polar bears are a semi-aquatic marine mammal that spends its time on land, sea, and ice.	Type: Potentially aggressive animal capable of killing human beings. When: Active year-round. Warning! Stay away from and avoid polar bears at all times.	• Be alert and cautious around open water. • Look for recent reports of activity and bear sign. • Use good food storage/preparation practices. • Make noise if a bear approaches, do not run. • Avoid prey carcasses and cubs. • Retain a “bear monitor” when possible. • Carry a firearm if comfortable doing so and appropriately qualified. Obtain permission of Manager, H&S prior to carrying a firearm. • Do not travel alone.

Species	Biology	Habitat Preferences	Threat	Prevention/Avoidance
Moose (*Alces alces*)  Range: Found across most of Canada, including every province and territory.	Large dark brown animal with gray legs. Distinguished by large size, overhanging snout and pendant "bell" throat. Males have large palmate antlers. Height 1.5-2.0m. Adults range from 270-530 kg.	Found in boreal and mixed deciduous forests and in temperate to sub-arctic climates with lakes and swamps. Often found near water.	Type: Potentially aggressive animal capable of killing human beings. When: Active year-round but most dangerous during the rut (Sept/Oct) and with young. Warning! Stay away from and avoid bull moose during the fall rut season (Sept-Nov).	• Do not approach. • Keep dogs under control. • Avoid calves. • Watch body language. • Do not corner a moose, leave an escape route. • If a moose charges, get behind something solid. • If knocked down, curl up in a ball and protect your head.
Cougar (*Felis concolor*)  Range: Found in Alberta, British Columbia and Saskatchewan.	Cougars heads are round and they have ears erect. Coat is typically tawny, but ranges to silvery-grey or reddish, with lighter patches. Adults can weigh between 34-90 kg.	Found in all forest types as well as in lowland and mountainous deserts.	Type: Potentially aggressive animal capable of killing human beings. When: Active year round. Generally only stalks people when starving or injured.	• Travel in groups. • Make yourself appear big if a cougar is encountered. • Aggressively defend your position. • Grab a weapon for defence if approached. • Make noise. • Do not run. • Do not take a dog with you.

Species	Biology	Habitat Preferences	Threat	Prevention/Avoidance
Coyote (Canis latrans)  Range: Found throughout most of Canada.	Coyote's pelt varies from grayish-brown to yellowish-gray while the throat and belly tend to have a buff or white colour. The legs, sides of the head, muzzle and paws are reddish-brown. Adults can weigh between 7-15 kg. Northern and eastern coyotes are typically larger than its western counterpart. The largest weighting between 15-21 kg.	Found in wood lots, brush and grassy fields. The coyote prefers to den on the banks of a stream or the slope of a gorge, and typically chooses a concealed spot. They are loners.	Type: Potentially aggressive animal, however, the vast majority of coyotes remain fearful of humans and generally do not pose a threat to human safety. When: Active year round. Coyotes are most active at night and during early morning hours. During cool weather, they may be active throughout the day.	• Do not approach, slowly back away. • Do not run. • Make noise to frighten or threaten the animal. • Aggressively defend your position. • Extra awareness and caution should be taken in the eastern Canadian provinces. The eastern coyote is more aggressive than its counter parts.
REPTILES AND AMPHIBIANS				
Western Rattlesnake (*Crotalus oreganus)*  Range: Found in southern Saskatchewan, Alberta, and interior British Columbia	Tan or brown in color with irregular blotches on the back and sides, vertical pupils, triangular head, rattle at the end of the tail. Adults may reach up to 1.6 m+.	Found in desert, short grass prairie, and dry scrubland. Often seen sunning themselves near rock piles or boulders in areas with sandy soils, as well as near farms and fields.	Type: Poisonous bite. When: Spring through fall.	• Do not approach if aware of its presence (audible rattling noise). • Wear sturdy high ankle boots and long, thick pants.

Species	Biology	Habitat Preferences	Threat	Prevention/Avoidance
Massasauga Rattlesnake (*Sistrurus catenatus*)  Range: Found in southeastern Ontario. Is found only near the eastern shore of Georgian Bay, the Bruce Peninsula, Wainfleet Bog and Ojibway Prairie.	Color pattern consists of a grey or tan with a row of large rounded brown/black blotches or spots down the centre of the back. Rattle at the end of the tail.	It occurs in various habitats ranging from swamps and marshes to grasslands, usually below 1500 m elevation.	Type: Poisonous bite. When: Spring through fall.	• Do not approach if aware of its presence. • Wear sturdy high ankle boots and long, thick pants.
INSECTS AND ARTHRPODS				
Black Widow Spider (*Latrodectus* spp.)  Range: The northern widow is found in southeastern Canada (only on the Bruce Peninsula). The western widow is found in southwestern Canada.	Two species found within Canada (western and northern widow). Known for the black hair and red "hourglass" pattern. Adults can grow up to 1.5" with males half the size of females or smaller.	Commonly associated with urban and agricultural areas. Found in woodpiles, under eaves, in boxes, outdoor toilets, and any unbothered places.	Type: Poisonous bite. When: Spring through fall.	• Be cautious when working around areas where black widows may be present. • Wear gloves and pay attention to where you are working. • Black widow bites are sharp and painful and must be immediately treated by a doctor.

Species	Biology	Habitat Preferences	Threat	Prevention/Avoidance
Hobo Spider (*Tegenaris agrestis*)  Range: Southern BC and Alberta.	Brown and measures 12 to 18 mm in length. Abdomens with several chevron shaped markings. Large palps on male. Females with generally larger abdomens.	Funnel shaped webs often attached to stationary objects at or near ground level. Webs also attached to plants or weeds. Spider hunts rather than catches prey on webs.	Type: Poisonous bite. When: Spring through fall.	• Wear protective clothing and gloves when working in the field.
Ticks  Range: Throughout most of Canada.	Small, generally eight-legged arachnids with a hard or soft exoskeleton.	Variety of habitats but generally tall grass and shrubs.	Type: Known vector for several human diseases including Lyme disease. When: Spring through fall.	• Wear protective clothing and insect repellent. • Keep skin and head covered. • Wear gloves. • Tuck pants into boots or socks. Remove ticks with tweezers exerting slow and steady pressure. Do not crush the tick during removal.

Species	Biology	Habitat Preferences	Threat	Prevention/Avoidance
Mosquitos  Range: Throughout Canada except for some Arctic islands.	Small insect with a proboscis designed for piercing skin.	Variety of habitats. Larvae found in shallow stagnant water.	Type: Main insect vector for several human diseases including West Nile Virus. When: Spring through fall.	• Wear protective clothing (mosquito mesh hat) and insect repellent. • Swat mosquito when noticed.
Bees, Wasps & Hornets  Range: Throughout most of Canada.	Generally small yellow and black insects (of varying morphologies) with stingers.	Variety of habitats including forests, scrub vegetation and urban/suburban areas. Some bees are kept on agricultural lands for pollination.	Type: Sting painful but usually only a concern if allergic. When: Spring through fall.	• Wear protective clothing. • Avoid known nests, particularly if insects are agitated. • Be careful when walking in the forest as some species are known to nest underground.

Species	Biology	Habitat Preferences	Threat	Prevention/Avoidance
Black Flies  Range: Throughout most of Canada.	Stout-bodies insects with wingspans ranging from 3-9mm. Typically dark coloured but also gray, orange, yellow or iridescent.	Larvae mature in clear, running water.	Type: Bites painful but generally not serious. Can cause generalized anaphylactic shock in hypersensitive individuals. When: May to August depending on location.	• Wear suitable clothing (light coloured and loose fitting with fastened sleeves and pants tucked into socks or boots; fine mesh net can be worn to protect head and neck). • Use insect repellent including treated clothing. • Avoid area during peak season and times (morning, late afternoon and evening).
Hickory Tussock Moth  Range: Nova Scotia to Ontario.	Caterpillars are covered all over in long hair like setae, in spreading tufts. Most are white, but there are black tufts along the middle of the back, and four long black hair pencils (two near the front, and two near the back).	Primarily feeds on hickory, pecan and walnuts, but will also eat ash, elm, oak, willow, and many others.	Type: long hairs that protrude from the caterpillars excrete venom on contact. The venom can cause a rash similar to that caused by poison ivy. Symptoms can range from slight reddening of the skin to a burning sensation with swelling and pain. When: Mid to Late summer.	• Apply tape over the affected area and then pull it off quickly to remove any embedded broken spines then wash the affected area with soap and water as soon as possible. • If itching or swelling occurs, apply calamine lotion and/or ice packs to affected areas. • Individuals who experience more generalized allergic reactions should seek medical attention.

Species	Biology	Habitat Preferences	Threat	Prevention/Avoidance
White Marked Tussock Moth  Range: Newfoundland to Alberta and the entire eastern USA.	The head is bright red; the body has yellow or white stripes, with a black stripe along the middle of the back. There are bright red defensive glands on the hind end of the back. Four white toothbrush-like tufts stand out from the back, and there is a grey-brown hair pencil at the hind end.	Caterpillars found on a wide variety of trees both deciduous and coniferous.	Type: long hairs that protrude from the caterpillars excrete venom on contact. The venom can cause a rash similar to that caused by poison ivy. Symptoms can range from slight reddening of the skin to a burning sensation with swelling and pain. When: Mid to Late summer.	• Apply tape over the affected area and then pull it off quickly to remove any embedded broken spines then wash the affected area with soap and water as soon as possible. • If itching or swelling occurs, apply calamine lotion and/or ice packs to affected areas. • Individuals who experience more generalized allergic reactions should seek medical attention.

Species	Biology	Habitat Preferences	Threat	Prevention/Avoidance
Northern Scorpion (*Paruroctonus boreus*)  Range: Southern Alberta: near Drumheller to Jenner, east to Empress, and in southwestern Saskatchewan.	Small (~4 cm) scorpion, native to Alberta. They are only active during the summer months and are not lethal to man. Its sting is much like that of a bee. One end of the body is a pair of pincers, while the other end is the flexible stinger tail.	It lives in the dry grasslands in the southern parts of Alberta. Found beneath rocks or fallen logs.	Type: Venom is not toxic to humans. The symptoms and treatments are similar to that of a bee sting. When: Spring through fall; more likely at night.	• Timid and will stay away from people where possible, but avoid when observed. • Wear sturdy boot and pants
PLANTS				
Poison Oak (*Toxicodendron diversilobum*)  Range: Found only on the Pacific coast of southern Canada.	Extremely variable in growth habit and leaf appearance. The leaves are divided into 3 leaflets (3.5-10 cm long) with toothed edges, and can vary in color from bright green to red or pink. White flowers form in the spring and develop into white or tan berries.	Often found in oak woodlands and Douglas-fir forests. It can also be found in damp, shady areas near running water and out of direct sunlight.	Type: The leaves and twigs have surface oil which can cause an allergic reaction in most people which causes a very irritating rash. When: Year-round. Oil on dead plants can remain active for 5 years.	• Once exposed, wash the skim immediately with soap and water. • Once a reaction has occurred, a cold compress and anti-itch ointments are commonly used.

Species	Biology	Habitat Preferences	Threat	Prevention/Avoidance
Poison Ivy (*Toxicodendron radicans)*  Range: Commonly found in all provinces in Canada, but not the territories.	Can grow as a shrub (up to 1.2 m tall), a groundcover (10-25 cm tall), or as a climbing vine. The leaves consist of 3 pointed leaflets, with a longer middle stalk.	Found in wooded areas, especially along edges, as well as exposed rocky areas, in open fields, and disturbed areas.	Type: The leaves and twigs have surface oil which can cause an allergic reaction in most people which causes a very irritating rash. When: Year-round. Oil on dead plants can remain active for 5 years.	• Symptoms and treatments similar to poison oak.
Stinging Nettle (*Urtica dioica*)  Range: Commonly found in every province in Canada.	A herbaceous perennial growing 1-2 m tall in the summer. Has a distinctively yellow spreading root with soft, green leaves (3-15 cm long). Both the leaves and stems are covered with silky hairs.	The plant can form large colonies in orchards, farmyards, old pastures, ditches, and waste places.	Type: The stinging hairs break allowing secretions to enter the skin causing a painful sting, followed by an irritating rash and swelling. When: During leafout (spring to fall).	• Reactions usually last only a few minutes and may be treated with an anti-itch cream.

Species	Biology	Habitat Preferences	Threat	Prevention/Avoidance
Poison Sumac (*Toxicodendron vernix*)  Range: Found in southern Ontario and southern Quebec.	A woody shrub or small tree growing up to 7 m tall. The compound leaves are pinnate (25-50 cm long) with 7-13 leaflets. The fruit is a small white to grey berry growing in clusters 10-20 cm long. Stems have milky, poisonous juice which turns black with exposure.	Grows exclusively in very wet or flooded soils, usually in swamps and peat bogs.	Type: The leaves and twigs have surface oil which can cause an allergic reaction in most people which causes a very irritating rash. When: Year-round. Oil on dead plants can remain active for 5 years.	• Symptoms and treatments similar to poison oak.
Devil's Club (*Oplopanax horridus*)  Range: Found primarily in the Pacific northwest, and up into the Yukon.	A large shrub growing 1-1.5 m tall. The leaves are palmately-lobed, 20-40 cm across, and the erect stems are covered in short, stout spines.	Usually grows in rich, moist forests, especially near streams.	Type: The brittle spines can break off easily and contain a chemical that can cause an irritation to the skin. When: Year-round.	• Carefully remove spines. • Symptoms and treatments similar to poison oak.

Species	Biology	Habitat Preferences	Threat	Prevention/Avoidance
Wild Parsnip (Pastinaca Sativa)  Range: Throughout most of Canada in most provinces.	Can grow 60 cm to 90 cm on average, long thick tap root, produces a single, thick stem that contains hundreds of yellow flowers.	Usually, grows in abandoned yards, waste places, meadows, old fields, roadsides and railway embankments. It is shade-intolerant and prefers sunny conditions.	Type: Contact with the leaves and sap can cause severe skin irritation. The sap reacts to sunlight with hypersensitivity to ultra violet light. When: Spring through fall.	• Wear protective clothing, including gloves, long sleeves, and pants. • Avoid getting sap on your skin. If sap gets on your skin wash the area immediately with soap and cold water. Keep the exposed area out of sunlight for at least 48 hours.
Hogweed (Heradeum (mategazzianum)  Range: Throughout most of Canada in most provinces.	Can reach a height of approximately 4.5 to 6 meters. The plant has hollow steams with dark reddish purple splotches and coarse white hair. It produces flattened oval shaped fruit and in the summer white flowers form.	Noxious weed usually grows along roadsides, stream banks and waste areas in scattered localities.	Type: Contact with the sap can cause a skin reaction whereby skin becomes sensitive to the ultraviolet light in sun light. Reactions can occur up to 48 hours after contact, and sensitivity can lead to painful burns and blisters on the skin. When: Year-round.	• Wear protective clothing, including gloves, long sleeves, pants, and eye protection . • Avoid getting sap on your skin. If sap gets on your skin wash the area immediately with soap and cold water. Keep the exposed area out of sunlight for at least 48 hours.

Species	Biology	Habitat Preferences	Threat	Prevention/Avoidance
Himalayan Blackberry (*Rubus discolor*)  Range: An introduced species that is commonly found in southern British Columbia.	A perennial plant that grows up to 4-10 m. The leaves are green, 7-10 cm long with 5 leaflets. Flowers are 2-2.5 cm with 5 pale pink or white petals. Fruits are black or deep purple. Mature plants form a tangle of dense arching stems.	Typically grows in open weedy sites, along field margins, railroad ROW's, roadsides, and on disturbed sites. It is also common in riparian woodlands and intertidal zones.	Type: The aggressive colonization of HBB can make access to field sites difficult. Spines can be painful. When: Year-round.	• Be cautious when working around areas where HBB may be established. • Wear gloves to avoid the sharp thorns.

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This safe work practice is intended to provide common sense guidance on managing hazards that are typically encountered in common activities. It should be used in conjunction with any other guidelines or safe work practices that may be relevant. Where there is a conflict, the more onerous advice should be followed. In any case where Dillon safe work practices do not match local jurisdictional requirements, the jurisdictional requirements take precedence. If there is any doubt, consult with the project manager or the Coordinator, Health and Safety.

A - Hazard Identification

For each project, the project manager, in collaboration with the project team, should identify the expected hazards and the hazardous activities to be executed on the site.

The following is not an exhaustive list, but hazards are commonly encountered around these areas:

- overhead power lines
- traffic or congestion (mobile equipment/pedestrians/private vehicles)
- hazardous materials onsite
- underground utilities
- bulk fuel storage
- operating equipment.

Specific attention should be given to the following:

Activities in Traffic Areas
Workers or the public may be exposed to hazards of being hit by moving vehicles or other equipment.

Borehole drilling/monitor well installation
Drilling operations expose workers to rotating equipment, pinch points and raised weights. The drill mast may potentially contact overhead structures such as power lines, and the drill can penetrate underground utilities, pipes or tanks.

There is potential for exposure to hazardous agents in soils or fluids raised to the surface.

There is a potential for entanglement should sub-surface geotextiles be encountered.

Monitoring well sampling or maintenance
There is potential for exposure to hazardous agents in excavated or sampled materials.

Mobile heavy equipment activity
On active sites, heavy equipment can pose significant hazards because drivers and operators may have restricted fields of view. They would also, in many cases, be unable to hear shouted warnings. Equipment may include, but is not limited to, drill rigs, excavators, dump trucks, bulldozers, cranes, tractors, graders, loaders, backhoes, bobcats, self-propelled rollers or compactors, hydro-vacs and vacuum trucks.

Excavation of test pits

Hazards include:

- excavator operations: injury from contact with moving equipment or machinery parts
- excavated material falling onto workers
- contact with underground services (electric, gas, fuel lines)
- undermining nearby structures e.g. scaffolding, walls
- vehicle falling into pit
- worker falling into pit, injury from fall
- pit wall collapse: injury from collapse, engulfment
- exhaust fumes and other gases accumulating in pit.

Working near oil and gas wells

Hazards include:

- continuous noise
- toxic hazards
- fire
- moving equipment
- explosion.

Working with powered hand-held auger boring machine

Hazards include:

- awkward posture
- intermittent noise
- caught in moving equipment
- electricity
- flammability
- struck by
- vibration
- cold/heat.

B - Risk Assessment and Management

Exposure to the hazards listed above needs to be assessed on a case-by-case basis. Where workers or members of the public may be exposed to hazards, the following methods can be employed to manage these risks.

Activities in Traffic Areas

- Refer to SWP 1 Working around traffic.
- Traffic management: consideration should be given to barricades, vehicle positioning, fencing, signage, and/or flag people.
- All site personnel working around traffic must wear high visibility vests.

Borehole drilling/monitor well installation

- Refer to SWP 7 Working Around Overhead and Underground Services.
- The drill rig should be inspected to ensure it is in good working order prior to starting any drilling activity.

- Ensure familiarity with safety plan and safe work practices for the drill site and equipment and review maintenance records may be reviewed as appropriate.
- Obey instructions from driller and crew as applicable.
- Sufficient sub-surface clearance activities must be completed to the potential depth of sub-surface structures prior to drilling or use of heavy equipment. Sub-surface clearance (sometimes called "daylighting") can use the following techniques:
    - air/pressure water lance and vacuum soil removal
    - probing
    - hand digging
    - hand augering.
- Loose clothing and items such as ties, scarves, jewellery etc., should not be worn, as these items are liable to become caught in moving or rotating parts.
- Hair should be tie back.
- Where hazardous agents are observed or suspected in soil or groundwater, apply control measures described for contaminants in section below.

Monitoring well sampling or maintenance

- Refer to desk study and site reconnaissance to identify likely contaminants, based on past and current site uses and neighbouring activities (see SWPs 2, 19 and 20).
- Minimize exposure to contaminants so far as is practicable, by limiting time of exposure and reducing physical contact with contaminants, including airborne contaminants.
- As necessary and appropriate, use correct personal protective equipment.

Mobile heavy equipment activity

- Refer to SWPs 14 Working Around Equipment and 23 General Site Hazards.
- Advise staff of your presence. Make sure in particular that you alert drivers of vehicles that you are there. Heed instructions, especially those given by a traffic director or spotter.
- Be aware of the location and direction of moving equipment. Never assume that an operator sees you. Ground personnel should maintain a safe distance; equipment can lose its footing, especially near slopes and trenches or on wet ground.
- Do not walk behind heavy equipment.
- 2-way radios, cell phones, horns and hand signals may all be used to communicate hazards, directions, information. Be aware of and obey communication procedures at the site.
- Site personnel and others must stay outside the swing area and blind spots of equipment.

Excavation of test pits

- Refer to SWP 22 Working Around Trenches and Excavations.
- See above for advice on safety around site machinery.
- Services that may cause a hazard should be identified before site work begins.
- The effect of excavations on the stability of nearby structures must be considered.
- Stop blocks can be used to keep the excavator away from the excavation.
- An excavation 1.5 metres (5 feet) deep may be deemed a confined space. See Health and Safety Program Manual Guideline A.12 for guidance on confined space awareness.

- Entry into an excavation greater than 1.2 m (4 ft) deep requires that the activity be assessed. The assessment should address the potential for collapse. Pit or trench walls should be properly supported, or sloped. Soil characteristics affect slope stability.
- Barriers and guardrails can be used to exclude people and equipment from the vicinity of an excavation. Instructions, signs and marker tape can identify its location.
- When approaching unconsolidated excavated material, for example to take a sample, take account of its potential to collapse.

Working near oil and gas wells

- Familiarize yourself with the contractor's site health and safety requirements.
- Ear muffs/hearing protection should be used in noisy areas at oil/gas drilling operations. Combination hearing protection may be required under extreme high noise conditions.

Exposure to drilling fluid

- WHMIS training and site safety orientation is required prior to working on site. See Guideline A.6 for WHMIS information.
- Familiarize yourself with the location of washing facilities.
- Familiarize yourself with any on-site emergency shower locations (could be portable or a fixed deluge shower).
- Consult the site representative regarding appropriate eye and skin protection for working near drilling fluids.
- Avoid working near drilling fluids where possible.
- Follow site occupational health and safety procedures for working near drilling fluids.

Hydrogen Sulphide

- Obtain H2S Alive training prior to working on the site.
- Ensure that site orientation and training have been provided prior to commencement of work.
- Evacuate the area when H2S alarms sounds.
- Wear/use H2S monitor where applicable.
- Familiarize yourself with the contractor's occupational health and safety programs.

Ignition of Flammable Gases or Petrochemicals

- Basic training or competency in fire extinguisher use is required.
- WHMIS training and site safety orientation is required prior to working on site. See Guideline A.6 for WHMIS information.
- Use Nomex coveralls if there is serious fire risk in the work area.
- Determine if intrinsically safe equipment is required for activities to be undertaken on site by discussing with the designated competent person on site.

Moving Equipment - Drill Rig

- Familiarize yourself with operator's work plan.
- Be aware of basic hand signals to "stop".
- Wear a high visibility vest.
- Avoid proximity when dark or poor weather.
- Maintain distance from equipment equal to at least overall length of the equipment x2.

- Ensure the operator is aware of your presence.
- Do not wear loose clothing or fall protection equipment when working near moving parts.

Over Pressurized Hazards

- Ensure that site orientation and all site training has been obtained prior to commencing work.
- Familiarize yourself with the contractor's site health and safety program and discuss hazards with the site competent person prior to commencement of work.
- Avoid working in areas where a risk of over pressurization exists.

Working with powered hand-held auger/ boring machine

- Adjust the height of the auger/boring machine to minimize back strain to the worker (if practicable).
- If required to use an auger/boring machine in multiple locations or for extended periods, take breaks periodically.
- If transporting the auger/boring machine by vehicle, approach the vehicle as close as possible to the boring location to minimize lifting or carrying.
- Obtain assistance from co-workers or other staff nearby to lift heavy tools.
- Wear hearing protection.

Caught in the rotating component of the auger

- Inspect the auger/boring machine prior to each use for any defects. If defects are observed, report the defects to the owner of the equipment and do not use the tool.
- Operate the auger/boring machine in accordance with the manufacturers instructions (refer to the operating manual of the tool).
- Do not repair or modify the auger/boring machine in a manner that will compromise the health and safety of the equipment.
- Wear steel toe CSA approved safety boots.
- Do not wear loose clothing, gloves or jewellery and keep hair tied back.

Contact with below-ground electrical lines

- Review drawings/site plans to ensure no underground lines are present.
- Verify that locates has been conducted of the area prior to use of the auger/boring machine.
- If underground lines are present, do not bore or drill into the surface until proper utility company has been contacted and you have received confirmation that it is safe to drill.

Falling through ice

- Adhere to the requirements of the SWP 5 Working On or Over Ice.

Release of gas from accidental contact with underground gas lines or contact with gasoline with an ignition source

- Review drawings/site plans to ensure no underground lines are present.
- Verify that locates have been conducted prior to auger/boring machine use.
- Adhere to WHMIS requirements for handling flammable or combustible liquids and dispensing/decanting flammable or combustible liquids when re-fuelling.

- Keep fuel for the auger/boring machine away from any sources of ignition (e.g. sparks, open flames, heat, etc.).
- Keep the fuel lid for the auger/boring machine closed and sealed.
- Struck by pieces of material being bored.
- Wear long pants, long sleeves and safety glasses.

C – Training and Competency

Persons entering a site must be familiar with any safety plans and procedures for the site and any activities that need to take place. The risk associated with certain activities, such as work around confined spaces, must be assessed.

D - Equipment and Personal Protective Equipment

See Health and Safety Program Manual Guideline A.5 for guidance on the selection, use and maintenance of personal protective equipment.

As a minimum, persons having access to a site must wear CSA (or equivalent) approved hard hat and safety footwear.

Where there is a risk to eyes, for example where grinding is being done or hazardous chemicals may be encountered (such as during sampling), approved eye protection should be worn.

For noise exposures at or above 85 decibels (A-weighted) as an 8-hour time-weighted average [85dB(A), 8-hr TWA], hearing protection must be worn. The type of hearing protection selected should reflect the character of the noise exposure. Consideration should be given to wearing hearing protection at lower noise exposures. See SWP 27 Physical Hazards (Noise, Vibration and Working in the Dark).

Exposure to hazardous agents should be avoided where possible. Where exposure is unavoidable, for example in sampling, suitable protection should be used. This may include gloves, aprons, masks and breathing apparatus. See SWP 20 Exposure to Chemical or Biological Agents.

High visibility vests should be worn when working around mobile equipment and vehicular traffic.

E - Documentation

Health and Safety Program Manual Guidelines:

- A.1 Working under a Client, Contractor or Owner's Health and Safety Plan
- A.5 Selection, Use and Maintenance of PPE
- A.7 Sub-consultant and Sub-Contractor Health and Safety
- A.12 Confined Space Awareness.

Health and Safety Program Manual Safe Work Practices:

- SWP 1 Working Around Traffic
- SWP 2 General Hazards Related to Contamination or Remediation Sites
- SWP 7 Working Around Overhead or Underground Services
- SWP 14 Working Around Equipment
- SWP 19 Site Reconnaissance
- SWP 20 Exposure to Chemical or Biological Agents
- SWP 21 Physical Hazards (Heat, Cold)
- SWP 22 Working Around Trenches and Excavations
- SWP 23 General Site Hazards (Construction or Demolition Sites)
- SWP 27 Physical Hazards (Noise, Vibration and Working in the Dark)
- SWP 30 Hydrogen Sulfide.

This safe work practice is intended to provide common sense guidance on managing hazards that are typically encountered in common activities. It should be used in conjunction with any other guidelines or safe work practices that may be relevant. Where there is a conflict, the more onerous advice should be followed. In any case where Dillon safe work practices do not match local jurisdictional requirements, the jurisdictional requirements take precedence. If there is any doubt, consult with the project manager or the Coordinator, Health and Safety.

A - Hazard Identification

These activities include general characteristics of an area by site walkover and may include collection of data or samples by non-intrusive means. In some cases, this may be the initial review of site conditions by usual observation to identify site legends or conditions that may impact health and safety of Dillon staff.

Hazards that are common to site reconnaissance may include but are not limited to the following:

- Physical Hazards: weather related conditions (e.g., rain, ice, snow, sun) including heat/cold exposure; slip/trip hazards; overhead hazards; confined spaces; noise/vibration hazards; vehicular traffic; facility operations (e.g., machinery); subsurface voids or other topographic anomalies (e.g. mine shafts); hostile individuals; and/or other hazards that may impede easy movement about the site and ingress and egress from the site.
- Chemical Hazards: chemicals from active facility operations, residual chemicals from historic operations, dust, and drums.
- Biological Hazards: plants (e.g., poisonous or thorny); animals (e.g., black flies, mosquitoes, ticks, bees, bear, coyotes, snakes, household pets, etc.); mould; feces; and animal carcases.

Sometimes, due to physical barriers, client confidentiality or lack of permission, access to all or part of a site may be restricted. These restrictions should be noted and the survey done to the best practicable standard (e.g., from the site boundary).

B - Risk Assessment and Management

Most site reconnaissance visits will be low risk. Nevertheless, in some situations, site conditions may be encountered that present significant risks.

Current site uses should be identified from the client, the site owner and the site operator. If there is a site safety plan, Dillon employees should become familiar with it before entering the site. Employees engaged in site reconnaissance should consult with people who may be familiar with the site, including the client, the owner and/or the operator (as appropriate) prior to visiting the site. If possible, employees should meet someone who is familiar with the site at the site to review existing operations and past activities, where these are known, and identify associated hazards.

Where an employee proposes to visit the site alone, the work requires to be assessed in line with SWP 26 (Working Alone). Travel to remote or wilderness locations needs special precautions to comply with SWP 15 (Working in Remote or Wilderness Areas).

Upon arrival at occupied sites, each employee should report to the visitor reception area, site superintendent, owner or operator, as appropriate, to announce their arrival. They should advise this 3rd party of the scope of their site reconnaissance and ascertain whether there are any potential hazards of which the employee should be aware. The employee should evaluate the conditions on site (whether in a wilderness area or a developed facility) for potential hazards and verify that they are prepared for the prevailing conditions. If they are not, they should quickly leave the site and contact the project manager.

Employees conducting reconnaissance should comply with the following practices:

- Avoid confrontation with hostile individuals and/or animals. Should employees encounter a hostile situation, they should immediately leave the site and contact the project manager.
- Do not enter a confined space. Employees shall document the location of the confined space and advise the project manager who will then develop a plan to enter the confined space if necessary.
- Wear the appropriate Personal Protective Equipment as prescribed.
- Avoid contact with chemicals and their containers. Employees should record what is indicated on the label and photograph the container or chemical.
- Do not view maps and drive at the same time. To look at maps and record information, employees should stop and park their vehicles.
- Be cognizant of the location of known or suspected subsurface voids or soft spots and avoid travelling directly across these areas.
- Avoid travelling across areas of stressed vegetation. Employees should document these areas.
- Consider special seasonal considerations (e.g., hunting season).

