Public Works and Government Services Canada

Rideau Canal – Ottawa Walls

RS 2.1.2 – Investigations, Studies and Reports
Clegg Street - Site 2

Project reference: R.079197.036

Prepared by:

AECOM
85, Sainte-Catherine Street West 514 287 8500 tel
Montréal, Québec, Canada H2X 3P4 514 287 8600 fax
www.aecom.com

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Project Number: 60557894

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AECOM
85, Sainte-Catherine Street West
Montréal, Québec, Canada
H2X 3P4
www.aecom.com

514 287 8500 tel
514 287 8600 fax

January 10, 2019

Ms. Sarah Davidson
Project Manager, Parks Canada Infrastructure,
Real Property Branch,
Public Services and Procurement Canada
E-mail: sarah.davidson@pwgsc-tpsgc.gc.ca

Dear Ms. Davidson:

Project No: 60557894

Regarding: Rideau Canal – Ottawa Walls
RS 2.1.2 – Investigations, Studies and Reports
Clegg Street - Site 2
PWGSC Project Number R.079197.036

AECOM Consultants Inc. is pleased to provide Public Works and Government Services Canada (PWGSC) with our RS 2.1.2– Investigations, Studies and Reports for Clegg Street – Site 2.

The RS 2.1.2 analysis was conducted in general conformance with the Project Call up dated October 25, 2017 and our Project Proposal submitted in October 2017.

The geotechnical investigations and bathymetric surveys were conducted between November 2017 and May 2018. The keys tasks undertaken in completing this report included geotechnical recommendations based on the field investigations results.

We express our appreciation to PWGSC and Parks Canada staff for providing valuable input and assistance throughout the course of the study. We are available to elaborate on any aspect of the report at your request.

Sincerely,
AECOM Consultants Inc.

Annie Dumas, P.Eng.
Project Manager
annie.dumas@aecom.com

AD/rb
Encl.
cc:

Quality information

Report Prepared By:

Mamadou Badiane,
Geotechnical Engineer

Report Reviewed By:

Romeo Ciubotariu,
Geotechnical Engineer

Report Approved By:

Annie Dumas, Hydraulic Engineer
Project Manager

Revision History

Revision	Revision date	Details	Authorized	Name	Position

Distribution List

# Hard Copies	PDF Required	Association / Company Name
0	Yes	PWGSC

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1. Introduction

1.1 Background

The Ontario Waterways Unit of the PCA owns and operates the Rideau Canal which is a 202 km waterway that extends from Kingston to Ottawa. PCA operates approximately 40 dams and locks on the waterway. Many of the marine assets on the waterway date back to their original construction period of 1826 -1831 and are of national historic significance. The Rideau Canal itself is designated as a National Historic site and part of UNESCO's World Heritage sites. The main purpose of the canal system is for navigation and recreation. Boating navigation Season is from mid-May to mid-October.

The Concrete retaining walls along the Rideau Canal are concrete mass gravity structures that have seen multiple phases of rehabilitation programs since their original inception starting in 1826. The present concrete retaining walls would have been erected in the early 1930's or there about to stabilize the embankments.

These resources, which are conserved in their current state as part of a life cycle maintenance program by Parks Canada, are subject to many other applicable regulations and Acts, including the act and regulation under the responsibility of the National Capital Commission (NCC).

1.2 Objectives

AECOM was mandated by Public Works and Government Services Canada (PWGSC) to undertake a bathymetric survey and geotechnical and concrete investigation of the Rideau Canal in four locations. The four locations are all situated in the Downtown Ottawa portion of the Rideau Canal, from lock 8 by the National Arts Centre (NAC) to Bank Street. The sites are the following:

- Site 1 – Pig Island, Colonel By Drive, East Bank; Approximately 130 m length, 20 m off the front face of the canal wall.
- Site 2 – Clegg Street Intersection and Fifth Avenue, East and West Banks, Approximately 450 m and 550 m on the East and West Banks respectively, 15 m off front face of canal wall.
- Site 3 – Colonel By Drive parallel to Echo Drive, East Bank; Approximately 1000 m length, 15 m off front face of canal wall.
- Site 4 – Downtown Rideau Canal core from Plaza Bridge (Wellington) at the top of Lock 8 to approximately 50 m south of Corktown Bridge. Approximately 950 m length, full width of the canal channel.

Figure 1-1 shows a general location plan.

The current report presents the bathymetric survey and the results of the geotechnical investigations at site 2. The bathymetric survey and geotechnical and concrete investigations for sites 3 and 4 are presented in separate reports.

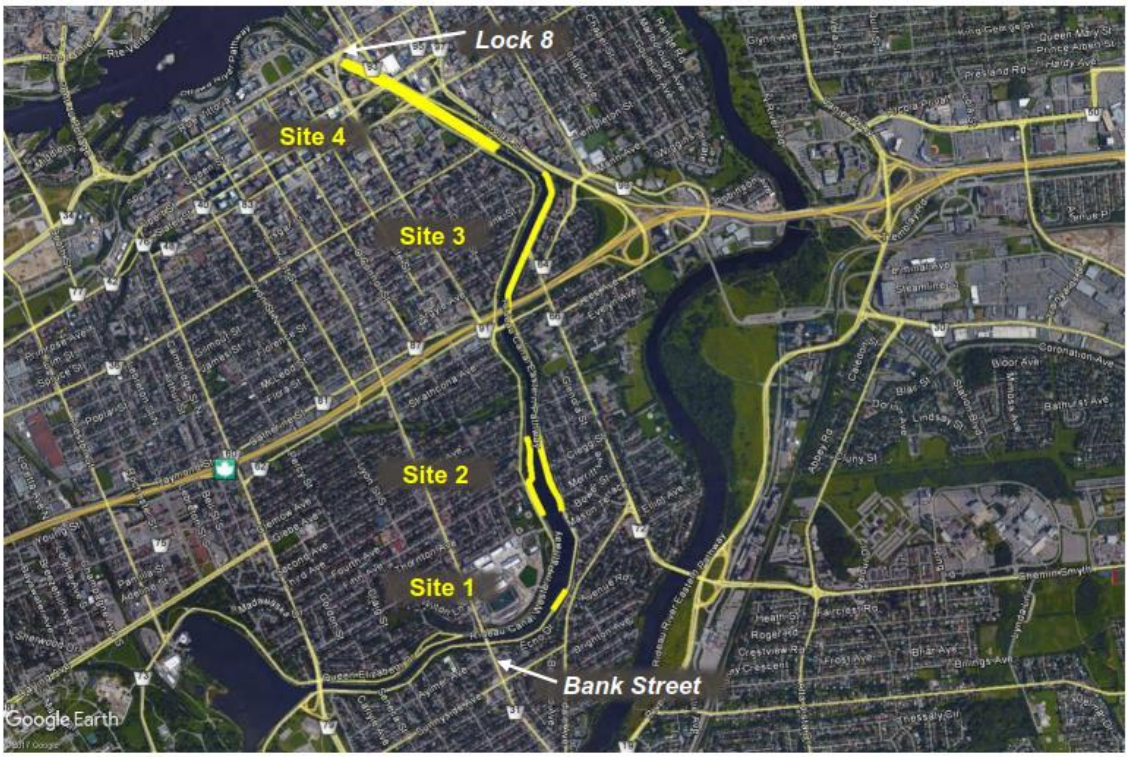


Figure 1-1 General location plan

The purpose of the geotechnical and concrete investigations is to determine the design parameters (seismic site class, net bearing capacity of the existing soil (Ultimate Limit State/Serviceability Limit State), active and passive soil pressure coefficients, concrete condition, etc.) for the design of the rehabilitation of retaining walls along the Rideau Canal. The purpose of the bathymetric survey is to determine the soil and canal bed elevations and profiles along the walls at the identified work locations for potential future cofferdam systems.

1.3 Report Content

The current report includes the following sections:

- Section 2: Geotechnical Investigations ;
- Section 3: Geotechnical Recommendations;
- Section 4: Utility Report;
- Section 5: Bathymetric Survey.

2. Geotechnical Investigations

2.1 General

Geotechnical field investigations were carried out by GHD for site 2 in order to determine the subsurface conditions. Two (2) boreholes were executed with varying depths. Soil laboratory testing (Grain size distributions and Atterberg limits) on samples collected from the boreholes have been carried out in order to characterize the geotechnical properties of the soil materials.

This section presents a summary of the results of the Geotechnical Investigations carried out by GHD at site 2 in May 2018.

Table 2-1 presents the list of boreholes with their coordinates. Boreholes location plan is presented in Appendix A.

Table 2-1 Location of Boreholes

Boreholes (BH)	Northing	Easting
BH15 – Canal	5 029 868	368 914
BH17 – Canal	5 029 631	368 991

Note : Coordinates are based on the MTM datum, zone 9, NAD 1983 adjustment. Elevations are based on the CGVD 1928-1978 datum.

2.2 Geotechnical Drillings and Laboratory Testing

Two boreholes were performed on site 2, BH15 and BH17. Boreholes were advanced into the Rideau Canal bed to a depth of approximately 10 meters below the water sediment interface. A track mounted CME-55LC drill rig adapted for geotechnical sampling, mounted on a barge was used. These boreholes were advanced into the overburden using wash-boring equipment between the dates of May 8 through May 11, 2018 to carry out the drilling. Two grain sizes analyses and two Atterberg limits from the 2 boreholes were executed.

2.3 Results of the Geotechnical Investigations

A detailed description of the subsurface conditions is presented in the borehole logs attached in Appendix B. Table 2-2 summarizes the subsurface conditions for boreholes BH15 and BH17 which were advanced into the Rideau Canal bed to a depth of approximately 10 meters below the water-sediment interface.

Table 2-2 Stratigraphy on site 2

Borehole ID	Sediments		Silty sand		Silt and clay		Glacial till	
	Top of layer Elevation (m)	Thick-ness (m)	Top of layer Elevation (m)	Thick-ness (m)	Top of layer Elevation (m)	Thick-ness (m)	Top of layer Elevation (m)	Thick-ness (m)
BH15	61.99	0.19	61.8	1.3	60.5	8.3	52.2	> 0.4
BH17	61.81	0.91	60.9	> 9.3	-	-	-	-

2.3.1 Sediments

Sediments found in boreholes BH15 and BH17 were described as silty sand with trace or some gravel and organics, loose, dark grey or light brown and wet. The thickness of this layer varies between 0.19 m (BH15) and 0.91 m (BH17).

2.3.2 Silty Sand

A native silty sand deposit with a thickness of 1.3 m was encountered in BH15 and extended to the full depth of the borehole (thickness > 9.3 m) in BH17. Based on the SPT "N" profile presented in Figure 2-1, the compactness of this material can be described as very loose to loose between elevations 61.5 and 55.6 m. Below elevation 55.6 m, it can be described as compact. Table 2-3 presents the sieves analysis results of the silty sand material. Sieve analysis graphs are illustrated in Appendix C.

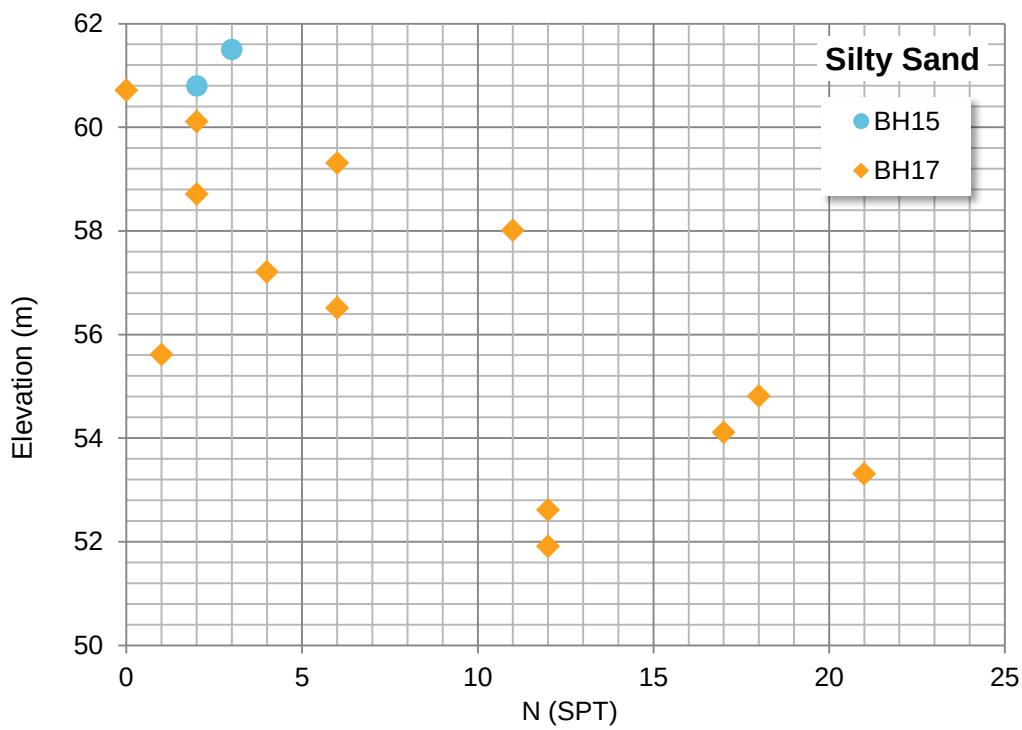


Figure 2-1 SPT "N" profile of silty sand material on site 2

Table 2-3 Laboratory testing results (Sieve analysis) of silty sand material sample on site 2

Sample ID and depth	% gravel	% sand	% fine particles
BH17-SS5 (2.7 - 3.3 m)	0.1	63.3	36.6
BH17-SS7 (4.3 - 4.9 m)	0	61.8	38.2

2.3.3 Silt and Clay

A native silt and clay deposit was encountered in borehole BH15 with a thickness of 8.3 m. Based on the shear strength measured in-situ and showed in Figure 2-2, this soil can be described as stiff in consistency. The sensitivity value of the soil varies between 7.2 and 17 which represents a very high value (Canadian Foundation Engineering Manuel, 2006). Atterberg limit testing completed on two representative samples SS3 (1.5-2.1 depth) and SS6 (7.3-7.9 m) indicate a classification of low plasticity inorganic clay (CL) in SS3 and high plasticity inorganic clay (CH) in SS6. The results are presented in Table 2-4 below.

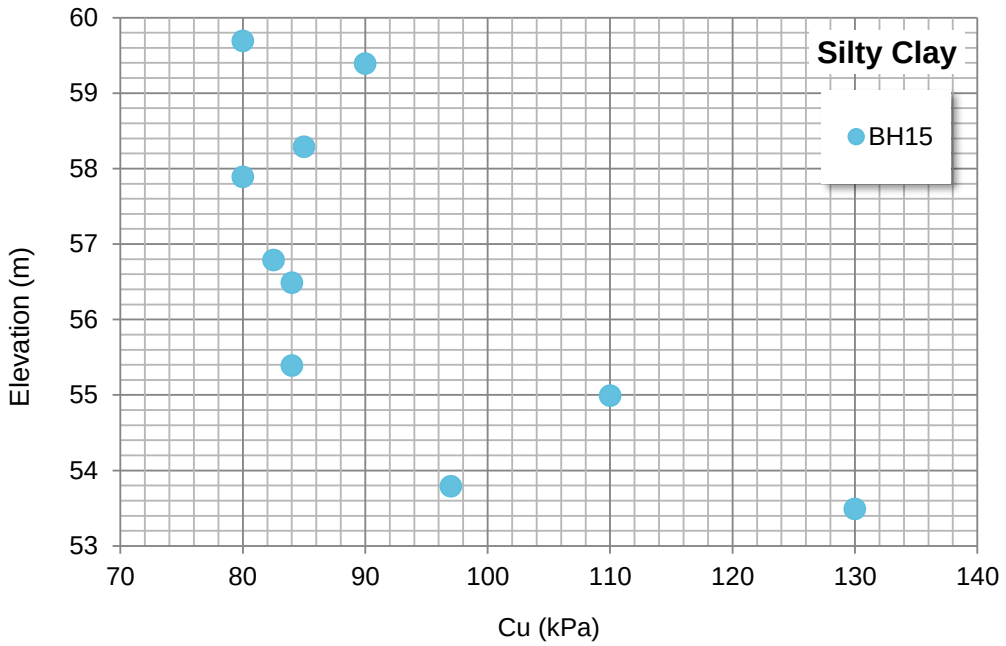


Figure 2-2 Shear strength profile of silty clay materials on site 2

Table 2-4 Laboratory testing (Atterberg limits) results of silty clay material sample on site 2

Sample ID and depth	Liquid limit (LL)	Plastic limit (PL)	Plasticity index (PI)	Natural water content (%)	USCS Classification
BH15-SS3 (1.5 - 2.1 m)	27	14	13	28	CL
BH15-SS6 (7.3 - 7.9 m)	53	20	33	38	CH

2.3.4 Glacial till

A native glacial till deposit was encountered in borehole BH15. This layer was described as grey in colour, dense and wet.

3. Geotechnical Recommendations

3.1 Seismic Site Classification

The Canadian Highway Bridge Design Code (S6-14) presents the Site Classification for seismic site response at Table 4.1 of section 4.4.3.2 and is illustrated in Table 3-1 below.

Based on the geotechnical investigations results (Undrained shear stress for the silty clay material and $N_{1\text{-}60}$ for the silty sand material), a class D can be retained for site 2.

