



## **ANNEX X: APPENDIX E**

# **2013 FIELD PROGRAM DATA**



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## Abbreviations

Abbreviation	Definition
~	approximately
#	number
Avg	average
Dominion Diamond	Dominion Diamond Ekati Corporation
DEM	digital elevation model
E	east
e.g.,	for example
et al.	more than one additional author
GIS	Geographic Information System
GPS	Global Positioning System
LDB	left downstream bank
LIDAR	light detection and ranging
Max	maximum
N	north
NAD	North American Datum
NTS	National Topographic System
Q	Discharge
Qi	Interval Discharge
RDB	right downstream bank
UTM	Universal Transverse Mercator
W	west

## Units of Measure

Unit	Definition
%	percent
<	less than
>	greater than
ha	hectare
hr	hour
m	metre
m <sup>2</sup>	square metre
m/m	metres per metre
m/s	metres per second
m <sup>3</sup> /s	cubic metres per second
masl	metres above sea level
N/m <sup>2</sup>	Newtons per square metre

## E1 INTRODUCTION

Baseline hydrological data collected in the open-water season of 2013 were intended to advance the understanding of the hydrology of the Lac du Sauvage watershed, Paul Lake watershed, Lac du Sauvage, and the Lac de Gras outlet. These initial data were also used for input and calibration of the regional water balance model of the Lac de Gras watershed. The 2013 field program had four components: reconnaissance surveys, discrete hydrology surveys, the establishment of continuous hydrometric stations, and lake shoreline surveys.

The following sections provide a summary of field data from the 2013 field program. The locations of the discrete hydrology survey sites and continuous hydrometric stations within the Lac du Sauvage and Paul Lake watersheds are provided in Map 3.3-1.

## E2 RECONNAISSANCE SURVEYS

Reconnaissance surveys were completed at selected lakes within the Lac du Sauvage watershed. Lakes selected for reconnaissance surveys were those with large storage capacities and upstream drainage areas that were not part of the discrete hydrology survey or continuous hydrometric station surveys.

Reconnaissance surveys were completed using the following methods:

- Visual surveys and observations during overflights; and,
- Shooting of oblique aerial photography while recording Global Positioning System (GPS) tracks to provide geo-referenced photography.

Information on the general watershed characteristics and outlet conditions at a large number of lakes in the watershed is required to develop the water balance model. Observations during reconnaissance surveys included, but were not limited to:

- bed and bank material;
- outlet and channel vegetation;
- number of outlets and connectivity to downstream lakes (including evidence of subsurface flow through natural rock drain or esker material);
- channel morphology types;
- boulder gardens, ledges, waterfalls, or other potential obstructions to fish passage; and,
- severely constricted outlets at any lake (e.g., gorge-type situations that would lead to large annual variation in water level and large attenuation capacity).

Summary sheets and photos for each reconnaissance survey are provided in the following sections.

## E2.1 Lake B15 Outlet

Channel Name: Stream B15

Reconnaissance Date: August 13, 2013

Coordinates: (UTM Zone 12, NAD 83) 538247 m E, 7164113 m N

**Table E2-1 Reconnaissance Observations and GIS Parameters for Stream B15**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	B15	
Upstream Lake Area (ha)	63	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	224	Estimated from light detection and ranging (LiDAR) data
Upstream Lake Elevation (masl)	435.0	Estimated from LiDAR data
Number of Outlet Channels	1	
Channel Connectivity	Continuous	B15 outlet is connected to B1 (Christine Lake) inlet
Channel Type	Sinuuous (perhaps braided)	Difficult to conclude due to very narrow channel (<5 m width) and dense vegetation in some areas
Sinuosity	Degree 2 (1.06 to 1.25)	
Streambed Material	Fine-grained material	Inferred from absence of boulders and cobbles
Streambank Material	Fine-grained material	Inferred from absence of boulders and cobbles
Stream bed/bank Vegetation	Low-shrub tundra (predominant) except for channel midpoint (high-shrub tundra)	
Channel Slope (m/m)	0.015	Estimated from LiDAR data
Potential Obstructions to Fish Passage	Potential obstruction in heavily vegetated high-shrub tundra zone at channel midpoint	
<p><b>General Notes/Observations:</b> The B15-B1 (Christine Lake) outlet channel is moderately sinuous and perhaps braided, but because of very narrow widths and a densely vegetated zone in the middle of the stream, this is inconclusive. Furthermore, visible water is not continuous, but there are enough pools and streambanks defined by low-shrub tundra to suggest that B15 is connected to B1 (Christine Lake). On the left downstream bank, there is a long ridge adjacent to the channel (probably an esker) with sandy deposits.</p>		

m/m = metres per metre; ha = hectare; m = metre; masl = metres above sea level; < = less than; GIS = Geographic Information System.