Employees should contact their project manager prior to returning from the site to verify that they have completed site reconnaissance safely, as well as verify that there are no additional observations that the project manager would like made.

C – Training and Competency

Employees doing site reconnaissance should be competent, in terms of their education, training and experience, to understand potential risks and associated precautions relevant to project activities at the site.

Employees should be familiar with all relevant safe work procedures and applicable site-specific systems (e.g., facility check-in procedures, health and safety plans) being used.

D - Equipment and Personal Protective Equipment

Clothing and personal protective equipment appropriate to the worksite, task and field conditions should be worn. See Appendix A.5 of the Dillon H&S Program Manual for advice on the selection, use and maintenance of PPE.

Personal protective equipment should be protected against impact damage, adverse weather and accidental immersion.

E - Documentation

Relevant Dillon SWPs include, but are not limited to:

- SWP 1 Working Around Traffic
- SWP 2 General Hazards Related to Contamination or Remediation Sites
- SWP 4 Working On or Over Water
- SWP 5 Working On or Over Ice
- SWP 6 Solid Waste Facilities
- SWP 14 Working Around Equipment
- SWP 15 Working in Remote or Wilderness Areas
- SWP 20 Exposure to Chemical or Biological Agents
- SWP 21 Physical Hazards (Heat, Cold)
- SWP 24 General Plant Hazards
- SWP 25 Microbiological Hazards
- SWP 26 Working Alone
- SWP 27 Physical Hazards (Noise, Vibration, Working in the Dark).

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A - Hazard Identification

A *hazard* is something with the potential to cause harm, and for the purposes of this safe work practice (SWP); a hazardous agent is a substance to which exposure may result in injury, sickness or ill-health. Hazardous agents can be chemical or biological in origin. Exposure limits for many agents are listed, many of which are well-known (e.g. asbestos, benzene, hydrogen sulphide) and many of which are more esoteric (e.g. vinyl bromide, m-phthalodinitrile, propylene oxide). Biological substances for which exposure limits are published include but not limited to cellulose, grain dust, hardwood and softwood dusts, starch and vegetable oils.

Physical hazards (such as extreme temperatures, vibration and noise) and infectious agents are not addressed in this SWP. The explosive or flammable potential of gases, dusts and mists are, similarly, not addressed.

Hazardous agents may be encountered as gases, vapours, mists, dusts, liquids or solids. Hazardous agents can be used directly for work tasks (e.g. solvents); be generated by work activities (e.g. welding fumes); be naturally occurring (e.g. grain dust); or be released either accidentally or under controlled conditions as a secondary product or contaminant (e.g. hydrogen sulphide in the oil industry). People can be exposed to hazardous agents by the following routes:

- Inhalation,
- dermal contact (skin or mucous membranes),
- ingestion, and/or
- injection.

By far the most common exposure route is inhalation. Occupational exposure limits (OELs), which help protect worker's health by limiting occupational exposure to hazardous agents, all deal with this route of exposure. Gases can be hazardous both by their action on a person's body, and by displacing oxygen in an enclosed work site, leading to asphyxiation. Asphyxiants include acetylene, ethane, helium and hydrogen, and risk from exposure to these is determined by monitoring the available oxygen concentration.

Dermal contact can also be significant where a hazardous agent can penetrate the skin, or in the case of substances which are corrosive or highly reactive. Ingestion or injection of a hazardous agent can be serious, but exposure by these routes is less common.

Examples of the effects of hazardous substances include:

- asthma as a result of developing allergy to substances used at work,
- losing consciousness as a result of being overcome by gases or fumes,
- chronic disease from exposure to toxic substances like metal compounds or solvents,

- cancer, which may appear many years after the exposure that caused it, and
- skin irritation or dermatitis as a result of skin contact.

B - Risk Assessment and Management

Work activities and the workplace should always be assessed for the presence of hazardous agents. These may be used or handled directly by Dillon employees, or may be used, stored or produced by others.

If Dillon employees are working where chemical or biological hazards may be present, a risk assessment must be carried out. A risk assessment combines information on the nature of the hazardous agent, and an assessment of the worker's exposure to it, to characterise the risk to the worker's health.

The Joint Occupational Health and Safety Committee (JOHSC) should be advised where there is a suspicion of hazardous workplace exposures, and should be involved where measurement, control measures and/or additional surveillance are required.

The first stage in assessing exposures is to find out what activities take place at the site. Discuss with the project manager to determine which chemicals are stored, transported and used on the site. There may be hazardous exposures associated with processes entirely unconnected with Dillon's work.

Feedstock, intermediate chemicals, fugitive emissions, the final product, and waste products and emissions may all need to be considered. In addition, an accidental release may pose significant risks. At established facilities, a monitoring program for hazardous agents is likely already in place and may provide helpful data.

If there is a potential exposure to hazardous agents, an initial walk-through survey must be done. If this identifies the potential for over-exposure to an airborne contaminant, air sampling must be carried out. Where possible, personal sampling should be done to estimate individual exposure, but may also be done around the site to assess ambient levels. Exposure assessments should not assume any mitigation by personal protective equipment.
Some Canadian jurisdictions specify that exposure measurement should be done using methods approved by the National Institute for Occupational Safety and Health (NIOSH). Others are less prescriptive, but in any event the method used should be defensible as suitable and appropriate.

Note: Exposure assessments must be done by trained individuals. All Canadian jurisdictions have mandated strategies for carrying out an occupational exposure assessment. All provincial or territorial requirements must be complied with.

Once exposure to hazardous agents has been measured, a simple risk assessment may be done using the occupational exposure limits (OELs), sometimes called threshold limit values (TLVs), which have been defined for many commonly encountered substances. The terminology varies between organizations and jurisdictions, but generally there are three types of OEL: a ceiling exposure limit (CEL), which should not be exceeded at any time during a work period; a short-term exposure limit (STEL), usually averaged over 15 minutes; and a time-weighted average (TWA), usually averaged over an 8-hour period and assuming a 40-hour working week.
Note that not all Canadian jurisdictions publish CELs.

Occupational Exposure Limits (from the American Conference of Industrial Hygienists (ACGIH) Threshold Limit Values for Chemical Substances and Physical Agents – 2016)			
Agent	**TLV**	**STEL**	**CEL**
Ammonia	25 parts per million (ppm)	35 ppm	
Benzene	0.5 ppm	2.5 ppm	
Calcium sulphate (incl. Gypsum)	10 mg/m^3		
Carbon dioxide	5000 ppm	30,000 ppm	
Chloroform	10 ppm		
Gasoline	300 ppm	500 ppm	
Hydrogen cyanide		4.7 ppm	
Hydrogen sulphide	1 ppm	5 ppm	
Nicotine	0.5 mg/m^3		
Sulphur dioxide		0.25 ppm	
Toluene	20 ppm		
Zinc chloride fume	1 mg/m^3	2 mg/m^3	

Note: These are examples only; refer to provincial/territorial requirements in your jurisdiction as they may be different.

TWAs are sometimes adjusted in line with published arithmetic formulae, to determine permissible exposure concentrations over periods either longer or shorter than the 8 hours to which the standard is defined. This should be done with caution, with due consideration of the pharmacological properties of the substance. It is crucial to note that in defining occupational exposure limits, it is assumed that an employee is only exposed at work, and the periods away from work allow the body to recover from the effects of occupational exposures. Adjustments to exposure limits should only be done by qualified staff.

The effects of exposure to multiple substances may also need to be considered. Different substances may act on the body independently (e.g. xylene and asbestos), or chemicals may interact to have effects which are additive (e.g. xylene and toluene), synergistic, antagonistic, or potentiating (i.e. an earlier exposure becomes more toxic when combined with a later one). While formulae are available to assess multiple exposures, the toxicological effects are often poorly understood, and OELs are generally based on exposure to a single chemical.

It is important to remember that permitted exposure levels define the upper limits to which workers can legally be exposed, but that they are not necessarily defined at a level which protects all the people exposed.

Exposure to hazardous agents should be eliminated wherever possible. Where elimination is not possible, exposures must be reduced so far as is practicable. There is no clear line between “safe” and “unsafe”, and OELs do not guarantee safety.

Where employees may be exposed to harmful concentrations of chemical or biological agents, an exposure control plan must be prepared and implemented. As with the exposure assessment, this must be done by an

appropriately qualified person, in compliance with local requirements. The main components of a plan are listed below:

- a statement of purpose and responsibilities,
- risk identification, assessment and control,
- training requirements,
- written work procedures, when required,
- hygiene facilities and decontamination procedures, when required,
- health monitoring, when required, and
- documentation, when required.

When controlling risks, available mitigations should be applied in this order, known as the hierarchy of control:

- Elimination: remove the hazard from the workplace.
- Substitution: find a less risky option, e.g. substitute a less hazardous chemical.
- Engineering controls: modify plant, equipment, ventilation systems or processes to reduce exposure.
- Administrative controls: alter the way work is done, including timing, policies and practices (training, housekeeping, equipment maintenance, hygiene).
- Personal protective equipment: equipment worn by individuals to reduce exposure to a hazard.
- Facilities: first aid, washing facilities.

Source and engineering controls:

- may not exist for the process in question,
- may not be reasonable or practical because of technical difficulty or cost and the duration or frequency of exposures (for example during maintenance),
- may be rendered ineffective by temporary breakdown, and
- may become ineffective during an emergency.

However, for normal operations every effort should be made to apply the hierarchy of control. Only where source controls, engineering controls or administrative controls cannot reasonably be applied should personal protective equipment be used.

For certain exposures such as lead, cadmium or mercury, consideration may need to be given to biological (medical) monitoring, to determine a employees' uptake. For such substances, biological exposure indices (BEIs) are published in the ACGIH TLV's and BEI's for Chemical Agents and Physical Agents which represent the concentration of chemicals in the body that would correspond to inhalation exposure at a specific concentration in air. Please note the ACGIH TLV's and BEI's booklet is updated yearly.
If an employee or their physician thinks the employee's health may have been impaired by a workplace exposure, medical examinations and clinical tests may be required to determine whether the employee has an illness associated with occupational exposure to chemical or biological agents.

C – Training and Competency

Employees must be trained in the Workplace Hazardous Materials Information System (WHMIS) in respect of any controlled product used, stored or handled at the workplace.

All employees on a project must demonstrate familiarity with the project health and safety plan, and any applicable exposure control plan. Exposure monitoring and sampling, and design of any exposure control plan, should be done by a qualified person, in accordance with appropriate methods. Required sampling and analytical methods are generally those specified by NIOSH.

D - Equipment and Personal Protective Equipment

Refer to Guideline A.5 and A.17 for personal protective equipment and respiratory requirements. Refer to safety data sheets and WHMIS documentation for advice on selection of personal protective equipment. The supplier and/or manufacturer should be able to provide any supplementary information that may be needed.

If a worker may be exposed to substances harmful to the eyes or skin, there must be provision for immediate access to emergency eyewash and emergency shower, as appropriate. Equipment should meet ANSI Standard Z358.1-04, Emergency Eyewash and Shower Equipment, and the equipment manufacturer's specifications. As an alternative, if an emergency eyewash station and shower is not readily available, a portable eyewash station should be made available to staff.

Note: if clothing and/or equipment is contaminated, a provision for decontamination must be made. Provision for washing, laundering or otherwise disposing of contaminated clothing and equipment should be made, in a manner that prevents cross-contamination of clean areas or equipment.

E - Documentation

- ANSI Standard, American National Standard for Emergency Eyewash and Shower Equipment, Z358.1-04
- Guideline A.16 Hazard Identification, Risk Assessment and Risk Management
- Guideline A.5 Selection, Use and Maintenance of PPE
- ACGIH TLV's and BEI's for Chemical Agents and Physical Agents

This safe work practice is intended to provide common sense guidance on managing hazards that are typically encountered in common activities. It should be used in conjunction with any other guidelines or safe work practices that may be relevant. Where there is a conflict, the more onerous advice should be followed. In any case where Dillon safe work practices do not match local jurisdictional requirements, the jurisdictional requirements take precedence. If there is any doubt, consult with the project manager or the Coordinator, Health and Safety.

Hazard Identification

The hazards of exposure to heat and cold are generally distinct, and will be addressed separately in this safe work practice.

Heat

Heat puts stress on your body's cooling system. When heat is combined with other stresses such as physical work, loss of fluids, fatigue or some medical conditions, it may lead to heat-related illness, disability and even death. This is mainly a concern for employees who work outdoors in hot, humid weather, but heat exposure can occur in other workplaces. Furnaces, industrial plants and heavy equipment are also significant sources of heat and humidity.

Employees on medications or with pre-existing medical conditions may be more susceptible to heat stress. Employees should speak to their personal physicians about working in hot environments.

Risk Assessment and Management

Heat

If working outdoors in hot weather is necessary, it is vital to drink plenty of liquids and take frequent rest breaks. In hot, humid conditions, there is a risk of heat stress and heat stroke.

Humidex

The humidex was first devised in 1965 by Canadian meteorologists to describe how hot, humid weather feels to the average person. The humidex combines the temperature and humidity into one number to reflect the perceived temperature. An extremely high humidex reading can be defined as one that is over 40°C. In such conditions, all unnecessary activity should be decreased. If the reading is in the mid to high 30s°C, then certain types of outdoor activities should be toned down or modified, depending on the age and health of the individual, physical shape, the type of clothes worn, and other weather conditions. A Canadian humidex calculator can be found easily on-line by doing a search.

While it is unlikely that Dillon employees will be routinely exposed to dangerously hot industrial or commercial environments, it should be noted that the American Conference of Governmental Industrial Hygienists (ACGIH) publishes Threshold Limit Values (TLVs) for Heat Stress and Heat Strain. These values are based on preventing unacclimatized workers' core temperatures from rising above 38°C. Additional information on exposures limits

for working in hot environments can be found Canadian Centre for Occupational Health and Safety web-site Extreme Hot and Cold Temperature Conditions

Acclimatization

The human body can adapt to heat exposure to some extent. Acclimatization basically involves exposing employees to work in a hot environment for progressively longer periods. According to the National Institute for Occupational Safety and Health (NIOSH), for new or young workers who will be similarly exposed, the regimen should be 20% on day one, 40% on day two, with a 20% increase in exposure each additional day.

Heat Related Illnesses and Prevention (This information should be used as a guide only to help employees in need)

Condition and Cause	Symptoms	First Aid	Recommended Prevention
Heat Stroke - If a person's body has used up all its water and salt reserves, it will stop sweating. This can cause body temperature to rise. Heat stroke may develop suddenly.	Confusion Fainting Seizures Excessive sweating or red hot dry skin Very high body temperature	CALL 911. This condition can kill a person quickly. While waiting for help: • Place worker in shady, cool area • Loosen clothing, remove outer clothing • Fan air on worker; cold packs in armpits • Wet worker with cool water; apply ice packs, cool compresses, or ice if available • Provide fluids (preferably water) as soon as possible • Stay with worker until help arrives.	Reduce activity levels and/or heat exposure. Drink fluids regularly. Workers should check on each other to help spot the symptoms that often precede heat stroke.
Heat Exhaustion - Fluid loss and inadequate salt and water intake causes a person's body's cooling system to start to break down.	Cool, moist skin Heavy sweating Headache Nausea or vomiting Dizziness or light headedness Weakness Thirst Irritability Fast heart beat	GET MEDICAL AID. This condition can lead to heat stroke, which can kill. Have worker sit or lie down in a cool, shady area • Give worker plenty of water or other cool beverages to drink • Cool worker with cold compresses/ice packs • Take to clinic or emergency room for medical evaluation or treatment if signs or symptoms worsen or do not improve within 60 minutes. • Do not return to work that day.	Reduce activity levels and/or heat exposure. Drink fluids regularly. Workers should check on each other to help spot the symptoms that often precede heat stroke.
Heat Cramps - Heavy sweating drains a person's body of salt, which cannot be replaced just by drinking water.	Painful cramps in arms, legs or stomach pain Muscle spasms	• Have worker rest in shady, cool area • Worker should drink water or other cool beverages • Wait a few hours before allowing worker to return to strenuous work • Have worker seek medical attention if cramps don't go away.	Reduce activity levels and/or heat exposure. Drink fluids regularly. Workers should check on each other to help spot the symptoms that often precede heat stroke.
Heat Rash - Hot humid environment; plugged sweat glands.	Red bumpy rash with severe itching (often appears on neck, upper chest)	• Try to work in a cooler, less humid environment when possible • Keep the affected area dry.	Wash regularly to keep skin clean and dry.

Hazard Identification

Cold

A cold environment takes away body heat. Too much heat loss can cause lowering of the inner body temperature to dangerously low levels causing hypothermia. Exposed body parts may freeze in extreme cold, causing frostbite.

Hypothermia can be fatal unless the victim is moved to a warm shelter and receives timely medical attention. Hypothermia victims are unable to recognize their own signs and symptoms of hypothermia. Their survival depends on co-workers ability to do so. As a precaution, you should not work alone in cold extremes. Use the "buddy system" to detect signs of cold injury in co-workers.

Frostbite is the freezing of extremities such as fingers, nose tip, toes, ears and cheeks, which become numb and hard. Because of poor blood supply, these extremities may become frostbitten even if the rest of the body remains warm or even overheated. Frostbitten parts should be placed against warm body surfaces and re-warmed. Cold air is dry air and can cause dry skin and loss of body fluid.

Prolonged exposure to moderate cold and dampness can result in an injury called "trench foot", which can occur at temperatures above freezing point when feet are cold and damp while wearing constricting footwear.

Working in cold environments increases the risk of back injuries and other musculoskeletal injuries.

Risk Assessment and Management

Cold

Protect yourself from the cold.

DON'TS:

- DO NOT use alcohol, nicotine or other drugs that may affect blood flow.
- DO NOT expose yourself to cold temperatures after a recent shower or bath.

DO'S:

- Wear cotton or polypropylene long underwear for all-over warmth.
- Wear multiple layers of light, loose-fitting clothes. Air between the layers provides warmth. Outer wear should be waterproof.
- Wear cold weather clothing or arctic clothing that is appropriate for the outdoor temperature range and the type of activity.
- Wear mittens instead of gloves whenever possible, as mittens are warmer.
- Wear a warm hat with ear protection to prevent heat loss from the head. A wool knit cap provides the best protection. As much as 40% of body heat can be lost from an uncovered head.
- Use an appropriate hard hat liner to reduce heat loss when wearing a hard hat.
- Wear wool socks to protect your ankles and feet.
- Carry an extra pair of socks where moisture or sweat is likely, and change when necessary.
- Perform "warm up" stretching exercises before handling heavy equipment and material.

Wind Chill Hazards and What To Do

Wind Chill	Exposure Risk	Health Concerns	What to Do
0 to -9	**Low Risk**	Slight increase in discomfort	• Dress warmly • Stay dry
-10 to -27	**Moderate Risk**	• Uncomfortable • Risk of hypothermia and frostbite if outside for long periods without adequate protection.	• Dress in layers of warm clothing, with an outer layer that is wind-resistant. • Wear a hat, mittens or insulated gloves, a scarf and insulated, waterproof footwear. • Stay dry and keep active.
-28 to -39	**High Risk**: exposed skin can freeze in 10 to 30 minutes.	• High risk of frostbite: Check face and extremities for numbness or whiteness. • High risk of hypothermia if outside for long periods without adequate clothing or shelter from wind and cold.	• Dress in layers of warm clothing, with an outer layer that is wind-resistant. • Cover exposed skin. • Wear a hat, mittens or insulated gloves, a scarf, neck tube or face mask and insulated, waterproof footwear. • Stay dry and keep active.
-40 to -47	**Very High Risk**: exposed skin can freeze in 5 to 10 minutes*	• Very high risk of frostbite. Check face and extremities for numbness or whiteness. • Very high risk of hypothermia if outside for long periods without adequate clothing or shelter from wind and cold.	• Dress in layers of warm clothing, with an outer layer that is wind-resistant. • Cover all exposed skin. • Wear a hat, mittens or insulated gloves, a scarf, neck tube or face mask and insulated, waterproof footwear. • Stay dry and keep active.
-48 to -54	**Severe Risk:** exposed skin can freeze in 2 to 5 minutes*	• Severe risk of frostbite: Check face and extremities frequently for numbness or whiteness. • Severe risk of hypothermia if outside for long periods without adequate clothing or shelter from wind and cold.	• Be careful. Dress very warmly in layers of clothing, with an outer layer that is wind-resistant. • **Cover all exposed skin** • Wear a hat, mittens or insulated gloves, a scarf, neck tube or face mask and insulated, waterproof footwear. • **Be ready to cut short or cancel outdoor activities**. • Stay dry and keep active.
-55 and colder	**Extreme risk**: exposed skin can freeze in less than 2 minutes*	**DANGER!** Outdoor conditions are **hazardous.**	**Stay indoors**

*In sustained winds over 50 km/h, frostbite can occur faster than indicated.

Are there regulated exposure limits for working in cold environment?

In Canada, there are no maximum exposure limits for cold working environments, rather, there are guidelines that can be used to conduct work/task assessments, create safe work plans, and monitor conditions to protect the health and safety of workers who may be exposed to cold temperatures. The "work warm-up schedule" developed by the Saskatchewan Department of Labour has been adopted by the American Conference of Governmental Industrial Hygienists (ACGIH) as Threshold Limit Values (TLVs) for cold stress.

The "work warm-up schedule" provides guidance on warm-up breaks that may be needed when working in cold conditions. As the wind increased or as the temperature decreases, additional breaks should be taken (which shortens the length of time when working in the cold). Consider having warm-up breaks when the temperature reaches -26 °C (-15 °F) and when the winds are 16 km/h (10mph) or greater. All non-emergency work should be stopped at temperatures of -43 °C (-45°F) if there is no noticeable wind. Refer to the chart for other scenarios when non-emergency work should be stopped.

THRESHOLD LIMIT VALUES WORK/WARM-UP SCHEDULE FOR FOUR-HOUR SHIFT*

Air Temperature Sunny Sky		No Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind	
°C (approx)	°F (approx)	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks
-26° to -28°	-15° to -19°	(Norm breaks) 1		(Norm breaks) 1		75 min.	2	55 min.	3	40 min.	4
-29° to -31°	-20° to -24°	(Norm breaks) 1		75 min.	2	55 min.	3	40 min.	4	30 min.	5
-32° to -34°	-25° to -29°	75 min.	2	55 min.	3	40 min.	4	30 min.	5	Non-emergency work should cease ↓	
-35° to -37°	-30° to -34°	55 min.	3	40 min.	4	30 min.	5	Non-emergency work should cease ↓			
-38° to -39°	-35° to -39°	40 min.	4	30 min.	5	Non-emergency work should cease ↓					
-40° to -42°	-40° to -44°	30 min.	5	Non-emergency work should cease ↓							
-43° to below	-45° & below	Non-emergency work should cease									

Source: Adapted from Threshold Limit Values (TLV) and Biological Exposure Indices (BEI) booklet: published by ACGIH, Cincinnati, Ohio, 2016, page 210.

Notes/Considerations:

1. Applies to moderate to heavy physical work in any 4 hour period.
2. Warm-up breaks should be in a warm environment for 10 minutes.

3. Norm breaks means the normal break after 2 hours of work.
4. Guidelines apply to workers wearing dry clothing.
5. If there is limited physical activity, apply the schedule one step lower (more protective).

E – Documentation/References

- Canadian Centre for Occupational Health and Safety (CCOHS)
- American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs)
- The National Institute for Occupational Safety and Health (NIOSH)
- Government of Canada, Environment and Climate Change Canada (Wind Chill and Cold Weather

This safe work practice is intended to provide common sense guidance on managing hazards that are typically encountered in common activities. It should be used in conjunction with any other guidelines or safe work practices that may be relevant. Where there is a conflict, the more onerous advice should be followed. In any case where Dillon safe work practices do not match local jurisdictional requirements, the jurisdictional requirements take precedence. If there is any doubt, consult with the project manager or the Coordinator, Health and Safety.

This safe work practice (SWP) is intended to provide guidance to Dillon employees who are required to work around trenches or excavations in order to observe, sample, survey or undertake similar investigative activities.

This SWP is <u>not</u> intended to provide guidance or direction to excavating contractors.

A - Hazard Identification

Excavation and trenching are among the most hazardous construction operations. Generally, an excavation is defined as any human-made cut, cavity, trench, or depression in the earth's surface formed by earth removal. A trench is defined as a narrow excavation that is deeper and longer than it is wide.

When working in and around trenches and excavations, hazards can be both seen and unseen. For each project, the project or submission manager, or their delegated activity supervisor, should identify the expected hazards on the site.

When working around trenches and excavations the hazards include, but are not limited to:

- falling into the trench or excavation
- ground instability (soft or uneven ground) and wall collapse
- objects falling in from above
- dangerous atmosphere
- flooding and
- restricted ingress and egress.

Many excavations fall into the category of confined spaces as well. In this case, the provisions of the Health and Safety Program Manual Guideline A.12 Confined Space Awareness should be applied.

B - Risk Assessment and Management

Exposure to the hazards listed above needs to be assessed on a case-by-case basis. Where an excavation is greater than 1.5 metres (5 feet) deep, it should be treated as a potential confined space and the provisions of Health and Safety Program Manual Guideline A.12 Confined Space Awareness would apply.

Note: Most fatal cave-ins happen on small jobs of short duration, such as service connections and excavations for drains and wells. Too often, people think that these jobs are not hazardous enough to require safeguards against collapse.

Around trenches and excavations, the following methods should be employed to manage risks.

- Soil conditions and protective systems should be inspected regularly.
- Never enter a trench or excavation while working alone.
- To avoid falling in to a trench or excavation, watch where you are going, particularly if trenches and excavations have not been marked by flags, barriers, guard rails, stop blocks or other suitable methods.
- If a trench or excavation is deeper than 1.2 metres, the potential for collapse should be assessed by a competent person before working around it or entering it. Factors to consider in the assessment include:
    - the walls of the trench or excavation should be stabilized by shoring, sloping back or artificial soil stabilization techniques
    - water from heavy rainfall may cause instability in trench or excavation walls. Avoid entry during or immediately after periods of heavy rain
    - if artificial soil stabilization techniques such as grouting or freezing by artificial means are used, they must be designed by a professional engineer and installed to the engineer's specifications. Natural freezing should not be used as an alternative or partial alternative to engineered stabilization
    - heavy machinery and powered mobile equipment operating in the immediate vicinity may endanger the stability of the walls of a trench or excavation
    - spoil piles must be at least 1 metre away from the top of the trench or excavation. The slope of the side facing the trench or exaction should be flatter than 1:1.
- Risk of being struck by falling objects:
    - adjacent trees, utility poles, boulders and other objects located near a trench or excavation should be relocated or adequately supported before excavation work proceeds
    - no work equipment or materials should be placed near the edge of an excavation, if there is a possibility that they will fall in
    - do not move under or stay under any material being lowered into an excavation or trench.
- Risk of dangerous atmosphere:
    - when the atmosphere in a trench or excavation is suspected to be hazardous, treat the trench or excavation as a confined space. See Guideline A.12 Confined Space Awareness.
- Risk of flooding:
    - do not enter a trench or excavation if there is heavy inflow or standing water in it
    - inspect trenches following a rain storm.
- Trips and falls:
    - if an excavation is a hazard to workers, it must be effectively covered or guarded
    - a walkway across an excavation must be at least 50 cm wide, and if crossing an excavation over 1.2 m deep, be equipped with guardrails on both sides
    - be aware of ground conditions and grade.
- Working around traffic:
    - where a trench or excavation is located in an area used by vehicles, ensure proper traffic control measures are in place to protect the trench or excavation and workers in and around it
    - familiarize yourself with operator's work plan
    - all site personnel working around traffic must wear high visibility vests

    - exhaust gas from combustion engines is heavier than air, so if vehicles are present, air quality monitoring equipment must be used in the trench or excavation. Stand down wind of exhausts. Keep adequate distance to permit dilutions of exhausts.
- Access:
    - safe means of entry and exit must be provided for an excavation a worker enters. Safe access and egress to all excavations including ladders, steps, ramps or other safe means of exit for employees should be made available and in the vicinity of all workers
    - if workers are required to enter a trench over 1.2 m deep and it has been assessed by a competent person, the safe point of entry and exit must be located within 8 m of the workers and the excavation must be safely supported or sloped to the entry and exit location
    - if a ladder is used as the means for entering and leaving an open excavation or trench, the ladder should:
        - extend 1 metre above the top of the excavation or trench, and
        - be located not more than 3 m from the worker, when the ladder is used in a trench.
- Utilities:
    - before excavating, trenching or drilling with equipment, the location of underground utility service in the area must be accurately determined and any danger to employees from the services must be controlled. Excavation work in proximity to an underground service must be undertaken in conformity with the requirements of the services owner
    - all underground utilities are to be confirmed (verbal acknowledgment to proceed with excavating is not acceptable if utilities are on site and not positively located)
    - locate documentation must be valid and must pertain to the work area in question.

C – Training and Competency

Dillon employees working in and around trenches or excavations should be trained in relevant safe working procedures. Dillon employees should recognize when a trench or excavation may be considered a Confined Space. In those circumstances the provisions of the Health and Safety Program Manual Guideline A.12 Confined Space Awareness would apply.

D - Equipment and Personal Protective Equipment

Construction site PPE, including CSA-approved hard hat, safety footwear (with suitable treads) and eye protection should be worn by persons working around trenches and excavations. High visibility vests should be worn when working around mobile equipment and vehicular traffic

Additional equipment appropriate to the worksite and field conditions may include air quality monitoring equipment; respiratory equipment; body harness and lifeline; approved caging and shoring.

See Health and Safety Program Manual Guideline A.5 Selection, Use and Maintenance of PPE for additional guidance.