Table 3-1 Site Classification for Seismic Site Response (from S6-14)

		Average properties in top 30 m		
Site class	**Ground profile name**	**Shear wave average velocity, $\bar{V}_s$ (m/s)**	**Standard penetration resistance, $\bar{N}_{60}$**	**Soil undrained shear strength, s_u**
A	Hard rock(1,2)	$\bar{V}_s > 1500$	Not applicable	Not applicable
B	Rock(1)	$760 < \bar{V}_s \leq 1500$	Not applicable	Not applicable
C	Very dense soil and soft rock	$360 < \bar{V}_s < 760$	$\bar{N}_{60} > 50$	$s_u > 100$ kPa
D	Stiff soil	$180 < \bar{V}_s < 360$	$15 \leq \bar{N}_{60} \leq 50$	$50 < s_u \leq 100$ kPa
E	Soft soil	$\bar{V}_s < 180$	$\bar{N}_{60} < 15$	$s_u < 50$ kPa
		Any profile with more than 3 m of soil with the following characteristics: • Plastic index PI > 20; • Moisture content w ≥ 40%; and • Undrained shear strength $s_u < 25$ kPa		
F	Other soil(3)	Site specific evaluation required		

3.2 Liquefaction Potential of On-Site Soils

3.2.1 Analysis Method and Results

The liquefaction potential of the silty sand deposit encountered in BH17 has been verified following the method proposed by Youd et al, 2001.The analysis was carried out using magnitude earthquake (Mw) of 6.8; Mean seismic hazard values for this site were provided by the Canadian Geological Survey. The corresponding PGA, according to Natural Resources Canada for this site is 0.281 g.

The results of the analysis indicate that some portions of the silty sand deposit encountered presents a liquefaction potential.

3.2.2 Recommendations

In order to give recommendations about the liquefaction at this site, further investigations are required due to the following reasons:

- Two boreholes were executed at site 2, one shows a silty sand foundation material and the second a silty clay materials. It is important to know exactly the proportion of foundation constituted by silty sand.
- There is no information about the type of foundation (shallow or deep). If the foundation is deep and supported by piles resting on dense materials, there is no risk of liquefaction. However, if the foundation is shallow the risks exist and should be further evaluated after additional information is made available (boreholes, field and laboratory tests).

3.3 Foundation

3.3.1 Bearing capacity at ULS and SLS

Ultimate bearing capacity of the retaining wall is calculated considering that the foundation is placed at the same level as the existing one (EL. 59 to 61 m approx.) which corresponds to a depth of 4-6 m.

The bearing capacity at the Ultimate Limit State (ULS), for a foundation placed directly on the undisturbed native deposit, can be calculated using the following formula:

$$q_{ULS} = c\,N_c + q\,N_q + 0{,}5\gamma\,BN_\gamma$$

where:

q_{ULS}	:	Ultimate geotechnical resistance pressure (kPa);
c	:	Soil cohesion (kPa);
N_c, N_q, N_γ	:	Bearing coefficients, function of the value of the effective internal friction angle (φ);
Q	:	Vertical stress acting at the elevation of the base of the foundation
γ	:	Unit weight of the soil under the foundation (kN/m³);
B	:	Width of the foundation (m).

Strength parameters(friction angle) and unit weight for the materials have been chosen based on the literature and on relationships with blow count N_{SPT} from LRFD bridge design (AASTHO, 2004). Table 3-2 summarizes the geotechnical parameters to be used considering a silty sand or silt and clay foundation. Short term analyses were conducted for the silty clay foundation. Calculations are made for both soil types and the most critical is chosen.

Table 3-2 Geotechnical parameters for bearing capacity calculations on site 2

Parameters		Values	
		Silt and Clay	**Silty Sand**
Cohesion (kPa)		85 (undrained shear strength Cu)	0 (drained shear strength c')
Unit weight ϒ(kN/m^3)		17	19.3
Vertical stress (kPa)		ϒ*H (total stress)	ϒ' * H (effective stress)
Bearing parameters :	Nc	5.14	32.7
	Nq	1	20.6

Parameters	Values	
	Silt and Clay	**Silty Sand**
Ngamma	0	16.1

The ultimate geotechnical resistance pressure (ULS) must be multiplied by an ultimate geotechnical resistance factor (φ) to provide the factored geotechnical resistance pressure for foundation design. These factors are presented at Table 8.1 of Canadian Foundation Engineering Manual. An ultimate geotechnical resistance factor (φ) of 0.5 is recommended.

All foundations shall be designed so as not to exceed the allowable stress in the soil. The allowable stress (SLS) can be calculated by using the following formula:

$$q_a = \frac{q_u}{FS}$$

Table 3-3 summarizes the ULS and SLS bearing values for different foundation depths and a foundation width B of 2.5 m.

Table 3-3 Bearing resistances for shallow foundations at site 2

Foundation depth (m)	Silty Clay			Silty Sand		
	ULS (kPa)	Factored ULS (kPa)	SLS (kPa)	ULS (kPa)	Factored ULS (kPa)	SLS (kPa)
4	505	253	168	977	488	326
4.5	514	257	171	1075	537	358
5	522	261	174	1173	586	391
5.5	531	265	177	1271	635	424
6	539	270	180	1369	685	456

3.3.2 Settlements

Preconsolidation pressure (σ'_p) of the silt and clay deposit has been estimated based on following equations proposed by Leroueil and al. (1983):

$$Cu_{FVT}/\sigma'_p = 0{,}20 + 0{,}0024\ PI$$

With:

$C_{u\ FVT}$: Shear strength from Field Vane Tests (kPa) ;

I_p : Plasticity Index (%)

Based on the Plasticity Index of the silty clay measured in the laboratory (see Table 2-4), preconsolidation pressure σ'_p varies between 346 kPa and 562 kPa . Figure 3-1 illustrates the preconsolidation and effective pressure profile at site 2.

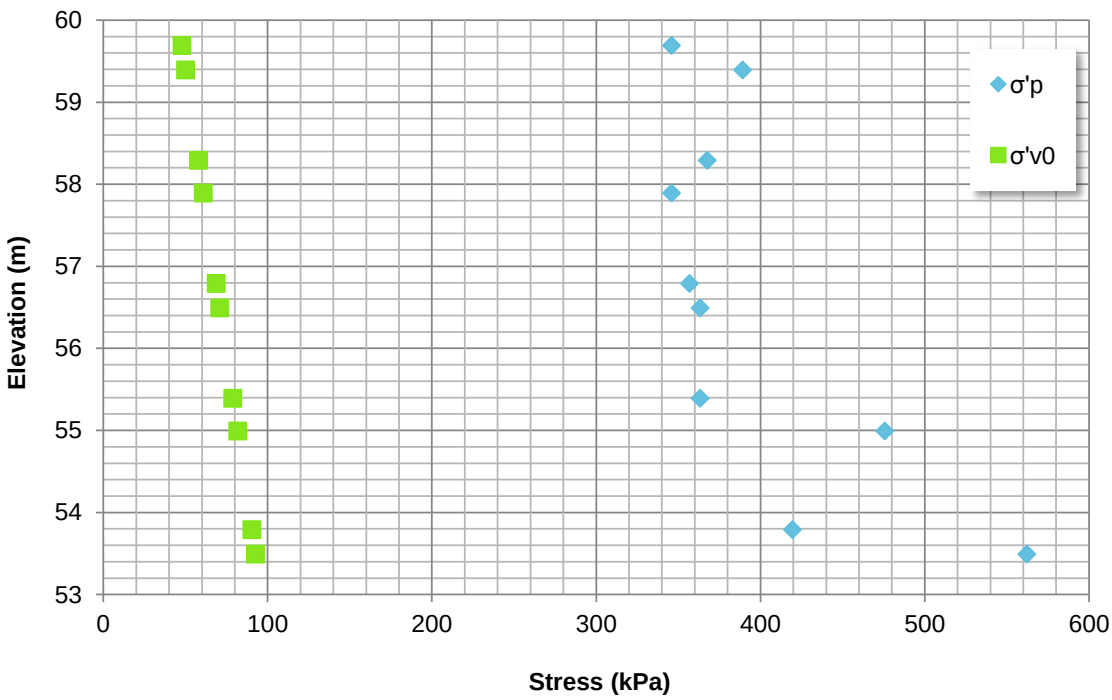


Figure 3-1 Preconsolidation and effective pressure profile at site 2

In Figure 3-1, it is possible to observe that the available pressure gap ($\sigma'_p - \sigma'_{v0}$) is between 284 and 470 kPa. If the wall rests directly on the native soil, the pressure applied by the retaining wall should be less than these values to avoid settlements.

3.4 Lateral Static and Dynamic Earth Design Pressures on Retaining Structure

The geotechnical parameters to be considered for the calculation of the earth pressure on the retaining wall are given in Table 3-4. No boreholes were performed behind the retaining wall at site 2. It is assumed in the calculations that the material behind the wall is mostly similar to the material observed in front of the wall as observed also at site 4.

Table 3-4 Geotechnical parameters for calculation of earth design pressures on the retaining wall at site 2

Silty Clay	Geotechnical Parameter
Angle of internal friction (ϕ)	28
Bulk unit weight (γ)	17
At rest pressure coefficient (K_0)	0.53
Active earth pressure (Ka)	0.33
Dynamic active earth pressure (K_{ae})	0.47
Passive earth pressure (Kp)	4.33
Dynamic passive earth pressure (K_{pe})	3.63

Equations used for these calculations are from the Canadian Foundation Engineering Manual and are presented below:

$$K_0 = 1 - sin(\phi)$$

$$K_a = \frac{cos^2(\emptyset - \theta)}{cos^2(\theta)\, cos(\delta + \theta)\left(1 + \sqrt{\frac{sin(\delta + \emptyset) sin(\emptyset - \beta)}{cos(\delta + \theta) cos(\beta - \theta)}}\right)^2}$$

$$K_{ae} = \frac{cos^2(\emptyset - \theta - \psi)}{cos(\psi)\, cos^2(\theta)\, cos(\delta + \theta + \psi)\left(1 + \sqrt{\frac{sin(\delta + \emptyset) sin(\emptyset - \beta - \psi)}{cos(\delta - \theta + \psi) cos(\beta - \theta)}}\right)^2}$$

$$K_p = \frac{cos^2(\emptyset + \theta)}{cos^2(\theta)\, cos(\delta - \theta)\left(1 - \sqrt{\frac{sin(\delta + \emptyset) sin(\emptyset + \beta)}{cos(\delta - \theta) cos(\beta - \theta)}}\right)^2}$$

$$K_{pe} = \frac{cos^2(\emptyset + \theta - \psi)}{cos(\psi)\, cos^2(\theta)\, cos(\delta - \theta + \psi)\left(1 - \sqrt{\frac{sin(\delta + \emptyset) sin(\emptyset + \beta - \psi)}{cos(\delta - \theta + \psi) cos(\beta - \theta)}}\right)^2}$$

With:

φ	:	Internal friction angle of soil (°)
δ	:	Friction angle at the interface wall-soil (°)
β	:	Slope of embankment to the horizontal plane (°)
θ	:	Slope of the wall (°)
ψ	:	Seismic component **=** $tan^{-1}(\frac{k_h}{1-k_v})$
k_h and k_v	:	respectively horizontal and vertical acceleration coefficients

3.5 Recommendations for Site Preparation, Frost Protection and Excavation

The high sensibility of the silty clay deposit at site 2 can cause a loose consistency and low bearing capacity of the material if it is disturbed. Therefore, all precautions should be taken during construction to avoid disturbance of the native soil. The installation of a thin layer of concrete or granular material can be contemplated to allow circulation of machines.

For frost protection, the footings of the foundation should be placed at a depth greater than the frost depth in this area (1.8 – 2 m).

During the works, the excavation should be carried out in accordance with the latest edition of the Ontario Occupational Health & Safety Act (OHSA) and Regulations for Construction Projects. OHSA indicates the maximum slope of excavation depending on the type of soil. The type of soil based on the boreholes is 3 and 4. The bottom of the excavations and the slopes should be dewatered by building a cofferdam on the river side, and by excavating trenches and pumping continuously at the land side. The pumped water should be discharged far away from the work site so as to not recharge the pumped water table.

4. Utility Locates

Utility of public and privately owned services has been located on site 2.

For all borehole locations, a private utility locating subcontractor was used to provide clearance of both public and privately owned services on the site. Clearance was obtained by GHD for all boreholes

A separate Utility Locations Report is also prepared to summarize utilities location for sites 2, 3 and 4.

5. Bathymetric Surveys

Survey works to provide bathymetric information at all four sites were conducted in January 2018 by a Professional Land Surveyor registered and licensed by the Association of Ontario Land Surveyors. The bathymetry coverage extends approximately to 20 m from the canal retaining wall at sites 1, 2 and 3. Horizontal data has been referenced into NAD83 MTM Zone 9 and vertical data referenced to the CGVD 1928-1978. The bathymetric surveys reports are presented in Appendix D.

6. References

1. AASTHO, 2004 - LRFD Bridge Design.

2. Canadian Foundation Engineering Manual. 2006 - Fourth Edition - Canadian Geotechnical Society.

3. CSA Group 2014 – CSA S6-14 Canadian Highway Bridge Design Code.

4. De Leuw, Cather & Company of Canada Limited, Colonel By Drive Extension, Sheets 44 to 46, 1966.

5. Lefebvre, 1981 : Strength and slope stability in Canadian soft clay deposits

6. Leroueil, S; Tavenas, F.; Samson, L and Morin, P; 1983 – Preconsolidation pressure of Champlain Clays. Part Ⅱ: laboratory determination

7. Youd, T. L. and al. « Liquefaction Resistance of Soils : Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils », Journal of Geotechnical and Geoenvironmental Engineering, vol. 127, n° 10, October 2001, p. 817-833.

Appendix A

Boreholes Location Plan

Source: MNRF NRVIS, 2017. Produced by GHD under licence from Ontario Ministry of Natural Resources and Forestry, © Queen's Printer 2018.
Aerial: Image ©2018 Google

0 10 20 30
Meters

Coordinate System:
NAD 1983 UTM Zone 18N

Legend

- Borehole Location
- Corehole Location

AECOM CONSULTANTS INC.
RIDEAU CANAL EASTERN PATHWAY
SITE 2
OTTAWA WALLS PROJECT

BOREHOLE AND COREHOLE LOCATION PLAN

11149792-A1
Jun 29, 2018

GIS File: Q:\GIS\PROJECTS\11149000s\11149792\Layouts\INT001\11149792-A1(INT001)GIS-WA002.mxd

Appendix B

Borehole Logs

Notes on Borehole and Test Pit Reports

Soil description :

Each subsurface stratum is described using the following terminology. The relative density of granular soils is determined by the Standard Penetration Index ("N" value), while the consistency of clayey sols is measured by the value of undrained shear strength (Cu).

Classification (Unified system)

Clay	< 0.002 mm		
Silt	0.002 to 0.075 mm		
Sand	0.075 to 4.75 mm	fine	0.075 to 4.25 mm
		medium	0.425 to 2.0 mm
		coarse	2.0 to 4.75 mm
Gravel	4.75 to 75 mm	fine	4.75 to 19 mm
		coarse	19 to 75 mm
Cobbles	75 to 300 mm		
Boulders	>300 mm		

Terminology

"trace"	1-10%
"some"	10-20%
adjective (silty, sandy)	20-35%
"and"	35-50%

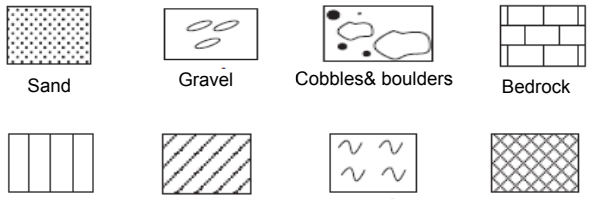
Relative density of granular soils	Standard penetration index "N" value (BLOWS/ft – 300 mm)
Very loose	0-4
Loose	4-10
Compact	10-30
Dense	30-50
Very dense	>50

Consistency of cohesive soils	Undrained shear strength (Cu) (P.S.F)	(kPa)
Very soft	<250	<12
Soft	250-500	12-25
Firm	500-1000	25-50
Stiff	1000-2000	50-100
Very stiff	2000-4000	100-200
Hard	>4000	>200

Rock quality designation

"RQD" (%) Value	Quality
<25	Very poor
25-50	Poor
50-75	Fair
75-90	Good
>90	Excellent

STRATIGRAPHIC LEGEND



Samples:

Type and Number

The type of sample recovered is shown on the log by the abbreviation listed hereafter. The numbering of samples is sequential for each type of sample.

SS: Split spoon
SSE, GSE, AGE: Environmental sampling
ST: Shelby tube
PS: Piston sample (Osterberg)
AG: Auger
RC: Rock core
GS: Grab sample

Recovery

The recovery, shown as a percentage, is the ratio of length of the sample obtained to the distance the sampler was driven/pushed into the soil

RQD

The "Rock Quality Designation" or "RQD" value, expressed as percentage, is the ratio of the total length of all core fragments of 4 inches (10 cm) or more to the total length of the run.

