

APPENDIX B

PHOTOGRAPHIC RECORD



Photo 1.

Photo taken: October 20, 2006

Bank slump noted along Reach C10.



Photo 2.

Photo taken: October 20, 2006

Looking upstream towards a chute during high flow conditions.



Photo 3.

Photo taken: October 20, 2006

Bank slump along left bank near Old Montreal Road. View looking downstream.



Photo 4.

Photo taken: October 20, 2006

Large knickpoint noted in the channel. Photo looking upstream.

APPENDIX C

DETAILED ASSESSMENT



Geomorphic Solutions

Fluvial Geomorphology Summary

Cardinal Creek - Reach C10

Location: **City of Ottawa**

Date: **November 24, 2006**

Length Surveyed: **240 m**

Number of Cross-Sections: **10**

GENERAL SITE CHARACTERISTICS

Drainage Area:

Geology/Soils: **Marine Clays, Till**

Surrounding Land Use: **Forest, Meadow**

Channel Disturbances: **None**

Aquatic Vegetation:

Dominant Vegetation Type: **Rooted macrophytes**

Portion of Reach with Vegetation: **10%**

Riparian Vegetation:

Dominant Vegetation Type: **Meadow**

Extent of Riparian Buffer Zone: **Continuous**

Width of Riparian Buffer Zone: **>15 channel widths**

Age Class of Riparian Vegetation: **Mature**

Extent of Encroachment into Channel: **Minimal**

Large Woody Debris: **Present in Channel and banks**

HYDROLOGY

Measured Discharge: **Not measured** m³/s

Calculated Bankfull Discharge: **#REF!** m³/s

Modeled 2-year Discharge: **Not modeled** m³/s

Calculated Bankfull Velocity: **#REF!** m/s

Modeled 2-year Velocity: **Not modeled** m/s

PLANFORM CHARACTERISTICS

Profile

Bankfull Gradient: **0.27 %**

Channel Bed Gradient: **0.39 %**

Riffle Gradient: **1.7 %**

Riffle Length: **4.3 m**

Riffle-Pool Spacing: **6.02 m**

Meander Geometry

Sinuosity: **2.03**

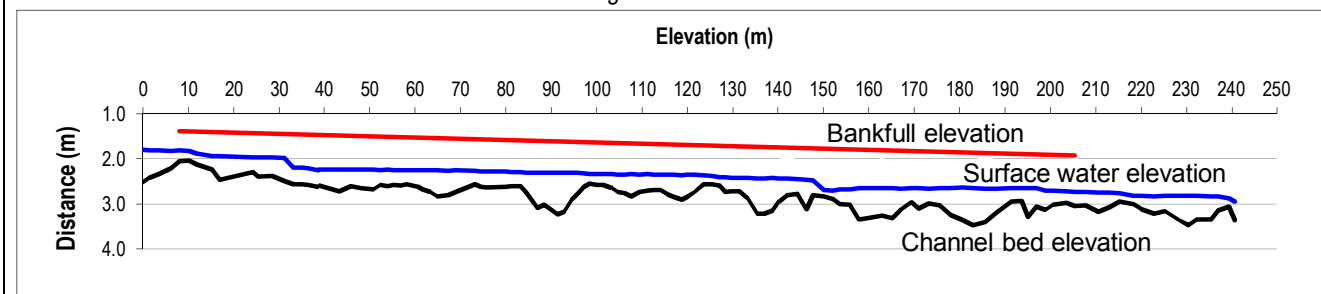
Belt Width: **112 m**

Radius of Curvature: **Not measured** m

Amplitude: **Not measured** m

Wavelength: **Not measured** m

Longitudinal Profile



BANK CHARACTERISTICS

	Minimum	Maximum	Average		Minimum	Maximum	Average
Bank Height (m):	0.6	8.0	1.5				
Bank Angle (degrees):	30.0	85.0	65.0	Torvane Value* (kg/cm ²):	0.05	0.35	0.2
Root Depth (m):	0.3	1.0	0.5	Penetrometer Value* (kg/cm ³):	Not Available		
Root Density (kg/m ²):	10	100.0	70.0	Bank Material (range):	Clay to Gravel		
Depth of Undercut (m):	0.10	0.25	0.15	* Mechanic shear stress/ failure as measured from instruments is NOT			

* Mechanic shear stress/ failure as measured from instruments is NOT equivalent to a threshold or entrainment shear stress