E - Documentation

Sources of relevant health and safety information on trenches and excavations include:

Alberta
OH&S Code, Part 32, Excavating and Tunnelling:
http://employment.alberta.ca/hre/whs/reg/Display.asp?EntityCode=HLEVEL_ 2&EntityKey=6178

British Columbia
Worksafe BC OHS Regulation, Part 20, Construction, Excavation, and Demolition:
http://www2.worksafebc.com/Publications/OHSRegulation/Part20.asp

Manitoba
Workplace Safety and Health Act and Manitoba Regulation Part 26, Excavations and Tunnels:
http://www.gov.mb.ca/labour/safety/pdf/regparts/part26.pdf

New Brunswick
Occupational Health and Safety Act, Part XIII
http://www.gnb.ca/0062/regs/91-191.htm

Newfoundland and Labrador
Consolidated Newfoundland Occupational Health and Safety Regulation 1996 (1165/96):
http://www.assembly.nl.ca/legislation/sr/annualregs/CNR1996/Cr961165.htm

Nova Scotia
Reference Guide to the Occupational Safety General Guidelines, Part 14
http://www.gov.ns.ca/enla/healthandsafety/docs/OccupSafetyGenRegRefGuide.pdf

Northwest Territories
NWT Safety Act, Safety Regulation 3/9
http://www.wcb.nt.ca/your_wcb/pdf/legislation/GeneralSafety3.pdf

Nunavut
Nunavut General Safety Regulations
http://www.ccohs.ca/legislation/documents/nunavut/nuesa/nurgene0.htm

Ontario
"O" Reg 213/91, Construction Projects Part III, Excavations
http://www.ccohs.ca/legislation/documents/ont/oneoha/onrcone0.htm

Prince Edward Island
OHS Act, General Regulations, Part 12: Excavations, Trenches, and Constructions:
http://www.gov.pe.ca/law/regulations/pdf/O&01-01G.pdf

Quebec
R.R.Q 1981, c. S-21, r.6 (as amended); Safety Code for the Construction Industry
http://www.ccohs.ca/legislation/documents/que/pqearo/pqccone0.htm#DivisionNumber:II

Saskatchewan
OHS Safety Bulletins – Safety in Excavations and Trenches:
http://www.labour.gov.sk.ca/Default.aspx?DN=d337bd61-05e6-4027-a9b3-c53ec2a159ae

Yukon
Occupational Health and Safety Act
http://www.gov.yk.ca/legislation/regs/oic1986A164.pdf

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Working at construction or demolition sites often results in Dillon staff being subject to the overall supervision of a contractor or 'constructor'. In these cases, it is important that we obtain copies of the subject contractor's health and safety policy/plan, to ensure our conformance to their policies, and facilitate our understanding of all aspects of the work that they undertake. Where the contractor's policies/procedures are less stringent than those outlined in the Dillon SWP's (or the information is not readily available), our safe work practices shall govern for Dillon staff.

Where the subject location is an operational facility, Dillon staff may also be subject to the unique safety policies of the facility owner. It will then be necessary to obtain documentation from the owner. Again, the most stringent requirements of the contractor, facility owner or the Dillon safe work practices will always govern.

A - Hazard Identification

While an attempt has been made to identify the most common hazards associated with construction or demolition sites, Dillon staff are to exercise common sense and due caution whenever attending these locations, especially for the first time. It is imperative that a hazard assessment is performed by a competent staff member at the earliest stage of Dillon's involvement, and if site conditions are not adequately addressed by the generic health and safety plan, a custom health and safety plan is prepared under the guidance of the project manager.

Common Site Hazards

- public traffic, where the site includes a road allowance, access route or parking area
- heavy and light construction machinery/equipment, including truck traffic
- open trenches and excavations
- uneven, slippery or obstructed terrain, trip hazards
- designated hazardous substances (esp. at demolition sites)
- electric shock sources, including overhead, buried and ground level sources
- ladders, scaffolding, catwalks and other elevated work areas
- excessive noise sources
- sources of hazardous exhaust, fumes and odours
- sources of airborne contaminants and/or excessive dust
- sources of liquid contaminants and/or chemicals
- sources of biological hazards
- confined spaces
- hazards of working on, over or near water or ice
- sources of extreme heat, flames, sparks and explosion.

B - Risk Assessment and Management

Generally, exposures to common site hazards are limited to site personnel, although there is the possibility of visitors or site 'tours' involving Dillon staff (in which cases 'Hazard Avoidance' must be practiced as much as possible).

Common Site Hazards	
Hazard	**Control Measure**
Public traffic	Follow the requirements of SWP 1 Working Around Traffic.
Heavy equipment, including truck traffic	Follow the requirements of SWP 14 Working Around Equipment.
Open trenches and excavations	Follow the requirements of SWP 22 Working Around Trenches and Excavations.
Uneven, slippery or obstructed terrain, trip hazards	Avoid hazardous route, if possible. Advise contractor/owner of hazardous condition, and postpone activity, if possible, until rectified. Ensure CSA Approved Safety Boots are worn, with treads suitable for the terrain, in good condition. Proceed with appropriate caution, if route must be followed in its uncorrected state, but only if the risk can be managed. Always scan area for trip hazards to avoid unnecessary slips, trips and falls.
Designated substances	Avoid exposure by communicating with contractor/owner and avoiding active areas. Obtain designated substance survey audit/study info and clarify risks. Consult WHMIS guidelines, MSDS, relevant applicable legislation and verify PPE for potential exposures in work areas.
Electric shock sources	Avoid exposure by communicating with contractor/owner and avoiding active areas. Follow the requirements of SWP 7 Working Around Overhead or Underground Services, SWP 9 Lockout, SWP 13 Portable Power Tools and SWP 33 Arc Flash.
Ladders, scaffolding, catwalks, etc.	Follow the requirements of SWP 10 Fall Protection and SWP 12 Working with Ladders or Scaffolding.
Excessive noise sources	Avoid exposure by communicating with contractor/owner and avoiding active areas. Follow the requirements of SWP 36 Hearing Conservation Program. Wear required PPE, including appropriate hearing protection.
Sources of hazardous exhaust, fumes and odours	Avoid exposure by communicating with contractor/owner and avoiding active areas. Appropriate air monitoring equipment (and associated documentation) may be required. If exposure is unavoidable, wear appropriate PPE (e.g. – nuisance odour/dust/ mist/cartridge mask, or breathing apparatus, safety glasses). Refer also to SWPs 2, 20, 24 and 25 as may be applicable.

Common Site Hazards	
Hazard	**Control Measure**
Sources of airborne contaminants and/or excessive dust	Avoid exposure by communicating with contractor/owner and avoiding active areas. Obtain designated substance survey (or equivalent) audit/study info, if available, and clarify risks. Consult WHMIS guidelines, MSDS and relevant applicable legislation. Appropriate air monitoring equipment (and associated documentation) may be required. If exposure is unavoidable, wear appropriate PPE (e.g. dust/mist/cartridge mask, or breathing apparatus, safety glasses). Refer also to SWPs 2, 20, 24 and 25 as may be applicable as well as A.17 Respiratory Protection Requirements.
Sources of liquid contaminants and/or chemicals	Avoid exposure by communicating with contractor/owner and avoiding active areas. Obtain designated substance survey audit/study info and clarify risks. Consult WHMIS guidelines, MSDS, relevant applicable legislation and verify PPE for potential exposures in work areas. Refer also to SWPs 2, 20, 24 and 25 as may be applicable.
Sources of microbiological hazards	Follow the requirements of SWP 25 Microbiological Hazards. Avoid exposure by communicating with contractor/owner and avoiding active areas. Consult WHMIS guidelines, relevant applicable legislation and verify PPE for potential exposures in work areas. Refer also to SWPs 2, 6, 20 and 24 as may be applicable.
Confined spaces	Avoid exposure by communicating with contractor/owner and avoiding active areas. Follow the requirements of Guideline A.12 for further information on confined spaces as well as applicable regulations.
Hazards of working on, over or near water or ice	Follow the requirements of SWP 4 Working On or Over Water. Follow the requirements of SWP 5 Working On or Over Ice.
Sources of extreme heat, flames, sparks and explosion	Avoid exposure by communicating with contractor/owner and avoiding active areas. Consult WHMIS guidelines, MSDS, relevant applicable legislation and verify PPE for potential exposures in work areas. Follow the requirements of SWP 27 Physical Hazards (Noise, Vibration and Working in the Dark).

C – Training and Competency

- As a minimum, Dillon staff who work on construction or demolition sites must have health and safety field staff awareness and WHMIS training, and be familiar with the site/project specific health and safety plan.
- Regulatory requirements for CPR/first aid training should be met.
- Verify where certain types of work are to be performed only by persons deemed ‘competent’ with reference to their training or education, qualifications and experience.

- Where the afore-mentioned common site hazards reference another SWP, follow the requirements of that SWP for training and competency.
- Where Dillon staff are required to use specialized equipment, they must have complete familiarity with the operating guidelines/requirements for that equipment.
- Verify the requirements of the contractor's/owner's health and safety plan/policy for relevant training requirements.
- Check applicable legislation for the unique requirements where a specialized 'competent person' responsibility is identified (e.g. confined space roles).
- If there is any doubt as to a person's training and competency for any hazard exposure, consult with the project manager, and always err on the side of caution until the need for training/competency is clarified.

D - Equipment and Personal Protective Equipment

- As a minimum, Dillon staff who work on construction or demolition sites must have CSA approved footwear, hard hat, safety glasses, high visibility vest and protective work gloves when appropriate.
- Other PPE required may include appropriate hearing protection, protective mask(s), face shields, breathing apparatus, 'Tyvek' coveralls, body harness, etc., depending on the anticipated hazard exposure. Sunscreen protection should be worn in outdoor exposures.
- Where the above-mentioned common site hazards reference another SWP, follow the PPE requirements of that SWP.
- Verify the requirements of the contractor/owner health and safety program for relevant PPE requirements.
- All PPE must be properly worn and maintained. Worn or damaged PPE should be replaced immediately.

E - Documentation

- Site/project specific health and safety plan.
- Material safety data sheets where there is a risk of exposure to any hazardous materials (and designated substance survey audit/study, if applicable).
- Where the above-mentioned common site hazards reference another SWP, follow the requirements of that SWP.
- Verify the requirements of the contractor's/owner's health and safety plan/policy for relevant documentation requirements.
- Check applicable legislation for the unique requirements where specialized documentation is identified (e.g. confined space regulation).
- All site staff must be familiar with their geographically-specific legislation and regulations.

This safe work practice is intended to provide common sense guidance on managing hazards that are typically encountered in common activities. It should be used in conjunction with any other guidelines or safe work practices that may be relevant. Where there is a conflict, the more onerous advice should be followed. In any case where Dillon safe work practices do not match local jurisdictional requirements, the jurisdictional requirements take precedence. If there is any doubt, consult with the project manager or the Coordinator, Health and Safety.

A - Hazard Identification

This safe work practice addresses the hazards posed by certain microbiological exposures. These can include but not limited to moulds, bacteria, protozoa, viruses and parasites, and some potential work-related exposures are considered here.

Moulds

Occupational health and safety legislation does not specifically address adverse health effects of mould exposure. However, mould is recognized as an occupational hazard for indoor workers. According to CCOHS, there have been reports linking health effects to mouldy surfaces in persons who worked in contaminated offices. Not all moulds are harmful. However certain types of moulds can cause adverse health effects.

Moulds produce allergens, irritants, and in some cases, potentially toxic substances (mycotoxins). Inhaling or touching mould or mould spores may cause allergic reactions in sensitive individuals. Allergic responses include hay fever-type symptoms, such as sneezing, runny nose, red eyes, and skin rash (dermatitis). Allergic reactions to mould are common. They can be immediate or delayed. Moulds can also cause asthma attacks in people with asthma who are allergic to mould. In addition, mould exposure can irritate the eyes, skin, nose, throat, and lungs of both mould-allergic and non-allergic people. Symptoms other than the allergic and irritant types are not commonly reported as a result of inhaling mould. Research on mould and health effects is ongoing.

Infectious agents

Hantavirus

Hantavirus has been reported in several parts of Canada. It is a potentially fatal infection contracted when people breathe the virus found in the urine, saliva or droppings of infected rodents, especially deer mice. Those infected show flu-like symptoms that turn into a pneumonia-like condition in 2-3 days.

HIV/AIDS, Hepatitis B and C

Dillon staff working in areas frequented by the public may be exposed to blood-borne pathogens, where they may come into contact with used needles and condoms. There is no cure for any of these conditions and it is important to prevent infection.

Lyme disease

Lyme disease is probably the best known of several tick-borne infections. It is transmitted by the bite of blacklegged (or deer) ticks. Symptoms include fever, headache, fatigue and a characteristic skin rash. If left untreated the infection can spread to the joints, heart and nervous system.

West Nile virus

West Nile virus is transmitted through mosquito vectors, which bite and infect birds. The birds are amplifying hosts, transmitting thee infection through mosquitoes to other birds and humans. The American robin and the American crow are the most common avian carriers. WNV has three different effects on humans: asymptomatic infection, a febrile syndrome called West Nile fever, and a rare neuroinvasive disease termed West Nile meningitis or encephalitis.

B - Risk Assessment and Management

Mould

Mould is ubiquitous, and is present in every workplace. The question is not whether the workplace is affected by mould, but the degree to which it is affected. Mould growth is not always visible; typically, light-coloured moulds are visible against dark backgrounds and dark-coloured moulds are visible against light backgrounds, but the converse may not be true. Furthermore, mould often proliferates within building elements – walls, roof and sub-floor space. It can be especially problematic if growing in the building ventilation system. Air conditioning drip pans, and particle filters in humid conditions, can present good environments for mould growth. If staff exhibit symptoms that may indicate mould exposure, the workplace should be assessed for mould. This would normally involve inspection and sampling, and should be done by experienced staff

Moisture control is the key to mould control. Thorough clean- up, drying, and/or removal of water-damaged materials will prevent or limit mould growth.

Infectious agents

Hantavirus

Cases have been associated with:

- sweeping out farm buildings
- trapping and studying mice
- cleaning up sawmill waste with compressed air
- handling grain contaminated with mouse droppings
- entering a barn infested by mice
- occupying vacant dwellings or living in infested properties
- disturbing rodent-infested areas while hiking or camping.

If it is reasonable to expect that workers may be exposed to rodents, or their saliva, urine or droppings, as part of their normal job duties, an exposure control plan must be developed. This should include provisions for decontaminating PPE.

HIV/AIDS, Hepatitis B and C

The risks of infection following exposure to infected blood through needle stick injury are as follows:

- 3 in 10 for hepatitis B
- 1 in 10 for hepatitis C
- 3 in 1000 for HIV.

Workers should always look before reaching into an area or container, and should use a stick or other long-handled device to explore hidden spots. A flashlight is useful to move objects as well as for shedding light.

Sharps must not be picked up unless the worker has the proper PPE and has been instructed in doing so safely. In the event that used needles must be disposed of from the workplace, waterproof gloves should be worn. The needle should be picked up using tongs, and placed in a proper sharps container. There is no "best" glove; it depends on the worker's preference, balancing protection and dexterity. Alternatively, suitable gloves and a specialized one-needle disposal container should be used. Double glove at a minimum.

Spilled blood must only be cleaned up by workers who have been trained to do so and are equipped with the proper equipment and PPE to do so safely.

Lyme disease

Lyme disease is diagnosed based on the symptoms (e.g. rash) and the possibility of exposure to ticks. Prevention includes:

- avoiding wooded and bushy areas with tall grass,
- tucking clothes in (including pants legs into socks or boots) to keep ticks off your body,
- the use of insect repellent containing 20-30% DEET
- application of permethrin to pants, shoes and socks, and
- prompt removal of ticks; to kill ticks that you may have missed, wash your clothes with hot water and dry them using high heat for at least one hour.

To remove a tick from your skin, grasp it close to the skin with fine-tipped tweezers and pull it away from your body with a steady motion. Clean your skin with soap and water and throw the dead tick away in the trash. Avoid crushing the tick's body; if you do, wash the area with soap and water or alcohol. Don't be concerned if the tick's mouthparts remain in the skin.

West Nile virus

Avoid mosquito bites. Wear long sleeves, long pants and socks when outdoors, especially in the evening or early morning when mosquitoes are more active. Use repellent; a product containing 20% DEET will provide nearly 4 hours of protection. An alternative is to use permethrin on clothing. Permethrin must not be applied directly to skin.

C – Training and Competency

Workers dealing with infectious agents should be trained in safe work practices. Workers using PPE must be trained in its fit, storage, use and maintenance.

Workers dealing with infectious agents should be trained in decontamination techniques, and the safe removal and disposal of PPE (including gloves).

D - Equipment and Personal Protective Equipment

To control exposures in mould investigation and remediation, an N 95 respirator, goggles and rubber or plastic gloves should be worn. (An N 95 respirator filters at least 95% of airborne particles.)

To control hantavirus exposure, a range of respiratory protection may be required, from N 95 respirator to powered air-purifying respirators worn by properly trained employees. This will be determined by the exposure control plan. Protective coveralls, eye protection and gloves should also be worn. Washing facilities are required.

Sharps containers, suitable tongs, and gloves should he used in dealing with used needles and syringes.

E - Documentation

CCOHS – The following CCOHS Web site provides useful links:
http://www.ccohs.ca/oshanswers/biol_hazards.

This safe work practice is intended to provide common sense guidance on managing hazards that are typically encountered in common activities. It should be used in conjunction with any other guidelines or safe work practices that may be relevant. Where there is a conflict, the more onerous advice should be followed. In any case where Dillon safe work practices do not match local jurisdictional requirements, the jurisdictional requirements take precedence. If there is any doubt, consult with the project manager or the Coordinator, Health and Safety.

Dillon will provide a safe work environment for its employees. In doing so, all reasonable and practical measures will be taken to eliminate or minimize injury or incident risks associated with the nature of the work performed when employees work alone.

A - Hazard Identification

Risks from certain events may be increased to employees who are working alone. A fall, an accident with a portable power tool, or an assault can have very different consequences if a worker is alone than if the victim has co-workers or capable assistants in the immediate vicinity. Therefore, extra precautions may be needed to manage these risks.

While no jurisdiction in Canada prohibits working alone, all those dealing with this issue require employers to conduct a hazard assessment, and develop controls to manage the risks associated with the identified hazards.

A worker can be considered to be working alone if there is a reasonable expectation that a call for assistance will not or cannot be responded to and the worker's absence may not be noticed for some time. An employee is *not* working alone if the following three criteria are all met:

1. *Awareness* - will other persons capable of providing assistance be aware of the worker's needs?
2. *Willingness* - is it reasonable to expect that those other persons will provide helpful assistance?
3. *Timeliness* - will assistance be provided within a reasonable period of time?

If two or more employees are working together, or if an employee and an employee of a different company are working together, it is reasonable to expect that the workers can provide assistance to one another. However, if a Dillon employee is working at a location where other people are present, but where these people are engaged in different activities, the employee *may* be deemed to be working alone, based on an assessment of the task. When a worker cannot be seen or heard, they are working alone.

To minimize risk to employees who may work alone and assistance is not readily available, Dillon will:

- conduct written hazard assessments to identify existing or potential working alone hazards
- take measures to eliminate or control the hazards of working alone at work sites
- ensure that affected employees are informed of the hazards and methods used to control or eliminate them
- provide an effective system for communication between any employee who works alone and persons capable of assisting the employee
- ensure all incidents (work related or otherwise) are reported, investigated and documented
- review the working alone plan

Safe Work Procedures

This procedure applies if an employee is working alone at a work site where assistance is not readily available, if there is an emergency, or the employee is ill or injured.

Work Site Assessment and Controls

For the purpose of local regulatory requirements for occupational safety, each work site must have a written risk and hazard identification and assessment. The assessment must be completed before an employee is assigned to work alone or in isolation. This is done to identify, eliminate and minimize any associated hazards and risks from the conditions and/or circumstances.

To assess this hazard, project managers must review records, past incidents and identify measures or actions needed to correct any hazards.

B - Risk Assessment and Management

The following activities may not be undertaken while working alone:

- confined space entry
- working at heights
- working on or over water/ice
- stack testing
- working in wilderness areas (unless specifically approved by Coordinator, Health & Safety)
- working in trenches or excavations greater than 1.2 metres in depth (see SWP 20)
- operation of heavy equipment
- working at heights and requiring a personal fall arrest system
- working outside if temperatures are low enough to pose an imminent risk to the worker.

Other limitations will be placed based on the site-specific hazard assessment.

Minimum Training or Experience

All employees will be trained (if working alone is a hazard at that location) in:

- the written local working alone plan and safe work practices
- hazards at the work site and the methods used to control or eliminate them
- the methods for identification, hazard reduction and prevention when working alone and dealing with situations or individuals that presents a potential risk
- the procedure for checking the worker's well-being while during the assigned working period.

All training shall be documented.

Routine work activities often involve working alone. The following is a summary of identified hazards and risk mitigation strategies for select routine work activities:

Work Activity	Risk	Risk Mitigation Strategy
Working Alone – Dillon Office (outside of business hours)	Risk to personal safety due to isolation	Ensure the office is secured to prevent unauthorized access. Do not enter the work site alone if security appears to be compromised. Provide security escort to vehicle or taxi if employees are at increased risk (e.g., entering parking area late at night). Make sure all doors close behind you. Keep your cell phone and pass card (where applicable) with you at all times. If you encounter someone unfamiliar in the office, leave the premises and contact the police. Do not confront them.
Working Alone - Meeting Clients or Public Away from Dillon Office	Risk to personal safety due to violent behaviour	Don't meet an unknown client or member of the public alone in an isolated location. If there is a known risk of workplace violence, refer to Health and Safety Program Manual Guideline A.8 Workplace Violence.
Working Alone - Business Travel	Risk to personal safety due to isolation	Refer to Health and Safety Program Manual Guideline A.13 Domestic Business Travel.
Working Alone - Non-intrusive field investigations and site reconnaissance	Risk to personal safety due to isolation	Do not conduct site work alone in areas outside of cell phone coverage, unless check-in procedures have been established. Leave the site if there is risk to personal safety.

In assessing risk of other activities, consider the following points, as appropriate. Where practicable, assign more than one worker to minimize higher risks.

Time the worker will be alone

- What is a reasonable length of time for the worker to be alone?
- How long will the worker be alone to finish the job?
- At what time of the day will the worker be alone?

Communication

- What forms of communication are available?
- Will emergency communication systems work properly in all situations?
- If the communication systems are located in a vehicle, do you need alternate arrangements when the worker is away from the vehicle?

Location of the work

- Is the work in a remote or isolated location? Remember, an isolated location is not necessarily far away.
- What kind of transportation is needed to get there?
- Is the vehicle equipped with emergency supplies?
- Will the employee have to leave the vehicle? Will they need to carry emergency supplies when leaving the vehicle?
- What are the consequences if the vehicle breaks down?

Type or nature of work

- Is it legal for the worker to be alone while doing certain tasks, for example in a confined space?
- If personal protective equipment is required, is it available, is it in good working order, and has the worker been trained in its use, care and storage?
- What machinery, tools or equipment will be used?
- Is there a high risk activity involved, such as working with hazardous materials, or in extreme weather conditions?
- Is there possibility of an animal attack?

Characteristics of the individual who is working alone

- Is the worker adequately trained and educated to work alone safely?
- Are there pre-existing medical conditions that may increase the risk?
- Does the worker have enough experience?
- Are women especially at risk?
- Does the worker have special requirements, such as for visible indicators in the case of an employee who is deaf?

The risk assessor should:

- identify the hazards of the work site and work activity
- talk to employees about their work and get their input about the work they do
- consider records of incidents at the work site, and those from similar workplaces
- avoid having an alone worker whenever possible, especially for jobs with a recognized risk that cannot be eliminated
- assign workers that are properly trained and educated for the task and
- establish a checking procedure (if appropriate) or equivalent, such as providing employees with a personal locator beacon with GPS interface.

Checking Procedure

If a checking procedure is identified as a risk management strategy, it should:

- specify the mechanism and time intervals for checking on the worker
- specify the person responsible for contacting the worker and recording the results of the contact
- outline the procedure to be followed if the worker cannot be contacted, including provisions for an emergency rescue and
- provide for checking with the worker at the end of the work activity.

Periodic visits from an individual who can put pre-planned emergency responses into effect may be necessary in some cases. For most situations, regular phone check-in contact would be expected. A cell phone is useful for check-in. If cell phone reception is unreliable in the area, consider alternative methods of communication (e.g. satellite phone) or automated systems (e.g. “safetyline”).

If an employee does not respond within a defined amount of time to an employee check, the situation will be treated as an emergency until the employee has been located or the employee finally responds.
The following procedures should be followed:

- if possible, respond immediately to the work area and assess the situation or
- if necessary, call for emergency assistance (e.g., first aid, 911, search & rescue).

A written procedure (see example below) is required for checking the well-being of a worker assigned to work alone or in isolation under conditions which presents a risk of disabling injury, if the worker might not be able to secure assistance in the event of injury or other misfortune.

The procedure for checking a worker's well-being must include the time interval between checks and the procedure to follow in case the worker cannot be contacted, including provisions for emergency rescue. In addition to checks at regular intervals, a check at the end of the work day must be done. Each work site’s working alone plan shall address having an established contact person. A person must be designated to establish contact with the employee at predetermined intervals and the results must be recorded by the person.

If electronic communication is not practicable or readily available at the work site, Dillon must ensure that a representative of Dillon or another competent employee visits the employee, or the employee contacts Dillon or another competent employee.

Example : Written Procedure for Working Alone

1) _____ will be working alone at _____ between the hours of _____am/pm and _____am/pm for the following days of the week: _____
_____ is responsible for checking on the above-noted employee at these set intervals:

2) List time(s) (e.g., every two hours at 9:00am, 11:00am and 1pm and end of day etc.) _____
All contacts are to be recorded in the health and safety plan.

3) Method of contact will be by (cell phone, e-mail, text, face-to-face, etc.) _____

4) If the employee cannot be reached or does not respond within ____ minutes, the designated contact person will arrange for face-to-face contact to be made with the employee by (e.g., driving to the site, calling police, etc.) _____.

5) If the worker encounters an unsafe situation while working alone, the worker is to immediately alert the designated contact person at phone number _____ and, if deemed necessary, the police.

6) As part of the employee's pre-job safety briefing, the project manager or designate will review this procedure and provide copies to the employee and the designated contact person before the employee commences working alone.

7) Working alone procedures developed for this work location will be reviewed at least annually or more frequently if there is a change in work arrangements which could adversely affect the employee's well-being or if the reporting system is not working effectively. The employee and/or the designated contact person are expected to inform the project manager or designate of any concerns they may have with the reporting system.

8) Acknowledgements and Signatures:
The project manager or designate has explained to me the working alone procedures developed for my work location. I understand these procedures are for my well-being and will cooperate with the check-ins initiated by the designated contact person.

Employee_____ Date_____

Project manager or designate _____has explained the working alone procedures to me. I understand these procedures and agree to regularly check- in on the employee's well-being as directed above.

Signature of Designated Contact Person_____ Date_____

I have explained the working alone procedures to the worker and the designated contact person and have provided both parties with copies of these procedures.

Signature of project manager or their designate _____ Date_____

Safe Work Practices

Controls implemented within the office environment, as a minimum:

- Restricted building access to buildings - card keys or regular keys after regular working hours.
- Office doors are to be locked when working alone after hours.
- Have employees check road reports and weather forecast before traveling and restrict travel if road conditions are dangerous.
- Ensure all Dillon vehicles are to be equipped with cell phones or radios and first aid kits.
- Advise employees to travel with another employee when possible.
- Advise employees to park close to the building in a lit area in the evening hours.
- Post signage, emergency contact information, and develop a communication system.
- Report suspicious activity.

Provision of Emergency Supplies

- All vehicles shall contain the appropriate emergency supplies including flares, marking devices, food, water, warm clothing during winter, and other supplies as determined by the hazard assessment.
- Workers working alone shall have spare batteries for communication devices in case of power failure, a radio for local weather conditions, and other equipment as determined by the hazard assessment.

Review & Updating Working Alone Plan

- The hazard assessment and working alone plan at each work site must be reviewed periodically or more frequently if there is a change in work processes or arrangements which could adversely affect an employee's well-being.
- The local working alone plan shall also be revised if there is any indication or report that the plan is not working effectively or needs changing.

C – Training and Competency

Some jurisdictions require training be given in procedures for working alone (including requirements for first aid training). It is important that employees who work alone are competent in terms of their education, training and experience, understanding the risks and precautions, and carrying out their assigned tasks safely. Employees working alone should be familiar with the relevant safe work procedures, and should be familiar with any systems being used, for example for check-in.

D - Equipment and Personal Protective Equipment

Equipment used for scheduled check-in should be protected against impact damage, adverse weather and accidental immersion. Cold weather clothing shall be worn when appropriate if a worker is alone. Additional PPE for workers working alone will be identified in the site-specific hazard and PPE assessment process.

E - Documentation

Form D-1 Hazard Assessment/Generic Health and Safety Plan or custom site-specific health and safety plan (as appropriate).

Further information on-line (selected bibliography):

Alberta

OH&S Code Explanation Guide, Part 28, Working Alone:
http://employment.alberta.ca/documents/WHS/WHS-LEG_ohsc_p28.pdf
Working Alone Safely - A Guide for Employers and Employees:
http://employment.alberta.ca/documents/WHS/WHS-PUB_workingalone.pdf

British Columbia

Worksafe BC OHS Regulation Part 4.21 - Working Alone or in Isolation:
http://www2.worksafebc.com/Publications/OHSRegulation/Part4.asp#SectionNumber:4.21

Manitoba

Workplace Safety and Health Regulation Part 9, Working Alone or in Isolation:
http://www.gov.mb.ca/labour/safety/pdf/regparts/part9.pdf
Code of Practice for Workers working Alone:
http://www.gov.mb.ca/labour/safety/pdf/codeworkingalone.pdf

New Brunswick

Regulation 92-133, Working Alone:
http://www.gnb.ca/0062/PDF-regs/92-133.pdf

Newfoundland and Labrador

Working Alone Safely Guidelines for Employers and Employees:
http://www.gs.gov.nl.ca/ohs/safety-info/si-working-alone.stm

Prince Edward Island

Part 53 OHS Regulations, Guide to Working Alone:
http://www.wcb.pe.ca/photos/original/wcb_work_alone.pdf

Saskatchewan

OH&S Regulations 1996, Reg 35, Working alone or at isolated place of employment

Canadian Centre for Occupational Health and Safety

Working Alone - General:
http://www.ccohs.ca/oshanswers/hsprograms/workingalone.html.

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A - Hazard Identification

The hazards of exposure to noise, vibration, and working in the dark are generally distinct, and will be addressed separately in this safe work practice.

Noise

Noise (unwanted sound) is a major occupational hazard. Short-term effects of noise exposure include temporary hearing loss, stress, annoyance, difficulty in verbal communication, and safety hazards. The primary long-term health effect of noise exposure is permanent hearing loss. Both short-term and long-term effects can be prevented by timely recognition, evaluation, and control of noise exposure.

All employees, who work in areas where the exposure to noise levels are 85 decibels or greater, must wear hearing protection. There are free smart phone apps such as, deciBel that measure noise levels easily and can be used to show approximate noise levels. It must be recognized that a smart phone is not a professionally calibrated sound measuring instrument, therefore results will vary. Noise source examples can be found in SWP 36 Hearing Conservation Program.

Vibration

Human vibration is the effect of mechanical vibration on the human body. Different parts of the body are sensitive to different frequencies. The human body is a strongly damped system, so it tends to resonate over a range of frequencies rather than a single frequency.