13/08/13: Lakes B15 (top right) and B1 (Christine Lake)  
(bottom left)

Photo #: P8130613



13/08/13: Lakes B15 (top lake with 2 islands) and B1  
(Christine Lake) (bottom left)

Photo #: P8130612



12/08/13: Lakes B15 (top left) and B1 (Christine Lake) (bottom)

Photo #: P8130611



12/08/13: Lakes B15 (left) and B1 (Christine Lake)  
(bottom right)

Photo #: P8130609

## E2.2 Lake B20 Outlet

Channel Name: Stream B20

Reconnaissance Date: August 13, 2013

Coordinates: (UTM Zone 12, NAD 83) 538850 m E, 7164180 m N

**Table E2-2 Reconnaissance Observations and GIS Parameters for Stream B20**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	B20	
Upstream Lake Area (ha)	0.4	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	2	Estimated from LiDAR data
Upstream Lake Elevation (masl)	445.6	Estimated from LiDAR data
Number of Outlet Channels	1	
Channel Connectivity	Continuous or sub-surface connection	B20 outlet connected to B1 (Christine Lake) inlet possibly through sub-surface flow
Channel Type	Sinuuous	
Sinuosity	Degree 1 (1.00 to 1.05) or degree 2 (1.06 to 1.25)	
Streambed Material	Relict channel	
Streambank Material	Relict channel	
Stream bed/bank Vegetation	Dwarf to low-shrub tundra long along former stream	
Channel Slope (m/m)	0.071	Estimated from LiDAR data
Potential Obstructions to Fish Passage	Relict channel	
<p><b>General Notes/Observations:</b> The B20-B1 (Christine Lake) channel clearly had water flowing at some point in time, but this stream did not have observable surface water flow at the time of reconnaissance. There was no visible flow or clearly defined outlet at B20. However, there are distinct low-shrub tundra segments along the B20-B1 (Christine Lake) path bounded by dwarf-shrub tundra. There are steep valley slopes due to the presence of eskers, so surface runoff clearly drains into this channel. Given the high longitudinal slope of this channel, and defined stream channel, it is likely that there is flow between the two lakes, subterranean during dry periods and surface flow in wet periods.</p>		

m/m = metres per metre; ha = hectare; m = metre; masl = metres above sea level; LiDAR = light detection and ranging; GIS = Geographic Information System.



12/08/13: Lakes B20 (top right), B21 (top left), and B1 (Christine Lake) (bottom middle)  
Photo #: P8130614