IN-SITU TESTS:

N: Standard penetration index
R: Refusal to penetration
N_c: Dynamic cone penetration index
Cu: Undrained shear strength
Pr: Pressure meter
k: Permeability
ABS: Absorption (Packer test)

LABORATORY TESTS:

I_p: Plasticity index
W_l: Liquid limit
Wp: Plastic limit
H: Hydrometer analysis
GSA: Grain size analysis
A: Atterberg limits
w: Water content
γ: Unit weight
C: Consolidation
CS: Swedish fall cone
CHEM: Chemical analysis
O.V.: Organic vapor

REFERENCE No.: 11149792-A1 ENCLOSURE No.: 12

BOREHOLE No.: BH15

ELEVATION: 61.99 m

BOREHOLE LOG

Page: 1 of 1

CLIENT: AECOM Consultants Inc.

PROJECT: Ottawa Walls Geotechnical Investigation

LOCATION: Rideau Canal, Ottawa Ontario

DESCRIBED BY: S. Wheeler CHECKED BY: B. Vazhbakht

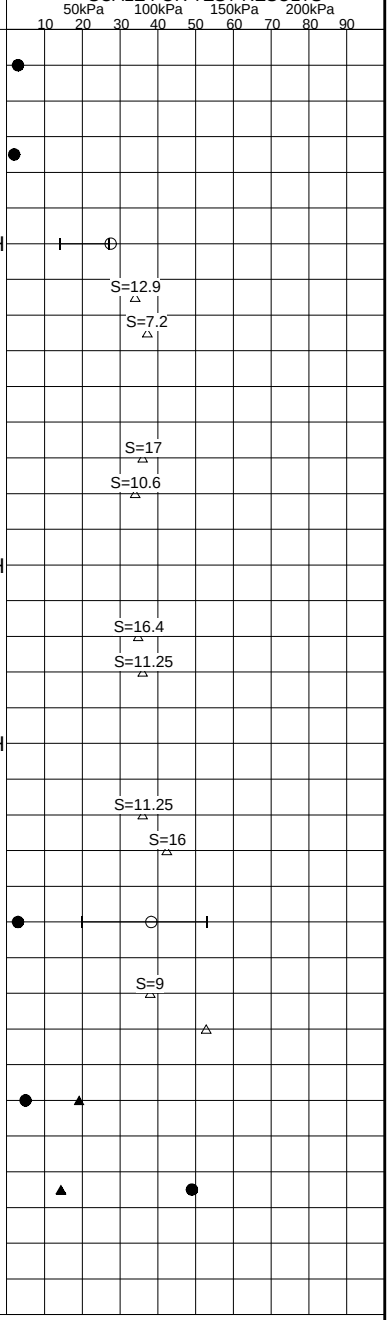
DATE (START): 10 May 2018 DATE (FINISH): 10 May 2018

LEGEND

- SS Split Spoon
- GS Auger Sample
- ST Shelby Tube
- Water Level
- Water content (%)
- Atterberg limits (%)
- N Penetration Index based on Split Spoon sample
- N Penetration Index based on Dynamic Cone sample
- Cu Shear Strength based on Field Vane
- Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- Shear Strength based on Pocket Penetrometer

SCALE		STRATIGRAPHY		SAMPLE DATA					
Depth BGS	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	OVC	Penetration Index / RQD	
meters	61.99		GROUND SURFACE			%	ppm	N	
	61.8		**SEDIMENTS-** Silty sand some gravel, some organics dark grey, loose, wet		SS1	8/24		3	
0.5			**SILTY SAND SOME GRAVEL-** Grey, loose, wet						
1.0			*Becoming clayey silt and sand, moist		SS2	19/24		2	
1.5	60.5		**SILT AND CLAY-** Trace sand, grey, stiff, moist		SS3	24/24		WH	
2.0					FV1				S=12.9
2.5					FV2				S=7.2
3.0			*Material in Shelby tube appeared similar to material above		ST1				
3.5					FV3				S=17
4.0					FV4				S=10.6
4.5			*Becoming clay some silt trace sand seams		SS4	24/24		WH	
5.0					FV5				S=16.4
5.5					FV6				S=11.25
6.0					SS5	24/24		WH	
6.5					FV7				S=11.25
7.0					FV8				S=16
7.5					SS6	24/24		3	
8.0			*Exceeded vane capacity		FV9				S=9
8.5					FV10				
9.0			*Becoming some sand		SS7	24/24		5	
9.5	52.2		**GLACIAL TILL-** Silty sand, grey, dense, wet		SS8	8/24		49	
10.0	51.8		End of borehole at approximately 10.2 m depth						
10.5									

SCALE FOR TEST RESULTS



NOTES:
*FV indicates Field Vane Test
*Pocket Pen values are for internal GHD use only
*Elevations surveyed by GHD Field Staff relative to coping elevation 64.62 masl

REFERENCE No.: 11149792-A1 ENCLOSURE No.: 13

BOREHOLE No.: BH17

ELEVATION: 61.81 m

BOREHOLE LOG

Page: 1 of 1

CLIENT: AECOM Consultants Inc.

PROJECT: Ottawa Walls Geotechnical Investigation

LOCATION: Rideau Canal, Ottawa Ontario

DESCRIBED BY: S. Wheeler CHECKED BY: B. Vazhbakht

DATE (START): 11 May 2018 DATE (FINISH): 11 May 2018

LEGEND

- SS Split Spoon
- GS Auger Sample
- ST Shelby Tube
- Water Level
- Water content (%)
- Atterberg limits (%)
- N Penetration Index based on Split Spoon sample
- N Penetration Index based on Dynamic Cone sample
- Cu Shear Strength based on Field Vane
- Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- Shear Strength based on Pocket Penetrometer

SCALE		STRATIGRAPHY		SAMPLE DATA					
Depth BGS	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	OVC	Penetration Index / RQD	SCALE FOR TEST RESULTS (50kPa 100kPa 150kPa 200kPa; 10 20 30 40 50 60 70 80 90)
meters	61.81		GROUND SURFACE			%	ppm	N	
0.5			**SEDIMENTS-** Silty sand some organics light brown, loose, wet		SS1	13/24		4	
1.0	60.9		*Recovery limited by large piece of gravel **SILTY SAND-** Brownish grey, very loose, wet		SS2	2/24		WH	
1.5					SS3	20/24		2	
2.0									
2.5					SS4	14/24		6	
3.0					SS5	19/24		2	
3.5			*Becoming compact		SS6	16/24		11	
4.0									
4.5			*Becoming loose		SS7	9/24		4	
5.0									
5.5					SS8	11/24		6	
6.0			*Becoming trace silty seams, approximately 7 cm thick		SS9	15/24		1	
6.5			*Becoming compact						
7.0					SS10	16/24		18	
7.5					SS11	13/24		17	
8.0			*Some oxidation staining in sample						
8.5					SS12	13/24		21	
9.0					SS13	9/24		12	
9.5									
10.0	51.6				SS14	8/24		12	
10.5			End of borehole at approximately 10.2 m depth						

NOTES:
*FV indicates Field Vane Test
*Pocket Pen values are for internal GHD use only
*Elevations surveyed by GHD Field Staff relative to coping elevation 64.67 masl

AECOM

Appendix C

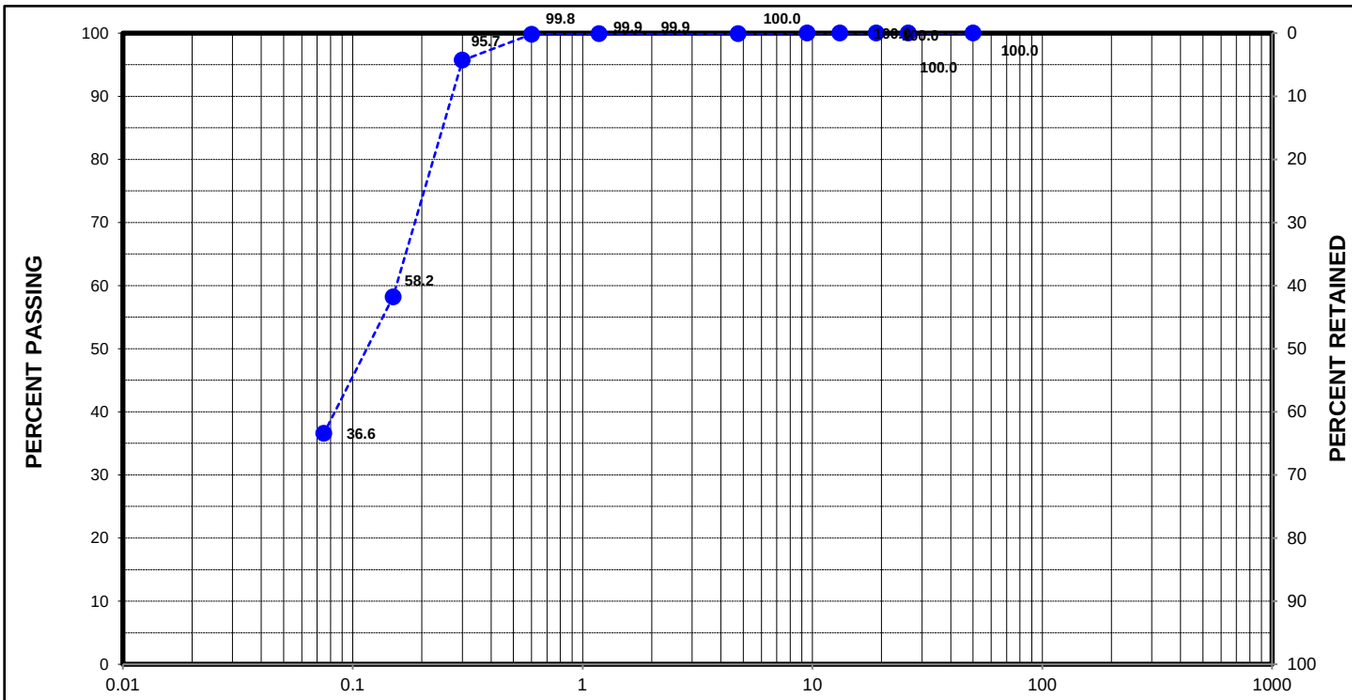
Laboratory Analysis Results

SIEVE ANALYSIS

CLIENT:	Aecom Consultants Inc.	**LAB No.:**	G-18-002
PROJECT/SITE:	Ottawa Walls Project	**PROJECT No.:**	11149792-A1

SOURCE:	BH17 SS5 (9' - 11')	**SAMPLE LOCATION:**	N/A
MATERIAL TYPE:	N/A	**PROPOSED USE:**	N/A
SAMPLED BY:	N/A	**DATE SAMPLED:**	N/A

SIEVE SIZE (mm)	SAMPLE % PASSING	
50.0	100.0	
26.2	100.0	
19.0	100.0	
13.2	100.0	
9.5	100.0	
4.75	99.9	
1.18	99.9	
0.600	99.8	
0.300	95.7	
0.150	58.2	
0.075	36.6	



REMARKS:

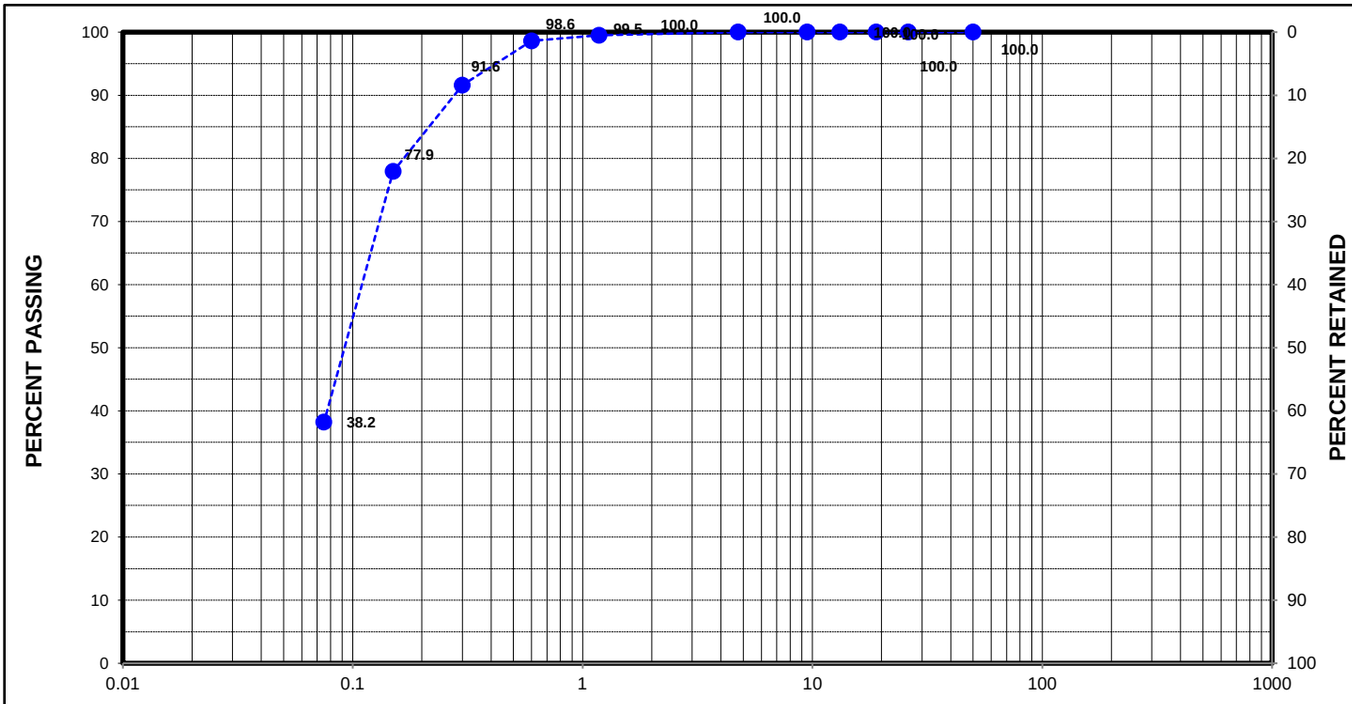
PERFORMED BY:	D. Umutoni	**DATE:**	June 21, 2018
VERIFIED BY:		**DATE:**	June 26, 2018

SIEVE ANALYSIS

CLIENT:	Aecom Consultants Inc.	**LAB No.:**	G-18-002
PROJECT/SITE:	Ottawa Walls Project	**PROJECT No.:**	11149792-A1

SOURCE:	BH17 SS7 (14' - 16')	**SAMPLE LOCATION:**	N/A
MATERIAL TYPE:	N/A	**PROPOSED USE:**	N/A
SAMPLED BY:	N/A	**DATE SAMPLED:**	N/A

SIEVE SIZE (mm)	SAMPLE % PASSING	
50.0	100.0	
26.2	100.0	
19.0	100.0	
13.2	100.0	
9.5	100.0	
4.75	100.0	
1.18	99.5	
0.600	98.6	
0.300	91.6	
0.150	77.9	
0.075	38.2	



REMARKS:

PERFORMED BY:	D. Umutoni	**DATE:**	June 21, 2018
VERIFIED BY:		**DATE:**	June 26, 2018

AECOM

Appendix D

Bathymetric Surveys Reports

J.D.BARNES LIMITED

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RIDEAU CANAL - SITE 2

Ottawa, Clegg Street Intersection and Fifth Avenue, East and West Banks

INFORMATION SHOWN BASED ON FIELD SURVEYS CARRIED OUT ON NOVEMBER 20, 2017, BY J.D. BARNES LIMITED.

Job No. 17-23-773-00

CROSS SECTION 001 WEST

CROSS SECTION CENTRE COORDINATES:

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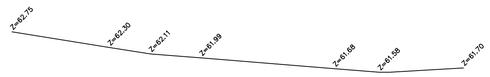
Y=5029933.45



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 001 EAST

CROSS SECTION CENTRE COORDINATES:

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Y=5029933.45

CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 002 WEST

CROSS SECTION CENTRE COORDINATES:

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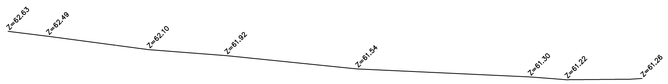
Y=5029926.10



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 002 EAST

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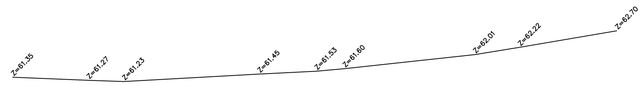

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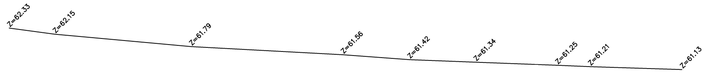

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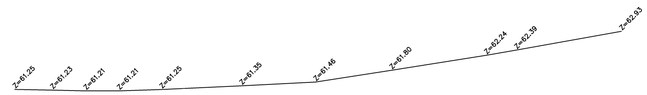

CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 004 WEST

CROSS SECTION CENTRE COORDINATES:

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CROSS SECTION LOOKING DOWNSTREAM

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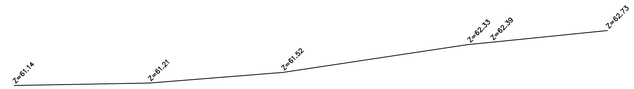
Y=5029906.58



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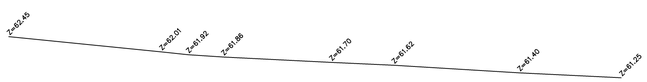

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CROSS SECTION 005 EAST

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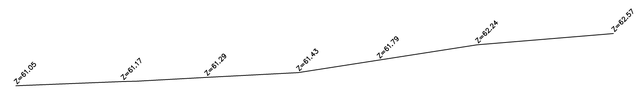

CROSS SECTION LOOKING DOWNSTREAM

NOTES:

1. INFORMATION SHOWN BASED ON FIELD SURVEYS CARRIED OUT ON MONDAY, NOVEMBER 20 2017 BY J.D. BARNES LIMITED.
2. DRAWING PREPARED IN BENTLEY POWERDRAFT V8i (DESCARTES).
3. DIMENSIONS SHOWN ARE IN METRES.
4. CROSS SECTIONS TAKEN EVERY 10m.
5. OUTER MOST ELEVATIONS SHOT AT FOOT OF CANAL WALL.
6. CENTRE OF RIVER NOT SURVEYED.