There are two main types of human vibration: *whole-body vibration*, transmitted from a vibrating surface on which a person stands or sits, and *hand-arm vibration*, transmitted through vibrating objects such as hand tools. These are mechanically different and are assessed separately.

Working in the Dark

Working in the dark can make working conditions more difficult. Insufficient lighting can cause impaired vision and can ultimately cause the employee to be at risk of a hazard.

B - Risk Assessment and Management

Noise

Refer to SWP 36 - Hearing Conservation Program for more information on measurement, threshold limits, and equipment.

Vibration

Vibration exposure limits

An employer must ensure, to the extent practicable, that workers are not exposed to vibration in excess of the limits specified in:

(a) For hand-arm vibration - ISO Standard 5349-1:2001, Mechanical Vibration - Measurement and Evaluation of Human Exposure to Hand-transmitted Vibration - Part 1: General Requirements.
(b) For hand-arm vibration - ISO Standard 5349-2:2001, Mechanical Vibration - Measurement and Evaluation of Human Exposure to Hand-transmitted Vibration - Part 2: Practical Guidance for Measurement at the Workplace.
(c) Whole body vibrations - Documentation from the Threshold Limit Values for Physical Agents – TLV's and BELs American Conference of Governmental Industrial Hygienists.
(d) Whole body vibrations - ISO 2631-1-1997, Mechanical Vibration and Shock - Evaluation of Human Exposure to the Whole Body Vibration - Part 1: General Requirements.

Any evaluations of hand-arm and whole-body vibration must be conducted by the employer in accordance with the standards and regulations above.

If workers are exposed to undue vibration, the following should be done:

- Maintain machines in proper working order. Unbalanced rotating parts or unsharpened cutting tools can give off excessive vibration.
- Arrange work tasks so vibrating and non-vibrating tools can be used alternately.
- Restrict the hours a worker uses a vibrating tool during the workday. Allow employees to take 10 to 15 minute break from the source of the vibration every hour.
- Train workers about the hazards of working with vibrating tools. Instruction should include the sources of vibration exposure, early signs, and symptoms of hand-arm vibration syndrome and work practices for minimizing vibration exposure.
- Instruct workers to keep their hands warm and dry and to not grip a vibrating tool too tightly. Workers should allow the tool or machine to do the work.

Working in the Dark

Insufficient lighting may make working conditions difficult and can be resolved by the following:

- Post reflective signs at/around hazards.
- Carry devices (radios or other means) to communicate with other teams and with emergency personnel.
- Devise an emergency evacuation plan.
- Provide additional lighting when working with powered equipment to prevent exposure to additional hazards (i.e. boom contact with aerial wires).
- Wear reflective vests, arm and leg bands.
- Be familiar with the work area in the daylight.
- Work in teams of at least two people.
- If necessary, wear a personal audible alarm.

- Be familiar with other hazards in the area (i.e. confined space, construction, water, rail lines, ice, wilderness, etc.). Refer to SWP 26 Working Alone for additional information.
- Pay attention to the signs of exhaustion and fatigue and stop working.

C – Training and Competency

Only persons trained and experienced in acoustic and vibration measurement and protection should carry out assessments and design protective interventions.

D - Equipment and Personal Protective Equipment

Noise
Refer to SWP 36 - Hearing Conservation Program for more information.

Working in the Dark
High visibility vests and reflective arm and leg bands should be worn during dusk, dawn, and dark working situations. Miner headlights may also be worn on hard hats to increase visibility when working in dark situations.

E - Documentation

The Canadian Centre for Occupational Health and Safety: Vibration -
http://www.ccohs.ca/oshanswers/phys_agents/vibration/vibration_intro.html

American Conference of Governmental Industrial Hygienists Threshold Limit Values and Biological Exposure Indices publication for whole body vibrations.

ISO Standard 5349 – 1 & 2:2001 - Measurement and evaluation of human exposure to hand-transmitted vibration.

Section 4

Tailgate Health & Safety Meeting Form

Form D.7 Tailgate Meeting/Field Level Hazard Assessment

PROJECT INFORMATION	
Site Activity Supervisor Name:	Date:
Project Name and Number:	

The objective of this process is to aid awareness of the hazards associated with the tasks to be completed today and to identify the safest way to complete those tasks. This form does not take the place of the Hazard Assessment & Health & Safety Plan Form D1. This form must be completed daily & updated as site change throughout the day as required.

GENERAL SAFETY CHECKLIST			
Health and Safety Plan Review ☐	PPE for All Staff ☐	MSDS ☐	Scan Area for New Hazards ☐
Emergency Response Plan Includes: Escape Route, Muster Point ☐	First Aid Kit & Fire Extinguisher ☐	Utility Locates ☐	Traffic Control ☐

PERSONAL PROTECTIVE EQUIPMENT		
PPE Required:		
High Visibility Vest ☐	Work Gloves ☐	Safety footwear ☐
Safety Glasses ☐	Hard Hat ☐	Other ☐

Confirm all PPE used on this project is:	YES	NO
Inspected for damage by employee before use	☐	☐
Worn correctly by all employees	☐	☐

FIELD LEVEL HAZARD ASSESSMENT

Priority Ranking System is a method for field staff to minimize or eliminate potential injuries by enabling them to recognize, assess and control risks.

Severity Index:		Probability Index:	
1	Extreme Danger (death/disaster)	A	Probable (imminent/soon/without controls in place)
2	Serious Danger (major injury)	B	Potential (eventual incident without controls in place)
3	Minor Danger (first aid injury/minor)	C	Remote (unlikely, but possible without controls in place)

Task(s) of the Day	Identify Potential Hazards (what could foreseeably go wrong?)	Ranking	What controls are being used to reduce the identified risk?

*Use additional sheets as necessary

Form D.7 Tailgate Meeting/Field Level Hazard Assessment

Additional Notes/Observations/Safety Issues (i.e. known near misses/incidents associated with the work & prevention measures put in place):

Important Note:
Immediately contact the project manager of all new hazards not indicated on the H&S plan, safety issues that cannot be resolved or if an incident/accident has occurred while working on-site. Ensure all new hazards are documented and communicated to the project manager, so appropriate action is taken.

Signatures				
Name	Signature	Company	Date	Renewal
				☐
				☐
				☐
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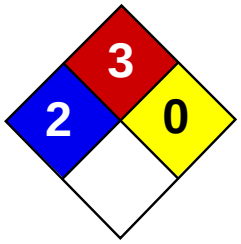
*Use additional sheets as necessary

Section 5
MSDS



Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Toluene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Toluene

Catalog Codes: SLT2857, SLT3277

CAS#: 108-88-3

RTECS: XS5250000

TSCA: TSCA 8(b) inventory: Toluene

CI#: Not available.

Synonym: Toluol, Tolu-Sol; Methylbenzene; Methacide; Phenylmethane; Methylbenzol

Chemical Name: Toluene

Chemical Formula: C6-H5-CH3 or C7-H8

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Toluene	108-88-3	100

Toxicological Data on Ingredients: Toluene: ORAL (LD50): Acute: 636 mg/kg [Rat]. DERMAL (LD50): Acute: 14100 mg/kg [Rabbit]. VAPOR (LC50): Acute: 49000 mg/m 4 hours [Rat]. 440 ppm 24 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator).

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to blood, kidneys, the nervous system, liver, brain, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 480°C (896°F)

Flash Points: CLOSED CUP: 4.4444°C (40°F). (Setaflash) OPEN CUP: 16°C (60.8°F).

Flammable Limits: LOWER: 1.1% UPPER: 7.1%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances:
Flammable in presence of open flames and sparks, of heat. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable liquid, insoluble in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray or fog.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards:
Toluene forms explosive reaction with 1,3-dichloro-5,5-dimethyl-2,4-imidazolididione; dinitrogen tetraoxide; concentrated nitric acid, sulfuric acid + nitric acid; N2O4; AgClO4; BrF3; Uranium hexafluoride; sulfur dichloride. Also forms an explosive mixture with tetranitromethane.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Toxic flammable liquid, insoluble or very slightly soluble in water. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 200 STEL: 500 CEIL: 300 (ppm) from OSHA (PEL) [United States] TWA: 50 (ppm) from ACGIH (TLV) [United States] SKIN TWA: 100 STEL: 150 from NIOSH [United States] TWA: 375 STEL: 560 (mg/m3) from NIOSH [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Sweet, pungent, Benzene-like.

Taste: Not available.

Molecular Weight: 92.14 g/mole

Color: Colorless.

pH (1% soln/water): Not applicable.

Boiling Point: 110.6°C (231.1°F)

Melting Point: -95°C (-139°F)

Critical Temperature: 318.6°C (605.5°F)

Specific Gravity: 0.8636 (Water = 1)

Vapor Pressure: 3.8 kPa (@ 25°C)

Vapor Density: 3.1 (Air = 1)

Volatility: Not available.

Odor Threshold: 1.6 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 2.7

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether, acetone.

Solubility:
Soluble in diethyl ether, acetone. Practically insoluble in cold water. Soluble in ethanol, benzene, chloroform, glacial acetic acid, carbon disulfide. Solubility in water: 0.561 g/l @ 25 deg. C.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources (flames, sparks, static), incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Incompatible with strong oxidizers, silver perchlorate, sodium difluoride, Tetranitromethane, Uranium Hexafluoride. Frozen Bromine Trifluoride reacts violently with Toluene at -80 deg. C. Reacts chemically with nitrogen oxides, or halogens to form nitrotoluene, nitrobenzene, and nitrophenol and halogenated products, respectively.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 636 mg/kg [Rat]. Acute dermal toxicity (LD50): 14100 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 440 24 hours [Mouse].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC. May cause damage to the following organs: blood, kidneys, the nervous system, liver, brain, central nervous system (CNS).

Other Toxic Effects on Humans:
Hazardous in case of skin contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator).

Special Remarks on Toxicity to Animals:
Lowest Published Lethal Dose: LDL [Human] - Route: Oral; Dose: 50 mg/kg LCL [Rabbit] - Route: Inhalation; Dose: 55000 ppm/40min

Special Remarks on Chronic Effects on Humans:
Detected in maternal milk in human. Passes through the placental barrier in human. Embryotoxic and/or foetotoxic in animal. May cause adverse reproductive effects and birth defects (teratogenic). May affect genetic material (mutagenic)

Special Remarks on other Toxic Effects on Humans:

Acute Potential Health Effects: Skin: Causes mild to moderate skin irritation. It can be absorbed to some extent through the skin. Eyes: Cauess mild to moderate eye irritation with a burning sensation. Splash contact with eyes also causes conjunctivitis, blepharospasm, corneal edema, corneal abraisons. This usually resolves in 2 days. Inhalation: Inhalation of vapor may cause respiratory tract irritation causing coughing and wheezing, and nasal discharge. Inhalation of high concentrations may affect behavior and cause central nervous system effects characterized by nausea, headache, dizziness, tremors, restlessness, lightheadedness, exhilaration, memory loss, insomnia, impaired reaction time, drowsiness, ataxia, hallucinations, somnolence, muscle contraction or spasticity, unconsciousness and coma. Inhalation of high concentration of vapor may also affect the cardiovascular system (rapid heart beat, heart palpitations, increased or decreased blood pressure, dysrhythmia,), respiration (acute pulmonary edema, respiratory depression, apnea, asphyxia), cause vision disturbances and dilated pupils, and cause loss of appetite. Ingestion: Aspiration hazard. Aspiration of Toluene into the lungs may cause chemical pneumonitis. May cause irritation of the digestive tract with nausea, vomiting, pain. May have effects similar to that of acute inhalation. Chronic Potential Health Effects: Inhalation and Ingestion: Prolonged or repeated exposure via inhalation may cause central nervous system and cardiovascular symptoms similar to that of acute inhalation and ingestion as well liver damage/failure, kidney damage/failure (with hematuria, proteinuria, oliguria, renal tubular acidosis), brain damage, weight loss, blood (pigmented or nucleated red blood cells, changes in white blood cell count), bone marrow changes, electrolyte imbalances (Hypokalemia, Hypophostatemia), severe, muscle weakness and Rhabdomyolysis. Skin: Repeated or prolonged skin contact may cause defatting dermatitis.

Section 12: Ecological Information

Ecotoxicity:
Ecotoxicity in water (LC50): 313 mg/l 48 hours [Daphnia (daphnia)]. 17 mg/l 24 hours [Fish (Blue Gill)]. 13 mg/l 96 hours [Fish (Blue Gill)]. 56 mg/l 24 hours [Fish (Fathead minnow)]. 34 mg/l 96 hours [Fish (Fathead minnow)]. 56.8 ppm any hours [Fish (Goldfish)].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Toluene UNNA: 1294 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Toluene California prop. 65 (no significant risk level): Toluene: 7 mg/day (value) California prop. 65 (acceptable daily intake level): Toluene: 7 mg/day (value) California prop. 65: This product contains the following ingredients for which the State of California has found to cause birth defects which would require a warning under the statute: Toluene Connecticut hazardous material survey.: Toluene Illinois

toxic substances disclosure to employee act: Toluene Illinois chemical safety act: Toluene New York release reporting list: Toluene Rhode Island RTK hazardous substances: Toluene Pennsylvania RTK: Toluene Florida: Toluene Minnesota: Toluene Michigan critical material: Toluene Massachusetts RTK: Toluene Massachusetts spill list: Toluene New Jersey: Toluene New Jersey spill list: Toluene Louisiana spill reporting: Toluene California Director's List of Hazardous Substances.: Toluene TSCA 8(b) inventory: Toluene TSCA 8(d) H and S data reporting: Toluene: Effective date: 10/04/82; Sunset Date: 10/0/92 SARA 313 toxic chemical notification and release reporting: Toluene CERCLA: Hazardous substances.: Toluene: 1000 lbs. (453.6 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R11- Highly flammable. R20- Harmful by inhalation. S16- Keep away from sources of ignition - No smoking. S25- Avoid contact with eyes. S29- Do not empty into drains. S33- Take precautionary measures against static discharges.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:30 PM

Last Updated: 05/21/2013 12:00 PM

Material Safety Data Sheet

Carbon tetrachloride

MSDS# 90116

Section 1 - Chemical Product and Company Identification

MSDS Name:	Carbon tetrachloride
Catalog Numbers:	AC148170000, AC148170250, AC167720000, AC167720010, AC167720025, AC167720100 AC167720100, AC167721000, AC258530000, AC269370000, AC269370010, AC269371000 AC269371000, AC326580000, AC326580010, AC326580025, AC600220000, AC600220010 AC600220010, AC600220025, AC600230000, AC600230010, AC600230025, 14817-0010, 14817-0025, 16772-5000, 25853-0010, 25853-0025, C1874, C1994, NC9267677, NC9472507, NC9835532
Synonyms:	Tetrachloromethane; Carbon tet; Carbona; Carbon chloride; Methane tetrachloride.

Company Identification:	Fisher Scientific One Reagent Lane Fair Lawn, NJ 07410
For information in the US, call:	201-796-7100
Emergency Number US:	201-796-7100
CHEMTREC Phone Number, US:	800-424-9300

Section 2 - Composition, Information on Ingredients

CAS#:	56-23-5
Chemical Name:	Carbon tetrachloride
%:	99-100
EINECS#:	200-262-8

Hazard Symbols: T N

Risk Phrases: 23/24/25 40 48/23 52/53 59

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Danger! Cancer suspect agent. Aspiration hazard if swallowed. Can enter lungs and cause damage. May cause central nervous system effects. May cause liver and kidney damage. May be fatal if inhaled, absorbed through the skin or swallowed. Marine pollutant. This is a CFC substance which destroys ozone in the upper atmosphere. Destruction of the ozone layer can lead to increased ultraviolet radiation which, with excess exposure to sunlight, can lead to an increase in skin cancer and eye cataracts. Causes eye, skin, and respiratory tract irritation. Target Organs: Kidneys, central nervous system, liver.

Potential Health Effects

Eye:	Causes eye irritation. Vapors cause eye irritation.
Skin:	Causes skin irritation. May be absorbed through the skin in harmful amounts. Contact with the skin defats the skin.
Ingestion:	May cause liver and kidney damage. May cause central nervous system depression, characterized by excitement, followed by headache, dizziness, drowsiness, and nausea. Advanced stages may cause collapse, unconsciousness, coma and possible death due to respiratory failure. Substance is a hepatotoxin and is capable of producing a toxic effect on the liver.
Inhalation:	Causes respiratory tract irritation. May cause liver and kidney damage. Exposure produces central nervous

system depression. May be harmful if inhaled.

Chronic: Prolonged or repeated skin contact may cause dermatitis. Chronic ingestion may cause effects similar to those of acute ingestion. May cause liver and kidney damage. May cause cancer according to animal studies. Chronic exposure may cause visual disturbances. Carbon tetrachloride is a CNS depressant.

Section 4 - First Aid Measures

Eyes: In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical aid.

Skin: In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid immediately. Wash clothing before reuse.

Ingestion: Potential for aspiration if swallowed. Get medical aid immediately. Do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If vomiting occurs naturally, have victim lean forward.

Inhalation: POISON material. If inhaled, get medical aid immediately. Remove victim to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.

Notes to Physician:

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Material will not burn. Use water spray to keep fire-exposed containers cool. Containers may explode in the heat of a fire. Non-combustible, substance itself does not burn but may decompose upon heating to produce corrosive and/or toxic fumes.

Extinguishing Media: Use extinguishing media most appropriate for the surrounding fire.

Autoignition Temperature: > 982 deg C (> 1,799.60 deg F)

Flash Point: Not applicable.

Explosion Limits: Lower: Not available

Explosion Limits: Upper: Not available

NFPA Rating: health: 3; flammability: 0; instability: 0;

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks: Absorb spill with inert material (e.g. vermiculite, sand or earth), then place in suitable container. Avoid runoff into storm sewers and ditches which lead to waterways. Clean up spills immediately, observing precautions in the Protective Equipment section. Isolate area and deny entry. Provide ventilation.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Avoid contact with eyes, skin, and clothing. Keep container tightly closed. Do not breathe vapor. Use only with adequate ventilation.

Storage: Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances.

Section 8 - Exposure Controls, Personal Protection

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Carbon tetrachloride	5 ppm; 10 ppm STEL; Skin - potential significant contribution to overall exposure by the cutaneous r oute	200 ppm IDLH	10 ppm TWA; 25 ppm Ceiling

OSHA Vacated PELs: Carbon tetrachloride: 2 ppm TWA; 12.6 mg/m3 TWA

Engineering Controls:

Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits. Use only under a chemical fume hood.

Exposure Limits

Personal Protective Equipment

Eyes:	Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin:	Wear appropriate protective gloves to prevent skin exposure.
Clothing:	Wear appropriate protective clothing to prevent skin exposure.
Respirators:	Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Section 9 - Physical and Chemical Properties

Physical State:	Liquid
Color:	clear, colorless
Odor:	chloroform-like
pH:	Not available
Vapor Pressure:	91 mm Hg @ 20 deg C
Vapor Density:	5.31 (air=1)
Evaporation Rate:	12.8 (butyl acetate=1)
Viscosity:	0.97 PAS 20 deg C
Boiling Point:	76 deg C @ 760 mm Hg (168.80°F)
Freezing/Melting Point:	-23 deg C (-9.40°F)
Decomposition Temperature:	
Solubility in water:	Insoluble
Specific Gravity/Density:	1.5900 g/cm3
Molecular Formula:	CCl4
Molecular Weight:	153.82

Section 10 - Stability and Reactivity

Chemical Stability:	Stable under normal temperatures and pressures.
Conditions to Avoid:	Light, excess heat.
Incompatibilities with Other Materials	Alkali metals, fluorine, powered beryllium, powdered aluminum, allyl alcohol, barium, powdered magnesium, decaborane, potassium tert-butoxide, zinc powder, ethylene, dimethylformamide.
Hazardous Decomposition Products	Hydrogen chloride, chlorine, phosgene, carbon monoxide, carbon dioxide, chlorine dioxide, which may be spontaneously explosive.
Hazardous Polymerization	Will not occur.

Section 11 - Toxicological Information

RTECS#:	CAS# 56-23-5: FG4900000
LD50/LC50:	RTECS: **CAS# 56-23-5:** Dermal, guinea pig: LD50 = >9400 uL/kg; Draize test, rabbit, eye: 2200 ug/30S Mild; Draize test, rabbit, eye: 500 mg/24H Mild; Draize test, rabbit, skin: 4 mg Mild; Draize test, rabbit, skin: 500 mg/24H Mild; Inhalation, mouse: LC50 = 9526 ppm/8H; Inhalation, mouse: LC50 = 34500 mg/m3/2H; Inhalation, rat: LC50 = 8000 ppm/4H; Inhalation, rat: LC50 = 46000 mg/m3/6H; Oral, mouse: LD50 = 7749 mg/kg; Oral, rabbit: LD50 = 5760 mg/kg;

Oral, rat: LD50 = 2350 mg/kg;
Skin, rabbit: LD50 = >20 gm/kg;
Skin, rat: LD50 = 5070 mg/kg;
.
Other: Carbon tetrachloride is harmful to the liver and a CNS depressant following short-term inhalation, skin contact or ingestion. The liver effects have been observed at concentrations lower than those required to produce CNS effects. Two reviews indicate that ingestion of 14-20 ml or 50-150 ml could be fatal. Although, 1.5 ml (34 mg/kg) has caused death in a few cases.

Carcinogenicity: Carbon tetrachloride - ACGIH: A2 - Suspected Human Carcinogen California: carcinogen, initial date 10/1/87 NTP: Suspect carcinogen IARC: Group 2B carcinogen

Other: See actual entry in RTECS for complete information.

Section 12 - Ecological Information

Ecotoxicity:
Fish: Fathead Minnow: LC50 = 20.8-41.4 mg/L; 96 Hr.; Flow-through; 21.7 degrees C
Fish: Bluegill/Sunfish: LC50 = 27-125 mg/L; 96 Hr.; Static Conditions; 23 degrees C
Bacteria: Phytobacterium phosphoreum: EC50 = 6.0 mg/L; Not available; Microtox test
Bacteria: Phytobacterium phosphoreum: EC50 = 33.0 mg/L; 30 minutes; Microtox test

Section 13 - Disposal Considerations

Dispose of in a manner consistent with federal, state, and local regulations.

Section 14 - Transport Information

US DOT
Shipping Name: CARBON TETRACHLORIDE
Hazard Class: 6.1
UN Number: UN1846
Packing Group: II
Canada TDG
Shipping Name: CARBON TETRACHLORIDE
Hazard Class: 6.192
UN Number: UN1846
Packing Group: II

USA RQ: CAS# 56-23-5: 10 lb final RQ; 4.54 kg final RQ

Section 15 - Regulatory Information

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols: T N

Risk Phrases:

R 23/24/25 Toxic by inhalation, in contact with skin and if swallowed.

R 40 Limited evidence of a carcinogenic effect.

R 48/23 Toxic : danger of serious damage to health by prolonged exposure through inhalation.

R 52/53 Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

R 59 Dangerous for the ozone layer.

Safety Phrases:

S 23 Do not inhale gas/fumes/vapour/spray.

S 36/37 Wear suitable protective clothing and gloves.

S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

S 59 Refer to manufacturer/supplier for information on recovery/recycling.

S 61 Avoid release to the environment. Refer to special instructions/safety data sheets.

WGK (Water Danger/Protection)

CAS# 56-23-5: 3

Canada

CAS# 56-23-5 is listed on Canada's DSL List

Canadian WHMIS Classifications: D2A, D1A

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.

CAS# 56-23-5 is listed on Canada's Ingredient Disclosure List

US Federal

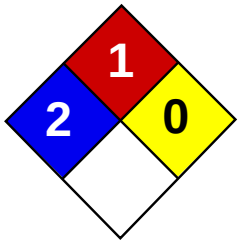
TSCA

CAS# 56-23-5 is listed on the TSCA Inventory.

Section 16 - Other Information

MSDS Creation Date: 7/20/1999

Revision #8 Date 7/20/2009



Health	2
Fire	1
Reactivity	0
Personal Protection	E

Material Safety Data Sheet
Copper MSDS

Section 1: Chemical Product and Company Identification

Product Name: Copper

Catalog Codes: SLC4939, SLC2152, SLC3943, SLC1150, SLC2941, SLC4729, SLC1936, SLC3727, SLC5515

CAS#: 7440-50-8

RTECS: GL5325000

TSCA: TSCA 8(b) inventory: Copper

CI#: Not available.

Synonym:

Chemical Name: Not available.

Chemical Formula: Cu

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Copper	7440-50-8	100

Toxicological Data on Ingredients: Copper LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of ingestion. Hazardous in case of eye contact (irritant), of inhalation. Slightly hazardous in case of skin contact (irritant).

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to lungs, mucous membranes. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact: Check for and remove any contact lenses. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact: Not available.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation: Not available.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances: Not available.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not breathe dust. Avoid contact with eyes Wear suitable protective clothing In case of insufficient ventilation, wear suitable respiratory equipment If you feel unwell, seek medical attention and show the label when possible.

Storage:
Keep container dry. Keep in a cool place. Ground all equipment containing material. Keep container tightly closed. Keep in a cool, well-ventilated place. Combustible materials should be stored away from extreme heat and away from strong oxidizing agents.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 1 (mg/m3) from ACGIH [1990] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid.

Odor: Not available.

Taste: Not available.

Molecular Weight: 63.54 g/mole

Color: Not available.

pH (1% soln/water): Not applicable.

Boiling Point: 2595°C (4703°F)

Melting Point: 1083°C (1981.4°F)

Critical Temperature: Not available.

Specific Gravity: 8.94 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available. LC50: Not available.

Chronic Effects on Humans: The substance is toxic to lungs, mucous membranes.

Other Toxic Effects on Humans:
Very hazardous in case of ingestion. Hazardous in case of inhalation. Slightly hazardous in case of skin contact (irritant).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Human: passes through the placenta, excreted in maternal milk.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are as toxic as the original product.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: Copper Massachusetts RTK: Copper TSCA 8(b) inventory: Copper CERCLA: Hazardous substances.: Copper

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada): CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC): R36- Irritating to eyes.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 1

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 1

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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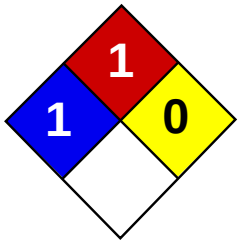
Last Updated: 05/21/2013 12:00 PM



Health	1
Fire	1
Reactivity	0
Personal Protection	B

Material Safety Data Sheet
Tin MSDS

Section 1: Chemical Product and Company Identification

Product Name: Tin

Catalog Codes: SLT3304, SLT1291, SLT2584, SLT3880

CAS#: 7440-31-5

RTECS: XP7320000

TSCA: TSCA 8(b) inventory: Tin

CI#: Not available.

Synonym:

Chemical Name: Tin

Chemical Formula: Sn

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Tin	7440-31-5	100

Toxicological Data on Ingredients: Not applicable.

Section 3: Hazards Identification

Potential Acute Health Effects: Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. Repeated or prolonged exposure is not known to aggravate medical condition.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances:
Slightly flammable to flammable in presence of open flames and sparks, of heat. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards:
When heated in Chlorine, Tin reacts, producing light and much heat. In the presence of water, cupric nitrate and tin foil, on prolonged intimate contact, will produce flaming and sparking. Sodium peroxide and Potassium peroxide, potassium dioxide, oxidize tin with incandescence. The reaction between tin and tellurium attains incandescence.

Special Remarks on Explosion Hazards:
Tin reacts violently or explosively with fused ammonium nitrate below 200 deg. C. Contact of metallic tin with turpentine may cause fires and explosions.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:

Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not breathe dust. Keep away from incompatibles such as oxidizing agents, acids, alkalis.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 25°C (77°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Gloves (impervious).

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Boots. Gloves. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 2 (mg/m3) from OSHA (PEL) [United States] TWA: 2 (mg/m3) from ACGIH (TLV) [United States] TWA: 2 (mg/m3) from NIOSH TWA: 2 STEL: 4 (mg/m3) [Canada]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid.

Odor: Odorless.

Taste: Not available.

Molecular Weight: 118.71 g/mole

Color: Silver-white Grey.

pH (1% soln/water): Not applicable.

Boiling Point: 2507°C (4544.6°F)

Melting Point: 231.9°C (449.4°F)

Critical Temperature: Not available.

Specific Gravity: 7.31 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Excess heat, incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, acids, alkalis.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Incompatible with bromine, bromine trifluoride, Chlorine, Chlorine trifluoride + Carbon, water + Cupric Nitrate, Sodium peroxide, water vapor + Carbon Tetrachloride, Disulfur Dichloride, fused Ammonium Nitrate, Potassium dioxide, Tellurium, Turpentine, Acids (Nitric acid, Sulfuric Acid, Hydrochloric Acid, Acetic Acid), caustic Alkali, IOdine Bromide. In the presence of water vapor, the interaction between tin and carbon tetrachloride is violent. The interaction between tin and disulfur dichloride is violent. Tin reacts violently with Iodine Bromide

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Ingestion.

Toxicity to Animals:
LD50: Not available. LC50: Not available.

Chronic Effects on Humans: Not available.

Other Toxic Effects on Humans: Slightly hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: May cause skin irritation. Eyes: May cause eye irritation to due mechanical action. Inhalation: Inhalation of tin dust may cause respiratory tract and mucous membrane tract irritation due to mechanical action Ingestion: It is poorly absorbed from the digestive tract. It can cause gastrointestinal tract disturbances which may be from irritant or astringent action on the stomach.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport:
Transportation information for Tin Metal Powder: Metal Powder, Flammable, n.o.s. (Tin Metal, Powder), Class 4.1, Flammable Solid, UN3089, PGIII

Section 15: Other Regulatory Information

Federal and State Regulations:
Rhode Island RTK hazardous substances: Tin Pennsylvania RTK: Tin Massachusetts RTK: Tin New Jersey: Tin California Director's List of Hazardous Substances: Tin TSCA 8(b) inventory: Tin

Other Regulations: EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): Not controlled under WHMIS (Canada).

DSCL (EEC):
This product is not classified according to the EU regulations. Not applicable.

HMIS (U.S.A.):

Health Hazard: 1

Fire Hazard: 1

Reactivity: 0

Personal Protection: B

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 1

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves (impervious). Lab coat. Not applicable. Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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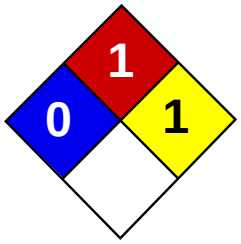
Last Updated: 05/21/2013 12:00 PM



Health	1
Fire	1
Reactivity	1
Personal Protection	E

Material Safety Data Sheet
Zinc Metal MSDS

Section 1: Chemical Product and Company Identification

Product Name: Zinc Metal

Catalog Codes: SLZ1054, SLZ1159, SLZ1267, SLZ1099, SLZ1204

CAS#: 7440-66-6

RTECS: ZG8600000

TSCA: TSCA 8(b) inventory: Zinc Metal

CI#: Not applicable.