## E2.3 Lake D2 Outlet

Channel Name: Stream D2

Reconnaissance Date: August 13, 2013

Coordinates: (UTM Zone 12, NAD 83) 536594 m E, 7170246 m N

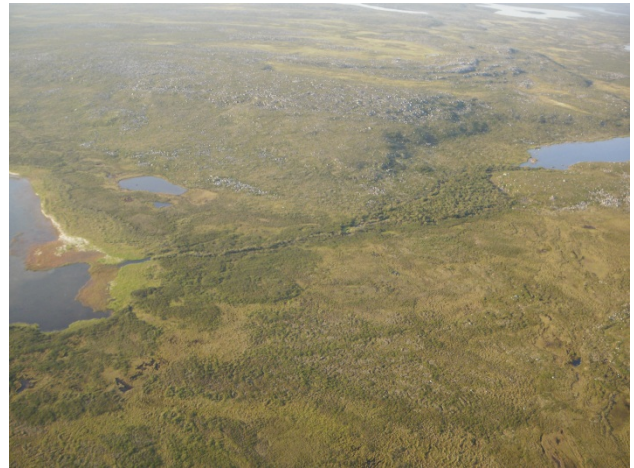
**Table E2-3 Reconnaissance Observations and GIS Parameters for Channel D2**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	D2	
Upstream Lake Area (ha)	6.2	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	56	Estimated from LiDAR data
Upstream Lake Elevation (masl)	427.4	Estimated from LiDAR data
Number of Outlet Channels	1	
Channel Connectivity	Continuous	D2 outlet is connected to D1 inlet
Channel Type	Sinuuous; however, the channel might be braided in the thick high-shrub tundra segment	
Sinuosity	Degree 1 (1.00 to 1.05)	
Streambed Material	Fine-grained material	Inferred from sediment deposition at D1 inlet
Streambank Material	Fine-grained material	Inferred from absence of boulders and relatively steep and stable banks
Stream bed/bank Vegetation	From high-shrub tundra at D2 outlet towards low-shrub tundra and graminoids at D1 inlet	
Channel Slope (m/m)	0.023	Estimated from LiDAR data
Potential Obstructions to Fish Passage	None observed at time of survey	
<p><b>General Notes/Observations:</b> The D2 outlet channel is very narrow (5 to 10 m wide) and its width is uniform downstream of the thick high-shrub tundra. The channel is likely braided in this zone, but the vegetation masks the flow. Downstream of the dense shrub area, the channel has very low sinuosity and appears stable, and has relatively steep banks. The channel carries a lot of sediment as evidenced by the delta-like deposition pattern at the D1 inlet. Note that the longitudinal slope is between 2.5% to 3.0%.</p>		

m/m = metres per metre; ha = hectare; masl = metres above sea level; LiDAR = light detection and ranging; m = metre; % = percent; GIS = Geographic Information System.



13/08/13: D2 outlet channel flowing into D1 (middle), which flows into Lac du Sauvage (long lake on top left)  
Photo #: P8130582



13/0813: Lakes D2 (right) and D1 (left)  
Photo #: P8130581



13/08/13: Upstream view of channel flowing from D2 to D1  
Photo #: P8130580



13/08/13: D2 outlet channel (middle left) flowing into D1  
Photo #: P8130578

## E2.4 Lake E11 Outlet

Channel Name: Stream E11

Reconnaissance Date: August 12, 2013

Coordinates: (UTM Zone 12, NAD 83) 524022 m E, 7185773 m N

**Table E2-4 Reconnaissance Observations and GIS Parameters for Stream E11**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	E11	
Upstream Lake Area (ha)	959	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	1531	Estimated from LiDAR data
Upstream Lake Elevation (masl)	469.8	Estimated from LiDAR data
Number of Outlet Channels	1	
Channel Connectivity	Continuous	E11 outlet is connected to Ursula Lake (Lake E10) inlet
Channel Type	Sinuous	
Sinuosity	Degree 2 (1.06 to 1.25)	
Streambed Material	Coarse-grained deposits (boulders and cobbles)	
Streambank Material	Poorly defined banks; high stage flow is bounded by sinuous boulder garden	
Stream bed/bank Vegetation	Low shrub tundra (predominant), grassland adjacent to large pool (right downstream bank)	
Channel Slope (m/m)	0.0081	Estimated from LiDAR data
Potential Obstructions to Fish Passage	Potentially during low stage flow (boulder gardens at E11 outlet and Ursula Lake (Lake E10) inlet)	
<p><b>General Notes/Observations:</b> Single-phase sinuous channel with no apparent riffles, very wide pool at the bend situated at the channel midpoint, low gradient both longitudinally and perpendicular to flow. The channel has poorly defined banks, but the sinuous boulder passage outlines high-stage flow regimes. There is a broadly defined floodplain, particularly visible by light-toned vegetation right of the downstream bank adjacent to the large pool. During high flow, the channel might braid into an additional branch (adjacent to the pool), but this segment terminates before reaching any lake.</p>		

m/m = metres per metre; ha = hectare; masl = metres above sea level; LiDAR = light detection and ranging;  
GIS = Geographic Information System.