ISSUED FOR INFORMATION ONLY

NOT FOR CONSTRUCTION

SCALE BAR

5 0 5 metres

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RIDEAU CANAL CROSS SECTION – SITE 2

CROSS SECTIONS 1 – 5

REV. No.

SHEET No. 1/9

Job No. 17-23-773-00

		YYYY/MM/DD
DRAWN	K. HUNTER	2018/01/18
CHECKED	M. MAKARENKO	2018/01/18
CORRECT	Z. HERMAN	2018/01/18

CROSS SECTION 006 WEST

CROSS SECTION CENTRE COORDINATES:

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Y=5029887.39

CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 006 EAST

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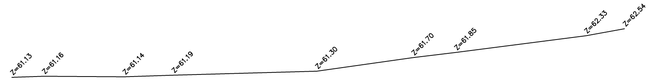

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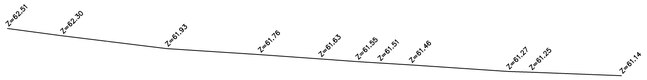

CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 007 EAST

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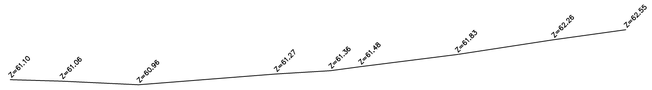

CROSS SECTION LOOKING DOWNSTREAM

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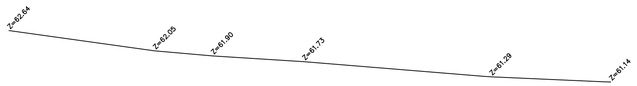

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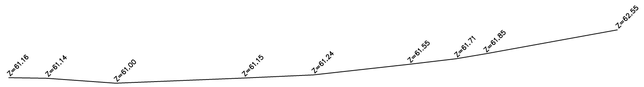

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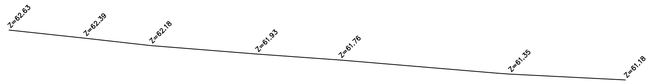

CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 009 EAST

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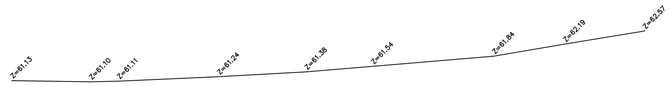

CROSS SECTION LOOKING DOWNSTREAM

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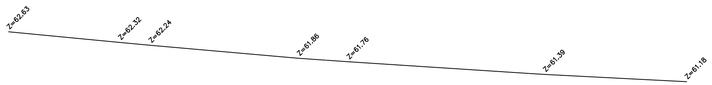

CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 010 EAST

CROSS SECTION CENTRE COORDINATES:

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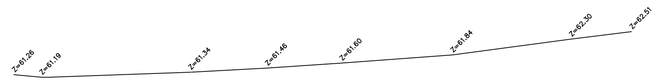

CROSS SECTION LOOKING DOWNSTREAM

NOTES:

1. INFORMATION SHOWN BASED ON FIELD SURVEYS CARRIED OUT ON MONDAY, NOVEMBER 20 2017 BY J.D. BARNES LIMITED.
2. DRAWING PREPARED IN BENTLEY POWERDRAFT V8i (DESCARTES).
3. DIMENSIONS SHOWN ARE IN METRES.
4. CROSS SECTIONS TAKEN EVERY 10m.
5. OUTER MOST ELEVATIONS SHOT AT FOOT OF CANAL WALL.
6. CENTRE OF RIVER NOT SURVEYED.

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SCALE BAR

5 0 5 metres

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RIDEAU CANAL CROSS SECTION – SITE 2

CROSS SECTIONS 6 – 10

REV. No.

SHEET No. 2 / 9

Job No. 17-23-773-00

		YYYY/MM/DD
DRAWN	K. HUNTER	2018/01/18
CHECKED	M. MAKARENKO	2018/01/18
CORRECT	Z. HERMAN	2018/01/18

CROSS SECTION 011 WEST

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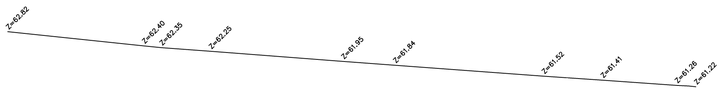

CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 011 EAST

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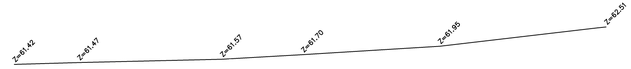

CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 012 WEST

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CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 012 EAST

CROSS SECTION CENTRE COORDINATES:
X=368900.65
Y=5029828.88

CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 013 WEST

CROSS SECTION CENTRE COORDINATES:
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CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 013 EAST

CROSS SECTION CENTRE COORDINATES:
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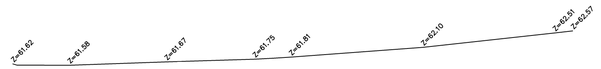

CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 014 EAST

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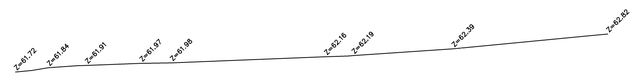
WEST SIDE UNDER CONSTRUCTION



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 015 WEST

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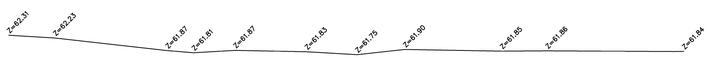


EAST SIDE UNDER CONSTRUCTION

CROSS SECTION LOOKING DOWNSTREAM

NOTES:

1. INFORMATION SHOWN BASED ON FIELD SURVEYS CARRIED OUT ON MONDAY, NOVEMBER 20 2017 BY J.D. BARNES LIMITED.
2. DRAWING PREPARED IN BENTLEY POWERDRAFT V8i (DESCARTES).
3. DIMENSIONS SHOWN ARE IN METRES.
4. CROSS SECTIONS TAKEN EVERY 10m.
5. OUTER MOST ELEVATIONS SHOT AT FOOT OF CANAL WALL.
6. CENTRE OF RIVER NOT SURVEYED.

ISSUED FOR INFORMATION ONLY
NOT FOR CONSTRUCTION

SCALE BAR
5 0 5 metres

J.D.BARNES LIMITED
SURVEYING PLANNING MAPPING GIS
LAND INFORMATION SPECIALISTS
140 RENFREW DRIVE, SUITE 100, MARKHAM, ON L3R 6B3
T: (905) 477-3600 F: (905) 477-3882 www.jdbarnes.com

RIDEAU CANAL CROSS SECTION – SITE 2

CROSS SECTIONS 11 – 15

REV. No.

SHEET No. 3 / 9

Job No. 17-23-773-00

		YYYY/MM/DD
DRAWN	K. HUNTER	2018/01/18
CHECKED	M. MAKARENKO	2018/01/18
CORRECT	Z. HERMAN	2018/01/18

CROSS SECTION 016 WEST

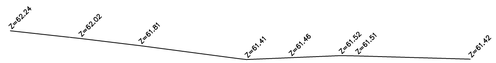
CROSS SECTION CENTRE COORDINATES:
X=368911.09
Y=5029759.43

EAST SIDE UNDER CONSTRUCTION

CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 017 WEST

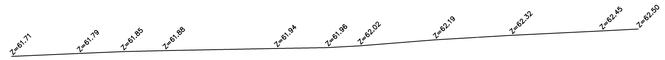
CROSS SECTION CENTRE COORDINATES:
X=368913.15
Y=5029749.70



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 017 EAST

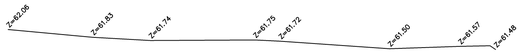
CROSS SECTION CENTRE COORDINATES:
X=368913.15
Y=5029749.70



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 018 WEST

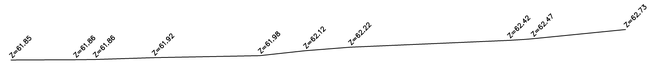
CROSS SECTION CENTRE COORDINATES:
X=368915.34
Y=5029739.94



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 018 EAST

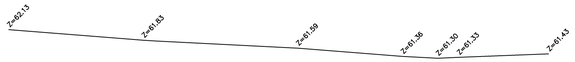
CROSS SECTION CENTRE COORDINATES:
X=368915.34
Y=5029739.94



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 019 WEST

CROSS SECTION CENTRE COORDINATES:
X=368917.41
Y=5029730.16



CROSS SECTION LOOKING DOWNSTREAM

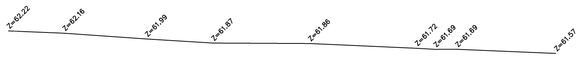
CROSS SECTION 019 EAST

CROSS SECTION CENTRE COORDINATES:
X=368917.41
Y=5029730.16

CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 020 WEST

CROSS SECTION CENTRE COORDINATES:
X=368919.51
Y=5029720.38



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 020 EAST

CROSS SECTION CENTRE COORDINATES:
X=368919.51
Y=5029720.38

CROSS SECTION LOOKING DOWNSTREAM

NOTES:

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5 0 5 metres

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RIDEAU CANAL CROSS SECTION – SITE 2

CROSS SECTIONS 16 – 20

REV. No.

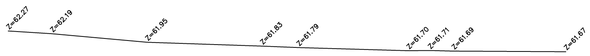
SHEET No. 4 / 9

Job No. 17-23-773-00

		YYYY/MM/DD
DRAWN	K. HUNTER	2018/01/18
CHECKED	M. MAKARENKO	2018/01/18
CORRECT	Z. HERMAN	2018/01/18

CROSS SECTION 021 WEST

CROSS SECTION CENTRE COORDINATES:
X=368921.70
Y=5029710.62



CROSS SECTION LOOKING DOWNSTREAM

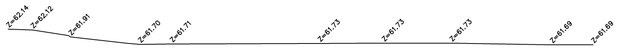
CROSS SECTION 021 EAST

CROSS SECTION CENTRE COORDINATES:
X=368921.70
Y=5029710.62

CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 022 WEST

CROSS SECTION CENTRE COORDINATES:
X=368924.09
Y=5029700.91



CROSS SECTION LOOKING DOWNSTREAM

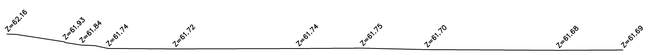
CROSS SECTION 022 EAST

CROSS SECTION CENTRE COORDINATES:
X=368924.09
Y=5029700.91

CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 023 WEST

CROSS SECTION CENTRE COORDINATES:
X=368926.54
Y=5029691.13



CROSS SECTION LOOKING DOWNSTREAM

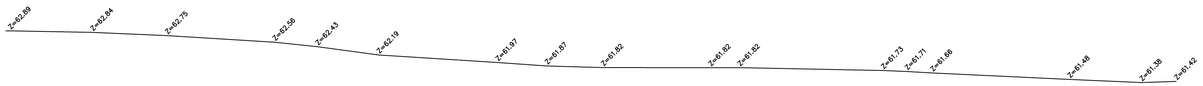
CROSS SECTION 023 EAST

CROSS SECTION CENTRE COORDINATES:
X=368926.54
Y=5029691.13

CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 024 WEST

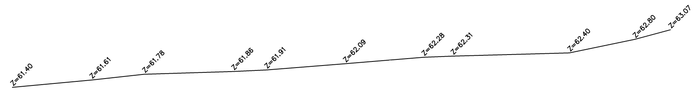
CROSS SECTION CENTRE COORDINATES:
X=368917.77
Y=5029676.42



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 024 EAST

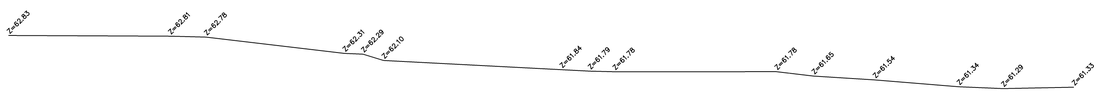
CROSS SECTION CENTRE COORDINATES:
X=368917.77
Y=5029676.42



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 025 WEST

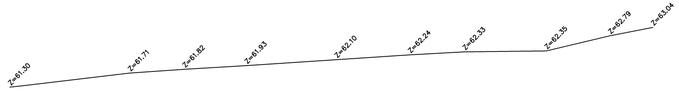
CROSS SECTION CENTRE COORDINATES:
X=368921.20
Y=5029668.98



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 025 EAST

CROSS SECTION CENTRE COORDINATES:
X=368921.20
Y=5029668.98



CROSS SECTION LOOKING DOWNSTREAM

NOTES:

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5 0 5 metres

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RIDEAU CANAL CROSS SECTION – SITE 2

CROSS SECTIONS 21 – 25

REV. No.

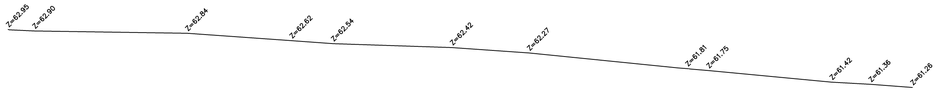
SHEET No. 5 / 9

Job No. 17-23-773-00

		YYYY/MM/DD
DRAWN	K. HUNTER	2018/01/18
CHECKED	M. MAKARENKO	2018/01/18
CORRECT	Z. HERMAN	2018/01/18

CROSS SECTION 026 WEST

CROSS SECTION CENTRE COORDINATES:
X=368925.20
Y=5029658.93



CROSS SECTION LOOKING DOWNSTREAM

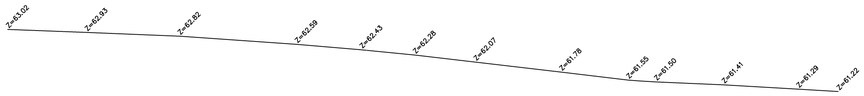
CROSS SECTION 026 EAST

CROSS SECTION CENTRE COORDINATES:
X=368925.20
Y=5029658.93

CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 027 WEST

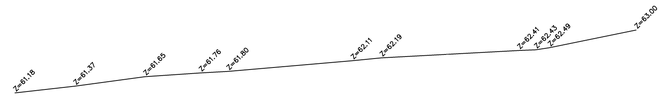
CROSS SECTION CENTRE COORDINATES:
X=368929.16
Y=5029648.96



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 027 EAST

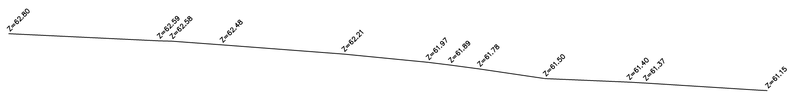
CROSS SECTION CENTRE COORDINATES:
X=368929.16
Y=5029648.96



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 028 WEST

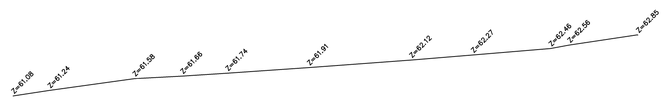
CROSS SECTION CENTRE COORDINATES:
X=368932.91
Y=5029639.69



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 028 EAST

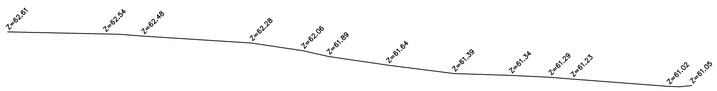
CROSS SECTION CENTRE COORDINATES:
X=368932.91
Y=5029639.69



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 029 WEST

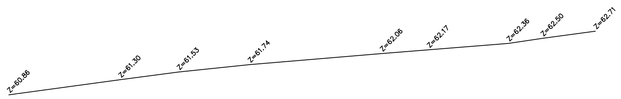
CROSS SECTION CENTRE COORDINATES:
X=368936.92
Y=5029630.03



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 029 EAST

CROSS SECTION CENTRE COORDINATES:
X=368936.92
Y=5029630.03



CROSS SECTION LOOKING DOWNSTREAM

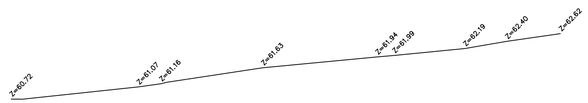
CROSS SECTION 030 WEST

CROSS SECTION CENTRE COORDINATES:
X=368941.10
Y=5029620.71

CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 030 EAST

CROSS SECTION CENTRE COORDINATES:
X=368941.10
Y=5029620.71



CROSS SECTION LOOKING DOWNSTREAM

NOTES:

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RIDEAU CANAL CROSS SECTION – SITE 2

CROSS SECTIONS 26 – 30

REV. No.