Synonym: Zinc Metal Sheets; Zinc Metal Shot; Zinc Metal Strips

Chemical Name: Zinc Metal

Chemical Formula: Zn

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Zinc Metal	7440-66-6	100

Toxicological Data on Ingredients: Zinc Metal LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects: Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. Repeated or prolonged exposure is not known to aggravate medical condition.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 480°C (896°F)

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances:
Slightly flammable to flammable in presence of open flames and sparks, of heat, of oxidizing materials, of acids, of alkalis, of moisture. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable solid. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards:
Zinc + NaOH causes ignition. Oxidation of zinc by potassium proceeds with incandescence. Residues from zinc dust /acetic acid reduction operations may ignite after long delay if discarded into waste bins with paper. Incandescent reaction when Zinc and Arsenic or Tellurium, or Selenium are combined. When hydrazine mononitrate is heated in contact with zinc, a flamming decomposition occurs at temperatures a little above its melting point. Contact with acids and alkali hydroxides (sodium hydroxide, postasium hydroxide, calcium hydroxide, etc.) results in evolution of hydrogen with sufficient heat of reaction to ignite the hydrogen gas. Zinc foil ignites if traces of moisture are present. It is water reactive and produces flammable gases on contact with water. It may ignite on contact with water or moist air.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Flammable solid that, in contact with water, emits flammable gases. Stop leak if without risk. Do not get water inside container. Do not touch spilled material. Cover with dry earth, sand or other non-combustible material. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not breathe dust. Keep away from incompatibles such as oxidizing agents, acids, alkalis, moisture.

Storage:
Keep container tightly closed. Keep container in a cool, well-ventilated area. Keep from any possible contact with water. Do not allow water to get into container because of violent reaction.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Lustrous solid. Metal solid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 65.39 g/mole

Color: Bluish-grey

pH (1% soln/water): Not applicable.

Boiling Point: 907°C (1664.6°F)

Melting Point: 419°C (786.2°F)

Critical Temperature: Not available.

Specific Gravity: Not available.

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water, hot water, methanol, diethyl ether, n-octanol, acetone.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Excess heat, incompatible materials, moisture

Incompatibility with various substances:
Reactive with oxidizing agents, acids, alkalis. Slightly reactive to reactive with moisture. The product may react violently with water to emit flammable but non toxic gases.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Incompatible with acids, halogenated hydrocarbons, NH_4NO_3, barium oxide, $Ba(NO_3)_2$, Cadmium, CS_2, chlorates, Cl_2, CrO_3, F_2, Hydroxylamine, $Pb(N_3)_2$, $MnCl_2$, HNO_3, performic acid, $KClO_3$, KNO_3, N_2O_2, Selenium, $NaClO_3$, Na_2O_2, Sulfur, Te, water, $(NH_4)_2S$, As_2O_3, CS_2, $CaCl_2$, chlorinated rubber, catalytic metals, halocarbons, o-nitroanisole, nitrobenzene, nonmetals, oxidants, paint primer base, pentacarbonoyliron, transition metal halides, seleninyl bromide, HCl, H_2SO_4, (Mg +$Ba(NO_3)_2$ +BaO_2), (ethyl acetoacetate +tribromoneopentyl alcohol. Contact with Alkali Hydroxides(Sodium Hydroxide, Potassium Hydroxide, Calcium Hydroxide, etc) results in evolution of hydrogen. Ammonium nitrate + zinc + water causes a violent reaction with evolution of steam and zinc oxide. May react with water.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available. LC50: Not available.

Chronic Effects on Humans: Not available.

Other Toxic Effects on Humans: Slightly hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: May cause skin irritation. Dermal exposure to zinc may produce leg pains, fatigue, anorexia and weight loss. Eyes: May cause eye irritation. Ingestion: May be harmul if swallowed. May cause digestive tract irritation with tightness in throat, nausea, vomiting, diarrhea, loss of appetite, malaise, abdominal pain. fever, and chills. May affect behavior/central nervous system and autonomic nervous system with ataxia, lethargy, staggering gait, mild derrangement in cerebellar function, lightheadness, dizzness, irritability, muscular stiffness, and pain. May also affect blood. Inhalation: Inhalation of zinc dust or fumes may cause respiratory tract and mucous membrane irritation with cough and chest pain. It can also cause "metal fume fever", a flu-like condition characterized appearance of chills, headached fever, maliase, fatigue, sweating, extreme thirst, aches in the legs and chest, and difficulty in breathing. A sweet taste may also be be present in metal fume fever, as well as a dry throat, aches, nausea, and vomiting, and pale grey cyanosis. The toxicological properties of this substance have not been fully investisgated.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: Not available.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:
New York release reporting list: Zinc Metal Rhode Island RTK hazardous substances: Zinc Metal Pennsylvania RTK: Zinc Metal Florida: Zinc Metal Michigan critical material: Zinc Metal Massachusetts RTK: Zinc Metal New Jersey: Zinc Metal California Director's List of Hazardous Substances: Zinc Metal TSCA 8(b) inventory: Zinc Metal TSCA 12(b) one time export: Zinc Metal SARA 313 toxic chemical notification and release reporting: Zinc Metal CERCLA: Hazardous substances.: Zinc Metal: 1000 lbs. (453.6 kg)

Other Regulations: EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): Not Available

DSCL (EEC):
R15- Contact with water liberates extremely flammable gases. R17- Spontaneously flammable in air. S7/8- Keep container tightly closed and dry.

HMIS (U.S.A.):

Health Hazard: 1

Fire Hazard: 1

Reactivity: 1

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 0

Flammability: 1

Reactivity: 1

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 12:18 AM

Last Updated: 05/21/2013 12:00 PM

SAFETY DATA SHEET

according to the Global Harmonized System (and with all of the information required by the CPR)

Date of issue: 05/05/2014 Version 1.0

SECTION 1.Identification

Product identifier

Product number	MX0486
Product name	Methanol LC-MS Grade For Liquid Chromatography- Mass Spectrometry OmniSolv®
Synonyms	MeOH
CAS-No.	67-56-1

Relevant identified uses of the substance or mixture and uses advised against

Identified uses	Reagent for analysis

Details of the supplier of the safety data sheet

Company	EMD Millipore Corporation | 290 Concord Road, Billerica, MA 01821, United States of America | General Inquiries: +1-978-715-4321 | Monday to Friday, 9:00 AM to 4:00 PM Eastern Time (GMT-5)
Emergency telephone	800-424-9300 CHEMTREC (USA) +1-703-527-3887 CHEMTREC (International) 24 Hours/day; 7 Days/week

SECTION 2. Hazards identification

GHS Classification

Flammable liquid, Category 2, H225
Acute toxicity, Category 3, Oral, H301
Acute toxicity, Category 3, Inhalation, H331
Acute toxicity, Category 3, Dermal, H311
Specific target organ systemic toxicity - single exposure, Category 1, Eyes, H370

For the full text of the H-Statements mentioned in this Section, see Section 16.

GHS-Labeling

Hazard pictograms

Signal Word
Danger

Hazard Statements
H225 Highly flammable liquid and vapor.
H301 + H311 + H331 Toxic if swallowed, in contact with skin or if inhaled.
H370 Causes damage to organs (Eyes).

Precautionary Statements
P210 Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P233 Keep container tightly closed.
P280 Wear protective gloves/ protective clothing.
P302 + P352 IF ON SKIN: Wash with plenty of soap and water.
P304 + P340 IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P308 + P310 IF exposed or concerned: immediately call a POISON CENTER or doctor/ physician.
P403 + P235 Store in a well-ventilated place. Keep cool.

Other hazards

None known.

SECTION 3. Composition/information on ingredients

Formula	CH_3OH	CH_4O (Hill)
Synonyms	MeOH	
Molar mass	32.04 g/mol	

Hazardous ingredients

Chemical Name (Concentration)
CAS-No.
methanol (>= 90 % - <= 100 %)
67-56-1

Exact percentages are being withheld as a trade secret.

SECTION 4. First aid measures

Description of first-aid measures

General advice
First aider needs to protect himself.

Inhalation
After inhalation: fresh air. If breathing stops: immediately apply artificial respiration, if necessary oxygen. Immediately call in physician.

Skin contact
After skin contact: wash off with plenty of water. Remove contaminated clothing. Call a physician immediately.

Eye contact
After eye contact: rinse out with plenty of water. Call in ophthalmologist.

Ingestion
After swallowing: fresh air. Make victim drink ethanol (e.g. 1 drinking glass of a 40% alcoholic beverage). Call a doctor immediately (mention methanol ingestion). Only in exceptional cases, if no medical care is available within one hour, induce vomiting (only in fully conscious persons) and make victim drink ethanol again (approx. 0.3 ml of a 40% alcoholic beverage/kg body weight/hour).

Never give anything by mouth to an unconscious person.

Most important symptoms and effects, both acute and delayed
irritant effects, Drowsiness, Dizziness, narcosis, agitation, spasms, inebriation, Nausea, Vomiting, Headache, blindness, Impairment of vision, Coma
Drying-out effect resulting in rough and chapped skin.

Indication of any immediate medical attention and special treatment needed
No information available.

SECTION 5. Fire-fighting measures

Extinguishing media
Suitable extinguishing media
Water, Carbon dioxide (CO2), Foam, Dry powder

Unsuitable extinguishing media
For this substance/mixture no limitations of extinguishing agents are given.

Special hazards arising from the substance or mixture
Combustible.
Vapors are heavier than air and may spread along floors.
Forms explosive mixtures with air at ambient temperatures.
Pay attention to flashback.
Development of hazardous combustion gases or vapors possible in the event of fire.

Advice for firefighters
Special protective equipment for fire-fighters
Stay in danger area only with self-contained breathing apparatus. Prevent skin contact by keeping a safe distance or by wearing suitable protective clothing.

Further information
Cool closed containers exposed to fire with water spray. Prevent fire extinguishing water from contaminating surface water or the ground water system.

SECTION 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures
Advice for non-emergency personnel: Do not breathe vapors, aerosols. Avoid substance contact. Keep away from heat and sources of ignition. Ensure adequate ventilation. Evacuate the danger area, observe emergency procedures, consult an expert.

Advice for emergency responders: Protective equipment see section 8.

Environmental precautions
Do not empty into drains. Risk of explosion.

Methods and materials for containment and cleaning up

Cover drains. Collect, bind, and pump off spills.
Observe possible material restrictions (see sections 7 and 10).
Take up with liquid-absorbent material (e.g. Chemizorb®). Dispose of properly. Clean up affected area.

SECTION 7. Handling and storage

Precautions for safe handling

Work under hood. Do not inhale substance/mixture. Avoid generation of vapors/aerosols.

Observe label precautions.

Advice on protection against fire and explosion
Keep away from open flames, hot surfaces and sources of ignition. Take precautionary measures against static discharge.

Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Keep away from heat and sources of ignition. Keep locked up or in an area accessible only to qualified or authorized persons.

Store at room temperature.

SECTION 8. Exposure controls/personal protection

Exposure limit(s)

Ingredients

Basis	Value	Threshold limits	Remarks
methanol 67-56-1			
CAD AB OEL	Time Weighted Average (TWA):	200 ppm 262 mg/m³	
	Short Term Exposure Limit (STEL):	250 ppm 328 mg/m³	
	Skin designation:		Can be absorbed through the skin.
CAD BC OEL	Short Term Exposure Limit (STEL):	250 ppm	
	Skin designation:		Can be absorbed through the skin.
	Time Weighted Average (TWA):	200 ppm	
CAD MB OEL	Time Weighted Average (TWA):	200 ppm	
	Short Term Exposure Limit (STEL):	250 ppm	
	Skin designation:		Can be absorbed through the skin.
CAD ON OEL	Time Weighted Average (TWAEV):	200 ppm	
	Short Term Exposure Limit (STEV):	250 ppm	
	Skin designation:		Can be absorbed through the skin.
OEL (QUE)	Time Weighted Average (TWA):	200 ppm 262 mg/m³	
	Short Term Exposure Limit (STEL):	250 ppm 328 mg/m³	
	Skin designation:		Can be absorbed through the skin.

Engineering measures

Technical measures and appropriate working operations should be given priority over the use of personal protective equipment.

Individual protection measures

Protective clothing should be selected specifically for the workplace, depending on concentration and quantity of the hazardous substances handled. The chemical resistance of the protective equipment should be inquired at the respective supplier.

Hygiene measures

Immediately change contaminated clothing. Apply skin- protective barrier cream. Wash hands and face after working with substance.

Eye/face protection

Safety glasses

Hand protection
Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.

Other protective equipment:
Flame retardant antistatic protective clothing

Respiratory protection
required when vapors/aerosols are generated.
Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

SECTION 9. Physical and chemical properties

Physical state	liquid
Color	colorless
Odor	characteristic
Odor Threshold	10 - 20000 ppm
pH	No information available.
Melting point	-98 °C
Boiling point/boiling range	148.1 °F (64.5 °C) at 1,013 hPa
Flash point	50 °F (10 °C) Method: c.c.
Evaporation rate	6.3 Reference substance: Diethyl ether 1.9 Reference substance: n-butyl acetate
Flammability (solid, gas)	No information available.
Lower explosion limit	5.5 %(V)
Upper explosion limit	44 %(V)
Vapor pressure	128 hPa at 68 °F (20 °C)
Relative vapor density	1.11

Density	0.792 g/cm³ at 68 °F (20 °C)
Relative density	No information available.
Water solubility	at 68 °F (20 °C) soluble
Partition coefficient: n-octanol/water	log Pow: -0.77 (experimental) (Lit.) Bioaccumulation is not expected.
Autoignition temperature	851 °F (455 °C)
Decomposition temperature	Distillable in an undecomposed state at normal pressure.
Viscosity, dynamic	0.597 mPa.s at 68 °F (20 °C)
Explosive properties	Not classified as explosive.
Oxidizing properties	none
Ignition temperature	851 °F (455 °C) DIN 51794
Minimum ignition energy	0.14 mJ
Conductivity	< 1 µS/cm

SECTION 10. Stability and reactivity

Reactivity

Vapors may form explosive mixture with air.

Chemical stability

The product is chemically stable under standard ambient conditions (room temperature) .

Possibility of hazardous reactions

Risk of explosion with:

Oxidizing agents, perchloric acid, perchlorates, salts of oxyhalogenic acids, chromium(VI) oxide, halogen oxides, nitrogen oxides, nonmetallic oxides, chromosulfuric acid, chlorates, hydrides, zinc diethyl, halogens, magnesium, hydrogen peroxide, Nitric acid

Exothermic reaction with:

acid halides, Acid anhydrides, Reducing agents, acids

Generates dangerous gases or fumes in contact with:

Alkaline earth metals, Alkali metals

Conditions to avoid

Warming.

Incompatible materials
various plastics, magnesium, zinc alloys

Hazardous decomposition products
no information available

SECTION 11. Toxicological information

Information on toxicological effects

Likely route of exposure
Inhalation, Eye contact, Skin contact

Acute oral toxicity
LDLO human: 143 mg/kg (RTECS)

LD50 rat: 5,628 mg/kg (IUCLID)

absorption
Symptoms: Nausea, Vomiting

Acute inhalation toxicity
LC50 rat: 85.26 mg/l; 4 h (IUCLID)

absorption
Symptoms: Irritation symptoms in the respiratory tract.

Acute dermal toxicity
LD50 rabbit: ca. 17,100 mg/kg
(External MSDS)

absorption

Skin irritation
Drying-out effect resulting in rough and chapped skin.

Eye irritation
Irritations of mucous membranes

Sensitization
Sensitization test: guinea pig
Result: negative
(IUCLID)

Genotoxicity in vivo
Mutagenicity (mammal cell test): micronucleus.
Result: negative
(IUCLID)

Genotoxicity in vitro
Ames test
Result: negative
(IUCLID)

CMR effects
Carcinogenicity:
Did not show carcinogenic effects in animal experiments.
Mutagenicity:
Regarding the available data the classification criteria are not fulfilled.
Teratogenicity:
Regarding the available data the classification criteria are not fulfilled.
Reproductive toxicity:
Regarding the available data the classification criteria are not fulfilled.

Specific target organ systemic toxicity - single exposure
Target Organs: Eyes
Causes damage to organs.

Specific target organ systemic toxicity - repeated exposure
The substance or mixture is not classified as specific target organ toxicant, repeated exposure.

Aspiration hazard
Regarding the available data the classification criteria are not fulfilled.

Carcinogenicity

IARC	No ingredient of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.
OSHA	No ingredient of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.
NTP	No ingredient of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.
ACGIH	No ingredient of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

Further information
Systemic effects:
acidosis, drop in blood pressure, agitation, spasms, inebriation, Dizziness, Drowsiness, Headache, Impairment of vision, blindness, narcosis, Coma
Symptoms may be delayed.
Damage to:
Liver, Kidney, Cardiac, Irreversible damage of the optical nerve.
Handle in accordance with good industrial hygiene and safety practice.

SECTION 12. Ecological information

Ecotoxicity

Toxicity to fish
LC50 Lepomis macrochirus (Bluegill sunfish): 15,400 mg/l; 96 h (in soft water) (ECOTOX Database)

Toxicity to daphnia and other aquatic invertebrates
EC5 E.sulcatum: > 10,000 mg/l; 72 h (Lit.)

EC50 Daphnia magna (Water flea): > 10,000 mg/l; 48 h (IUCLID)

Toxicity to algae
EC50 Pseudokirchneriella subcapitata (green algae): ca. 22,000 mg/l; 96 h (External MSDS)

IC5 Scenedesmus quadricauda (Green algae): 8,000 mg/l; 8 d (IUCLID)

Toxicity to bacteria
EC5 Pseudomonas fluorescens: 6,600 mg/l; 16 h (IUCLID)

Toxicity to fish (Chronic toxicity)
NOEC Oryzias latipes (Orange-red killifish): 7,900 mg/l; 200 h
(External MSDS)

Persistence and degradability

Biodegradability
99 %; 30 d
OECD Test Guideline 301D
Readily biodegradable.

Biochemical Oxygen Demand (BOD)
600 - 1,120 mg/g (5 d)
(IUCLID)

Chemical Oxygen Demand (COD)
1,420 mg/g
(IUCLID)

Theoretical oxygen demand (ThOD)
1,500 mg/g
(Lit.)

Ratio BOD/ThBOD
BOD5 76 %
Closed Bottle test

Bioaccumulative potential

Partition coefficient: n-octanol/water
log Pow: -0.77
(experimental)
(Lit.) Bioaccumulation is not expected.

Mobility in soil

No information available.

Other adverse effects

Surface tension
22.6 mN/m
at 68 °F (20 °C)

Stability in water
2.2 yr
reaction with hydroxyl radicals (IUCLID)

Additional ecological information
Discharge into the environment must be avoided.

SECTION 13. Disposal considerations

The information presented only applies to the material as supplied. The identification based on characteristic(s) or listing may not apply if the material has been used or otherwise contaminated. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste identification and disposal methods in compliance with applicable regulations. Disposal should be in accordance with applicable regional, national and local laws and regulations.

SECTION 14. Transport information

Land transport (DOT)

UN number	UN 1230
Proper shipping name	METHANOL
Class	3
Packing group	II
Environmentally hazardous	--

Air transport (IATA)

UN number	UN 1230
Proper shipping name	METHANOL
Class	3 (6.1)
Packing group	II
Environmentally hazardous	--
Special precautions for user	no

Sea transport (IMDG)

UN number	UN 1230
Proper shipping name	METHANOL
Class	3 (6.1)
Packing group	II
Environmentally hazardous	--
Special precautions for user	yes
EmS	F-E S-D

SECTION 15. Regulatory information

United States of America

Canada

WHMIS Classification

B2	Flammable Liquid

Flammable Liquid

This product has been classified according to the hazard criteria of the CPR and the MSDS contains all of the information required by the CPR.

Notification status

TSCA:	All components of the product are listed in the TSCA-inventory.
DSL:	All components of this product are on the Canadian DSL.

SECTION 16. Other information

Training advice

Provide adequate information, instruction and training for operators.

Full text of H-Statements referred to under sections 2 and 3.

H225	Highly flammable liquid and vapor.
H301	Toxic if swallowed.
H311	Toxic in contact with skin.
H331	Toxic if inhaled.
H370	Causes damage to organs.

Key or legend to abbreviations and acronyms used in the safety data sheet

Used abbreviations and acronyms can be looked up at www.wikipedia.org.

Date of issue: 05/05/2014

Material Safety Data Sheet

WHMIS (Pictograms)	WHMIS (Classification)	Protective Clothing	TDG (pictograms)
	B-2, D-2A, D-2B		

Section 1. Chemical Product and Company Identification

Product Name	**BENZENE**	**Code**	W117
Synonym	Benzol; aromatic hydrocarbons (C6H6); cyclohexatriene.	**Validated on**	**4/21/2004.**
Manufacturer	PETRO-CANADA P.O. Box 2844 Calgary, Alberta T2P 3E3	**In case of Emergency**	Petro-Canada: 403-296-3000 Canutec Transportation: 613-996-6666 Poison Control Centre: Consult local telephone directory for emergency number(s).
Material Uses	Petrochemical manufactured by extraction process of petroleum fraction. Component of crude oil. Found in various refinery streams (eg. gasoline). Laboratory solvent. Used in manufacture of organic compounds (eg detergents, dyes, insecticides).		

Section 2. Composition and Information on Ingredients

			Exposure Limits (ACGIH)		
Name	**CAS #**	**% (V/V)**	**TLV-TWA(8 h)**	**STEL**	**CEILING**
1) Benzene	71-43-2	99.6	0.5 ppm	2.5 ppm	Not established
2) Toluene	108-88-3	0.3	50 ppm	Not established	Not established
3) Non-aromatics	Mixture	0.1	Not established	Not established	Not established

Manufacturer Recommendation	Not applicable
Other Exposure Limits	Consult local, state, provincial or territory authorities for acceptable exposure limits.

Section 3. Hazards Identification.

Potential Health Effects	Flammable liquid. Exercise caution when handling this material. Contact with this product may cause skin and eye irritation. Prolonged or repeated contact may cause skin irritation, defatting, drying and dermatitis. Inhalation of this product may cause respiratory tract irritation and Central Nervous System (CNS) Depression, symptoms of which may include; weakness, dizziness, slurred speech, drowsiness, unconsciousness and in cases of severe overexposure; coma and death. Aspiration of liquid drops into the lungs may produce potentially fatal chemical pneumonitis (fluid in the lungs), severe lung damage, or respiratory failure. May cause cancer. May cause heritable genetic effects (mutagenicity). For more information refer to Section 11 of this MSDS.

Section 4. First Aid Measures

Eye Contact	IMMEDIATELY flush eyes with running water for at least 15 minutes, keeping eyelids open. Seek medical attention.
Skin Contact	Remove contaminated clothing - launder before reuse. Wash gently and thoroughly the contaminated skin with running water and non-abrasive soap. Seek medical attention.
Inhalation	Evacuate the victim to a safe area as soon as possible. If the victim is not breathing, perform artificial respiration. Allow the victim to rest in a well ventilated area. Seek medical attention.
Ingestion	DO NOT induce vomiting because of danger of aspirating liquid into lungs. Seek medical attention.
Note to Physician	Not available

Section 5. Fire-fighting Measures

Flammability	Class I - flammable liquid (NFPA).	**Flammable Limits**	LOWER: 1.3%; UPPER: 7.1% (NFPA).
Flash Points	CLOSED CUP: -11°C (12°F)	**Auto-Ignition Temperature**	498°C (928°F) (NFPA)
Fire Hazards in Presence of Various Substances	Extremely flammable in presence of open flames, sparks, and heat. Vapours are heavier than air and may travel considerable distance to sources of ignition and flash back. Rapid escape of vapour may generate static charge causing ignition. This product can accumulate static charge and ignite. May accumulate in confined spaces.	**Explosion Hazards in Presence of Various Substances**	Do not cut, weld, heat, drill or pressurize empty container. Containers may explode in heat of fire. Runoff to sewer may create fire or explosion hazard.
Products of Combustion	Carbon oxides (CO, CO2), aldehydes, ketones, smoke and irritating vapours as products of incomplete combustion.		

Continued on Next Page

Fire Fighting Media and Instructions	NAERG2000, GUIDE 130, Flammable liquids (Non-polar/ Water-immiscible/ Noxious). CAUTION: This product has a very low flash point: Use of water spray when fighting fire may be inefficient. If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also consider initial evacuation for 800 meters (1/2 mile) in all directions. SMALL FIRES: Dry chemical, CO_2, water spray or regular foam. LARGE FIRES: Water spray, fog or regular foam. Do not use straight streams. Move containers from fire area if you can do it without risk. FIRE INVOLVING TANKS OR CAR/TRAILER LOADS: Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in case of rising sound from venting safety devices or any discolouration of tank. ALWAYS stay away from the ends of tanks. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible withdraw from area and let fire burn. Wear positive pressure self-contained breathing apparatus (SCBA). Structural firefighters' protective clothing will only provide limited protection.

Section 6. Accidental Release Measures

Material Release or Spill	IN THE EVENT OF A LARGE SPILL CONSIDER THE FOLLOWING CONTROL MEASURES: Consult current National Emergency Response Guide Book (NAERG) for appropriate spill measures if necessary. Evacuate non-essential personnel. Extinguish all ignition sources. Ventilate area. Stop leak if safe to do so. Ensure clean-up personnel wear appropriate personal protective equipment. Dike spilled material. Use appropriate inert absorbent material to absorb spilled product. Collect used absorbent for later disposal. Ground and bond all equipment used to clean up the spilled material, as it may be a static accumulator. Avoid contact with spilled material. Avoid breathing vapours or mists of material. Avoid contaminating sewers, streams, rivers and other water courses with spilled material. Notify appropriate authorities immediately.

Section 7. Handling and Storage

Handling	FLAMMABLE MATERIAL. Handle with care. Avoid contact with any sources of ignition, flames, heat, and sparks. Ensure all equipment is grounded/bonded. Avoid skin contact. Avoid eye contact. Avoid inhalation of product vapours or mists. Avoid confined spaces and areas with poor ventilation. Avoid contact with any incompatible or reactive materials. Wear proper personal protective equipment (See Section 8). Empty containers may contain product residue. Do not pressurize, cut, heat, or weld empty containers. Do not reuse containers without commercial cleaning and/or reconditioning. Personnel who handle this material should practice good personal hygiene during and after handling to help prevent accidental ingestion of this product. Properly dispose of contaminated leather articles including shoes that cannot be decontaminated. Thoroughly wash all severely contaminated clothing before reuse.
Storage	Store away from heat and sources of ignition. Store in dry, cool, well-ventilated area. Store away from incompatible and reactive materials (See section 5 and 10). Avoid direct sunlight. Ensure the storage containers are grounded/bonded.

Section 8. Exposure Controls/Personal Protection

Engineering Controls	For normal application, special ventilation is not necessary. If user's operations generate vapours or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit. Make-up air should always be supplied to balance air removed by exhaust ventilation. Ensure that eyewash station and safety shower are close to work-station.
Personal Protection - ***The selection of personal protective equipment varies, depending upon conditions of use.***	
Eyes	Eye protection (i.e., safety glasses, safety goggles and/or face shield) should be determined based on conditions of use. If product is used in an application where splashing may occur, the use of safety goggles and/or a face shield should be considered.
Body	Wear appropriate clothing to prevent skin contact. As a minimum long sleeves and trousers should be worn.
Respiratory	Where concentrations in air may exceed the occupational exposure limits given in Section 2 (and those applicable to your area) and where engineering, work practices or other means of exposure reduction are not adequate, NIOSH approved respirators may be necessary to prevent overexposure by inhalation.
Hands	Wear appropriate chemically protective gloves.
Feet	Wear appropriate footwear to prevent product from coming in contact with feet and skin.

Section 9. Physical and Chemical Properties

Physical State and Appearance	Clear liquid.	**Viscosity**	Not available
Colour	Clear and colourless	**Pour Point**	Not available
Odour	Sweetish aromatic.	**Softening Point**	Not applicable.
Odour Threshold	Not available	**Dropping Point**	Not applicable.
Boiling Point	80ºC (176ºF) (NFPA)	**Penetration**	Not applicable.
Density	0.88 @ 15ºC (41ºF).	**Oil / Water Dist. Coefficient**	Not available
Vapour Density	2.8 (Air = 1) (NFPA)	**Ionicity (in water)**	Not available
Vapour Pressure	75 mmHg @ 20ºC (NFPA)	**Dispersion Properties**	Not available

Continued on Next Page

Volatility	Volatile.	**Solubility**	Soluble in alcohol, petroleum oil, carbon disulphide, chloroform, ether and acetone. Insoluble in water.

Section 10. Stability and Reactivity

Corrosivity	Not available		
Stability	The product is stable under normal handling and storage conditions.	**Hazardous Polymerization**	Will not occur under normal working conditions.
Incompatible Substances / Conditions to Avoid	Reactive with oxidizing agents, acids, chlorine, ozones, peroxides, plastics, rubbers and coatings.	**Decomposition Products**	May release COx, aldehydes, ketones, smoke and irritating vapours when heated to decomposition.