12/08/13: Lakes E11 (top) and Ursula Lake (Lake E10) (bottom)  
Photo #: P8120383



12/08/13: Lake E11 (left) and Ursula Lake (Lake E10) (top)  
Photo #: P8120380



12/08/13: Ursula Lake (Lake E10) (top right)  
Photo #: P8120382



12/08/13: Lakes Ursula (Lake E10) (top) and E11 (bottom)  
Photo #: P8120386

## E2.5 Lake E287 Outlet

Channel Name: Stream E287

Reconnaissance Date: August 12, 2013

Coordinates: (UTM Zone 12, NAD 83) 536329 m E, 7183688 m N

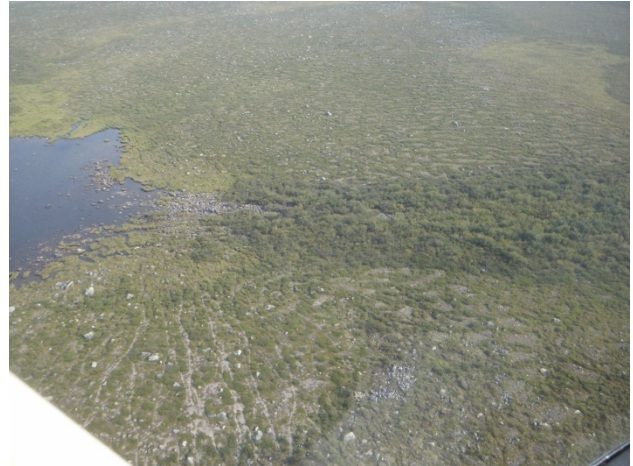
**Table E2-5 Reconnaissance Observations and GIS Parameters for Stream E287**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	E287	
Upstream Lake Area (ha)	40	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	135	Estimated from LiDAR data
Upstream Lake Elevation (masl)	428.8	Estimated from LiDAR data
Number of Outlet Channels	1	
Channel Connectivity	No observable surface flows	E287 outlet is not connected to Lake E4 with observable surface water flows
Channel Type	Straight	
Sinuosity	Degree 1 (1.00 to 1.05)	
Streambed Material	Boulders	Visibility of streambed material restricted to E287 outlet
Streambank Material	Poorly defined banks; high stage flow is bounded by boulder garden	
Stream bed/bank Vegetation	High shrub tundra	
Channel Slope (m/m)	0.027	Estimated from LiDAR data
Potential Obstructions to Fish Passage	Boulder garden is continuous from E287 outlet to E4 inlet	
<p><b>General Notes/Observations:</b> Very short (&lt;300 m) straight channel exiting Lake E287 (outlet). The stage is very low as no flowing water is visible except for at the E287 inlet. The remainder of the channel is a boulder garden with low sinuosity (1 to 1.05), but its visibility disappears as E4 is approached. This is partially because the density, as well as the cross-sectional width of the high-shrub tundra area increases from E287 to E4. However, any trace of visible flow, high-shrub tundra or boulder gardens disappears before E4 is reached. Therefore, E287 and E4 are likely connected only by subsurface flow pathways or interstitial boulder flows.</p>		

m/m = metres per metre; ha = hectare; m = metre; masl = metres above sea level, < = less than; LiDAR = light detection and ranging; m = metre; GIS = Geographic Information System.