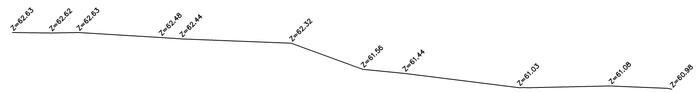
SHEET No. 6 / 9

Job No. 17-23-773-00

		YYYY/MM/DD
DRAWN	K. HUNTER	2018/01/18
CHECKED	M. MAKARENKO	2018/01/18
CORRECT	Z. HERMAN	2018/01/18

CROSS SECTION 031 WEST

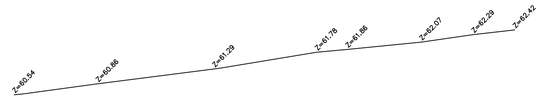
CROSS SECTION CENTRE COORDINATES:
X=368945.53
Y=5029611.73



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 031 EAST

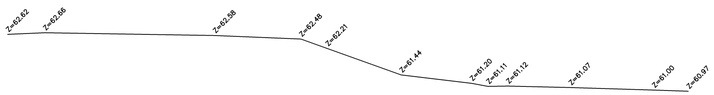
CROSS SECTION CENTRE COORDINATES:
X=368945.53
Y=5029611.73



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 032 WEST

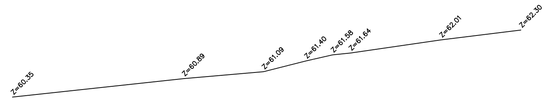
CROSS SECTION CENTRE COORDINATES:
X=368950.25
Y=5029602.66



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 032 EAST

CROSS SECTION CENTRE COORDINATES:
X=368950.25
Y=5029602.66



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 033 WEST

CROSS SECTION CENTRE COORDINATES:
X=368955.13
Y=5029593.90

CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 033 EAST

CROSS SECTION CENTRE COORDINATES:
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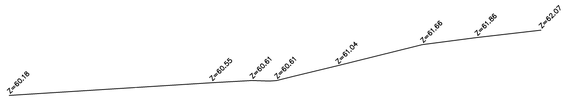
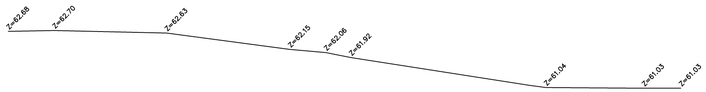
Y=5029593.90



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 034 WEST

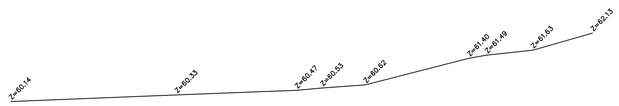
CROSS SECTION CENTRE COORDINATES:
X=368960.07
Y=5029584.97



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 034 EAST

CROSS SECTION CENTRE COORDINATES:
X=368960.07
Y=5029584.97



CROSS SECTION LOOKING DOWNSTREAM

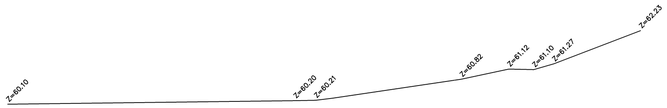
CROSS SECTION 035 WEST

CROSS SECTION CENTRE COORDINATES:
X=368964.89
Y=5029576.19

CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 035 EAST

CROSS SECTION CENTRE COORDINATES:
X=368964.89
Y=5029576.19



CROSS SECTION LOOKING DOWNSTREAM

NOTES:

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5 0 5 metres

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RIDEAU CANAL CROSS SECTION – SITE 2

CROSS SECTIONS 31 – 35

REV. No.

SHEET No. 7 / 9

Job No. 17-23-773-00

		YYYY/MM/DD
DRAWN	K. HUNTER	2018/01/18
CHECKED	M. MAKARENKO	2018/01/18
CORRECT	Z. HERMAN	2018/01/18

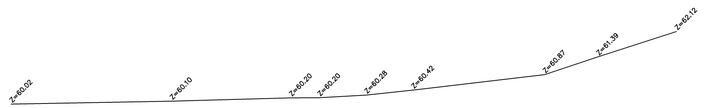
CROSS SECTION 036 WEST

CROSS SECTION CENTRE COORDINATES:
X=368969.55
Y=5029567.34

CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 036 EAST

CROSS SECTION CENTRE COORDINATES:
X=368969.55
Y=5029567.34



CROSS SECTION LOOKING DOWNSTREAM

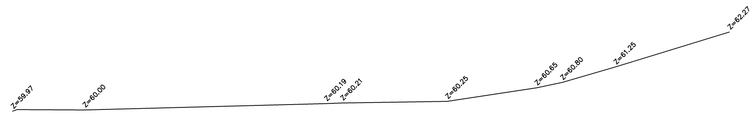
CROSS SECTION 037 WEST

CROSS SECTION CENTRE COORDINATES:
X=368974.07
Y=5029558.41

CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 037 EAST

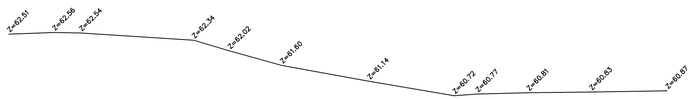
CROSS SECTION CENTRE COORDINATES:
X=368974.07
Y=5029558.41



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 038 WEST

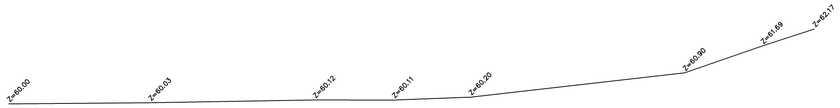
CROSS SECTION CENTRE COORDINATES:
X=368978.41
Y=5029549.40



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 038 EAST

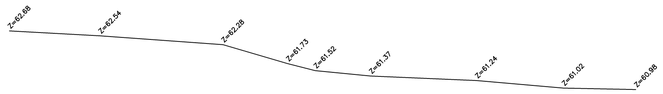
CROSS SECTION CENTRE COORDINATES:
X=368978.41
Y=5029549.40



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 039 WEST

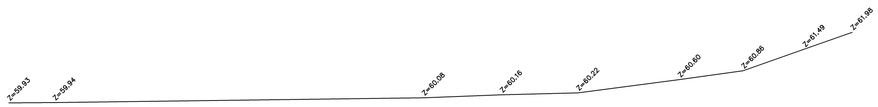
CROSS SECTION CENTRE COORDINATES:
X=368982.62
Y=5029540.33



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 039 EAST

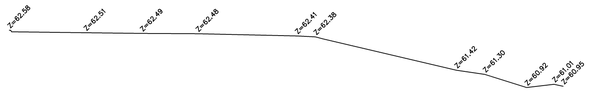
CROSS SECTION CENTRE COORDINATES:
X=368982.62
Y=5029540.33



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 040 WEST

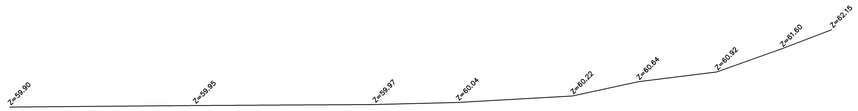
CROSS SECTION CENTRE COORDINATES:
X=368986.74
Y=5029531.22



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 040 EAST

CROSS SECTION CENTRE COORDINATES:
X=368986.74
Y=5029531.22



CROSS SECTION LOOKING DOWNSTREAM

NOTES:

1. INFORMATION SHOWN BASED ON FIELD SURVEYS CARRIED OUT ON MONDAY, NOVEMBER 20 2017 BY J.D. BARNES LIMITED.
2. DRAWING PREPARED IN BENTLEY POWERDRAFT V8i (DESCARTES).
3. DIMENSIONS SHOWN ARE IN METRES.
4. CROSS SECTIONS TAKEN EVERY 10m.
5. OUTER MOST ELEVATIONS SHOT AT FOOT OF CANAL WALL.
6. CENTRE OF RIVER NOT SURVEYED.

ISSUED FOR INFORMATION ONLY
NOT FOR CONSTRUCTION

SCALE BAR
5 0 5 metres

J.D.BARNES LIMITED
SURVEYING PLANNING MAPPING GIS
LAND INFORMATION SPECIALISTS
140 RENFREW DRIVE, SUITE 100, MARKHAM, ON L3R 6B3
T: (905) 477-3600 F: (905) 477-3882 www.jdbarnes.com

RIDEAU CANAL CROSS SECTION – SITE 2

CROSS SECTIONS 36 – 40

REV. No.

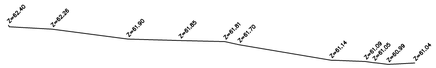
SHEET No. 8 / 9

Job No. 17-23-773-00

		YYYY/MM/DD
DRAWN	K. HUNTER	2018/01/18
CHECKED	M. MAKARENKO	2018/01/18
CORRECT	Z. HERMAN	2018/01/18

CROSS SECTION 041 WEST

CROSS SECTION CENTRE COORDINATES:
X=368990.72
Y=5029522.04



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 041 EAST

CROSS SECTION CENTRE COORDINATES:
X=368990.72
Y=5029522.04

CROSS SECTION LOOKING DOWNSTREAM

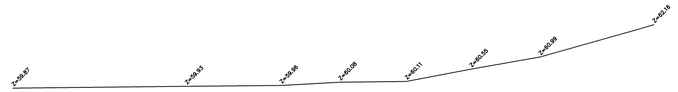
CROSS SECTION 042 WEST

CROSS SECTION CENTRE COORDINATES:
X=368994.58
Y=5029512.80

CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 042 EAST

CROSS SECTION CENTRE COORDINATES:
X=368994.58
Y=5029512.80



CROSS SECTION LOOKING DOWNSTREAM

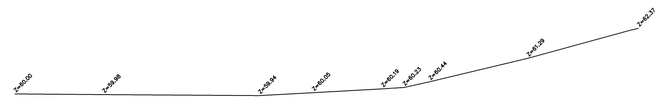
CROSS SECTION 043 WEST

CROSS SECTION CENTRE COORDINATES:
X=368998.06
Y=5029503.38

CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 043 EAST

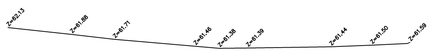
CROSS SECTION CENTRE COORDINATES:
X=368998.06
Y=5029503.38



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 044 WEST

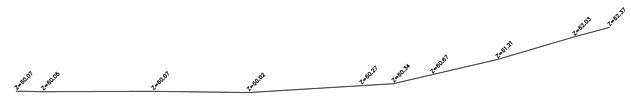
CROSS SECTION CENTRE COORDINATES:
X=369001.32
Y=5029493.85



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 044 EAST

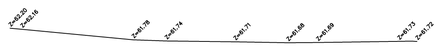
CROSS SECTION CENTRE COORDINATES:
X=369001.32
Y=5029493.85



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 045 WEST

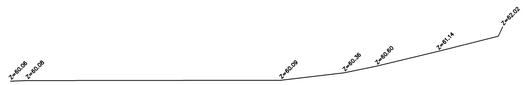
CROSS SECTION CENTRE COORDINATES:
X=369003.77
Y=5029483.94



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 045 EAST

CROSS SECTION CENTRE COORDINATES:
X=369003.77
Y=5029483.94



CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 046 WEST

CROSS SECTION CENTRE COORDINATES:
X=369001.59
Y=5029471.80

CROSS SECTION LOOKING DOWNSTREAM

CROSS SECTION 046 EAST

CROSS SECTION CENTRE COORDINATES:
X=369001.59
Y=5029471.80

CROSS SECTION LOOKING DOWNSTREAM

NOTES:
1. INFORMATION SHOWN BASED ON FIELD SURVEYS CARRIED OUT ON MONDAY, NOVEMBER 20 2017 BY J.D. BARNES LIMITED.
2. DRAWING PREPARED IN BENTLEY POWERDRAFT V8i (DESCARTES).
3. DIMENSIONS SHOWN ARE IN METRES.
4. CROSS SECTIONS TAKEN EVERY 10m.
5. OUTER MOST ELEVATIONS SHOT AT FOOT OF CANAL WALL.
6. CENTRE OF RIVER NOT SURVEYED.

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SCALE BAR
5 0 5 metres

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RIDEAU CANAL CROSS SECTION – SITE 2

CROSS SECTIONS 41 – 46

REV. No.

SHEET No. 9 / 9

Job No. 17-23-773-00

		YYYY/MM/DD
DRAWN	K. HUNTER	2018/01/18
CHECKED	M. MAKARENKO	2018/01/18
CORRECT	Z. HERMAN	2018/01/18

AECOM

Appendix D1

Survey Control Report

AECOM Project Control Report JDB Ref. 17-23-773-00 and 17-23-781-00

RE: Rideau Canal (17-23-773-00) and Hogs Back Dam (17-23-781-00) Projects - Control

As per our proposals P-34870 dated May 06, 2017, and P-42275-Revision 1 dated November 21, 2017, J.D. Barnes Limited has been contracted to carry out control, bathymetric and topographic surveys at 4 sites along the Rideau Canal, and at the NCC site and dam controlling water levels in the Rideau Canal (named Hogs Back Dam).
Even though the work was performed under separate contracts and projects, JDB has implemented a unified Horizontal and Vertical control network for all sites; to ensure compatibility and consistency of Datums and elevations for the integrated dam / lock / canal system.
It was decided that the projects would be integrated in the City of Ottawa Horizontal and Vertical Datums, namely: **NAD83 MTM Zone 9** (original) horizontally and **CGVD 1928 –1978** vertically**.**
The calculated project combined scale factor was **0.99995026**.

Survey Methodology:

Horizontally, the control survey was completed using Real Time Kinematic (RTK) Global Positioning System (GPS) and Total Station technology. All control points were observed multiple times with RTK GPS, at different times of day, and averaged for the final horizontal position. Some traversing was necessary in areas of poor sky visibility.
Vertically, the control survey was completed using a digital level. Leveling was also performed between the Hogs Back Dam site and all of the Rideau Canal Sites, to validate the overall vertical network. Sufficient Horizontal and Vertical published points were incorporated in the network to provide reliable project control and adequate geometry. The vertical network adjustment included numerous Benchmarks, of which two had to be floated. They did not fit with the rest of the network as described later in this report.

The 3D network analysis and adjustment was done using StarNet version 8.1.2.990.

List of Horizontal Controlling (Primary) Stations:

Monument ID	Publishing Agency (Source)	Order	Class / Type
019197534249	NCC (COSINE)	3rd	HCM / BC
019197534235	NCC (COSINE)	3rd	HCM / BC
019197531917	NCC (COSINE)	3rd	HCM / BC
01919720665	NCC (COSINE)	2nd	HCM / CM
019197534287	NCC (COSINE)	3rd	HCM / RIB w. Cap
019198234727	NCC (COSINE)	3rd	HCM / RIB w. Cap
2011-0004	NCC (NCC Survey Dept.)	Unknown	HCM-BM / BC
2011-0154	NCC (NCC Survey Dept.)	Unknown	HCM-BM / BC

The points above have been held fixed in the horizontal adjustment

List of Vertical Controlling (Primary) Stations:

Monument ID	Publishing Agency (Source)	Elev.	Order	Class / Type
0011963U129	GSC (COSINE)	69.519	1st	BM / Plate
0011963U128	GSC (COSINE)	69.066	1st	BM / Plate
0011954U001	GSC (COSINE)	71.174	1st	BM / Plate
0011950U886G	GSC (COSINE)	89.617	1st	BM / Plate
0011962U108	GSC (COSINE)	68.263	1st	DBM / Rod
0011948U574G	GSC (COSINE)	76.216	1st	BM / Tablet
0011948U033	GSC (COSINE)	71.332	1st	BM / Cathead
0011963U3640	GSC (COSINE)	66.701	1st	BM / Tablet
2011-0004	NCC (NCC Survey Dept.)	74.027	Unknown	HCM-BM / BC
2011-0154	NCC (NCC Survey Dept.)	78.923	Unknown	HCM-BM / BC

The points above have been held fixed in the vertical adjustment

List of Surveyed Vertical Stations NOT used:

Monument ID	Agency (Source)	Published Elev.	Surveyed Elev.	Order	Class / Type
0011963U3617	GSC (COSINE)	66.828	66.753	1st	BM / Plate
0011948U034	GSC (COSINE)	68.013	68.032	1st	BM / Plate

The points above were surveyed but floated in the vertical adjustment due to noted discrepancies.

In the tables above, COSINE stands for the Ministry of Natural Resources' Control Survey Information Exchange online database, HCM stands for Horizontal Control Monument, BM stands for Benchmark, CM stands for Concrete Monument, BC stands for Brass Cap, NCC stands for the National Capital Commission, and GSC stands for the Geodetic Survey of Canada / Energy, Mines and Resources Division.

Printouts from the publishing agencies are included at the end of this document in **Appendix A**.

New (Secondary) Monuments Established or Found:

The new monuments established consist of magnetized Nails (MagNails) set in hard surfaces. Some of the existing points provided by AECOM in a file titled *"Ctrl_Pnts Nov 7 2017.txt"* were also incorporated in our survey.
Please note that the secondary control points are less stable than the primary points, and prone to movement over time due to human activities or natural phenomena.
Caution should be exercised in using the secondary control points listed below. It is every user's responsibility to verify that the secondary control points below have not been disturbed prior to their use. Such verification should be carried out with respect to the primary control points listed on the previous page, or other reliable published monuments in the same system of reference, with due regard to any possible disturbed published monuments.