Section 11. Toxicological Information

Routes of Entry	Skin contact, eye contact, inhalation, and ingestion.
Acute Lethality	Acute toxicity information is not available for the product as a whole, therefore, data for some of the ingredients is provided below: Benzene (71-43-2): Acute oral toxicity (LD50): 930 mg/kg (rat). Acute dermal toxicity (LD50): >9400 mg/kg (rabbit). Acute inhalation toxicity (LC50): 13,700 ppm/4h (rat). Toluene (108-88-3): Acute oral toxicity (LD50): 636 mg/kg (rat). Acute dermal toxicity (LD50): 12,124 mg/kg (rabbit). Acute inhalation toxicity (LC50): 8800 ppm/4h (rat).
Chronic or Other Toxic Effects	
Dermal Route:	This product contains a component (at >= 1%) that can cause skin irritation. Therefore, this product is considered to be a skin irritant. Prolonged or repeated contact may defat and dry skin, and cause dermatitis. Harmful if absorbed through the skin.
Inhalation Route:	Inhalation of this product may cause respiratory tract irritation. Inhalation of this product may cause Central Nervous System (CNS) Depression, symptoms of which may include; weakness, dizziness, slurred speech, drowsiness, unconsciousness and in cases of severe overexposure; coma and death.
Oral Route:	Ingestion of this product may lead to aspiration of the liquid, especially if vomiting occurs. This may result in chemical pneumonitis (inflammation of the lungs) and/or pulmonary edema (an accumulation of fluid in the lungs). Ingestion of this product may cause Central Nervous System (CNS) Depression, symptoms of which may include; weakness, dizziness, slurred speech, drowsiness, unconsciousness and in cases of severe overexposure; coma and death.
Eye Irritation/Inflammation:	This product contains a component (at >= 1%) that can cause eye irritation. Therefore, this product is considered to be an eye irritant.
Immunotoxicity:	Not available
Skin Sensitization:	Contact with this product is not expected to cause skin sensitization, based upon the available data and the known hazards of the components.
Respiratory Tract Sensitization:	Contact with this product is not expected to cause respiratory tract sensitization, based upon the available data and the known hazards of the components.
Mutagenic:	This product contains a component(s) at >= 0.1% that has been shown to cause mutagenicity in laboratory tests. Therefore, this product is considered to be a mutagen. (Benzene).
Reproductive Toxicity:	This product is not known to contain any components at >= 0.1% that have been shown to cause reproductive toxicity. Therefore, based upon the available data and the known hazards of the components, this product is not expected to be a reproductive toxin.
Teratogenicity/Embryotoxicity:	Some test results have shown that Toluene was teratogenic in the absence of maternal toxicity, but the applicability of these results to WHMIS is unknown.
Carcinogenicity (ACGIH):	This product contains the following chemical(s) at >=0.1% that are listed as carcinogenic compounds. Therefore this product is considered to be carcinogenic. (Considered to be A1 by the ACGIH. Benzene, 71-43-2)
Carcinogenicity (IARC):	This product contains the following chemical(s) at >=0.1% that are listed as carcinogenic compounds. Therefore this product is considered to be carcinogenic. (Considered to be carcinogenic to humans (group 1) by IARC. Benzene, 71-43-2)
Carcinogenicity (NTP):	This product contains the following chemical(s) at >=0.1% that are listed as carcinogenic compounds. Therefore this product is considered to be carcinogenic. (Known to be a human carcinogen according to NTP. Benzene, 71-43-2)
Carcinogenicity (IRIS):	This product contains the following chemical(s) at >=0.1% that are listed as carcinogenic compounds. Therefore this product is considered to be carcinogenic. (Considered to be carcinogenic by IRIS. Benzene, 71-43-2)
Carcinogenicity (OSHA):	This product contains the following chemical(s) at >=0.1% that are listed as carcinogenic compounds. Therefore this product is considered to be carcinogenic. (Considered to be carcinogenic by OSHA. Benzene, 71-43-2)
Other Considerations	No additional remark.

Continued on Next Page

Section 12. Ecological Information

Environmental Fate	Not available	**Persistance/ Bioaccumulation Potential**	Not available
BOD5 and COD	Not available	**Products of Biodegradation**	Not available
Additional Remarks	No additional remark.		

Section 13. Disposal Considerations

Waste Disposal Spent/ used/ waste product may meet the requirements of a hazardous waste. Consult your local or regional authorities. Ensure that waste management processes are in compliance with government requirements and local disposal regulations.

Section 14. Transport Information

TDG Classification	BENZENE, 3, UN1114, PGII (CL-TDG)	**Special Provisions for Transport**	See Transportation of Dangerous Goods Regulations.

Section 15. Regulatory Information

Other Regulations

This product is acceptable for use under the provisions of WHMIS-CPR. All components of this formulation are listed on the CEPA-DSL (Domestic Substances List).

All components of this formulation are listed on the US EPA-TSCA Inventory.

All components of this product are on the European Inventory of Existing Commercial Chemical Substances (EINECS).

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

Please contact Product Safety for more information.

DSD/DPD (Europe)	Not evaluated.	**HCS (U.S.A.)**	CLASS: Contains material which may cause cancer. CLASS: Flammable liquid having a flash point lower than 37.8°C (100°F). CLASS: Irritating substance. CLASS: Target organ effects.
ADR (Europe) (Pictograms)	**NOT EVALUATED FOR EUROPEAN TRANSPORT** **NON ÉVALUÉ POUR LE TRANSPORT EUROPÉEN.**	**DOT (U.S.A) (Pictograms)**	

HMIS (U.S.A.)

Health Hazard	2*
Fire Hazard	3
Reactivity	0
Personal Protection	K

NFPA (U.S.A.)

Health **Fire Hazard** **Reactivity** **Specific hazard**

Rating	
0	Insignificant
1	Slight
2	Moderate
3	High
4	Extreme

Section 16. Other Information

References Available upon request.
* Marque de commerce de Petro-Canada - Trademark

Glossary

ACGIH - American Conference of Governmental Industrial Hygienists
ADR - Agreement on Dangerous goods by Road (Europe)
ASTM - American Society for Testing and Materials
BOD5 - Biological Oxygen Demand in 5 days
CAN/CGA B149.2 Propane Installation Code
CAS - Chemical Abstract Services
CEPA - Canadian Environmental Protection Act
CERCLA - Comprehensive Environmental Response, Compensation and Liability Act
CFR - Code of Federal Regulations
CHIP - Chemicals Hazard Information and Packaging Approved Supply List
COD5 - Chemical Oxygen Demand in 5 days
CPR - Controlled Products Regulations
DOT - Department of Transport
DSCL - Dangerous Substances Classification and Labeling (Europe)
DSD/DPD - Dangerous Substances or Dangerous Preparations Directives (Europe)
DSL - Domestic Substance List
EEC/EU - European Economic Community/European Union
EINECS - European Inventory of Existing Commercial Chemical Substances
EPCRA - Emergency Planning and Community Right to Know Act
FDA - Food and Drug Administration
IRIS - Integrated Risk Information System
LD50/LC50 - Lethal Dose/Concentration kill 50%
LDLo/LCLo - Lowest Published Lethal Dose/Concentration
NAERG'96 - North American Emergency Response Guide Book (1996)
NFPA - National Fire Prevention Association
NIOSH - National Institute for Occupational Safety & Health
NPRI - National Pollutant Release Inventory
NSNR - New Substances Notification Regulations (Canada)
NTP - National Toxicology Program
OSHA - Occupational Safety & Health Administration
PEL - Permissible Exposure Limit
RCRA - Resource Conservation and Recovery Act
SARA - Superfund Amendments and Reorganization Act
SD - Single Dose
STEL - Short Term Exposure Limit (15 minutes)
TDG - Transportation Dangerous Goods (Canada)
TDLo/TCLo - Lowest Published Toxic Dose/Concentration
TLm - Median Tolerance Limit
TLV-TWA - Threshold Limit Value-Time Weighted Average
TSCA - Toxic Substances Control Act
USEPA - United States Environmental Protection Agency
USP - United States Pharmacopoeia

FIFRA - Federal Insecticide, Fungicide and Rodenticide Act
HCS - Hazardous Communication System
HMIS - Hazardous Material Information System
IARC - International Agency for Research on Cancer
WHMIS - Workplace Hazardous Material Information System

For Copy of MSDS
Internet: www.petro-canada.ca/msds

Western Canada, Ontario & Central Canada, telephone: 1-800-668-0220; fax: 1-800-837-1228
Quebec & Eastern Canada, telephone: 514-640-8308; fax: 514-640-8385

For Product Safety Information: (905) 804-4752

Prepared by Product Safety - JDW on 4/21/2004.

Data entry by Product Safety - RS.

LIQUINOX MSDS

Section 1 : PRODUCT AND COMPANY IDENTIFICATION

Chemical family: Detergent.

Manufacturer: Alconox, Inc.
30 Glenn St.
Suite 309
White Plains, NY 10603.

Manufacturer emergency phone number: 800-255-3924.
813-248-0585 (outside of the United States).

Supplier: Same as manufacturer.

Product name: Liquinox

Section 2 : INGREDIENT INFORMATION

C.A.S.	CONCENTRATION %	Ingredient Name	T.L.V.	LD/50	LC/50
25155-30-0	10-30	SODIUM DODECYLBENZENESULFONATE	NOT AVAILABLE	438 MG/KG RAT ORAL 1330 MG/KG MOUSE ORAL	NOT AVAILABLE

Section 3 : HAZARD IDENTIFICATION

Route of entry: Skin contact, eye contact, inhalation and ingestion.

Effects of acute exposure

Eye contact: May cause irritation.

Skin contact: Prolonged and repeated contact may cause irritation.

Inhalation: May cause headache and nausea.

Ingestion: May cause vomiting and diarrhea.
May cause gastric distress.

Effects of chronic exposure: See effects of acute exposure.

Section 4 : FIRST AID MEASURES

Skin contact: Remove contaminated clothing.
Wash thoroughly with soap and water.
Seek medical attention if irritation persists.

Eye contact: Check for and remove contact lenses.
Flush eyes with clear, running water for 15 minutes while holding eyelids open: if irritation persists, consult a physician.

Inhalation: Remove victim to fresh air.
If irritation persists, seek medical attention.

Ingestion: Do not induce vomiting, seek medical attention.
Dilute with two glasses of water.
Never give anything by mouth to an unconscious person.

Section 5 : FIRE FIGHTING MEASURES

Flammability: Not flammable.

Conditions of flammability: Surrounding fire.

Extinguishing media: Carbon dioxide, dry chemical, foam.
Water
Water fog.

Special procedures: Self-contained breathing apparatus required.
Firefighters should wear the usual protective gear.
Use water spray to cool fire exposed containers.

Auto-ignition temperature: Not available.

Flash point (°C), method: None

Lower flammability limit (% vol): Not applicable.

Upper flammability limit (% vol): Not applicable.

Explosion Data

Sensitivity to static discharge: Not available.

Sensitivity to mechanical impact: Not available.

Hazardous combustion products: Oxides of carbon (COx).
Hydrocarbons.

Rate of burning: Not available.

Explosive power: Containers may rupture if exposed to heat or fire.

Section 6 : ACCIDENTAL RELEASE MEASURES

Leak/Spill: Contain the spill.
Prevent entry into drains, sewers, and other waterways.
Wear appropriate protective equipment.
Small amounts may be flushed to sewer with water.
Soak up with an absorbent material.
Place in appropriate container for disposal.
Notify the appropriate authorities as required.

Section 7 : HANDLING AND STORAGE

Handling procedures and equipment: Protect against physical damage.
Avoid breathing vapors/mists.
Wear personal protective equipment appropriate to task.
Wash thoroughly after handling.
Keep out of reach of children.
Avoid contact with skin, eyes and clothing.
Avoid extreme temperatures.
Launder contaminated clothing prior to reuse.

Storage requirements: Store away from incompatible materials.
Keep containers closed when not in use.

Section 8 : EXPOSURE CONTROLS / PERSONAL PROTECTION

Precautionary Measures

Gloves/Type:

Wear appropriate gloves.

Respiratory/Type: None required under normal use.

Eye/Type:

Safety glasses recommended.

Footwear/Type: Safety shoes per local regulations.

Clothing/Type: As required to prevent skin contact.

Other/Type: Eye wash facility should be in close proximity.
Emergency shower should be in close proximity.

Ventilation requirements: Local exhaust at points of emission.

Exposure limit of material: Not available.

Section 9 : PHYSICAL AND CHEMICAL PROPERTIES

Physical state: Liquid.

Appearance & odor: Odourless.
Pale yellow.

Odor threshold (ppm): Not available.

Vapour pressure (mmHg): @ 20°C (68°F).
17

Vapour density (air=1): >1

Volatiles (%)

By volume: Not available.

Evaporation rate (butyl acetate = 1): < 1.

Boiling point (°C): 100 (212F)

Freezing point (°C): Not available.

pH: 8.5

Specific gravity @ 20 °C: (water = 1).
1.083

Solubility in water (%): Complete.

Coefficient of water\oil dist.: Not available.

VOC: None

Chemical family: Detergent.

Section 10 : STABILITY AND REACTIVITY

Chemical stability: Product is stable under normal handling and storage conditions.

Conditions of instability: Extreme temperatures.

Hazardous polymerization: Will not occur.

Incompatible substances: Strong acids.
Strong oxidizing agents.

Hazardous decomposition products: See hazardous combustion products.

Section 11 : TOXICOLOGICAL INFORMATION

LD50 of product, species & route: > 5000 mg/kg rat oral.

LC50 of product, species & route: Not available.

Sensitization to product: Not available.

Carcinogenic effects: Not listed as a carcinogen.

Reproductive effects: Not available.

Teratogenicity: Not available.

Mutagenicity: Not available.

Synergistic materials: Not available.

Section 12 : ECOLOGICAL INFORMATION

Environmental toxicity: No data at this time.

Environmental fate: No data at this time.

Section 13 : DISPOSAL CONSIDERATIONS

Waste disposal: In accordance with local and federal regulations.

Section 14 : TRANSPORT INFORMATION

D.O.T. CLASSIFICATION: Not regulated.

Special shipping information: Not regulated.

Section 15 : REGULATORY INFORMATION

Canadian Regulatory Information

WHMIS classification: Not controlled.

DSL status: Not available.

USA Regulatory Information

SARA hazard catagories sections 311/312: Immediate (Acute) Health Hazard: No.
Delayed (Chronic) Health Hazard: No.
Fire Hazard: No.
Sudden Release of Pressure: No.
Reactive: No.

SARA Section 313: None

TSCA inventory: All components of this product are listed on the TSCA inventory.

NFPA

Health Hazard: 1

Flammability: 0

Reactivity: 0

HMIS

Health Hazard: 1

Flammability: 0

Physical hazard: 0

PPE: A

Section 16 : OTHER INFORMATION

Supplier MSDS date: 2006/07/14

Data prepared by: Global Safety Management
3340 Peachtree Road, #1800
Atlanta, GA 30326

Phone: 877-683-7460
Fax: (877) 683-7462

Web: www.globalsafetynet.com
Email: info@globalsafetynet.com.

General note: This material safety data sheet was prepared from information obtained from various sources, including product suppliers and the Canadian Center for Occupational Health and Safety.

Health and Safety Policy

DILLON
CONSULTING

Dillon Consulting Inc. has adopted the following health and safety policy.

The management of Dillon Consulting Inc. is vitally interested in the health and safety of its employees. The company recognizes its responsibility to implement and maintain a safe and healthy work environment for its employees and take appropriate precautions to reduce the risk of injury and illness in the workplace. Dillon Consulting Inc. is committed to providing a safe environment and it is expected that all management and employees be equally dedicated to the continuing objective of reducing risk of injury and illness. Supervisors and employees are expected to know their individual responsibilities and function in a manner consistent with them, including working in accordance with regulatory requirements and Dillon's internal programs.

Dillon Consulting Inc. is committed to the prevention of workplace violence and harassment, as well as preserving a safe and healthy working environment.

Through its health and safety program, Dillon commits to:

- *comply with applicable health and safety acts and regulations in all of the jurisdictions in which it operates;*
- *avoid activities with excessive health and safety risks;*
- *clearly define the health and safety roles, responsibilities, and rights of employees;*
- *assess health and safety hazards in the workplace;*
- *develop and implement plans and strategies to minimize these risks;*
- *provide health and safety training and information to its employees;*
- *provide health and safety equipment to its employees;*
- *adhere to best practices and due diligence standards for worker protection in all activities;*
- *supervise, monitor and enforce compliance with the program;*
- *work in a spirit of consultation and cooperation with its employees;*
- *monitor the effectiveness of the program and implement appropriate improvements.*

Gary J. Komar, P.Eng
President

September 11, 2017

A - EQUIPMENT & MATERIALS

- Field Book/Inspection Form
- First Aid Kit
- Appropriate sampling devices and containers
- Pylons (for areas with traffic)
- Paper towels
- Garbage Bags
- Liquid Detergent
- Distilled or Deionized Water

B - PERSONAL PROTECTIVE EQUIPMENT

- Hard Hat1
- Safety Footwear[1]
- Safety Eyewear[1, 2 & 3]
- Safety Vest[1]
- Respirator and Cartridges (appropriate for expected or known vapour constituents)
- Latex Gloves (nitrile disposable gloves for hydrocarbon contaminated sites)
- Ear Plugs

Notes:
1. Items must be worn in areas of construction. Items must also be worn as prescribed by the Occupational Health & Safety Regulations specific to the area where the work is taking place.
2. Safety eyewear must be worn where contamination (including debris) that may be harmful to the eye, is suspected to be present. Safety eyewear should always be available to field staff.
3. Items must be worn in areas of drilling. Safety glasses must be worn to protect eyes from flying particles. Ear plugs must be worn to protect ears from high decibels produced from drill rig.

C - JOB STEPS

1. Refer to H&S plan for site specific hazards, precautions, monitoring, Personal Protective Equipment (PPE), and emergency response.

2. Form D.7 Tailgate Meeting/Field Level Hazard Assessment to be completed with all present before work commences.

3. Wear appropriate PPE and clothing suitable to the environment.

4. Ensure stable footing and balance to avoid slips and trips.

5. Label container, as appropriate prior to sampling program.

6. Wear new, disposable latex gloves for each sample collection, per project requirements, to minimize potential for cross-contamination.

7. Collect sample in appropriate sample container from location in surface/depth as per project requirements.

8. If necessary, wipe off container with a paper towel, and label prior to placing in a cooler.

9. Decontaminate any sampling devices as necessary for project requirements using liquid detergent and a clear water rinse between sample collections, to minimize potential for cross-contamination.

10. Place the waste in garbage bags and dispose of properly.

11. Wash hands as soon as possible/reasonable.

A - EQUIPMENT and MATERIALS

- Field Book
- First Aid Kit
- Survey Equipment
- Safety Pylons and
- Signs
- SPOTs (where applicable)

B - PERSONAL PROTECTIVE EQUIPMENT

- Hard Hat
- Safety Boots
- Safety Vest
- Safety Eyewear
- Long pants/long sleeve shirt (min.)

C - JOB STEPS

1. Refer to H&S Plan for site-specific hazards, precautions, monitoring, Personal Protective Equipment (PPE), and emergency response.

2. Tailgate Meeting Record / Field Level Hazard Assessment Form D.7 must be completed by all staff on-site before work commences.

3. Identify the type of survey to be conducted, including the area and features to be surveyed.

4. Ensure the survey equipment is in good working condition and calibrated as appropriate.

5. Ensure warning signs, barricades and traffic control are in place, where necessary.

6. Be aware of slip, trip and fall hazards. i.e., construction sites, fields with tall grass or other areas with obstructed views.

7. Identify potential hazards within the survey area, i.e., overhead utility lines.

8 Continually monitor vehicular traffic (public traffic and flow) and moving construction equipment.

9. Be aware of hazards associated with water course banks, such as slippery edges, instability and/or obstructions.

10. Be aware of hazards associated with excavations, such as sidewall collapse, undermined edges, slumping or caving sidewalls. Refer to SWP 22 (Working Around Trenches and Excavations). Stay away from edges and do not enter trenches without proper training and authorization from the project manager.

11. Be aware of weather conditions, such as falling due to icy conditions, UV exposure, heat stress and lightning. Refer to SWP 3 (Working On or Over Ice), SWP 21 and SWP 27 (Physical Hazards).

12. Do not enter Confined Spaces (spaces not meant for human occupancy, with no egress or ingress and have possible atmospheric hazards). Confined Spaces can be but not limited to manholes, culverts, silos, trenches, tanks or valve chambers. Proper confined space training and project manager approval to work in a confined space is mandatory. It is important to note that laws and regulations for each province and territory may vary. Ensure they are reviewed. Also refer to Health and Safety Guideline, Confined Space Awareness (A.12) for more information.

Appendix C

Site Photos (June 2018)

Site 1 – Helipad (April 2018)

Photo 1a: Picture of overall site. All debris has been removed, with fences collapsed around the existing debris.

Photo 1b: Soil conditions after the fire.

Site 1 – Helipad (April 2018)

Photo 1c: Picture of one of three fuel drums located at the helipad site.

Photo 1d: Close-up picture of one of the three fuel drums detected on site. The tank appears to have minor burn damage, with no perforations detected. The cap is secure on the tank and there is no evidence of soil staining underneath or around the fuel drums. Fuel drums appear to be relatively empty.

Site 4 – Gate House (April 2018)

Photo 4a: Picture taken from the entrance of the house (facing north).

Photo 4b: Interior of the house.

Site 4 – Gate House (April 2018)

Photo 4c: Picture of the garage remnants.

Photo 4d: Picture from the southwest side of the building, looking north.

Site 4 – Gate House (April 2018)

Photo 4e: Picture from the southwest side of the building.

Photo 4f: Interior of the house, looking northeast.

Site 4 – Gate House (April 2018)

Photo 4g: Picture of the gatehouse looking south.

Photo 4h: Area around the garage pad, looking south.

Site 4 – Gate House (April 2018)

Photo 4i: Picture of garage debris.

Photo 4j: Picture of garage debris.

Site 4 – Gate House (April 2018)

Photo 4k: Picture from the east side of the building, looking west.

Photo 4l: Picture from the south side of the building, looking at the driveway into the garage.

Site 5 – Heavy Equipment Area (June 2018)

Photo 5a: Picture of the heavy equipment site, looking east.

Photo 5b: Remnants of a trailer.

Site 5 – Heavy Equipment Area (June 2018)

Photo 5c: Interior of the trailer.

Photo 5d: Debris around the trailer.

Site 5 – Heavy Equipment Area (June 2018)

Photo 5e: Image of the half-burnt vacuum truck.

Photo 5f: Image of the burnt trailer.

Site 5 – Heavy Equipment Area (June 2018)

Photo 5g: Conditions of the vacuum truck after fire.

Photo 5h: Underside of relocated vacuum truck

Site 5 – Heavy Equipment Area (June 2018)

Photo 5i: Underside of relocated trailers directly north of the vacuum truck

Photo 5j: Underside of northermost relocated trailer

Site 5 – Heavy Equipment Area (June 2018)

Photo 5k: Underside of easternmost relocated trailer

Site7 – Waterton Lakes Golf Course - Golf Cart Storage Area (April 2018)

Photo 7a: Picture taken north of the site, looking south. Burnt tree area visible in the southeast portion of the site.

Site7 – Waterton Lakes Golf Course - Golf Cart Storage Area (April 2018)

Photo 7b: Picture taken from south of site, looking north. An undamaged golf cart is present at the northwest boundary of the site.

Site10 – Waterton Lakes Golf Course – Salamander Barriers (April 2018)

Photo 10a: Partially burnt Salamander Barrier. Image taken from COR#1 dated Jan 19, 2018.

Site10 – Waterton Lakes Golf Course – Salamander Barriers (April 2018)

Photo 10b: Picture taken along the burnt salamander barriers. A trace of black burnt debris is visible where the barrier was previously.

Appendix D

Water Well Sampling Data at Sites 1 and 9

Exova
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T1Y-5L3, Canada

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F: +1 (403) 291-2021
E: Calgary@exova.com
W: www.exova.com

Exova

Report Transmission Cover Page

Bill To:	Parks Canada - Waterton Lakes	Project ID:	Kenow	Lot ID:	**1268415**
	Courier: Government Compound	Project Name:	Compound	Control Number:	C107139
	Waterton Lakes National Park	Project Location:	Waterton	Date Received:	May 3, 2018
	Waterton, AB, Canada	LSD:		Date Reported:	May 23, 2018
	T0K 2M0	P.O.:	Mastercard	Report Number:	2283034
Attn:	Layton Banack	Proj. Acct. code:			
Sampled By:					
Company:					

Contact	Company	Address
Layton Banack	**Parks Canada - Waterton Lakes**	Courier: Government Compound, Waterton Lakes National Park Waterton, AB T0K 2M0 Phone: (403) 859-5104 Fax: (403) 859-5152 Email: layton.banack@pc.gc.ca

Delivery	Format	Deliverables
Automated Fax	PDF	COC / Test Report
Email - Merge Reports	PDF	COC / Test Report
Email - Single Report	PDF	COA
Email - Single Report	PDF	Invoice

Notes To Clients:

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Analytical Report

Bill To:	Parks Canada - Waterton Lakes	Project ID:	Kenow	Lot ID:	**1268415**
	Courier: Government Compound	Project Name:	Compound	Control Number:	C107139
	Waterton Lakes National Park	Project Location:	Waterton	Date Received:	May 3, 2018
	Waterton, AB, Canada	LSD:		Date Reported:	May 23, 2018
	T0K 2M0	P.O.:	Mastercard	Report Number:	2283034
Attn:	Layton Banack	Proj. Acct. code:			
Sampled By:					
Company:					

Reference Number	1268415-1
Sample Date	May 03, 2018
Sample Time	11:00
Sample Location	
Sample Description	Compound / 9.1C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Inorganic Nonmetallic Parameters						
Ammonia - N		mg/L	<0.03	0.025		
Ammonium/Ammonia Preservation			Yes			
Sulfide	Total	mg/L	<0.002	0.002	0.05	Below AO
Organic Carbon	Total Nonpurgeable	mg/L	1.3	0.5		
Chlorine	Total	mg/L	<0.1	0.1		
Chlorine	Free	mg/L	<0.1	0.1		
Chloramine		mg/L	<0.1	0.1	3	Below MAC
Chlorate	Dissolved	mg/L	<0.1	0.1	1.0	Below MAC
Chlorite	Dissolved	mg/L	<0.2	0.2	1.0	Below MAC
Cyanide	Dissolved	mg/L	<0.002	0.002	0.2	Below MAC
Bromate	Dissolved	mg/L	<0.003	0.003	0.01	Below MAC
Hydrogen Sulfide	Calculated	mg/L	<0.002			
Metals Total						
Mercury	Total	mg/L	<0.000005	0.000005	0.001	Below MAC
Aluminum	Total	mg/L	<0.005	0.005	0.1	Below OG
Antimony	Total	mg/L	<0.0002	0.0002	0.006	Below MAC
Arsenic	Total	mg/L	<0.0002	0.0002	0.01	Below MAC
Barium	Total	mg/L	0.400	0.001	1.0	Below MAC
Boron	Total	mg/L	0.015	0.002	5.0	Below MAC
Cadmium	Total	mg/L	<0.00001	0.00001	0.005	Below MAC
Chromium	Total	mg/L	<0.0005	0.0005	0.05	Below MAC
Copper	Total	mg/L	0.011	0.001	1.0	Below AO
Lead	Total	mg/L	0.0005	0.0001	0.01	Below MAC
Selenium	Total	mg/L	<0.0002	0.0002	0.05	Below MAC
Silver	Total	mg/L	<0.00001	0.00001		
Uranium	Total	mg/L	<0.0005	0.0005	0.02	Below MAC
Zinc	Total	mg/L	0.009	0.001	5.0	Below AO
Physical and Aggregate Properties						
Colour	Apparent, Potable	Colour units	<5	5	15	Below AO
Turbidity		NTU	0.3	0.1	0.1	Above OG
Polycyclic Aromatic Hydrocarbons - Water						
Naphthalene		µg/L	<0.1	0.1		
Quinoline		µg/L	<0.3	0.3		
Acenaphthylene		µg/L	<0.1	0.1		
Acenaphthene		µg/L	<0.1	0.1		
Fluorene		µg/L	<0.1	0.1		
Phenanthrene		µg/L	<0.1	0.1		

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	T0K 2M0	P.O.:	Mastercard	Report Number:	2283034
Attn:	Layton Banack	Proj. Acct. code:			
Sampled By:					
Company:					

Reference Number	1268415-1
Sample Date	May 03, 2018
Sample Time	11:00
Sample Location	
Sample Description	Compound / 9.1C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Polycyclic Aromatic Hydrocarbons - Water - Continued						
Acridine		µg/L	<0.1	0.1		
Anthracene		µg/L	<0.005	0.005		
Fluoranthene		µg/L	<0.01	0.01		
Pyrene		µg/L	<0.01	0.01		
Benzo(a)anthracene		µg/L	<0.01	0.01		
Chrysene		µg/L	<0.1	0.1		
Benzo(b)fluoranthene		µg/L	<0.1	0.1		
Benzo(b+j)fluoranthene		µg/L	<0.1	0.1		
Benzo(k)fluoranthene		µg/L	<0.1	0.1		
Benzo(a)pyrene		µg/L	<0.008	0.008	0.04	Below MAC
Indeno(1,2,3-c,d)pyrene		µg/L	<0.05	0.05		
Dibenzo(a,h)anthracene		µg/L	<0.05	0.05		
Benzo(g,h,i)perylene		µg/L	<0.05	0.05		
CB(a)P	Total Potency Equivalents	µg/L	<0.01	0.01		
Benzo(a)pyrene		mg/L	<0.000008	0.000008	0.00004	Below MAC
Routine Water						
pH			7.92		7.0-10.5	Within OG Range
Temperature of observed pH		°C	22.2			
Electrical Conductivity	at 25 °C	µS/cm	307	1		
Calcium	Extractable	mg/L	36.7	0.2		
Magnesium	Extractable	mg/L	18.3	0.2		
Sodium	Extractable	mg/L	2.5	0.4	200	Below AO
Potassium	Extractable	mg/L	0.6	0.4		
Iron	Extractable	mg/L	0.03	0.01	0.3	Below AO
Manganese	Extractable	mg/L	<0.005	0.005	0.05	Below AO
Chloride	Dissolved	mg/L	1.5	0.4	250	Below AO
Fluoride		mg/L	<0.05	0.05	1.5	Below MAC
Nitrate - N		mg/L	0.89	0.01	10	Below MAC
Nitrite - N		mg/L	<0.005	0.005	1	Below MAC
Nitrate and Nitrite - N		mg/L	0.89	0.01	10	Below MAC
Sulfate (SO4)	Extractable	mg/L	9.7	0.9	500	Below AO
Hydroxide		mg/L	<5			
Carbonate		mg/L	<6			
Bicarbonate		mg/L	194			
P-Alkalinity	as CaCO3	mg/L	<5.0	5		
T-Alkalinity	as CaCO3	mg/L	159	5		

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Analytical Report

Bill To:	Parks Canada - Waterton Lakes	Project ID:	Kenow	Lot ID:	**1268415**
	Courier: Government Compound	Project Name:	Compound	Control Number:	C107139
	Waterton Lakes National Park	Project Location:	Waterton	Date Received:	May 3, 2018
	Waterton, AB, Canada	LSD:		Date Reported:	May 23, 2018
	T0K 2M0	P.O.:	Mastercard	Report Number:	2283034
Attn:	Layton Banack	Proj. Acct. code:			
Sampled By:					
Company:					