12/08/13: E287 outlet (top of image)  
Photo #: P8120685



12/08/13: E287 outlet (left of image)  
Photo #: P8120684



12/08/13: E287 outlet (left), E4 inlet (right)  
Photo #: P8120683



12/08/13: Lake E287 (top), Lake E4 (bottom)  
Photo #: P8120682

## E2.6 Lake E357 Outlet

Channel Name: Stream E357

Reconnaissance Date: August 12, 2013

Coordinates: (UTM Zone 12, NAD 83) 537530 m E, 7181305 m N

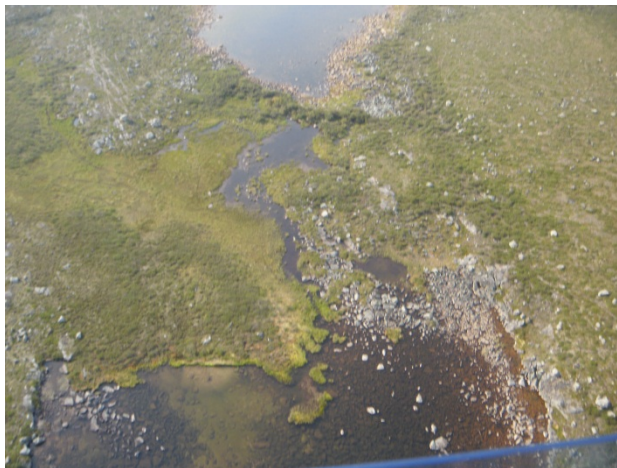
**Table E2-6 Reconnaissance Observations and GIS Parameters for Stream E357**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	E357	
Upstream Lake Area (ha)	38	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	116	Estimated from LiDAR data
Upstream Lake Elevation (masl)	438	Estimated from LiDAR data
Number of Outlet Channels	1	
Channel Connectivity	Continuous	E357 outlet is connected to E329 inlet
Channel Type	Straight	
Sinuosity	Degree 1 (1.00 to 1.05)	
Streambed Material	Boulders and cobbles	
Streambank Material	Poorly defined banks; boulders and cobbles are predominant in upstream section, but fine-grained material concentration increases downstream	
Stream bed/bank Vegetation	Dwarf-shrub tundra and graminoids (left downstream bank) and mainly low-shrub tundra (right downstream bank)	
Channel Slope (m/m)	0.005	Estimated from LiDAR data
Potential Obstructions to Fish Passage	Lateral strip of vegetation blocking flow at E329 inlet	
<p><b>General Notes/Observations:</b> The E357 outlet channel has very poorly defined banks and is approximately 110 m long. The longitudinal relief is very flat and an elongated island with high-shrub tundra normal to the stream is blocking/inhibiting flow at the E329 inlet. This is likely why there is a relatively deep pool (no boulders visible) just upstream of the lateral strip of vegetation. On the left downstream bank, there is evidence of runoff contributions from the adjacent terrain, as shown by a series of very long and narrow streaks, as well as low-lying and lightly toned tundra.</p>		

m/m = metres per metre; ha = hectare; m = metre; masl = metres above sea level; LiDAR = light detection and ranging; m = metre; GIS = Geographic Information System.



16/08/13: Lakes E329 (right) and E357 (left)  
Photo #: P8120479



16/0813: Lakes E329 (top) and E357 (bottom)  
Photo #: P8120478



16/08/13: Lakes E329 (left) and E357 (right)  
Photo #: P8120477



12/08/13: Lakes E329 (left) and E357 (right)  
Photo #: P8120476

## E2.7 Lake E383 Outlet

Channel Name: Stream E383

Reconnaissance Date: August 17, 2013

Coordinates: (UTM Zone 12, NAD 83) 532219 m E, 7178265 m N

**Table E2-7 Reconnaissance Observations and GIS Parameters for Stream E383**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	E383	
Upstream Lake Area (ha)	0.97	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	8	Estimated from LiDAR data
Upstream Lake Elevation (masl)	419.5	Estimated from LiDAR data
Number of Outlet Channels	1	
Channel Connectivity	Continuous	Lake E383 outlet is connected to E381 inlet
Channel Type	Meandering	
Sinuosity	Degree 2 (1.06 to 1.25)	
Streambed Material	Fine-grained material	Inferred from absence of boulders and cobbles
Streambank Material	Fine-grained material (but perhaps slightly coarser than E357 and E381 outlets)	Wavelength is greater than E357 and E381 outlets
Stream bed/bank Vegetation	Dwarf-shrub tundra	
Channel Slope (m/m)	~ 0	Estimated from LiDAR data
Potential Obstructions to Fish Passage	None observed at time of survey	
<p><b>General Notes/Observations:</b> The E383 outlet channel is a moderately meandering stream with narrow widths (5 to 10 m). Compared to other nearby meandering streams (E357 and E381 outlets), this channel has a longer wavelength and is not too far from an esker on the right downstream bank (Photo #: P8171095). The sandy deposits from the esker could form part of the streambed/streambank material, and thus this channel might have less resistance to bank erosion than the E357 and E381 outlets. The GIS maps show that this channel flows into lake E382, but that lake was not observed. Lake E492 is shown in Photo #: P8171097, but no surface connection with the E383 outlet is obvious. The channel slope in GIS is calculated between lakes E383 and E382.</p>		

m/m = metres per metre; ha = hectare; m = metre; masl = metres above sea level; ~ = approximately; # = number; LiDAR = light detection and ranging; m = metre; ~ = approximately; GIS = Geographic Information System.