AECOM Project Control Report JDB Ref. 17-23-773-00 and 17-23-781-00

Secondary Control Points:

17-23-773-00 and 17-23-781-00: Hogs Back Dam and Rideau Canal Secondary Control - Ottawa						
Count	JDB ID	Easting (m)	Northing (m)	Elevation (m)	Type	Alternate ID
1	03JK20244	368826.077	5029932.038	66.535	MAG NAIL	-
2	03JK20242	368813.585	5029723.813	65.833	MAG NAIL	-
3	03JK20243	368804.619	5029821.819	66.760	MAG NAIL	-
4	03JK21287	368910.041	5029911.254	64.616	NAIL	28
5	03JK21288	368929.613	5029847.090	64.643	NAIL	27
6	03JK21289	368960.761	5029737.349	64.736	NAIL	26
7	03JK21290	368986.422	5029656.660	64.677	MAG NAIL	-
8	03JK21291	368983.292	5029669.616	64.724	NAIL	24
9	03JK21292	369029.829	5029584.086	64.619	NAIL	25
10	03JK40772	368283.814	5031720.299	64.821	NAIL	12
11	03JK41685	368634.125	5031507.664	64.772	NAIL	22
12	03JK40874	367993.047	5031841.039	64.486	MAG NAIL	-
13	03JK40875	367885.726	5031889.697	64.483	MAG NAIL	-
14	03JK31195	368689.641	5030530.855	64.944	MAG NAIL	-
15	03JK31196	368744.603	5030534.069	64.563	MAG NAIL	-
16	03JK31197	368774.656	5030463.375	64.653	MAG NAIL	-
17	03JK31656	368769.780	5030501.675	67.520	MAG NAIL	-
18	03JK50000	367594.344	5025874.932	78.122	MAG NAIL	-
19	03JK50001	367557.721	5025913.166	77.330	MAG NAIL	-
20	03JK50002	367664.105	5025905.722	77.651	MAG NAIL	-
21	03JK50003	367718.638	5025944.524	78.108	MAG NAIL	-
22	03JK50004	367781.696	5025987.978	78.500	MAG NAIL	-
23	03JK50071	367844.255	5025868.034	76.540	MAG NAIL	-
24	03JK50072	367793.476	5025939.591	77.073	MAG NAIL	-
25	03JK50073	367846.461	5025843.527	76.000	MAG NAIL	-
26	03JK50142	367869.260	5026052.509	80.623	MAG NAIL	-
27	03JK50173	367819.691	5026094.400	80.055	MAG NAIL	-
28	03JK50174	367740.267	5026086.005	77.535	MAG NAIL	-
29	03JK50175	367766.322	5026025.477	77.803	MAG NAIL	-
30	03JK50368	367715.091	5025963.109	76.961	MAG NAIL	-
31	03JK10051	369048.715	5029009.513	64.790	MAG NAIL	-
32	03JK10050	369095.061	5029089.902	64.993	MAG NAIL	-
33	03JK10052	369094.600	5029129.016	64.588	MAG NAIL	-
34	03JK10135	369060.527	5029001.273	70.295	MAG NAIL	-
35	03JK10136	369076.003	5029032.429	69.311	MAG NAIL	-
36	03JK21287	368910.041	5029911.254	64.616	MAG NAIL	-
37	03JK21288	368929.613	5029847.090	64.643	MAG NAIL	-
38	03JK21289	368960.761	5029737.349	64.736	MAG NAIL	-
39	03JK21290	368986.422	5029656.660	64.677	MAG NAIL	-
40	03JK21291	368983.292	5029669.616	64.724	MAG NAIL	-
41	03JK21292	369029.829	5029584.086	64.619	MAG NAIL	-
42	03JK31668	368769.778	5030501.673	67.521	MAG NAIL	-
43	03JK40844	367849.027	5031928.580	65.531	MAG NAIL	-
44	03JK40855	368067.282	5031835.785	64.875	MAG NAIL	-
45	03JK40856	368123.189	5031809.909	64.874	MAG NAIL	-
46	03JK40857	368218.476	5031756.813	64.856	MAG NAIL	-
47	03JK40858	368338.406	5031684.900	64.771	MAG NAIL	-
48	03JK40860	368643.265	5031501.755	64.768	MAG NAIL	-
49	03JK40859	368505.282	5031584.895	64.748	MAG NAIL	-
50	03JK42131	368838.076	5031384.901	64.760	MAG NAIL	-
51	03JK50298	367782.703	5025896.412	75.390	MAG NAIL	-
52	03JK50369	367692.670	5025996.281	73.877	MAG NAIL	-
53	03JK50296	361663.319	4999369.402	88.001	MAG NAIL	-

All project control points that have coordinates can be located from the following files:

www.jdbarnes.com/~hz01/SITE_Control.dgn
www.jdbarnes.com/~hz01/SITE_Control.dwg
www.jdbarnes.com/~hz01/SITE_Control.kmz
www.jdbarnes.com/~hz01/SITE_Control.pts

Timeline of the Project Milestones:

Project Award - Ottawa Canal: November 10, 2017
Project Award – Hogs Back Dam: November 29, 2017
Research, Project Preparation: November 13 and November 30, 2017
Field Work: November 13 – December 08, 2017
Data Processing, Calculations: November 20 – December 12, 2017
Project Control Report: December 15, 2017
Delivery: December 2017 – January 2018 (estimated)
Invoicing: January 2018 (estimated)
Tasks left to complete: LiDAR Modeling, CAD preparation and delivery, invoicing.

J.D. Barnes Limited retains ownership of all of the materials provided, software developed and any data collected during the course of this project. Any reproduction or distribution of the materials provided to third parties without the written consent of J.D. Barnes Limited is strictly prohibited. The reproduction and distribution clause is waived with respect to parties affiliated with AECOM, in relation to the Hogs Back Dam and Rideau Canal projects.

Any questions regarding the above should be addressed to the undersigned.

Yours truly,

J.D. BARNES LIMITED

Zoltan Herman, B.A.Sc., O.L.S., O.L.I.P.
Manager, Engineering Surveys
Geodetic and Engineering Surveys Division
140 Renfrew Drive, Suite 100
Markham, Ontario, L3R 6B3
Office: (905)-477-3600 x231
Mobile: (416)-566-7808
Fax: (905)-477-3882
E-mail: zherman@jdbarnes.com

December 15, 2017

APPENDIX A – Used Control Monument Sheets from Publishing Agencies

AECOM Project Control Report JDB Ref. 17-23-773-00 and 17-23-781-00

12/14/2017 COSINE Report

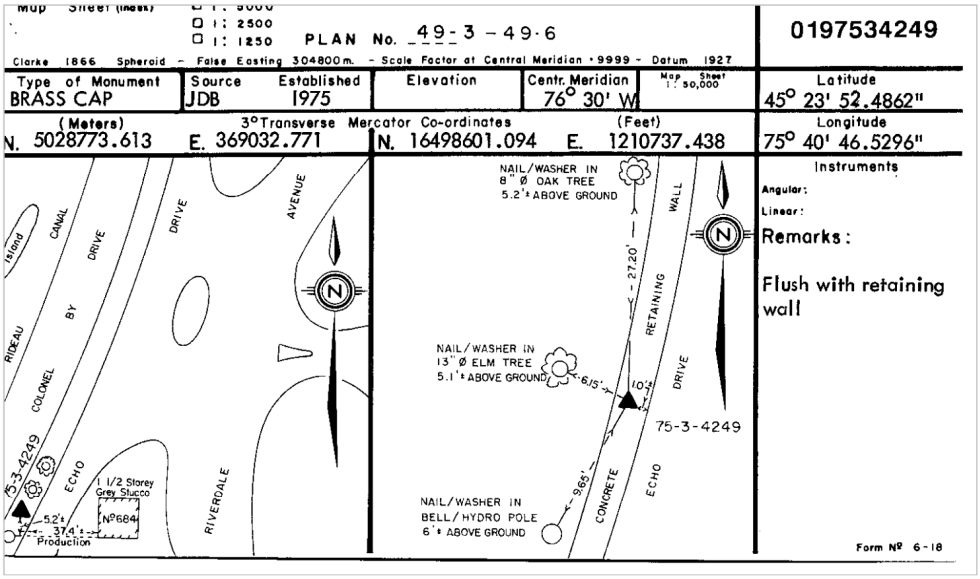
STATION: 019197534249

Also known as:	0197534249, 3-4249
Monument status:	Existing
Station type:	TRAV
Horizontal datum:	NAD-1983:ORIG
Horizontal accuracy:	Third order
Latitude:	N45 °23 ′52.67018 ″
Longitude:	W75 °40 ′45.34685 ″
Ellipsoidal elevation:	38.xxx
Ellipsoidal elevation order:	Unclassified
UTM-18 Easting:	E446835.599
UTM-18 Northing:	N5027385.082
UTM-18 Cmbd sc-fact:	0.99962879
UTM-18 Mrdnl convg:	-0 °29 ′01.1 ″
MTM-9 Easting:	E369056.523
MTM-9 Northing:	N5028997.138
MTM-9 Cmbd sc-fact:	0.99994479
MTM-9 Mrdnl convg:	0 °35 ′03.8 ″
Vertical datum:	CGVD-1928:1978
Vertical accuracy:	UNCLASSIFIED
Orthometric elev:	71.xxx
Meridional defl:	-1.0 ″
Prime vert defl:	3.7 ″
Undulation:	
Other horiz data [ord]:	NAD-1927:1974 [3], NAD-1927:1976 [-]
Networks [usage]:	1510 [FREE]
Number of Ref Sketches:	1

http://www.gisapplication.lrc.gov.on.ca/services/COSINE/Remote/f08f0658_fb11_4ea6_86b5_10c07ceb1062.html?print=true 1/1

AECOM Project Control Report JDB Ref. 17-23-773-00 and 17-23-781-00

12/14/2017 COSINE Report



http://www.gisapplication.lrc.gov.on.ca/services/COSINE/Remote/f08f0658_fb11_4ea6_86b5_10c07ceb1062.html?print=true 1/1

AECOM Project Control Report JDB Ref. 17-23-773-00 and 17-23-781-00

12/14/2017 COSINE Report

STATION: 019197534235

Also known as:	0197534235, 3-4235
Monument status:	Existing
Station type:	TRAV
Horizontal datum:	NAD-1983:ORIG
Horizontal accuracy:	Third order
Latitude:	N45 °24 ′24.92570 ″
Longitude:	W75 °40 ′51.71998 ″
Ellipsoidal elevation:	33.xxx
Ellipsoidal elevation order:	Unclassified
UTM-18 Easting:	E446705.466
UTM-18 Northing:	N5028381.651
UTM-18 Cmbd sc-fact:	0.99962974
UTM-18 Mrdnl convg:	-0 °29 ′05.9 ″
MTM-9 Easting:	E368907.788
MTM-9 Northing:	N5029991.422
MTM-9 Cmbd sc-fact:	0.99994534
MTM-9 Mrdnl convg:	0 °34 ′59.6 ″
Vertical datum:	CGVD-1928:1978
Vertical accuracy:	UNCLASSIFIED
Orthometric elev:	66.xxx
Meridional defl:	-1.0 ″
Prime vert defl:	3.7 ″
Undulation:	
Other horiz data [ord]:	NAD-1927:1974 [3], NAD-1927:1976 [-]
Networks [usage]:	1510 [FREE]
Number of Ref Sketches:	0

http://www.gisapplication.lrc.gov.on.ca/services/COSINE/Remote/86d07e13_eb25_43ef_87fc_defcb8e3f185.html?print=true 1/1

AECOM Project Control Report JDB Ref. 17-23-773-00 and 17-23-781-00

12/14/2017 COSINE Report

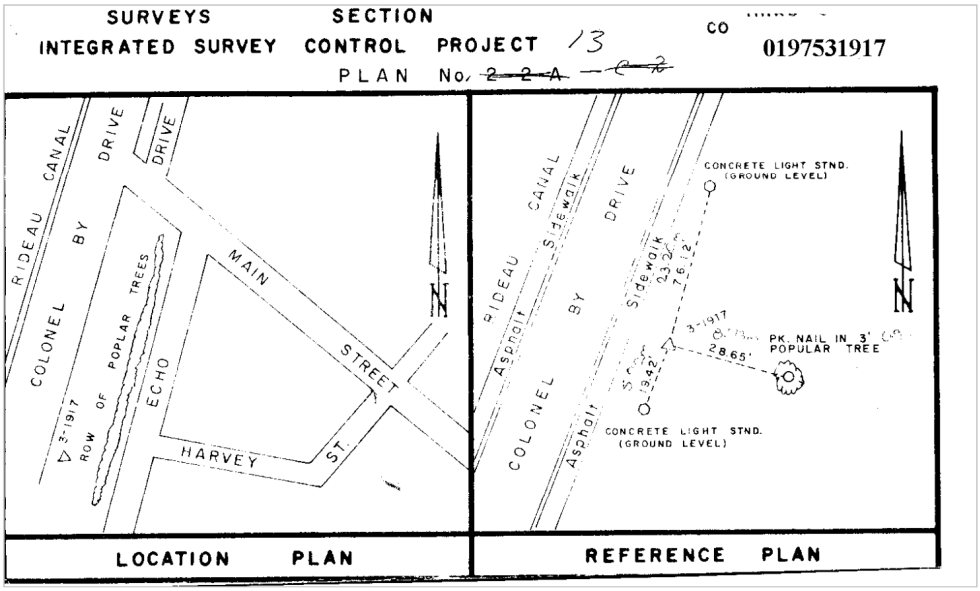
STATION: 019197531917

Also known as:	0197531917, 3-1917
Monument status:	Existing
Station type:	TRAV
Horizontal datum:	NAD-1983:ORIG
Horizontal accuracy:	Third order
Latitude:	N45 °24 ′48.15143 ″
Longitude:	W75 °40 ′57.33565 ″
Ellipsoidal elevation:	34.xxx
Ellipsoidal elevation order:	Unclassified
UTM-18 Easting:	E446589.476
UTM-18 Northing:	N5029099.426
UTM-18 Cmbd sc-fact:	0.99962974
UTM-18 Mrdnl convg:	-0 °29 ′10.1 ″
MTM-9 Easting:	E368778.396
MTM-9 Northing:	N5030707.136
MTM-9 Cmbd sc-fact:	0.99994498
MTM-9 Mrdnl convg:	0 °34 ′55.8 ″
Vertical datum:	CGVD-1928:1978
Vertical accuracy:	UNCLASSIFIED
Orthometric elev:	67.xxx
Meridional defl:	-1.0 ″
Prime vert defl:	3.7 ″
Undulation:	
Other horiz data [ord]:	NAD-1927:1974 [3], NAD-1927:1976 [-]
Networks [usage]:	1510 [FREE]
Number of Ref Sketches:	1

http://www.gisapplication.lrc.gov.on.ca/services/COSINE/Remote/49cab9d5_3d0c_4fd5_81a3_ffeb7d53a609.html?print=true 1/1

AECOM Project Control Report JDB Ref. 17-23-773-00 and 17-23-781-00

12/14/2017 COSINE Report



http://www.gisapplication.lrc.gov.on.ca/services/COSINE/Remote/49cab9d5_3d0c_4fd5_81a3_ffeb7d53a609.html?print=true 1/1

AECOM Project Control Report JDB Ref. 17-23-773-00 and 17-23-781-00

12/14/2017 COSINE Report

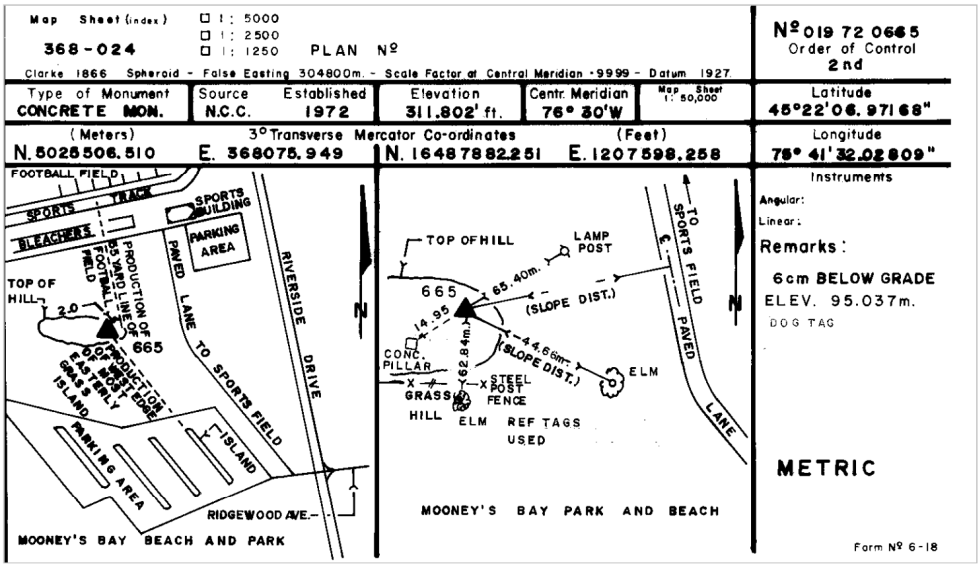
STATION: 01919720665

Also known as:	019720665, ISCM 665
Monument status:	Existing
Station type:	TRAV
Horizontal datum:	NAD-1983:ORIG
Horizontal accuracy:	Second order
Latitude:	N45 °22 ′07.15581 ″
Longitude:	W75 °41 ′30.84907 ″
Ellipsoidal elevation:	62.xxx
Ellipsoidal elevation order:	Unclassified
UTM-18 Easting:	E445818.343
UTM-18 Northing:	N5024137.375
UTM-18 Cmbd sc-fact:	0.99962637
UTM-18 Mrdnl convg:	-0 °29 ′32.6 ″
MTM-9 Easting:	E368099.663
MTM-9 Northing:	N5025730.010
MTM-9 Cmbd sc-fact:	0.99993952
MTM-9 Mrdnl convg:	0 °34 ′30.3 ″
Vertical datum:	CGVD-1928:1978
Vertical accuracy:	UNCLASSIFIED
Orthometric elev:	95.xxx
Meridional defl:	-1.0 ″
Prime vert defl:	3.8 ″
Undulation:	
Other horiz data [ord]:	NAD-1927:1974 [2], NAD-1927:1976 [-]
Networks [usage]:	1505 [FIX], 1510 [FREE]
Number of Ref Sketches:	1

http://www.gisapplication.lrc.gov.on.ca/services/COSINE/Remote/490dcd44_fdba_4cb1_a81e_7d72cee3d99b.html?print=true 1/1