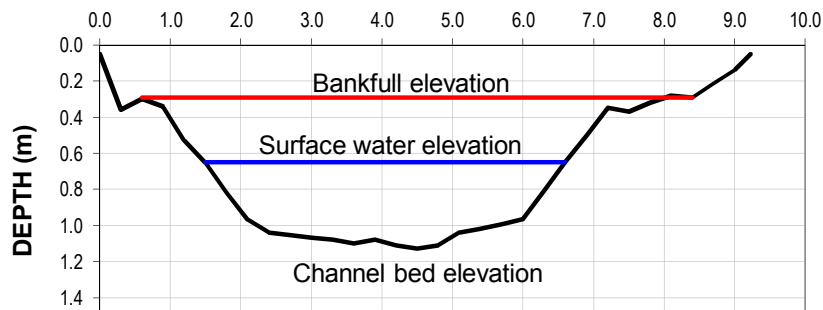
CROSS-SECTIONAL CHARACTERISTICS

	<i>Minimum</i>	<i>Maximum</i>	<i>Average</i>
Bankfull Width (m):	5.70	10.10	7.47
Average Bankfull Depth (m):	0.40	0.91	0.69
Bankfull Width/Depth:	11.42	34.24	19.86
Wetted Width (m):	3.90	8.70	5.59
Water Depth (m):	0.09	0.37	0.25
Wetted Width/Depth:	13.62	98.85	29.25
Entrenchment (m):	14	22	17.6
Entrenchment Ratio:	1.49	3.17	2.43
Maximum Depth (m):	0.45	1.1	0.8
Manning's n:	0.035		

Representative Cross-Section

CROSS-SECTION 4

DISTANCE (m)



SUBSTRATE CHARACTERISTICS

Particle size

D ₁₀	N/A mm
D ₅₀	3.0 mm
D ₉₀	70.0 mm

Subpavement: **Marine deposits (consolidated clay)**

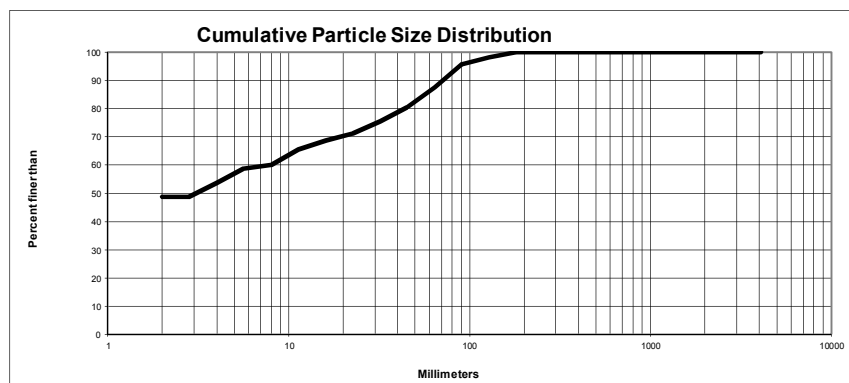
Particle shape: **Sub-angular to sub-rounded**

Embeddedness (%): **20**

Particle range (riffle): **Sand to Cobble**

Particle Range (pool): **Clay to Gravel**

Grain Size Distribution



CHANNEL THRESHOLDS

Flow Competency (non-cohesive sediments):

for D_{50} : **0.33 m/s**

for D_{84} : **1.23 m/s**

Unit Stream Power at Bankfull: **38.19 W/m²**

Tractive Force at Bankfull:

27.1 N/m²

Tractive Force at 2-year flow:

N/A N/m²

Critical Shear Stress (Bed):

2.2 N/m²

Critical Shear Stress (Bank):

3.6 N/m²

GENERAL FIELD OBSERVATIONS

Formation of islands at the downstream section of the reach

Large wood debris scattered in and around stream

Valley wall contact along downstream extent of survey

Steep banks

Substrate - Consolidated clay and clay aggradations (clay balls - gravel sized)

Erosion Pin Installation

Cross-section # 5; GPS Coordinates: 462906.0211, 5038248.874 NAD 83 ZONE 18N

Erosion pin (left bank - upper) = 10.5 cm; (left bank - lower) = 8.5 cm; Erosion pin (right bank) = 12.0 cm