17/08/13: Inlet from merged E462/E387 merged channel (left) and E383 outlet (right)  
Photo #: P8171095



17/08/13: Lake E383 (bottom left)  
Photo #: P8171096



17/08/13: Lake E383 outlet channel (downstream direction towards right of image)  
Photo #: P8171097



16/08/13: E383 outlet channel flowing into E381 (right)  
Photo #: P8171098

## E2.8 Lake E462 Outlet

Channel Name: Stream E462

Reconnaissance Date: August 17, 2013

Coordinates: (UTM Zone 12, NAD 83) 532572 m E, 7180622 m N

**Table E2-8 Reconnaissance Observations and GIS Parameters for Stream E462**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	E462	
Upstream Lake Area (ha)	3.7	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	52	Estimated from LiDAR data
Upstream Lake Elevation (masl)	446.2	Estimated from LiDAR data
Number of Outlet Channels	1	
Channel Connectivity	Continuous	E462 outlet is connected to E381 inlet
Channel Type	Meandering	
Sinuosity	Degree 2 (1.06 to 1.25)	
Streambed Material	Boulders and cobbles are predominant near E462 outlet, but decrease in concentration further downstream	
Streambank Material	Boulders and cobbles are present along all water edges	
Stream bed/bank Vegetation	Dwarf-shrub tundra is predominant, but continuous bands of low-shrub tundra (dark green) clearly define the bankfull width	
Channel Slope (m/m)	0.013	Estimated from LiDAR data
Potential Obstructions to Fish Passage	Dense boulder garden at E462 outlet	
<p><b>General Notes/Observations:</b> The E462 outlet channel merges with the E387 outlet channel and ultimately flows into E381. Downstream of the merging point, the channel develops into a more stable meandering stream with less boulders, more clearly defined banks, and fairly constant channel widths.</p>		

m/m = metres per metre; ha = hectare; masl = metres above sea level; LiDAR = light detection and ranging; GIS = Geographic Information System.



17/08/13: Lake E462 outlet (top right)  
Photo #: P8171085



17/0813: Lake E462 outlet channel; downstream direction  
towards the top of image  
Photo #: P8171086



17/08/13: Lake E462 outlet channel; downstream direction  
towards the top of image  
Photo #: P8171087



16/08/13: Merged channel (E462 and E387 outlet channels)  
flowing towards Lake E381 (top left)  
Photo #: P8171090

## E2.9 Lake G7 Outlet

Channel Name: Stream G7

Reconnaissance Date: August 12, 2013

Coordinates: (UTM Zone 12, NAD 83) 538263 m E, 7194529 m N

**Table E2-9 Reconnaissance Observations and GIS Parameters for Stream G7**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	G7	
Upstream Lake Area (ha)	294	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	711	Estimated from LiDAR data
Upstream Lake Elevation (masl)	447.3	Estimated from LiDAR data
Number of Outlet Channels	1	
Channel Connectivity	Continuous	G7 outlet is connected to G6 inlet
Channel Type	Sinuuous	
Sinuosity	Degree 1 (1.00 to 1.05)	
Streambed Material	Boulders and cobbles	
Streambank Material	Banks are very poorly defined	
Stream bed/bank Vegetation	Predominantly low-shrub tundra at the G7 outlet and dwarf-shrub tundra at G6 inlet	
Channel Slope (m/m)	0.013	Estimated from LiDAR data
Potential Obstructions to Fish Passage	None observed at time of survey	
<p><b>General Notes/Observations:</b> Although there is an obvious sinuous flow direction with only two crossings, the streambank is very poorly defined. The valley slope is extremely flat and during high stage events, G7 and G6 might appear to be part of the same lake. The width of the stream is highly irregular and there is a large pool at the one bend close to the channel midpoint. Although boulders are present everywhere, visible water is continuous for the entire stream. The streambank vegetation shifts from mainly low-shrub tundra at the G7 outlet to dwarf-shrub tundra at the G6 inlet.</p>		

m/m = metres per metre; ha = hectare; masl = metres above sea level; LiDAR = light detection and ranging; GIS = Geographic Information System.