AECOM Project Control Report JDB Ref. 17-23-773-00 and 17-23-781-00

12/14/2017 COSINE Report



http://www.gisapplication.lrc.gov.on.ca/services/COSINE/Remote/490dcd44_fdba_4cb1_a81e_7d72cee3d99b.html?print=true 1/1

AECOM Project Control Report JDB Ref. 17-23-773-00 and 17-23-781-00

12/14/2017 COSINE Report

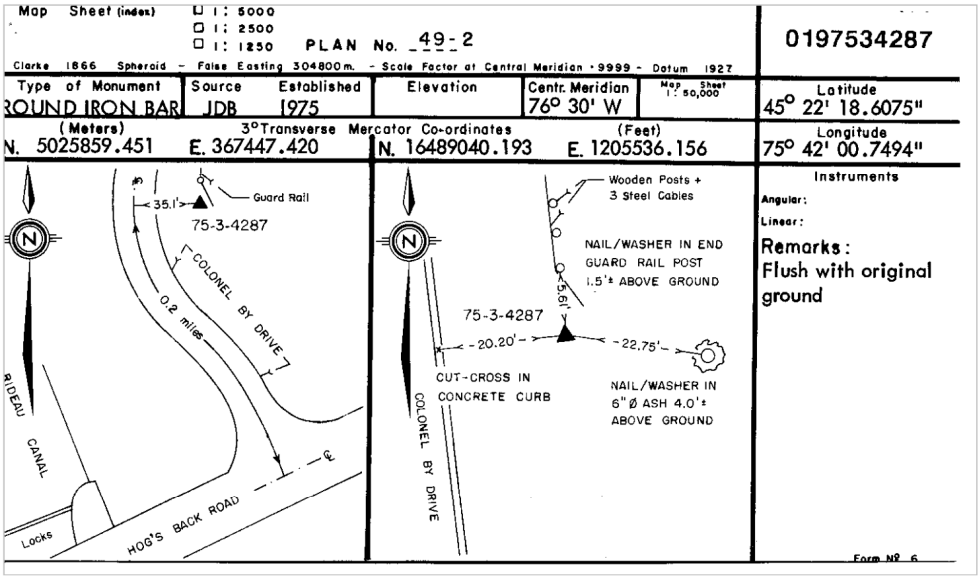
STATION: 019197534287

Also known as:	0197534287, 3-4287
Monument status:	Existing
Station type:	TRAV
Horizontal datum:	NAD-1983:ORIG
Horizontal accuracy:	Third order
Latitude:	N45 °22 ′18.79131 ″
Longitude:	W75 °41 ′59.57067 ″
Ellipsoidal elevation:	37.xxx
Ellipsoidal elevation order:	Unclassified
UTM-18 Easting:	E445196.704
UTM-18 Northing:	N5024501.842
UTM-18 Cmbd sc-fact:	0.99963112
UTM-18 Mrdnl convg:	-0 °29 ′53.2 ″
MTM-9 Easting:	E367471.146
MTM-9 Northing:	N5026082.943
MTM-9 Cmbd sc-fact:	0.99994247
MTM-9 Mrdnl convg:	0 °34 ′10.0 ″
Vertical datum:	CGVD-1928:1978
Vertical accuracy:	UNCLASSIFIED
Orthometric elev:	70.xxx
Meridional defl:	-1.0 ″
Prime vert defl:	3.8 ″
Undulation:	
Other horiz data [ord]:	NAD-1927:1974 [3], NAD-1927:1976 [-]
Networks [usage]:	1510 [FREE]
Number of Ref Sketches:	1

http://www.gisapplication.lrc.gov.on.ca/services/COSINE/Remote/1307bfec_24cc_4f0c_bd72_11078a6f880f.html?print=true 1/1

AECOM Project Control Report JDB Ref. 17-23-773-00 and 17-23-781-00

12/14/2017 COSINE Report



http://www.gisapplication.lrc.gov.on.ca/services/COSINE/Remote/1307bfec_24cc_4f0c_bd72_11078a6f880f.html?print=true 1/1

AECOM Project Control Report JDB Ref. 17-23-773-00 and 17-23-781-00

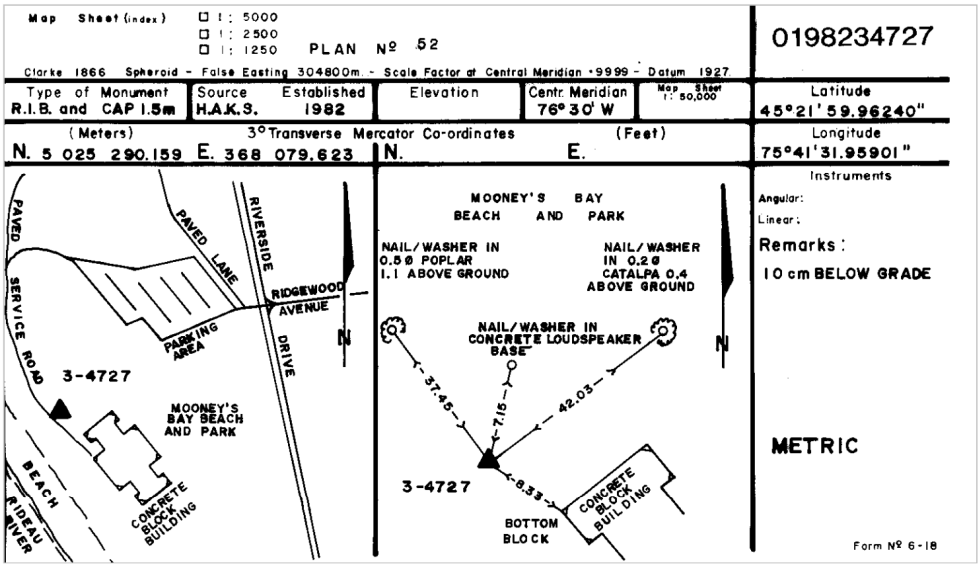
12/14/2017 COSINE Report

STATION: 019198234727

Also known as:	0198234727, 3-4727
Monument status:	Existing
Station type:	TRAV
Horizontal datum:	NAD-1983:ORIG
Horizontal accuracy:	Third order
Latitude:	N45 °22 ′00.14640 ″
Longitude:	W75 °41 ′30.78006 ″
Ellipsoidal elevation:	46.xxx
Ellipsoidal elevation order:	Unclassified
UTM-18 Easting:	E445817.985
UTM-18 Northing:	N5023921.055
UTM-18 Cmbd sc-fact:	0.99962888
UTM-18 Mrdnl convg:	-0 °29 ′32.5 ″
MTM-9 Easting:	E368103.336
MTM-9 Northing:	N5025513.653
MTM-9 Cmbd sc-fact:	0.99994204
MTM-9 Mrdnl convg:	0 °34 ′30.3 ″
Vertical datum:	CGVD-1928:1978
Vertical accuracy:	UNCLASSIFIED
Orthometric elev:	79.xxx
Meridional defl:	-1.0 ″
Prime vert defl:	3.8 ″
Undulation:	
Other horiz data [ord]:	NAD-1927:1974 [3], NAD-1927:1976 [-]
Networks [usage]:	1510 [FREE]
Number of Ref Sketches:	1

http://www.gisapplication.lrc.gov.on.ca/services/COSINE/Remote/8e7b1fbf_f137_4fda_862c_45a161a7fa19.html?print=true 1/1

AECOM Project Control Report JDB Ref. 17-23-773-00 and 17-23-781-00



AECOM Project Control Report JDB Ref. 17-23-773-00 and 17-23-781-00

STATION DESCRIPTION 2011-0004

STATION NUMBER:	HORIZONTAL AND VERTICAL CONTROL	DATE: (DD/MM/YYYY)
2011-0004		19/12/2011
UNITS: METRIC	MARKER TYPE: Convex Brass Cap for Rock/Concrete	INSTALLED BY: ANNIS, O'SULLIVAN, VOLLEBEKK LTD.

CO-ORDINATES (Metres, 3° MTM, Zone 9, CENTRAL MERIDIAN 76°30'W):

MTM NAD 83 (ORIGINAL)		MTM NAD 83 (CSRS) 1997	
NORTHING	EASTING	NORTHING	EASTING
5031942.571	367792.977	5031942.217	367792.889

ELEVATION: 74.027

LOCATION:

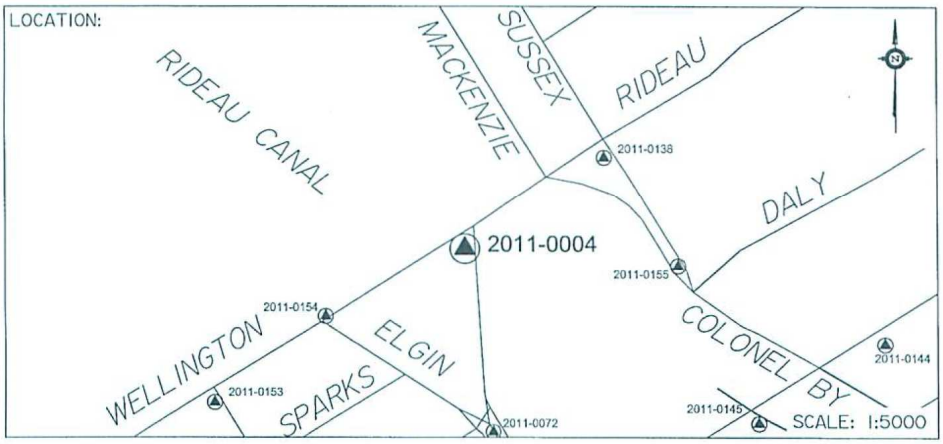
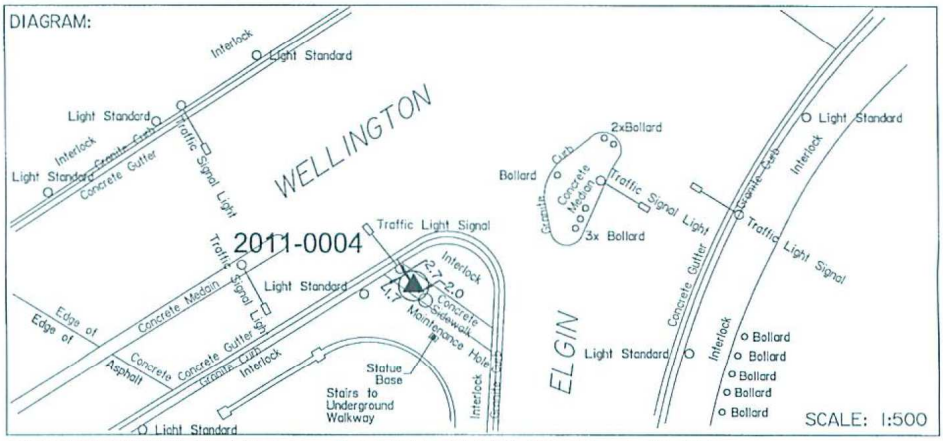


DIAGRAM:



DESCRIPTION/COMMENTS: Intervisible between Control Points 2011-0072, 2011-0138 and 2011-0154

AECOM Project Control Report JDB Ref. 17-23-773-00 and 17-23-781-00

STATION DESCRIPTION 2011-0154

STATION NUMBER:	HORIZONTAL AND VERTICAL CONTROL	DATE: (DD/MM/YYYY)
2011-0154		19/12/2011
UNITS: METRIC	MARKER TYPE: Convex Brass Cap for Rock/Concrete	INSTALLED BY: ANNIS, O'SULLIVAN, VOLLEBEKK LTD.

CO-ORDINATES (Metres, 3° MTM, Zone 9, CENTRAL MERIDIAN 76°30'W):

MTM NAD 83 (ORIGINAL)		MTM NAD 83 (CSRS) 1997	
NORTHING	EASTING	NORTHING	EASTING
5031882.876	367668.235	5031882.520	367668.146

ELEVATION: 78.923

LOCATION:

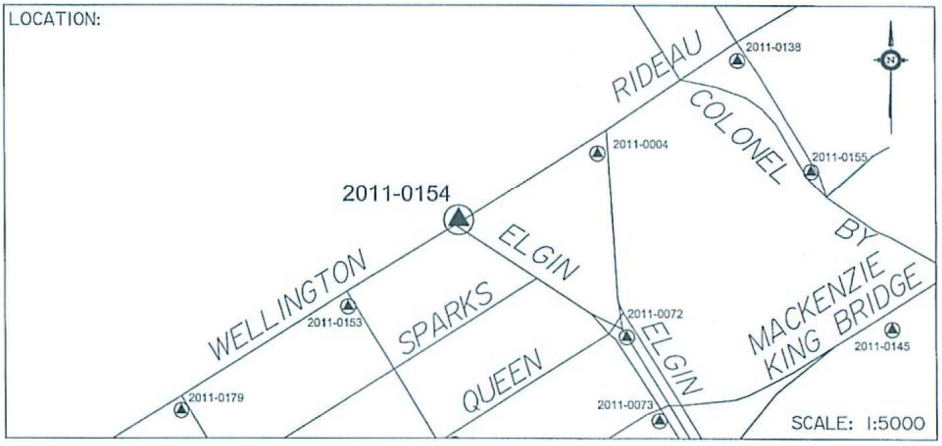
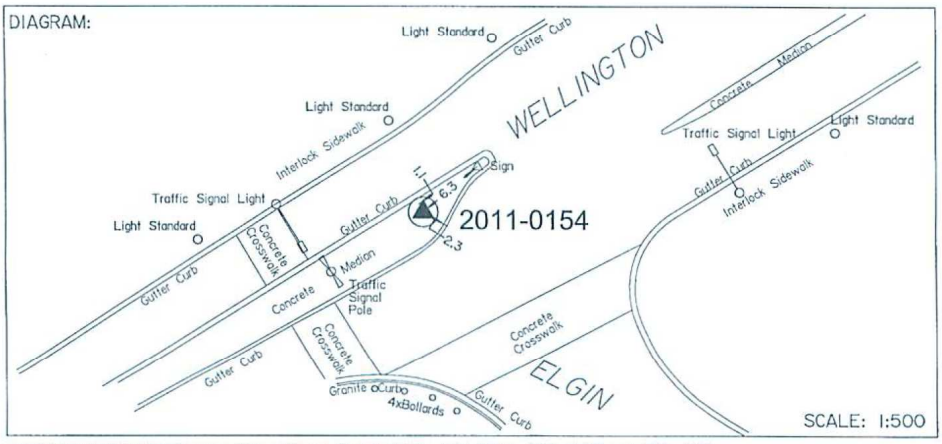


DIAGRAM:



DESCRIPTION/COMMENTS: Intervisible between Control Points 2011-0004, 2011-0072 and 2011-0153

AECOM Project Control Report JDB Ref. 17-23-773-00 and 17-23-781-00

12/14/2017 COSINE Report

STATION: 0011963U129

Also known as:	00163U129, 63U129, OTT 27, VANO
Monument status:	Existing
Station type:	SPIR
Horizontal datum:	NAD-1927:SCAL
Horizontal accuracy:	UNCLASSIFIED
Latitude:	N45 °24 ′21.0xxxx ″
Longitude:	W75 °41 ′16.0xxxx ″
Ellipsoidal elevation:	70.xxx
Ellipsoidal elevation order:	Unclassified
UTM-18 Easting:	E446175.xxx
UTM-18 Northing:	N5028047.xxx
UTM-18 Cmbd sc-fact:	0.99962464
UTM-18 Mrdnl convg:	-0 °29 ′23.2 ″
MTM-9 Easting:	E368382.xxx
MTM-9 Northing:	N5029647.xxx
MTM-9 Cmbd sc-fact:	0.99993871
MTM-9 Mrdnl convg:	0 °34 ′42.2 ″
Vertical datum:	CGVD-1928:1978
Vertical accuracy:	First order
Orthometric elev:	69.519
Meridional defl:	
Prime vert defl:	
Undulation:	
Location:	Township: OTTAWA SMALL BRICK DOUBLE RESIDENCE ON NORTHWEST CORNER OF O'CONNOR STREET AND PATTERSON AVENUE (139 PATTERSON AVENUE), PLATE IN SOUTH OR FRONT STONE FOUNDATION, 9 CM WEST OF SOUTHEAST CORNER, 52 CM BELOW BRICKWORK, 52 CM ABOVE GROUND. ESTABLISHED BY THE CITY OF OTTAWA.
Maintenance:	GSC; last inspected: --
Other vert data [ord]:	CGVD2013 [1]
Number of Ref Sketches:	0

http://www.gisapplication.lrc.gov.on.ca/services/COSINE/Remote/849ec8bf_d783_4366_abf5_07ab674f6311.html?print=true 1/1