Reference Number	1268415-1
Sample Date	May 03, 2018
Sample Time	11:00
Sample Location	
Sample Description	Compound / 9.1C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Routine Water - Continued						
Total Dissolved Solids		mg/L	165	1	500	Below AO
Hardness	as CaCO3	mg/L	167.0			
Ionic Balance		%	99			
Extractable Petroleum Hydrocarbons - Water						
F2 C10-C16		mg/L	<0.1	0.1		
F3 C16-C34		mg/L	<0.1	0.1		
Glyphosate in Water						
Glyphosate		mg/L	<0.01	0.01	0.28	Below MAC
PAH - Water - Surrogate Recovery						
Nitrobenzene-d5	PAH - Surrogate	%	83	50-140		
2-Fluorobiphenyl	PAH - Surrogate	%	71	50-140		
p-Terphenyl-d14	PAH - Surrogate	%	66	50-140		
Subcontracted Analysis						
Nitrilotriacetic Acid		mg/L	<0.1	0.1	0.4	Below MAC
Health Canada Drinking Water - Organics						
Benzene		mg/L	<0.001	0.001	0.005	Below MAC
Bromodichloromethane		mg/L	0.001	0.001		
Bromoform		mg/L	<0.001	0.001		
Carbon Tetrachloride		mg/L	<0.001	0.001	0.002	Below MAC
Chlorobenzene		mg/L	<0.001	0.001	0.03	Below AO
Chloroform		mg/L	0.003	0.001		
Dibromochloromethane		mg/L	<0.001	0.001		
1,2-Dichlorobenzene		mg/L	<0.001	0.001	0.003 AO; 0.2 MAC	Below AO
1,4-Dichlorobenzene		mg/L	<0.001	0.001	0.001 AO; 0.005 MAC	Below AO
1,2-Dichloroethane		mg/L	<0.001	0.001	0.005	Below MAC
1,1-Dichloroethene		mg/L	<0.001	0.001	0.014	Below MAC
2,4 & 2,5-Dichlorophenol		mg/L	<0.0001	0.0001	0.0003 AO; 0.9 MAC	Below AO
Ethylbenzene		mg/L	<0.001	0.001	0.0016 AO; 0.14 MAC	Below AO
Methyl t-Butyl Ether		mg/L	<0.001	0.001	0.015	Below AO
Methylene Chloride		mg/L	<0.005	0.005	0.05	Below MAC
Pentachlorophenol		mg/L	<0.0001	0.0001	0.03	Below AO
Tetrachloroethene		mg/L	<0.001	0.001	0.01	Below MAC
2,3,4,6-Tetrachlorophenol		mg/L	<0.0001	0.0001	0.001	Below AO
Toluene		mg/L	<0.001	0.001	0.024 AO; 0.060 MAC	Below AO

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	T0K 2M0	P.O.:	Mastercard	Report Number:	2283034
Attn:	Layton Banack	Proj. Acct. code:			
Sampled By:					
Company:					

Reference Number	1268415-1
Sample Date	May 03, 2018
Sample Time	11:00
Sample Location	
Sample Description	Compound / 9.1C
Sample Matrix	Water

Analyte	Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Health Canada Drinking Water - Organics - Continued					
Total Trihalomethanes	mg/L	0.005	0.001	0.1	Below MAC
Total Xylenes (m,p,o)	mg/L	<0.001	0.001	0.02 AO; 0.09 MAC	Below AO
Trichloroethene	mg/L	<0.001	0.001	0.005	Below MAC
2,4,6-Trichlorophenol	mg/L	<0.0001	0.0001	0.002	Below AO
Vinyl Chloride	mg/L	<0.002	0.002	0.002	Below MAC
Health Canada Drinking Water - Pesticides					
Aldicarb	mg/L	<0.0001	0.0001		
Aldrin	mg/L	<0.0005	0.0005		
Dieldrin	mg/L	<0.0005	0.0005		
Atrazine	mg/L	<0.0001	0.0001	0.005	Below MAC
Deethylatrazine	mg/L	<0.0001	0.0001	0.005	Below MAC
Deisopropylatrazine	mg/L	<0.0001	0.0001	0.005	Below MAC
Didealkylatrazine	mg/L	<0.0001	0.0001	0.005	Below MAC
Azinphos-methyl	mg/L	<0.0005	0.0005	0.02	Below MAC
Bendiocarb	mg/L	<0.0001	0.0001		
Bromoxynil	mg/L	<0.0001	0.0001	0.005	Below MAC
Carbaryl	mg/L	<0.0001	0.0001	0.09	Below MAC
Carbofuran	mg/L	<0.0001	0.0001	0.09	Below MAC
Chlorpyrifos	mg/L	<0.0005	0.0005	0.09	Below MAC
Cyanazine	mg/L	<0.0001	0.0001		
2,4-D	mg/L	<0.0001	0.0001	0.1	Below MAC
Diazinon	mg/L	<0.0001	0.00010	0.02	Below MAC
Dicamba	mg/L	<0.0001	0.0001	0.12	Below MAC
Diclofop-methyl	mg/L	<0.0002	0.0002	0.009	Below MAC
Dimethoate	mg/L	<0.0005	0.0005	0.02	Below MAC
Dinoseb	mg/L	<0.0001	0.0001		
Diuron	mg/L	<0.0001	0.0001	0.15	Below MAC
Malathion	mg/L	<0.0001	0.0001	0.19	Below MAC
MCPA	mg/L	<0.0001	0.0001	0.1	Below MAC
Methoxychlor	mg/L	<0.0005	0.0005		
Metolachlor	mg/L	<0.0005	0.0005	0.05	Below MAC
Metribuzin	mg/L	<0.0005	0.0005	0.08	Below MAC
Parathion	mg/L	<0.0005	0.0005		
Phorate	mg/L	<0.0005	0.0005	0.002	Below MAC
Picloram	mg/L	<0.0001	0.0001	0.19	Below MAC
Simazine	mg/L	<0.0001	0.0001	0.01	Below MAC
Terbufos	mg/L	<0.0005	0.0005	0.001	Below MAC

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	Waterton, AB, Canada	LSD:		Date Reported:	May 23, 2018
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Attn:	Layton Banack	Proj. Acct. code:			
Sampled By:					
Company:					

Reference Number	1268415-1
Sample Date	May 03, 2018
Sample Time	11:00
Sample Location	
Sample Description	Compound / 9.1C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Health Canada Drinking Water - Pesticides - Continued						
Triallate		mg/L	<0.0001	0.00010		
Trifluralin		mg/L	<0.0001	0.0001	0.045	Below MAC
Health Canada DW - Pesticides - Surrogate Recovery						
TPP	Surrogate	%	118	50-140		
3,5-DCBA	Surrogate	%	69	50-140		
BDMC	Surrogate	%	82	50-140		
Monuron	Surrogate	%	82	50-140		
Haloacetic Acids - Water						
Monochloroacetic Acid		µg/L	<2.0	2.0		
Monobromoacetic Acid		µg/L	<2.0	2.0		
Dichloroacetic Acid		µg/L	<2.0	2.0		
Dibromoacetic Acid		µg/L	<2.0	2.0		
Trichloroacetic Acid		µg/L	<2.0	2.0		
Total Haloacetic Acids (HAA5)		µg/L	<10.0	2.0	80	Below MAC

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	Courier: Government Compound	Project Name:	Compound	Control Number:	C107139
	Waterton Lakes National Park	Project Location:	Waterton	Date Received:	May 3, 2018
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	T0K 2M0	P.O.:	Mastercard	Report Number:	2283034
Attn:	Layton Banack	Proj. Acct. code:			
Sampled By:					
Company:					

Reference Number	1268415-2
Sample Date	May 03, 2018
Sample Time	11:00
Sample Location	
Sample Description	Townsite / 9.1C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Inorganic Nonmetallic Parameters						
Ammonia - N		mg/L	<0.03	0.025		
Ammonium/Ammonia Preservation			Yes			
Sulfide	Total	mg/L	<0.002	0.002	0.05	Below AO
Organic Carbon	Total Nonpurgeable	mg/L	0.6	0.5		
Chlorine	Total	mg/L	1.1	0.1		
Chlorine	Free	mg/L	1.0	0.1		
Chloramine		mg/L	<0.1	0.1	3	Below MAC
Chlorate	Dissolved	mg/L	0.1	0.1	1.0	Below MAC
Chlorite	Dissolved	mg/L	<0.2	0.2	1.0	Below MAC
Cyanide	Dissolved	mg/L	<0.002	0.002	0.2	Below MAC
Bromate	Dissolved	mg/L	<0.003	0.003	0.01	Below MAC
Hydrogen Sulfide	Calculated	mg/L	<0.002			
Metals Total						
Mercury	Total	mg/L	<0.000005	0.000005	0.001	Below MAC
Aluminum	Total	mg/L	<0.005	0.005	0.1	Below OG
Antimony	Total	mg/L	<0.0002	0.0002	0.006	Below MAC
Arsenic	Total	mg/L	<0.0002	0.0002	0.01	Below MAC
Barium	Total	mg/L	0.173	0.001	1.0	Below MAC
Boron	Total	mg/L	0.008	0.002	5.0	Below MAC
Cadmium	Total	mg/L	<0.00001	0.00001	0.005	Below MAC
Chromium	Total	mg/L	<0.0005	0.0005	0.05	Below MAC
Copper	Total	mg/L	0.004	0.001	1.0	Below AO
Lead	Total	mg/L	0.0001	0.0001	0.01	Below MAC
Selenium	Total	mg/L	<0.0002	0.0002	0.05	Below MAC
Silver	Total	mg/L	<0.00001	0.00001		
Uranium	Total	mg/L	<0.0005	0.0005	0.02	Below MAC
Zinc	Total	mg/L	0.003	0.001	5.0	Below AO
Physical and Aggregate Properties						
Colour	Apparent, Potable	Colour units	<5	5	15	Below AO
Turbidity		NTU	<0.1	0.1	0.1	Below OG
Polycyclic Aromatic Hydrocarbons - Water						
Naphthalene		µg/L	<0.1	0.1		
Quinoline		µg/L	<0.3	0.3		
Acenaphthylene		µg/L	<0.1	0.1		
Acenaphthene		µg/L	<0.1	0.1		
Fluorene		µg/L	<0.1	0.1		
Phenanthrene		µg/L	<0.1	0.1		

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Sampled By:					
Company:					

Reference Number	1268415-2
Sample Date	May 03, 2018
Sample Time	11:00
Sample Location	
Sample Description	Townsite / 9.1C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Polycyclic Aromatic Hydrocarbons - Water - Continued						
Acridine		µg/L	<0.1	0.1		
Anthracene		µg/L	<0.005	0.005		
Fluoranthene		µg/L	<0.01	0.01		
Pyrene		µg/L	<0.01	0.01		
Benzo(a)anthracene		µg/L	<0.01	0.01		
Chrysene		µg/L	<0.1	0.1		
Benzo(b)fluoranthene		µg/L	<0.1	0.1		
Benzo(b+j)fluoranthene		µg/L	<0.1	0.1		
Benzo(k)fluoranthene		µg/L	<0.1	0.1		
Benzo(a)pyrene		µg/L	<0.008	0.008	0.04	Below MAC
Indeno(1,2,3-c,d)pyrene		µg/L	<0.05	0.05		
Dibenzo(a,h)anthracene		µg/L	<0.05	0.05		
Benzo(g,h,i)perylene		µg/L	<0.05	0.05		
CB(a)P	Total Potency Equivalents	µg/L	<0.01	0.01		
Benzo(a)pyrene		mg/L	<0.000008	0.000008	0.00004	Below MAC
Routine Water						
pH			7.96		7.0-10.5	Within OG Range
Temperature of observed pH		°C	22.1			
Electrical Conductivity	at 25 °C	µS/cm	206	1		
Calcium	Extractable	mg/L	26.8	0.2		
Magnesium	Extractable	mg/L	10.0	0.2		
Sodium	Extractable	mg/L	2.0	0.4	200	Below AO
Potassium	Extractable	mg/L	<0.4	0.4		
Iron	Extractable	mg/L	<0.01	0.01	0.3	Below AO
Manganese	Extractable	mg/L	<0.005	0.005	0.05	Below AO
Chloride	Dissolved	mg/L	1.5	0.4	250	Below AO
Fluoride		mg/L	<0.05	0.05	1.5	Below MAC
Nitrate - N		mg/L	0.21	0.01	10	Below MAC
Nitrite - N		mg/L	0.019	0.005	1	Below MAC
Nitrate and Nitrite - N		mg/L	0.23	0.01	10	Below MAC
Sulfate (SO4)	Extractable	mg/L	11	0.9	500	Below AO
Hydroxide		mg/L	<5			
Carbonate		mg/L	<6			
Bicarbonate		mg/L	126			
P-Alkalinity	as CaCO3	mg/L	<5.0	5		
T-Alkalinity	as CaCO3	mg/L	103	5		

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Company:					

Reference Number	1268415-2
Sample Date	May 03, 2018
Sample Time	11:00
Sample Location	
Sample Description	Townsite / 9.1C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Routine Water - Continued						
Total Dissolved Solids		mg/L	113	1	500	Below AO
Hardness	as CaCO3	mg/L	108.0			
Ionic Balance		%	96			
Extractable Petroleum Hydrocarbons - Water						
F2 C10-C16		mg/L	<0.1	0.1		
F3 C16-C34		mg/L	<0.1	0.1		
Glyphosate in Water						
Glyphosate		mg/L	<0.01	0.01	0.28	Below MAC
PAH - Water - Surrogate Recovery						
Nitrobenzene-d5	PAH - Surrogate	%	72	50-140		
2-Fluorobiphenyl	PAH - Surrogate	%	59	50-140		
p-Terphenyl-d14	PAH - Surrogate	%	59	50-140		
Subcontracted Analysis						
Nitrilotriacetic Acid		mg/L	<0.1	0.1	0.4	Below MAC
Health Canada Drinking Water - Organics						
Benzene		mg/L	<0.001	0.001	0.005	Below MAC
Bromodichloromethane		mg/L	<0.001	0.001		
Bromoform		mg/L	<0.001	0.001		
Carbon Tetrachloride		mg/L	<0.001	0.001	0.002	Below MAC
Chlorobenzene		mg/L	<0.001	0.001	0.03	Below AO
Chloroform		mg/L	<0.001	0.001		
Dibromochloromethane		mg/L	<0.001	0.001		
1,2-Dichlorobenzene		mg/L	<0.001	0.001	0.003 AO; 0.2 MAC	Below AO
1,4-Dichlorobenzene		mg/L	<0.001	0.001	0.001 AO; 0.005 MAC	Below AO
1,2-Dichloroethane		mg/L	<0.001	0.001	0.005	Below MAC
1,1-Dichloroethene		mg/L	<0.001	0.001	0.014	Below MAC
2,4 & 2,5-Dichlorophenol		mg/L	<0.0001	0.0001	0.0003 AO; 0.9 MAC	Below AO
Ethylbenzene		mg/L	<0.001	0.001	0.0016 AO; 0.14 MAC	Below AO
Methyl t-Butyl Ether		mg/L	<0.001	0.001	0.015	Below AO
Methylene Chloride		mg/L	<0.005	0.005	0.05	Below MAC
Pentachlorophenol		mg/L	<0.0001	0.0001	0.03	Below AO
Tetrachloroethene		mg/L	<0.001	0.001	0.01	Below MAC
2,3,4,6-Tetrachlorophenol		mg/L	<0.0001	0.0001	0.001	Below AO
Toluene		mg/L	<0.001	0.001	0.024 AO; 0.060 MAC	Below AO

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Attn:	Layton Banack	Proj. Acct. code:			
Sampled By:					
Company:					

Reference Number	1268415-2
Sample Date	May 03, 2018
Sample Time	11:00
Sample Location	
Sample Description	Townsite / 9.1C
Sample Matrix	Water

Analyte	Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Health Canada Drinking Water - Organics - Continued					
Total Trihalomethanes	mg/L	<0.001	0.001	0.1	Below MAC
Total Xylenes (m,p,o)	mg/L	<0.001	0.001	0.02 AO; 0.09 MAC	Below AO
Trichloroethene	mg/L	<0.001	0.001	0.005	Below MAC
2,4,6-Trichlorophenol	mg/L	<0.0001	0.0001	0.002	Below AO
Vinyl Chloride	mg/L	<0.002	0.002	0.002	Below MAC
Health Canada Drinking Water - Pesticides					
Aldicarb	mg/L	<0.0001	0.0001		
Aldrin	mg/L	<0.0005	0.0005		
Dieldrin	mg/L	<0.0005	0.0005		
Atrazine	mg/L	<0.0001	0.0001	0.005	Below MAC
Deethylatrazine	mg/L	<0.0001	0.0001	0.005	Below MAC
Deisopropylatrazine	mg/L	<0.0001	0.0001	0.005	Below MAC
Didealkylatrazine	mg/L	<0.0001	0.0001	0.005	Below MAC
Azinphos-methyl	mg/L	<0.0005	0.0005	0.02	Below MAC
Bendiocarb	mg/L	<0.0001	0.0001		
Bromoxynil	mg/L	<0.0001	0.0001	0.005	Below MAC
Carbaryl	mg/L	<0.0001	0.0001	0.09	Below MAC
Carbofuran	mg/L	<0.0001	0.0001	0.09	Below MAC
Chlorpyrifos	mg/L	<0.0005	0.0005	0.09	Below MAC
Cyanazine	mg/L	<0.0001	0.0001		
2,4-D	mg/L	<0.0001	0.0001	0.1	Below MAC
Diazinon	mg/L	<0.0001	0.00010	0.02	Below MAC
Dicamba	mg/L	<0.0001	0.0001	0.12	Below MAC
Diclofop-methyl	mg/L	<0.0002	0.0002	0.009	Below MAC
Dimethoate	mg/L	<0.0005	0.0005	0.02	Below MAC
Dinoseb	mg/L	<0.0001	0.0001		
Diuron	mg/L	<0.0001	0.0001	0.15	Below MAC
Malathion	mg/L	<0.0001	0.0001	0.19	Below MAC
MCPA	mg/L	<0.0001	0.0001	0.1	Below MAC
Methoxychlor	mg/L	<0.0005	0.0005		
Metolachlor	mg/L	<0.0005	0.0005	0.05	Below MAC
Metribuzin	mg/L	<0.0005	0.0005	0.08	Below MAC
Parathion	mg/L	<0.0005	0.0005		
Phorate	mg/L	<0.0005	0.0005	0.002	Below MAC
Picloram	mg/L	<0.0001	0.0001	0.19	Below MAC
Simazine	mg/L	<0.0001	0.0001	0.01	Below MAC
Terbufos	mg/L	<0.0005	0.0005	0.001	Below MAC

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Analytical Report

Bill To:	Parks Canada - Waterton Lakes	Project ID:	Kenow	Lot ID:	**1268415**
	Courier: Government Compound	Project Name:	Compound	Control Number:	C107139
	Waterton Lakes National Park	Project Location:	Waterton	Date Received:	May 3, 2018
	Waterton, AB, Canada	LSD:		Date Reported:	May 23, 2018
	T0K 2M0	P.O.:	Mastercard	Report Number:	2283034
Attn:	Layton Banack	Proj. Acct. code:			
Sampled By:					
Company:					

Reference Number	1268415-2
Sample Date	May 03, 2018
Sample Time	11:00
Sample Location	
Sample Description	Townsite / 9.1C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Health Canada Drinking Water - Pesticides - Continued						
Triallate		mg/L	<0.0001	0.00010		
Trifluralin		mg/L	<0.0001	0.0001	0.045	Below MAC
Health Canada DW - Pesticides - Surrogate Recovery						
TPP	Surrogate	%	121	50-140		
3,5-DCBA	Surrogate	%	69	50-140		
BDMC	Surrogate	%	90	50-140		
Monuron	Surrogate	%	90	50-140		
Haloacetic Acids - Water						
Monochloroacetic Acid		µg/L	<2.0	2.0		
Monobromoacetic Acid		µg/L	<2.0	2.0		
Dichloroacetic Acid		µg/L	<2.0	2.0		
Dibromoacetic Acid		µg/L	<2.0	2.0		
Trichloroacetic Acid		µg/L	<2.0	2.0		
Total Haloacetic Acids (HAA5)		µg/L	<10.0	2.0	80	Below MAC

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Methodology and Notes

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	Courier: Government Compound	Project Name:	Compound	Control Number:	C107139
	Waterton Lakes National Park	Project Location:	Waterton	Date Received:	May 3, 2018
	Waterton, AB, Canada	LSD:		Date Reported:	May 23, 2018
	T0K 2M0	P.O.:	Mastercard	Report Number:	2283034
Attn:	Layton Banack	Proj. Acct. code:			
Sampled By:					
Company:					

Method of Analysis

Method Name	Reference		Method	Date Analysis Started	Location
Alkalinity, pH, and EC in water	APHA	*	Alkalinity - Titration Method, 2320 B	May 7, 2018	Exova Edmonton
Alkalinity, pH, and EC in water	APHA	*	Conductivity, 2510 B	May 7, 2018	Exova Edmonton
Alkalinity, pH, and EC in water	APHA	*	pH - Electrometric Method, 4500-H+ B	May 7, 2018	Exova Edmonton
Ammonium-N in Water	APHA	*	Automated Phenate Method, 4500-NH3 G	May 7, 2018	Exova Edmonton
Anions (Routine) by Ion Chromatography	APHA	*	Ion Chromatography with Chemical Suppression of Eluent Cond., 4110 B	May 7, 2018	Exova Edmonton
Approval-Edmonton	APHA		Checking Correctness of Analyses, 1030 E	May 7, 2018	Exova Edmonton
Bromate in Water	APHA	*	Single-Column Ion Chromatography with Electronic Suppression, 4110 C	May 8, 2018	Exova Edmonton
Carbon Organic (Total) in water (TOC)	APHA		High-Temperature Combustion Method, 5310 B	May 7, 2018	Exova Edmonton
Chlorate and Chlorite by Ion Chromatography	APHA	*	Ion Chromatography with Chemical Suppression of Eluent Cond., 4110 B	May 8, 2018	Exova Edmonton
Chloride in Water	APHA	*	Automated Ferricyanide Method, 4500-Cl-E	May 7, 2018	Exova Edmonton
Chlorine (Free) in water	APHA	*	DPD Colorimetric Method, 4500-Cl G	May 7, 2018	Exova Edmonton
Chlorine (Total) in water	APHA	*	DPD Colorimetric Method, 4500-Cl G	May 7, 2018	Exova Edmonton
Colour (Apparent) in water	APHA	*	Visual Comparison Method, 2120 B	May 7, 2018	Exova Edmonton
Cyanide (Dissolved) in water	Alta. Env. Method	*	Cyanide, Simple Extractable (Automated Pyridine-Barbituric Acid Colorimetric Method), 06608L	May 9, 2018	Exova Edmonton
Glyphosate - Water	US EPA	*	Solvent Extractable Nonvolatile Compounds by HPLC/TS/MS or UV Detection, 8321 B	May 10, 2018	Exova Calgary
Haloacetic Acids - Water	US EPA	*	US EPA method, 552.3	May 9, 2018	Eurofins Scientific - Ottawa
HCGCMS Pesticides - Water	US EPA	*	OC Pesticides by Gas Chromatography, 8081B	May 7, 2018	Exova Calgary
HCGCMS Pesticides - Water	US EPA	*	OP Compounds by Gas Chromatography: Capillary Column Techniq, 8141A	May 7, 2018	Exova Calgary
HCLCMS Pesticides - Water	USGS	*	Determination of Pesticides in Water by Graphitized Carbon-Based SPE & HPLC/MS, O-2060-1	May 7, 2018	Exova Calgary
HCVOC - Water	US EPA	*	Volatile Organic Compounds by GCMS / Purge and Trap for Aqueous Samples, 8260B/5030B	May 7, 2018	Exova Calgary
Mercury (Total) in water	US EPA	*	Determination of Hg in Sediment by Cold Vapor Atomic Absorption Spec, 245.5	May 8, 2018	Exova Edmonton
Metals ICP-MS (Total) in water	US EPA	*	Determination of Trace Elements in Waters and Wastes by ICP-MS, 200.8	May 7, 2018	Exova Edmonton
Metals Trace (Extractable) in water	APHA		Hardness by Calculation, 2340 B	May 7, 2018	Exova Edmonton

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Methodology and Notes

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	Waterton Lakes National Park	Project Location:	Waterton	Date Received:	May 3, 2018
	Waterton, AB, Canada	LSD:		Date Reported:	May 23, 2018
	T0K 2M0	P.O.:	Mastercard	Report Number:	2283034
Attn:	Layton Banack	Proj. Acct. code:			
Sampled By:					
Company:					

Method Name	Reference		Method	Date Analysis Started	Location
Metals Trace (Extractable) in water	APHA	*	Inductively Coupled Plasma (ICP) Method, 3120 B	May 7, 2018	Exova Edmonton
Nitrilotriacetic acid in water	Ext. Lab		Analysis performed by external laboratory, .	May 16, 2018	Saskatchewan Research Council
PAH - Water	AESRD		Carcinogenic PAHs Toxic Potency Equivalence (as B(a)P TPE), PAHw	May 7, 2018	Exova Calgary
PAH - Water	US EPA	*	Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry, 8270	May 7, 2018	Exova Calgary
PCP - Water	US EPA	*	Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry, 8270	May 7, 2018	Exova Calgary
Sulfide in water	APHA	*	Gas Dialysis, Automated Methylene Blue Method, 4500-S2- E	May 9, 2018	Exova Edmonton
TEH-CCME - Water	EPA/CCME	*	Separatory Funnel Liquid-liquid Extraction/CCME, EPA 3510/CCME	May 7, 2018	Exova Calgary
Turbidity in Water	APHA	*	Turbidity - Nephelometric Method, 2130 B	May 7, 2018	Exova Edmonton

** Reference Method Modified*

References

AESRD	Alberta Tier 1 Soil and Groundwater Remediation Guidelines
Alta. Env. Method	Alberta Environment Method
APHA	Standard Methods for the Examination of Water and Wastewater
APHA/USEPA	Standard Methods For Water/ Environmental Protection Agency
EPA	Environmental Protection Agency Test Methods - US
EPA/CCME	Environmental Protection Agency Test Methods - US/CCME
Ext. Lab	External Laboratory
US EPA	US Environmental Protection Agency Test Methods
USGS	U.S. Geological Survey National Water Quality Laboratory

Guidelines

Guideline Description	Health Canada GCDWQ
Guideline Source	Guidelines for Canadian Drinking Water Quality, Health Canada, February 2017
Guideline Comments	MAC = Maximum Acceptable Concentration AO = Aesthetic Objective OG = Operational Guideline for Water Treatment Plants (does not apply to private groundwater wells). Refer to Health Canada for complete guidelines at www.hc-sc.gc.ca

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Methodology and Notes

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Company:					

The comparison of test results to guideline limits is provided for information purposes only. This is not to be taken as a statement of conformance / nonconformance to any guideline, regulation or limit. The data user is responsible for all conclusions drawn with respect to the data and is advised to consult official regulatory references when evaluating compliance.