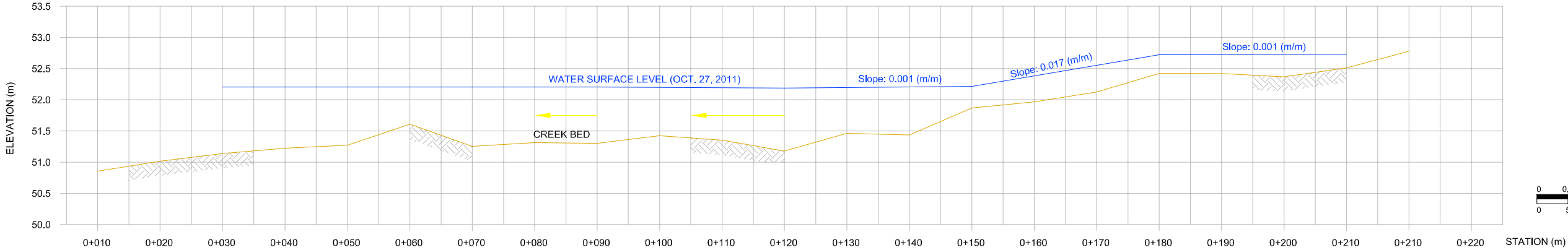
Scour pin (at 2.9 m mark on tape) = 5.2 cm; Scour pin (at 6.0 m mark on tape) = 3.5 cm

Representative Photo - Cross Section 6, downstream view





Cross-Section Locations



Legend

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City of Ottawa
Cardinal Creek Subwatershed Study