AECOM Project Control Report JDB Ref. 17-23-773-00 and 17-23-781-00

12/14/2017 COSINE Report

STATION: 0011963U128

Also known as:	00163U128, 63U128, OTT 26, VANO
Monument status:	Existing
Station type:	SPIR
Horizontal datum:	NAD-1927:SCAL
Horizontal accuracy:	UNCLASSIFIED
Latitude:	N45 °24 ′21.0xxxx ″
Longitude:	W75 °41 ′09.0xxxx ″
Ellipsoidal elevation:	70.xxx
Ellipsoidal elevation order:	Unclassified
UTM-18 Easting:	E446327.xxx
UTM-18 Northing:	N5028046.xxx
UTM-18 Cmbd sc-fact:	0.99962444
UTM-18 Mrdnl convg:	-0 °29 ′18.2 ″
MTM-9 Easting:	E368535.xxx
MTM-9 Northing:	N5029648.xxx
MTM-9 Cmbd sc-fact:	0.99993895
MTM-9 Mrdnl convg:	0 °34 ′47.2 ″
Vertical datum:	CGVD-1928:1978
Vertical accuracy:	First order
Orthometric elev:	69.066
Meridional defl:	
Prime vert defl:	
Undulation:	
Location:	Township: OTTAWA SMALL DOUBLE RESIDENCE ON SOUTHWEST CORNER OF PATTERSON AVENUE AND METCALFE STREET (70 PATTERSON AVENUE), PLATE IN EAST SIDE STONE FOUNDATION, 9 CM SOUTH OF NORTHEAST CORNER, 18 CM BELOW BRICKWORK, 64 CM ABOVE GROUND. ESTABLISHED BY THE CITY OF OTTAWA.
Maintenance:	GSC; last inspected: --
Other vert data [ord]:	CGVD2013 [1]
Number of Ref Sketches:	0

http://www.gisapplication.lrc.gov.on.ca/services/COSINE/Remote/f1d9b3da_9cbd_49b6_afad_3e5fb92b4dfa.html?print=true 1/1

AECOM Project Control Report JDB Ref. 17-23-773-00 and 17-23-781-00

12/14/2017 COSINE Report

STATION: 0011954U001

Also known as:	00154U001, 54U001, 886G2, CP89211
Monument status:	Existing
Station type:	SPIR
Horizontal datum:	NAD-1927:SCAL
Horizontal accuracy:	UNCLASSIFIED
Latitude:	N45 °25 ′33.0xxxx ″
Longitude:	W75 °41 ′42.0xxxx ″
Ellipsoidal elevation:	72.xxx
Ellipsoidal elevation order:	Unclassified
UTM-18 Easting:	E445629.xxx
UTM-18 Northing:	N5030274.xxx
UTM-18 Cmbd sc-fact:	0.99962506
UTM-18 Mrdnl convg:	-0 °29 ′42.3 ″
MTM-9 Easting:	E367795.xxx
MTM-9 Northing:	N5031864.xxx
MTM-9 Cmbd sc-fact:	0.99993748
MTM-9 Mrdnl convg:	0 °34 ′24.4 ″
Vertical datum:	CGVD-1928:1978
Vertical accuracy:	First order
Orthometric elev:	71.174
Meridional defl:	
Prime vert defl:	
Undulation:	
Location:	Township: OTTAWA CHATEAU LAURIER, AT MACKENZIE STREET ENTRANCE TO ROTUNDA, ORNAMENTAL BENCH MARK PLATE IN EAST STONE WALL, 2.44 M NORTH OF DOORWAY, 67 CM ABOVE SIDEWALK. OTTAWA CHATEAU LAURIER, AT MACKENZIE STREET ENTRANCE TO ROTUNDA, ORNAMENTAL BENCH MARK PLATE IN EAST STONE WALL, 2.44 M NORTH OF DOORWAY, 67 CM ABOVE SIDEWALK.
Maintenance:	GSC; last inspected: 1989
Other vert data [ord]:	CGVD2013 [1]
Number of Ref Sketches:	0

http://www.gisapplication.lrc.gov.on.ca/services/COSINE/Remote/617850ad_a1a1_432a_9c27_2e569c24d769.html?print=true 1/1

AECOM Project Control Report JDB Ref. 17-23-773-00 and 17-23-781-00

12/14/2017 COSINE Report

STATION: 0011950U886G

Also known as:	00150U886G, 50U886G, 886G, CP89211
Monument status:	Existing
Station type:	SPIR
Horizontal datum:	NAD-1927:SCAL
Horizontal accuracy:	UNCLASSIFIED
Latitude:	N45 °25 ′26.0xxxx ″
Longitude:	W75 °41 ′56.0xxxx ″
Ellipsoidal elevation:	90.xxx
Ellipsoidal elevation order:	Unclassified
UTM-18 Easting:	E445322.xxx
UTM-18 Northing:	N5030060.xxx
UTM-18 Cmbd sc-fact:	0.99962265
UTM-18 Mrdnl convg:	-0 °29 ′52.2 ″
MTM-9 Easting:	E367493.xxx
MTM-9 Northing:	N5031645.xxx
MTM-9 Cmbd sc-fact:	0.99993419
MTM-9 Mrdnl convg:	0 °34 ′14.4 ″
Vertical datum:	CGVD-1928:1978
Vertical accuracy:	First order
Orthometric elev:	89.617
Meridional defl:	
Prime vert defl:	
Undulation:	
Location:	Township: OTTAWA HOUSE OF COMMONS, AT MAIN ENTRANCE, RECTANGULAR BENCH MARK PLATE ON WEST WALL OF PEACE TOWER, 1.00 M SOUTH OF WEST PORTAL, 85 CM ABOVE STONE PAVEMENT. OTTAWA HOUSE OF COMMONS, AT MAIN ENTRANCE, RECTANGULAR BENCH MARK PLATE ON WEST WALL OF PEACE TOWER, 1.0 M SOUTH OF WEST PORTAL, 85 CM ABOVE STONE PAVEMENT.
Maintenance:	GSC; last inspected: 1989
Other vert data [ord]:	CGVD2013 [1]
Number of Ref Sketches:	0

http://www.gisapplication.lrc.gov.on.ca/services/COSINE/Remote/e9980398_84ae_4616_80f7_b3d2298953ac.html?print=true 1/1

AECOM Project Control Report JDB Ref. 17-23-773-00 and 17-23-781-00

12/14/2017 COSINE Report

STATION: 0011962U108

Also known as:	00162U108, 62U108, NRC 10, VANO
Monument status:	Existing
Station type:	SPIR
Horizontal datum:	NAD-1927:SCAL
Horizontal accuracy:	UNCLASSIFIED
Latitude:	N45 °24 ′39.0xxxx ″
Longitude:	W75 °41 ′16.0xxxx ″
Ellipsoidal elevation:	69.xxx
Ellipsoidal elevation order:	Unclassified
UTM-18 Easting:	E446179.xxx
UTM-18 Northing:	N5028602.xxx
UTM-18 Cmbd sc-fact:	0.99962479
UTM-18 Mrdnl convg:	-0 °29 ′23.3 ″
MTM-9 Easting:	E368377.xxx
MTM-9 Northing:	N5030202.xxx
MTM-9 Cmbd sc-fact:	0.99993886
MTM-9 Mrdnl convg:	0 °34 ′42.4 ″
Vertical datum:	CGVD-1928:1978
Vertical accuracy:	First order
Orthometric elev:	68.263
Meridional defl:	
Prime vert defl:	
Undulation:	
Location:	Township: OTTAWA DEEP BENCH MARK, AT SOUTHEAST CORNER OF CATHARINE AND METCALFE STREETS, 6.0 M SOUTH OF SOUTH CURB OF EXIT FROM QUEENSWAY, 6.5 M EAST OF EAST CURB OF METCALFE STREET, 14.3 M NORTH OF QUEENSWAY OVERPASS ABUTMENT,SLIGHTLY ABOVE STREET LEVEL. ESTABLISHED BY NATIONAL RESEARCH COUNCIL.
Maintenance:	GSC; last inspected: --
Other vert data [ord]:	CGVD2013 [1]
Number of Ref Sketches:	0

http://www.gisapplication.lrc.gov.on.ca/services/COSINE/Remote/f05b6c27_f09d_4d96_b224_7dcf451eb846.html?print=true 1/1

AECOM Project Control Report JDB Ref. 17-23-773-00 and 17-23-781-00

12/14/2017 COSINE Report

STATION: 0011948U574G

Also known as:	00148U574G, 48U574G, 574G, VANO
Monument status:	Existing
Station type:	SPIR
Horizontal datum:	NAD-1927:SCAL
Horizontal accuracy:	UNCLASSIFIED
Latitude:	N45 °22 ′11.9xxxx ″
Longitude:	W75 °42 ′00.0xxxx ″
Ellipsoidal elevation:	77.xxx
Ellipsoidal elevation order:	Unclassified
UTM-18 Easting:	E445183.xxx
UTM-18 Northing:	N5024074.xxx
UTM-18 Cmbd sc-fact:	0.99962487
UTM-18 Mrdnl convg:	-0 °29 ′53.4 ″
MTM-9 Easting:	E367465.xxx
MTM-9 Northing:	N5025655.xxx
MTM-9 Cmbd sc-fact:	0.99993619
MTM-9 Mrdnl convg:	0 °34 ′09.6 ″
Vertical datum:	CGVD-1928:1978
Vertical accuracy:	First order
Orthometric elev:	76.216
Meridional defl:	
Prime vert defl:	
Undulation:	
Location:	Township: OTTAWA HOGS BACK LOCKS, ON RIDEAU RIVER, TABLET IN NORTH FACE OF STONE ABUTMENT OF MIDDLE LOCK, SECOND COURSE OF STONE ABOVE EASTERLY WALL OF CANAL.
Maintenance:	GSC; last inspected: --
Other vert data [ord]:	CGVD2013 [1]
Number of Ref Sketches:	0

http://www.gisapplication.lrc.gov.on.ca/services/COSINE/Remote/007188de_1538_417e_b1bc_5c6f1f849698.html?print=true 1/1

AECOM Project Control Report JDB Ref. 17-23-773-00 and 17-23-781-00

12/14/2017 COSINE Report

STATION: 0011948U033

Also known as:	00148U033, 48U033, HARTWELL 1, VANO
Monument status:	Existing
Station type:	SPIR
Horizontal datum:	NAD-1927:SCAL
Horizontal accuracy:	UNCLASSIFIED
Latitude:	N45 °22 ′11.9xxxx ″
Longitude:	W75 °42 ′00.0xxxx ″
Ellipsoidal elevation:	72.xxx
Ellipsoidal elevation order:	Unclassified
UTM-18 Easting:	E445183.xxx
UTM-18 Northing:	N5024074.xxx
UTM-18 Cmbd sc-fact:	0.99962565
UTM-18 Mrdnl convg:	-0 °29 ′53.4 ″
MTM-9 Easting:	E367465.xxx
MTM-9 Northing:	N5025655.xxx
MTM-9 Cmbd sc-fact:	0.99993697
MTM-9 Mrdnl convg:	0 °34 ′09.6 ″
Vertical datum:	CGVD-1928:1978
Vertical accuracy:	First order
Orthometric elev:	71.332
Meridional defl:	
Prime vert defl:	
Undulation:	
Location:	Township: OTTAWA HARTWELLS LOCK, ON RIDEAU RIVER, TOP OF CATHEAD, UPPER END, SOUTHEAST CORNER. ESTABLISHED BY DEPARTMENT OF TRANSPORT.
Maintenance:	GSC; last inspected: --
Other vert data [ord]:	CGVD2013 [1]
Number of Ref Sketches:	0

http://www.gisapplication.lrc.gov.on.ca/services/COSINE/Remote/7f7a0174_0036_4950_94cd_5ef08a85d1c0.html?print=true 1/1

AECOM Project Control Report JDB Ref. 17-23-773-00 and 17-23-781-00

12/14/2017 COSINE Report

STATION: 0011963U3640

Also known as:	00163U3640, 3640, 63U3640, VANO
Monument status:	Existing
Station type:	SPIR
Horizontal datum:	NAD-1927:SCAL
Horizontal accuracy:	UNCLASSIFIED
Latitude:	N45 °24 ′28.0xxxx ″
Longitude:	W75 °40 ′40.0xxxx ″
Ellipsoidal elevation:	67.xxx
Ellipsoidal elevation order:	Unclassified
UTM-18 Easting:	E446959.xxx
UTM-18 Northing:	N5028256.xxx
UTM-18 Cmbd sc-fact:	0.99962408
UTM-18 Mrdnl convg:	-0 °28 ′57.6 ″
MTM-9 Easting:	E369163.xxx
MTM-9 Northing:	N5029871.xxx
MTM-9 Cmbd sc-fact:	0.99994041
MTM-9 Mrdnl convg:	0 °35 ′08.0 ″
Vertical datum:	CGVD-1928:1978
Vertical accuracy:	First order
Orthometric elev:	66.701
Meridional defl:	
Prime vert defl:	
Undulation:	
Location:	Township: OTTAWA A LARGE BRICK SCHOOL, ON EAST SIDE OF MAIN STREET, OPPOSITE HAZEL STREET, (223 MAIN STREET), TABLET IN NORTH SIDE STONE FOUNDATION, 2.83 M WEST OF MOST WESTERLY OF TWO BASEMENT WINDOWS, 2.0 M BELOW BRICKWORK, 12 CM ABOVE GROUND.
Maintenance:	GSC; last inspected: --
Other vert data [ord]:	CGVD2013 [1]
Number of Ref Sketches:	0

http://www.gisapplication.lrc.gov.on.ca/services/COSINE/Remote/c32e0ed7_e6b0_4d14_b9be_c8a27ae718cf.html?print=true 1/1

AECOM Project Control Report JDB Ref. 17-23-773-00 and 17-23-781-00

12/14/2017 COSINE Report

STATION: 0011963U3617

Also known as:	00163U3617, 3617, 63U3617, VANO
Monument status:	Existing
Station type:	SPIR
Horizontal datum:	NAD-1927:SCAL
Horizontal accuracy:	UNCLASSIFIED
Latitude:	N45 °24 ′39.0xxxx ″
Longitude:	W75 °41 ′09.0xxxx ″
Ellipsoidal elevation:	67.xxx
Ellipsoidal elevation order:	Unclassified
UTM-18 Easting:	E446331.xxx
UTM-18 Northing:	N5028601.xxx
UTM-18 Cmbd sc-fact:	0.99962491
UTM-18 Mrdnl convg:	-0 °29 ′18.4 ″
MTM-9 Easting:	E368529.xxx
MTM-9 Northing:	N5030204.xxx
MTM-9 Cmbd sc-fact:	0.99993941
MTM-9 Mrdnl convg:	0 °34 ′47.4 ″
Vertical datum:	CGVD-1928:1978
Vertical accuracy:	First order
Orthometric elev:	DO NOT USE - OUT based on JDB Levels. 66.828
Meridional defl:	
Prime vert defl:	
Undulation:	
Location:	Township: OTTAWA ELGIN STREET UNDERPASS, UNDER THE QUEENSWAY, TABLET IN EAST FACE OF WEST CONCRETE ABUTMENT WALL, 1.43 M NORTH OF SOUTH CORNER, 40 CM ABOVE SIDEWALK.
Maintenance:	GSC; last inspected: --
Other vert data [ord]:	CGVD2013 [1]
Number of Ref Sketches:	0

http://www.gisapplication.lrc.gov.on.ca/services/COSINE/Remote/af1f5b9f_a672_4655_b599_916b232861ac.html?print=true 1/1

AECOM Project Control Report JDB Ref. 17-23-773-00 and 17-23-781-00

12/14/2017 COSINE Report

STATION: 0011948U034

Also known as:	00148U034, 48U034, HARTWELL 2, VANO
Monument status:	Existing
Station type:	SPIR
Horizontal datum:	NAD-1927:SCAL
Horizontal accuracy:	UNCLASSIFIED
Latitude:	N45 °22 ′11.9xxxx ″
Longitude:	W75 °42 ′00.0xxxx ″
Ellipsoidal elevation:	69.xxx
Ellipsoidal elevation order:	Unclassified
UTM-18 Easting:	E445183.xxx
UTM-18 Northing:	N5024074.xxx
UTM-18 Cmbd sc-fact:	0.99962612
UTM-18 Mrdnl convg:	-0 °29 ′53.4 ″
MTM-9 Easting:	E367465.xxx
MTM-9 Northing:	N5025655.xxx
MTM-9 Cmbd sc-fact:	0.99993744
MTM-9 Mrdnl convg:	0 °34 ′09.6 ″
Vertical datum:	CGVD-1928:1978
Vertical accuracy:	First order
Orthometric elev:	DO NOT USE - OUT based on JDB Levels. 68.013
Meridional defl:	
Prime vert defl:	
Undulation:	
Location:	Township: OTTAWA HARTWELLS LOCK, ON RIDEAU RIVER, TOP OF CATHEAD, LOWER END, NORTHEAST CORNER. ESTABLISHED BY DEPARTMENT OF TRANSPORT.
Maintenance:	GSC; last inspected: --
Other vert data [ord]:	CGVD2013 [1]
Number of Ref Sketches:	0

http://www.gisapplication.lrc.gov.on.ca/services/COSINE/Remote/d1924993_6ff1_4628_9f73_e0b688d85c69.html?print=true 1/1

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AECOM
85 Sainte-Catherine Street West
Montréal, Québec H2X 3P4
Canada
T 514 287-8500
F 514 287 8600

aecom.com