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Report Transmission Cover Page

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	T0K 2M0	P.O.:	Mastercard	Report Number:	2283034
Attn:	Layton Banack	Proj. Acct. code:			
Sampled By:					
Company:					

Contact	Company	Address
Layton Banack	**Parks Canada - Waterton Lakes**	Courier: Government Compound, Waterton Lakes National Park Waterton, AB T0K 2M0 Phone: (403) 859-5104 Fax: (403) 859-5152 Email: layton.banack@pc.gc.ca

Delivery	Format	Deliverables
Automated Fax	PDF	COC / Test Report
Email - Merge Reports	PDF	COC / Test Report
Email - Single Report	PDF	COA
Email - Single Report	PDF	Invoice

Notes To Clients:

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	T0K 2M0	P.O.:	Mastercard	Report Number:	2283034
Attn:	Layton Banack	Proj. Acct. code:			
Sampled By:					
Company:					

Reference Number	1268415-1
Sample Date	May 03, 2018
Sample Time	11:00
Sample Location	
Sample Description	Compound / 9.1C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Inorganic Nonmetallic Parameters						
Ammonia - N		mg/L	<0.03	0.025		
Ammonium/Ammonia Preservation			Yes			
Sulfide	Total	mg/L	<0.002	0.002	0.05	Below AO
Organic Carbon	Total Nonpurgeable	mg/L	1.3	0.5		
Chlorine	Total	mg/L	<0.1	0.1		
Chlorine	Free	mg/L	<0.1	0.1		
Chloramine		mg/L	<0.1	0.1	3	Below MAC
Chlorate	Dissolved	mg/L	<0.1	0.1	1.0	Below MAC
Chlorite	Dissolved	mg/L	<0.2	0.2	1.0	Below MAC
Cyanide	Dissolved	mg/L	<0.002	0.002	0.2	Below MAC
Bromate	Dissolved	mg/L	<0.003	0.003	0.01	Below MAC
Hydrogen Sulfide	Calculated	mg/L	<0.002			
Metals Total						
Mercury	Total	mg/L	<0.000005	0.000005	0.001	Below MAC
Aluminum	Total	mg/L	<0.005	0.005	0.1	Below OG
Antimony	Total	mg/L	<0.0002	0.0002	0.006	Below MAC
Arsenic	Total	mg/L	<0.0002	0.0002	0.01	Below MAC
Barium	Total	mg/L	0.400	0.001	1.0	Below MAC
Boron	Total	mg/L	0.015	0.002	5.0	Below MAC
Cadmium	Total	mg/L	<0.00001	0.00001	0.005	Below MAC
Chromium	Total	mg/L	<0.0005	0.0005	0.05	Below MAC
Copper	Total	mg/L	0.011	0.001	1.0	Below AO
Lead	Total	mg/L	0.0005	0.0001	0.01	Below MAC
Selenium	Total	mg/L	<0.0002	0.0002	0.05	Below MAC
Silver	Total	mg/L	<0.00001	0.00001		
Uranium	Total	mg/L	<0.0005	0.0005	0.02	Below MAC
Zinc	Total	mg/L	0.009	0.001	5.0	Below AO
Physical and Aggregate Properties						
Colour	Apparent, Potable	Colour units	<5	5	15	Below AO
Turbidity		NTU	0.3	0.1	0.1	Above OG
Polycyclic Aromatic Hydrocarbons - Water						
Naphthalene		µg/L	<0.1	0.1		
Quinoline		µg/L	<0.3	0.3		
Acenaphthylene		µg/L	<0.1	0.1		
Acenaphthene		µg/L	<0.1	0.1		
Fluorene		µg/L	<0.1	0.1		
Phenanthrene		µg/L	<0.1	0.1		

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Attn:	Layton Banack	Proj. Acct. code:			
Sampled By:					
Company:					

Reference Number	1268415-1
Sample Date	May 03, 2018
Sample Time	11:00
Sample Location	
Sample Description	Compound / 9.1C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Polycyclic Aromatic Hydrocarbons - Water - Continued						
Acridine		µg/L	<0.1	0.1		
Anthracene		µg/L	<0.005	0.005		
Fluoranthene		µg/L	<0.01	0.01		
Pyrene		µg/L	<0.01	0.01		
Benzo(a)anthracene		µg/L	<0.01	0.01		
Chrysene		µg/L	<0.1	0.1		
Benzo(b)fluoranthene		µg/L	<0.1	0.1		
Benzo(b+j)fluoranthene		µg/L	<0.1	0.1		
Benzo(k)fluoranthene		µg/L	<0.1	0.1		
Benzo(a)pyrene		µg/L	<0.008	0.008	0.04	Below MAC
Indeno(1,2,3-c,d)pyrene		µg/L	<0.05	0.05		
Dibenzo(a,h)anthracene		µg/L	<0.05	0.05		
Benzo(g,h,i)perylene		µg/L	<0.05	0.05		
CB(a)P	Total Potency Equivalents	µg/L	<0.01	0.01		
Benzo(a)pyrene		mg/L	<0.000008	0.000008	0.00004	Below MAC
Routine Water						
pH			7.92		7.0-10.5	Within OG Range
Temperature of observed pH		°C	22.2			
Electrical Conductivity	at 25 °C	µS/cm	307	1		
Calcium	Extractable	mg/L	36.7	0.2		
Magnesium	Extractable	mg/L	18.3	0.2		
Sodium	Extractable	mg/L	2.5	0.4	200	Below AO
Potassium	Extractable	mg/L	0.6	0.4		
Iron	Extractable	mg/L	0.03	0.01	0.3	Below AO
Manganese	Extractable	mg/L	<0.005	0.005	0.05	Below AO
Chloride	Dissolved	mg/L	1.5	0.4	250	Below AO
Fluoride		mg/L	<0.05	0.05	1.5	Below MAC
Nitrate - N		mg/L	0.89	0.01	10	Below MAC
Nitrite - N		mg/L	<0.005	0.005	1	Below MAC
Nitrate and Nitrite - N		mg/L	0.89	0.01	10	Below MAC
Sulfate (SO4)	Extractable	mg/L	9.7	0.9	500	Below AO
Hydroxide		mg/L	<5			
Carbonate		mg/L	<6			
Bicarbonate		mg/L	194			
P-Alkalinity	as CaCO3	mg/L	<5.0	5		
T-Alkalinity	as CaCO3	mg/L	159	5		

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Sampled By:					
Company:					

Reference Number	1268415-1
Sample Date	May 03, 2018
Sample Time	11:00
Sample Location	
Sample Description	Compound / 9.1C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Routine Water - Continued						
Total Dissolved Solids		mg/L	165	1	500	Below AO
Hardness	as CaCO3	mg/L	167.0			
Ionic Balance		%	99			
Extractable Petroleum Hydrocarbons - Water						
F2 C10-C16		mg/L	<0.1	0.1		
F3 C16-C34		mg/L	<0.1	0.1		
Glyphosate in Water						
Glyphosate		mg/L	<0.01	0.01	0.28	Below MAC
PAH - Water - Surrogate Recovery						
Nitrobenzene-d5	PAH - Surrogate	%	83	50-140		
2-Fluorobiphenyl	PAH - Surrogate	%	71	50-140		
p-Terphenyl-d14	PAH - Surrogate	%	66	50-140		
Subcontracted Analysis						
Nitrilotriacetic Acid		mg/L	<0.1	0.1	0.4	Below MAC
Health Canada Drinking Water - Organics						
Benzene		mg/L	<0.001	0.001	0.005	Below MAC
Bromodichloromethane		mg/L	0.001	0.001		
Bromoform		mg/L	<0.001	0.001		
Carbon Tetrachloride		mg/L	<0.001	0.001	0.002	Below MAC
Chlorobenzene		mg/L	<0.001	0.001	0.03	Below AO
Chloroform		mg/L	0.003	0.001		
Dibromochloromethane		mg/L	<0.001	0.001		
1,2-Dichlorobenzene		mg/L	<0.001	0.001	0.003 AO; 0.2 MAC	Below AO
1,4-Dichlorobenzene		mg/L	<0.001	0.001	0.001 AO; 0.005 MAC	Below AO
1,2-Dichloroethane		mg/L	<0.001	0.001	0.005	Below MAC
1,1-Dichloroethene		mg/L	<0.001	0.001	0.014	Below MAC
2,4 & 2,5-Dichlorophenol		mg/L	<0.0001	0.0001	0.0003 AO; 0.9 MAC	Below AO
Ethylbenzene		mg/L	<0.001	0.001	0.0016 AO; 0.14 MAC	Below AO
Methyl t-Butyl Ether		mg/L	<0.001	0.001	0.015	Below AO
Methylene Chloride		mg/L	<0.005	0.005	0.05	Below MAC
Pentachlorophenol		mg/L	<0.0001	0.0001	0.03	Below AO
Tetrachloroethene		mg/L	<0.001	0.001	0.01	Below MAC
2,3,4,6-Tetrachlorophenol		mg/L	<0.0001	0.0001	0.001	Below AO
Toluene		mg/L	<0.001	0.001	0.024 AO; 0.060 MAC	Below AO

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Reference Number	1268415-1
Sample Date	May 03, 2018
Sample Time	11:00
Sample Location	
Sample Description	Compound / 9.1C
Sample Matrix	Water

Analyte	Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Health Canada Drinking Water - Organics - Continued					
Total Trihalomethanes	mg/L	0.005	0.001	0.1	Below MAC
Total Xylenes (m,p,o)	mg/L	<0.001	0.001	0.02 AO; 0.09 MAC	Below AO
Trichloroethene	mg/L	<0.001	0.001	0.005	Below MAC
2,4,6-Trichlorophenol	mg/L	<0.0001	0.0001	0.002	Below AO
Vinyl Chloride	mg/L	<0.002	0.002	0.002	Below MAC
Health Canada Drinking Water - Pesticides					
Aldicarb	mg/L	<0.0001	0.0001		
Aldrin	mg/L	<0.0005	0.0005		
Dieldrin	mg/L	<0.0005	0.0005		
Atrazine	mg/L	<0.0001	0.0001	0.005	Below MAC
Deethylatrazine	mg/L	<0.0001	0.0001	0.005	Below MAC
Deisopropylatrazine	mg/L	<0.0001	0.0001	0.005	Below MAC
Didealkylatrazine	mg/L	<0.0001	0.0001	0.005	Below MAC
Azinphos-methyl	mg/L	<0.0005	0.0005	0.02	Below MAC
Bendiocarb	mg/L	<0.0001	0.0001		
Bromoxynil	mg/L	<0.0001	0.0001	0.005	Below MAC
Carbaryl	mg/L	<0.0001	0.0001	0.09	Below MAC
Carbofuran	mg/L	<0.0001	0.0001	0.09	Below MAC
Chlorpyrifos	mg/L	<0.0005	0.0005	0.09	Below MAC
Cyanazine	mg/L	<0.0001	0.0001		
2,4-D	mg/L	<0.0001	0.0001	0.1	Below MAC
Diazinon	mg/L	<0.0001	0.00010	0.02	Below MAC
Dicamba	mg/L	<0.0001	0.0001	0.12	Below MAC
Diclofop-methyl	mg/L	<0.0002	0.0002	0.009	Below MAC
Dimethoate	mg/L	<0.0005	0.0005	0.02	Below MAC
Dinoseb	mg/L	<0.0001	0.0001		
Diuron	mg/L	<0.0001	0.0001	0.15	Below MAC
Malathion	mg/L	<0.0001	0.0001	0.19	Below MAC
MCPA	mg/L	<0.0001	0.0001	0.1	Below MAC
Methoxychlor	mg/L	<0.0005	0.0005		
Metolachlor	mg/L	<0.0005	0.0005	0.05	Below MAC
Metribuzin	mg/L	<0.0005	0.0005	0.08	Below MAC
Parathion	mg/L	<0.0005	0.0005		
Phorate	mg/L	<0.0005	0.0005	0.002	Below MAC
Picloram	mg/L	<0.0001	0.0001	0.19	Below MAC
Simazine	mg/L	<0.0001	0.0001	0.01	Below MAC
Terbufos	mg/L	<0.0005	0.0005	0.001	Below MAC

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Analytical Report

Bill To:	Parks Canada - Waterton Lakes	Project ID:	Kenow	Lot ID:	**1268415**
	Courier: Government Compound	Project Name:	Compound	Control Number:	C107139
	Waterton Lakes National Park	Project Location:	Waterton	Date Received:	May 3, 2018
	Waterton, AB, Canada	LSD:		Date Reported:	May 23, 2018
	T0K 2M0	P.O.:	Mastercard	Report Number:	2283034
Attn:	Layton Banack	Proj. Acct. code:			
Sampled By:					
Company:					

Reference Number	1268415-1
Sample Date	May 03, 2018
Sample Time	11:00
Sample Location	
Sample Description	Compound / 9.1C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Health Canada Drinking Water - Pesticides - Continued						
Triallate		mg/L	<0.0001	0.00010		
Trifluralin		mg/L	<0.0001	0.0001	0.045	Below MAC
Health Canada DW - Pesticides - Surrogate Recovery						
TPP	Surrogate	%	118	50-140		
3,5-DCBA	Surrogate	%	69	50-140		
BDMC	Surrogate	%	82	50-140		
Monuron	Surrogate	%	82	50-140		
Haloacetic Acids - Water						
Monochloroacetic Acid		µg/L	<2.0	2.0		
Monobromoacetic Acid		µg/L	<2.0	2.0		
Dichloroacetic Acid		µg/L	<2.0	2.0		
Dibromoacetic Acid		µg/L	<2.0	2.0		
Trichloroacetic Acid		µg/L	<2.0	2.0		
Total Haloacetic Acids (HAA5)		µg/L	<10.0	2.0	80	Below MAC

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Analytical Report

Bill To:	Parks Canada - Waterton Lakes	Project ID:	Kenow	Lot ID:	**1268415**
	Courier: Government Compound	Project Name:	Compound	Control Number:	C107139
	Waterton Lakes National Park	Project Location:	Waterton	Date Received:	May 3, 2018
	Waterton, AB, Canada	LSD:		Date Reported:	May 23, 2018
	T0K 2M0	P.O.:	Mastercard	Report Number:	2283034
Attn:	Layton Banack	Proj. Acct. code:			
Sampled By:					
Company:					

Reference Number	1268415-2
Sample Date	May 03, 2018
Sample Time	11:00
Sample Location	
Sample Description	Townsite / 9.1C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Inorganic Nonmetallic Parameters						
Ammonia - N		mg/L	<0.03	0.025		
Ammonium/Ammonia Preservation			Yes			
Sulfide	Total	mg/L	<0.002	0.002	0.05	Below AO
Organic Carbon	Total Nonpurgeable	mg/L	0.6	0.5		
Chlorine	Total	mg/L	1.1	0.1		
Chlorine	Free	mg/L	1.0	0.1		
Chloramine		mg/L	<0.1	0.1	3	Below MAC
Chlorate	Dissolved	mg/L	0.1	0.1	1.0	Below MAC
Chlorite	Dissolved	mg/L	<0.2	0.2	1.0	Below MAC
Cyanide	Dissolved	mg/L	<0.002	0.002	0.2	Below MAC
Bromate	Dissolved	mg/L	<0.003	0.003	0.01	Below MAC
Hydrogen Sulfide	Calculated	mg/L	<0.002			
Metals Total						
Mercury	Total	mg/L	<0.000005	0.000005	0.001	Below MAC
Aluminum	Total	mg/L	<0.005	0.005	0.1	Below OG
Antimony	Total	mg/L	<0.0002	0.0002	0.006	Below MAC
Arsenic	Total	mg/L	<0.0002	0.0002	0.01	Below MAC
Barium	Total	mg/L	0.173	0.001	1.0	Below MAC
Boron	Total	mg/L	0.008	0.002	5.0	Below MAC
Cadmium	Total	mg/L	<0.00001	0.00001	0.005	Below MAC
Chromium	Total	mg/L	<0.0005	0.0005	0.05	Below MAC
Copper	Total	mg/L	0.004	0.001	1.0	Below AO
Lead	Total	mg/L	0.0001	0.0001	0.01	Below MAC
Selenium	Total	mg/L	<0.0002	0.0002	0.05	Below MAC
Silver	Total	mg/L	<0.00001	0.00001		
Uranium	Total	mg/L	<0.0005	0.0005	0.02	Below MAC
Zinc	Total	mg/L	0.003	0.001	5.0	Below AO
Physical and Aggregate Properties						
Colour	Apparent, Potable	Colour units	<5	5	15	Below AO
Turbidity		NTU	<0.1	0.1	0.1	Below OG
Polycyclic Aromatic Hydrocarbons - Water						
Naphthalene		µg/L	<0.1	0.1		
Quinoline		µg/L	<0.3	0.3		
Acenaphthylene		µg/L	<0.1	0.1		
Acenaphthene		µg/L	<0.1	0.1		
Fluorene		µg/L	<0.1	0.1		
Phenanthrene		µg/L	<0.1	0.1		

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Analytical Report

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	Courier: Government Compound	Project Name:	Compound	Control Number:	C107139
	Waterton Lakes National Park	Project Location:	Waterton	Date Received:	May 3, 2018
	Waterton, AB, Canada	LSD:		Date Reported:	May 23, 2018
	T0K 2M0	P.O.:	Mastercard	Report Number:	2283034
Attn:	Layton Banack	Proj. Acct. code:			
Sampled By:					
Company:					

Reference Number	1268415-2
Sample Date	May 03, 2018
Sample Time	11:00
Sample Location	
Sample Description	Townsite / 9.1C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Polycyclic Aromatic Hydrocarbons - Water - Continued						
Acridine		µg/L	<0.1	0.1		
Anthracene		µg/L	<0.005	0.005		
Fluoranthene		µg/L	<0.01	0.01		
Pyrene		µg/L	<0.01	0.01		
Benzo(a)anthracene		µg/L	<0.01	0.01		
Chrysene		µg/L	<0.1	0.1		
Benzo(b)fluoranthene		µg/L	<0.1	0.1		
Benzo(b+j)fluoranthene		µg/L	<0.1	0.1		
Benzo(k)fluoranthene		µg/L	<0.1	0.1		
Benzo(a)pyrene		µg/L	<0.008	0.008	0.04	Below MAC
Indeno(1,2,3-c,d)pyrene		µg/L	<0.05	0.05		
Dibenzo(a,h)anthracene		µg/L	<0.05	0.05		
Benzo(g,h,i)perylene		µg/L	<0.05	0.05		
CB(a)P	Total Potency Equivalents	µg/L	<0.01	0.01		
Benzo(a)pyrene		mg/L	<0.000008	0.000008	0.00004	Below MAC
Routine Water						
pH			7.96		7.0-10.5	Within OG Range
Temperature of observed pH		°C	22.1			
Electrical Conductivity	at 25 °C	µS/cm	206	1		
Calcium	Extractable	mg/L	26.8	0.2		
Magnesium	Extractable	mg/L	10.0	0.2		
Sodium	Extractable	mg/L	2.0	0.4	200	Below AO
Potassium	Extractable	mg/L	<0.4	0.4		
Iron	Extractable	mg/L	<0.01	0.01	0.3	Below AO
Manganese	Extractable	mg/L	<0.005	0.005	0.05	Below AO
Chloride	Dissolved	mg/L	1.5	0.4	250	Below AO
Fluoride		mg/L	<0.05	0.05	1.5	Below MAC
Nitrate - N		mg/L	0.21	0.01	10	Below MAC
Nitrite - N		mg/L	0.019	0.005	1	Below MAC
Nitrate and Nitrite - N		mg/L	0.23	0.01	10	Below MAC
Sulfate (SO4)	Extractable	mg/L	11	0.9	500	Below AO
Hydroxide		mg/L	<5			
Carbonate		mg/L	<6			
Bicarbonate		mg/L	126			
P-Alkalinity	as CaCO3	mg/L	<5.0	5		
T-Alkalinity	as CaCO3	mg/L	103	5		

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	Waterton Lakes National Park	Project Location:	Waterton	Date Received:	May 3, 2018
	Waterton, AB, Canada	LSD:		Date Reported:	May 23, 2018
	T0K 2M0	P.O.:	Mastercard	Report Number:	2283034
Attn:	Layton Banack	Proj. Acct. code:			
Sampled By:					
Company:					

Reference Number	1268415-2
Sample Date	May 03, 2018
Sample Time	11:00
Sample Location	
Sample Description	Townsite / 9.1C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Routine Water - Continued						
Total Dissolved Solids		mg/L	113	1	500	Below AO
Hardness	as CaCO3	mg/L	108.0			
Ionic Balance		%	96			
Extractable Petroleum Hydrocarbons - Water						
F2 C10-C16		mg/L	<0.1	0.1		
F3 C16-C34		mg/L	<0.1	0.1		
Glyphosate in Water						
Glyphosate		mg/L	<0.01	0.01	0.28	Below MAC
PAH - Water - Surrogate Recovery						
Nitrobenzene-d5	PAH - Surrogate	%	72	50-140		
2-Fluorobiphenyl	PAH - Surrogate	%	59	50-140		
p-Terphenyl-d14	PAH - Surrogate	%	59	50-140		
Subcontracted Analysis						
Nitrilotriacetic Acid		mg/L	<0.1	0.1	0.4	Below MAC
Health Canada Drinking Water - Organics						
Benzene		mg/L	<0.001	0.001	0.005	Below MAC
Bromodichloromethane		mg/L	<0.001	0.001		
Bromoform		mg/L	<0.001	0.001		
Carbon Tetrachloride		mg/L	<0.001	0.001	0.002	Below MAC
Chlorobenzene		mg/L	<0.001	0.001	0.03	Below AO
Chloroform		mg/L	<0.001	0.001		
Dibromochloromethane		mg/L	<0.001	0.001		
1,2-Dichlorobenzene		mg/L	<0.001	0.001	0.003 AO; 0.2 MAC	Below AO
1,4-Dichlorobenzene		mg/L	<0.001	0.001	0.001 AO; 0.005 MAC	Below AO
1,2-Dichloroethane		mg/L	<0.001	0.001	0.005	Below MAC
1,1-Dichloroethene		mg/L	<0.001	0.001	0.014	Below MAC
2,4 & 2,5-Dichlorophenol		mg/L	<0.0001	0.0001	0.0003 AO; 0.9 MAC	Below AO
Ethylbenzene		mg/L	<0.001	0.001	0.0016 AO; 0.14 MAC	Below AO
Methyl t-Butyl Ether		mg/L	<0.001	0.001	0.015	Below AO
Methylene Chloride		mg/L	<0.005	0.005	0.05	Below MAC
Pentachlorophenol		mg/L	<0.0001	0.0001	0.03	Below AO
Tetrachloroethene		mg/L	<0.001	0.001	0.01	Below MAC
2,3,4,6-Tetrachlorophenol		mg/L	<0.0001	0.0001	0.001	Below AO
Toluene		mg/L	<0.001	0.001	0.024 AO; 0.060 MAC	Below AO

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	T0K 2M0	P.O.:	Mastercard	Report Number:	2283034
Attn:	Layton Banack	Proj. Acct. code:			
Sampled By:					
Company:					

Reference Number	1268415-2
Sample Date	May 03, 2018
Sample Time	11:00
Sample Location	
Sample Description	Townsite / 9.1C
Sample Matrix	Water

Analyte	Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Health Canada Drinking Water - Organics - Continued					
Total Trihalomethanes	mg/L	<0.001	0.001	0.1	Below MAC
Total Xylenes (m,p,o)	mg/L	<0.001	0.001	0.02 AO; 0.09 MAC	Below AO
Trichloroethene	mg/L	<0.001	0.001	0.005	Below MAC
2,4,6-Trichlorophenol	mg/L	<0.0001	0.0001	0.002	Below AO
Vinyl Chloride	mg/L	<0.002	0.002	0.002	Below MAC
Health Canada Drinking Water - Pesticides					
Aldicarb	mg/L	<0.0001	0.0001		
Aldrin	mg/L	<0.0005	0.0005		
Dieldrin	mg/L	<0.0005	0.0005		
Atrazine	mg/L	<0.0001	0.0001	0.005	Below MAC
Deethylatrazine	mg/L	<0.0001	0.0001	0.005	Below MAC
Deisopropylatrazine	mg/L	<0.0001	0.0001	0.005	Below MAC
Didealkylatrazine	mg/L	<0.0001	0.0001	0.005	Below MAC
Azinphos-methyl	mg/L	<0.0005	0.0005	0.02	Below MAC
Bendiocarb	mg/L	<0.0001	0.0001		
Bromoxynil	mg/L	<0.0001	0.0001	0.005	Below MAC
Carbaryl	mg/L	<0.0001	0.0001	0.09	Below MAC
Carbofuran	mg/L	<0.0001	0.0001	0.09	Below MAC
Chlorpyrifos	mg/L	<0.0005	0.0005	0.09	Below MAC
Cyanazine	mg/L	<0.0001	0.0001		
2,4-D	mg/L	<0.0001	0.0001	0.1	Below MAC
Diazinon	mg/L	<0.0001	0.00010	0.02	Below MAC
Dicamba	mg/L	<0.0001	0.0001	0.12	Below MAC
Diclofop-methyl	mg/L	<0.0002	0.0002	0.009	Below MAC
Dimethoate	mg/L	<0.0005	0.0005	0.02	Below MAC
Dinoseb	mg/L	<0.0001	0.0001		
Diuron	mg/L	<0.0001	0.0001	0.15	Below MAC
Malathion	mg/L	<0.0001	0.0001	0.19	Below MAC
MCPA	mg/L	<0.0001	0.0001	0.1	Below MAC
Methoxychlor	mg/L	<0.0005	0.0005		
Metolachlor	mg/L	<0.0005	0.0005	0.05	Below MAC
Metribuzin	mg/L	<0.0005	0.0005	0.08	Below MAC
Parathion	mg/L	<0.0005	0.0005		
Phorate	mg/L	<0.0005	0.0005	0.002	Below MAC
Picloram	mg/L	<0.0001	0.0001	0.19	Below MAC
Simazine	mg/L	<0.0001	0.0001	0.01	Below MAC
Terbufos	mg/L	<0.0005	0.0005	0.001	Below MAC

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	T0K 2M0	P.O.:	Mastercard	Report Number:	2283034
Attn:	Layton Banack	Proj. Acct. code:			
Sampled By:					
Company:					

Reference Number	1268415-2
Sample Date	May 03, 2018
Sample Time	11:00
Sample Location	
Sample Description	Townsite / 9.1C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Health Canada Drinking Water - Pesticides - Continued						
Triallate		mg/L	<0.0001	0.00010		
Trifluralin		mg/L	<0.0001	0.0001	0.045	Below MAC
Health Canada DW - Pesticides - Surrogate Recovery						
TPP	Surrogate	%	121	50-140		
3,5-DCBA	Surrogate	%	69	50-140		
BDMC	Surrogate	%	90	50-140		
Monuron	Surrogate	%	90	50-140		
Haloacetic Acids - Water						
Monochloroacetic Acid		µg/L	<2.0	2.0		
Monobromoacetic Acid		µg/L	<2.0	2.0		
Dichloroacetic Acid		µg/L	<2.0	2.0		
Dibromoacetic Acid		µg/L	<2.0	2.0		
Trichloroacetic Acid		µg/L	<2.0	2.0		
Total Haloacetic Acids (HAA5)		µg/L	<10.0	2.0	80	Below MAC

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Methodology and Notes

Bill To:	Parks Canada - Waterton Lakes	Project ID:	Kenow	Lot ID:	**1268415**
	Courier: Government Compound	Project Name:	Compound	Control Number:	C107139
	Waterton Lakes National Park	Project Location:	Waterton	Date Received:	May 3, 2018
	Waterton, AB, Canada	LSD:		Date Reported:	May 23, 2018
	T0K 2M0	P.O.:	Mastercard	Report Number:	2283034
Attn:	Layton Banack	Proj. Acct. code:			
Sampled By:					
Company:					

Method of Analysis

Method Name	Reference		Method	Date Analysis Started	Location
Alkalinity, pH, and EC in water	APHA	*	Alkalinity - Titration Method, 2320 B	May 7, 2018	Exova Edmonton
Alkalinity, pH, and EC in water	APHA	*	Conductivity, 2510 B	May 7, 2018	Exova Edmonton
Alkalinity, pH, and EC in water	APHA	*	pH - Electrometric Method, 4500-H+ B	May 7, 2018	Exova Edmonton
Ammonium-N in Water	APHA	*	Automated Phenate Method, 4500-NH3 G	May 7, 2018	Exova Edmonton
Anions (Routine) by Ion Chromatography	APHA	*	Ion Chromatography with Chemical Suppression of Eluent Cond., 4110 B	May 7, 2018	Exova Edmonton
Approval-Edmonton	APHA		Checking Correctness of Analyses, 1030 E	May 7, 2018	Exova Edmonton
Bromate in Water	APHA	*	Single-Column Ion Chromatography with Electronic Suppression, 4110 C	May 8, 2018	Exova Edmonton
Carbon Organic (Total) in water (TOC)	APHA		High-Temperature Combustion Method, 5310 B	May 7, 2018	Exova Edmonton
Chlorate and Chlorite by Ion Chromatography	APHA	*	Ion Chromatography with Chemical Suppression of Eluent Cond., 4110 B	May 8, 2018	Exova Edmonton
Chloride in Water	APHA	*	Automated Ferricyanide Method, 4500-Cl-E	May 7, 2018	Exova Edmonton
Chlorine (Free) in water	APHA	*	DPD Colorimetric Method, 4500-Cl G	May 7, 2018	Exova Edmonton
Chlorine (Total) in water	APHA	*	DPD Colorimetric Method, 4500-Cl G	May 7, 2018	Exova Edmonton
Colour (Apparent) in water	APHA	*	Visual Comparison Method, 2120 B	May 7, 2018	Exova Edmonton
Cyanide (Dissolved) in water	Alta. Env. Method	*	Cyanide, Simple Extractable (Automated Pyridine-Barbituric Acid Colorimetric Method), 06608L	May 9, 2018	Exova Edmonton
Glyphosate - Water	US EPA	*	Solvent Extractable Nonvolatile Compounds by HPLC/TS/MS or UV Detection, 8321 B	May 10, 2018	Exova Calgary
Haloacetic Acids - Water	US EPA	*	US EPA method, 552.3	May 9, 2018	Eurofins Scientific - Ottawa
HCGCMS Pesticides - Water	US EPA	*	OC Pesticides by Gas Chromatography, 8081B	May 7, 2018	Exova Calgary
HCGCMS Pesticides - Water	US EPA	*	OP Compounds by Gas Chromatography: Capillary Column Techniq, 8141A	May 7, 2018	Exova Calgary
HCLCMS Pesticides - Water	USGS	*	Determination of Pesticides in Water by Graphitized Carbon-Based SPE & HPLC/MS, O-2060-1	May 7, 2018	Exova Calgary
HCVOC - Water	US EPA	*	Volatile Organic Compounds by GCMS / Purge and Trap for Aqueous Samples, 8260B/5030B	May 7, 2018	Exova Calgary
Mercury (Total) in water	US EPA	*	Determination of Hg in Sediment by Cold Vapor Atomic Absorption Spec, 245.5	May 8, 2018	Exova Edmonton
Metals ICP-MS (Total) in water	US EPA	*	Determination of Trace Elements in Waters and Wastes by ICP-MS, 200.8	May 7, 2018	Exova Edmonton
Metals Trace (Extractable) in water	APHA		Hardness by Calculation, 2340 B	May 7, 2018	Exova Edmonton

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Methodology and Notes

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	Courier: Government Compound	Project Name:	Compound	Control Number:	C107139
	Waterton Lakes National Park	Project Location:	Waterton	Date Received:	May 3, 2018
	Waterton, AB, Canada	LSD:		Date Reported:	May 23, 2018
	T0K 2M0	P.O.:	Mastercard	Report Number:	2283034
Attn:	Layton Banack	Proj. Acct. code:			
Sampled By:					
Company:					

Method Name	Reference		Method	Date Analysis Started	Location
Metals Trace (Extractable) in water	APHA	*	Inductively Coupled Plasma (ICP) Method, 3120 B	May 7, 2018	Exova Edmonton
Nitrilotriacetic acid in water	Ext. Lab		Analysis performed by external laboratory, .	May 16, 2018	Saskatchewan Research Council
PAH - Water	AESRD		Carcinogenic PAHs Toxic Potency Equivalence (as B(a)P TPE), PAHw	May 7, 2018	Exova Calgary
PAH - Water	US EPA	*	Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry, 8270	May 7, 2018	Exova Calgary
PCP - Water	US EPA	*	Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry, 8270	May 7, 2018	Exova Calgary
Sulfide in water	APHA	*	Gas Dialysis, Automated Methylene Blue Method, 4500-S2- E	May 9, 2018	Exova Edmonton
TEH-CCME - Water	EPA/CCME	*	Separatory Funnel Liquid-liquid Extraction/CCME, EPA 3510/CCME	May 7, 2018	Exova Calgary
Turbidity in Water	APHA	*	Turbidity - Nephelometric Method, 2130 B	May 7, 2018	Exova Edmonton

** Reference Method Modified*

References

AESRD	Alberta Tier 1 Soil and Groundwater Remediation Guidelines
Alta. Env. Method	Alberta Environment Method
APHA	Standard Methods for the Examination of Water and Wastewater
APHA/USEPA	Standard Methods For Water/ Environmental Protection Agency
EPA	Environmental Protection Agency Test Methods - US
EPA/CCME	Environmental Protection Agency Test Methods - US/CCME
Ext. Lab	External Laboratory
US EPA	US Environmental Protection Agency Test Methods
USGS	U.S. Geological Survey National Water Quality Laboratory

Guidelines

Guideline Description	Health Canada GCDWQ
Guideline Source	Guidelines for Canadian Drinking Water Quality, Health Canada, February 2017
Guideline Comments	MAC = Maximum Acceptable Concentration AO = Aesthetic Objective OG = Operational Guideline for Water Treatment Plants (does not apply to private groundwater wells). Refer to Health Canada for complete guidelines at www.hc-sc.gc.ca

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Methodology and Notes

Bill To:	Parks Canada - Waterton Lakes	Project ID:	Kenow	Lot ID:	**1268415**
	Courier: Government Compound	Project Name:	Compound	Control Number:	C107139
	Waterton Lakes National Park	Project Location:	Waterton	Date Received:	May 3, 2018
	Waterton, AB, Canada	LSD:		Date Reported:	May 23, 2018
	T0K 2M0	P.O.:	Mastercard	Report Number:	2283034
Attn:	Layton Banack	Proj. Acct. code:			
Sampled By:					
Company:					

The comparison of test results to guideline limits is provided for information purposes only. This is not to be taken as a statement of conformance / nonconformance to any guideline, regulation or limit. The data user is responsible for all conclusions drawn with respect to the data and is advised to consult official regulatory references when evaluating compliance.

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