Plan and Profile

PROJECT NUMBER
60189560

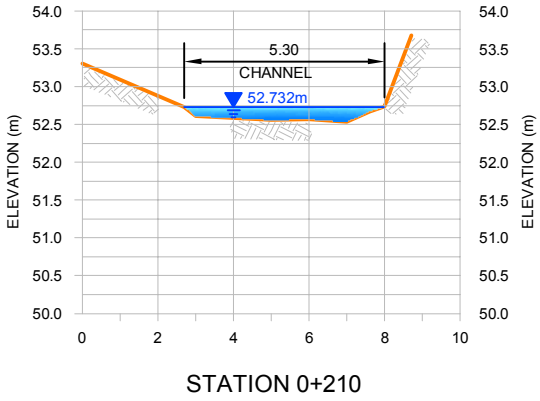
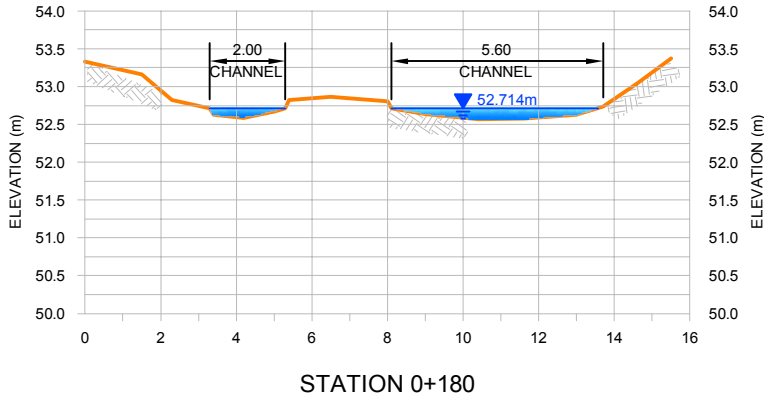
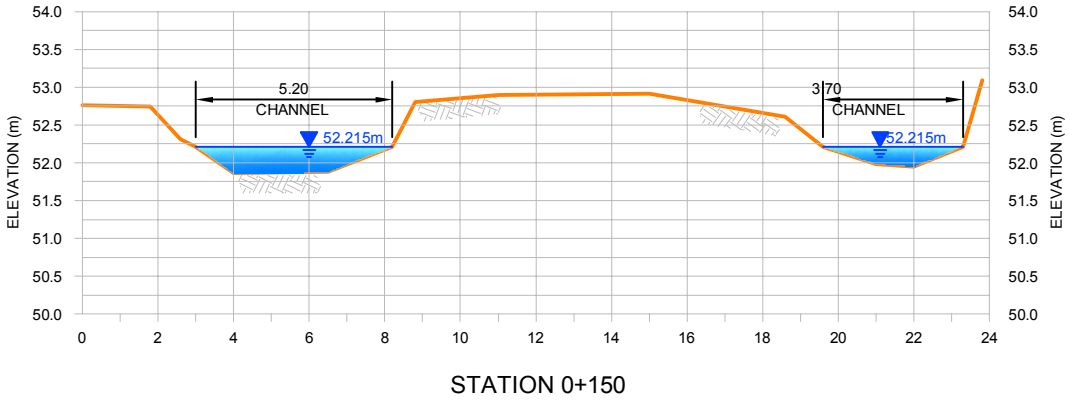
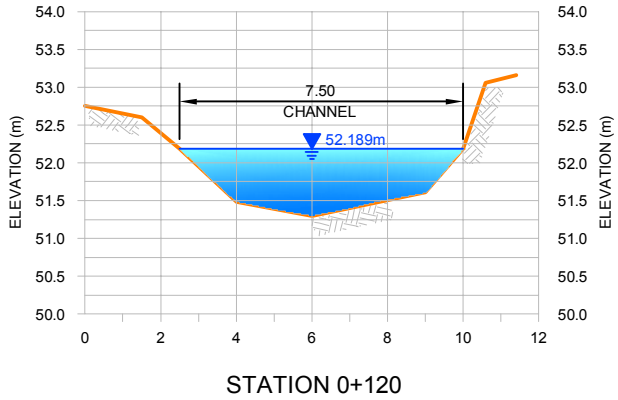
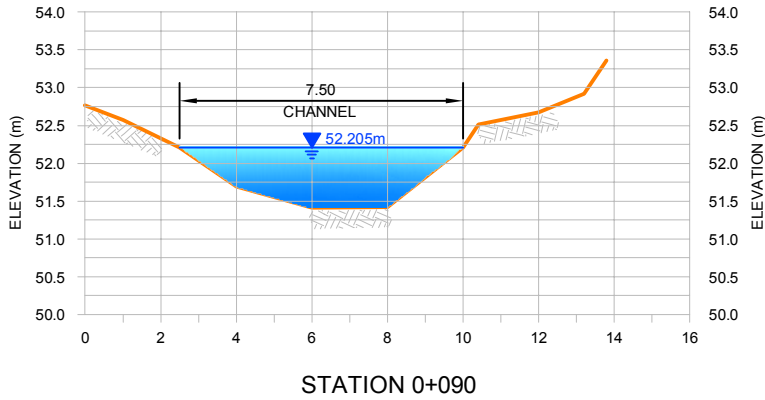
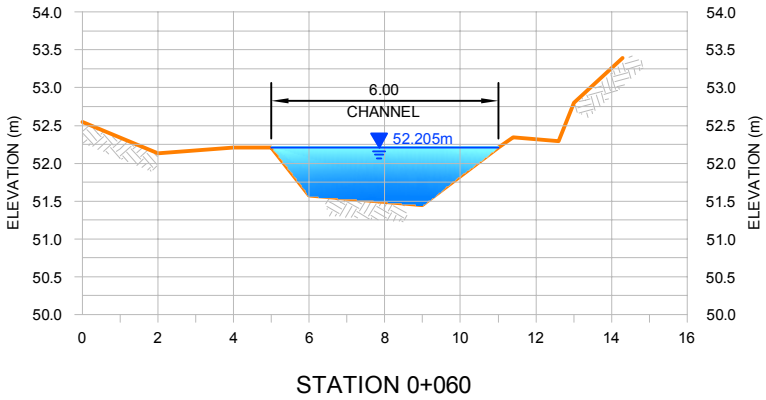
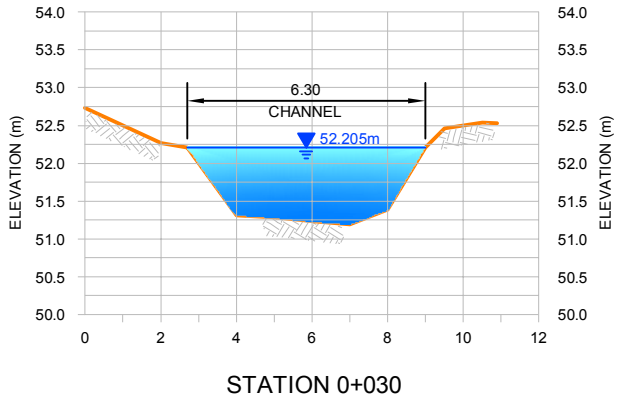
DATE
May, 2013

FIGURE
1

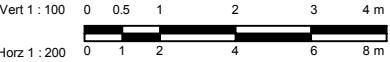
B SIZE 11" x 17" (279.4mm x 431.8mm)

PLOT: 5/10/2013 2:34:12 PM

FILE NAME: FIGURE 2-V1.DWG



NOTES:
1. ALL CROSS SECTIONS SHOWN ARE LOOKING TOWARDS UPSTREAM.



Legend

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City of Ottawa
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Cross Sections

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FIGURE
2