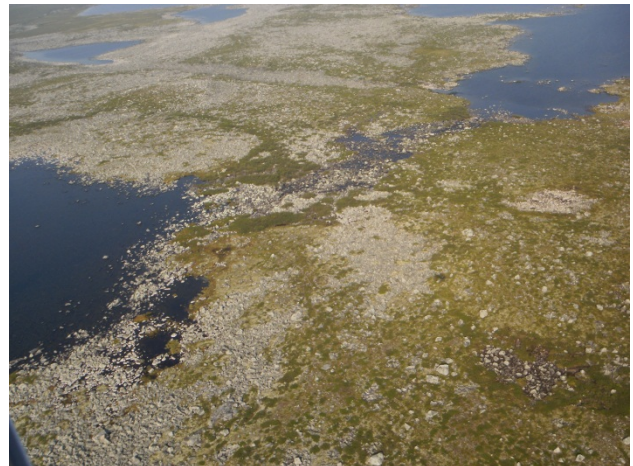
12/08/13: Lakes G7 (right) and G6 (left)  
Photo #: P8120525



12/0813: Lakes G7 (bottom right) and G6 (top left)  
Photo #: P8120526



12/08/13: Lakes G7 (bottom) and G6 (top)  
Photo #: P8120527



12/08/13: Lakes G7 (left) and G6 (top right)  
Photo #: P8120528

## E2.10 Lake G12 Outlet

Channel Name: Stream G12

Reconnaissance Date: August 12, 2013

Coordinates: (UTM Zone 12, NAD 83) 529894 m E, 7191980 m N \*

\* Because Lake G12 has two outlets, the coordinates shown are for the one channel mapped in GIS.

**Table E2-10 Reconnaissance Observations and GIS Parameters for Stream G12**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	G12	
Upstream Lake Area (ha)	22	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	87	Estimated from LiDAR data
Upstream Lake Elevation (masl)	463.2	Estimated from LiDAR data
Number of Outlet Channels	2	NTDB indicates two channels
Channel Connectivity	Continuous	Both G12 outlet channels connect to G11
Channel Type	Braided (right downstream bank channel [RDB channel]) from G12; sinuous (left downstream bank channel [LDB channel])	The LDB channel is mapped in GIS, but the RDB channel is not
Sinuosity	Degree 2 (1.06 to 1.25)	
Streambed Material	Boulders, cobbles, and organic material	
Streambank Material	Banks are poorly defined, but coarse-grained deposits are visible along the water edges at the G11 inlet	
Stream bed/bank Vegetation	RDB channel: Very dense high-shrub tundra at the G11 inlet; LDB channel: Low-shrub tundra close to G12 and dwarf-shrub tundra/graminoids near G11 inlet	
Channel Slope (m/m)	0.026	Estimated from LiDAR data
Potential Obstructions to Fish Passage	Potentially along LDB channel (boulder network is dense and current stage is very low)	A portion of the LDB channel could be subsurface flow
<p><b>General Notes/Observations:</b> G12 has two outlet channels. The RDB channel (not shown in GIS) begins as a sinuous stream near G12, but transforms into a highly braided channel flowing through dense high-shrub tundra. The LDB channel contains noticeably more boulders and less visible water than the RDB channel. Although continuous flow for the LDB channel is obvious, a portion of the channel could consist of subsurface flow, so there may be an obstruction for fish passage.</p>		

m/m = metres per metre; ha = hectare; masl = metres above sea level; RDB = right downstream bank; LDB = left downstream bank; LiDAR = light detection and ranging; GIS = Geographic Information System.



12/08/13: Lakes G13 (top), G12 (middle), and G11 (bottom);  
left downstream channel (middle right between G12 and G11);  
right downstream channel (middle left between G12 and G11)  
Photo #: P8120539



12/0813: Lakes G12 (right) and G11 (left); left downstream  
channel (bottom middle); right downstream channel  
(top middle)  
Photo #: P8120533



12/08/13: Lakes G13 (top), G12 (middle), and G11 (bottom);  
left downstream channel (middle right between G12 and G11);  
right downstream channel (middle left between G12 and G11)  
Photo #: P8120538



12/08/13: Lakes G12 (left) and G11 (right); right downstream  
channel (bottom middle); left downstream channel (top middle)  
Photo #: P8120537

## E2.11 Lake G14 Outlet

Channel Name: Stream G14

Reconnaissance Date: August 14, 2013

Coordinates: (UTM Zone 12, NAD 83) 525517 m E, 7193067 m N

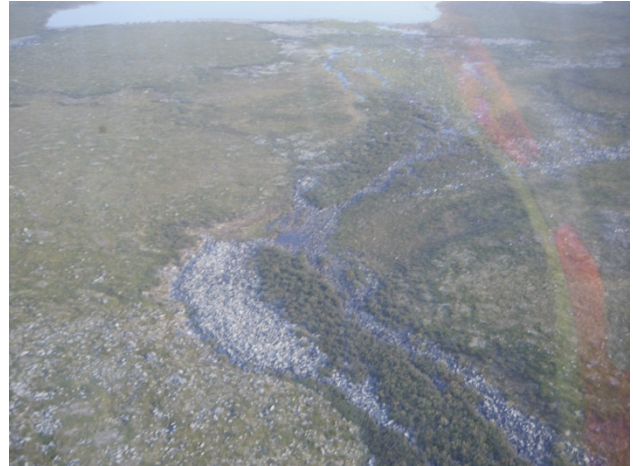
**Table E2-11 Reconnaissance Observations and GIS Parameters for Stream G14**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	G14	
Upstream Lake Area (ha)	146	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	495	Estimated from LiDAR data
Upstream Lake Elevation (masl)	474.5	Estimated from LiDAR data
Number of Outlet Channels	1	
Channel Connectivity	Continuous	G14 outlet is connected to G13 inlet
Channel Type	Braided	
Sinuosity	Degree 2 (1.06 to 1.25)	
Streambed Material	Boulders and cobbles	
Streambank Material	Banks are poorly defined, but boulders are present along most water edges	
Stream bed/bank Vegetation	From high-shrub tundra at G13 outlet towards low-shrub tundra and graminoids at G14 inlet	
Channel Slope (m/m)	0.0090	Estimated from LiDAR data
Potential Obstructions to Fish Passage	None observed at time of survey	
<p><b>General Notes/Observations:</b> This highly braided channel flows through a random distribution of small islands. The vegetation on the islands shifts from dwarf and low-shrub tundra at G14 to thicker high-shrub tundra at G13. Although the streambanks are generally poorly defined, there is a continuous segment of low-shrub tundra outlining bankfull capacity on the right downstream bank. During high stage events, a large depression situated on the right downstream bank close to G14 is likely flooded (Photo #: P8140710). The pool narrows as distance from the main channel increases, so a new stream might be in the process of formation.</p>		

m/m = metres per metre; ha = hectare; masl = metres above sea level; LiDAR = light detection and ranging; GIS = Geographic Information System.



14/08/13: Lakes G14 (left) and G13 (right)  
Photo #: P8140705



14/08/13: Upstream view of G14 outlet channel  
Photo #: P814707



14/08/13: Lake G14 (right)  
Photo #: P8140710



14/08/13: Lakes G14 (bottom) and G13 (top left)  
Photo #: P8140711

## E2.12 Lake G15 Outlet

Channel Name: Stream G15

Reconnaissance Date: August 14, 2013

Coordinates: (UTM Zone 12, NAD 83) 525647 m E, 7195020 m N

**Table E2-12 Reconnaissance Observations and GIS Parameters for Stream G15**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	G15	
Upstream Lake Area (ha)	154	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	495	Estimated from LiDAR data
Upstream Lake Elevation (masl)	475.7	Estimated from LiDAR data
Number of Outlet Channels	1	
Channel Connectivity	Continuous	G15 outlet is connected to G14 inlet
Channel Type	Straight	
Sinuosity	Degree 1 (1.00 to 1.05)	
Streambed Material	Boulders and cobbles	
Streambank Material	Boulders and cobbles	
Stream bed/bank Vegetation	Low-shrub and dwarf-shrub tundra	
Channel Slope (m/m)	0.0060	Estimated from LiDAR data
Potential Obstructions to Fish Passage	Boulder garden	
<p><b>General Notes/Observations:</b> The outlet channel from Lake G15 is a straight, short (&lt;200 m) boulder garden with a very gentle longitudinal slope. For the current stage, there is no visible flow and all the boulders look completely dry. There are a few small vegetation islands near the G14 inlet, but organic material only occupies approximately 10% of the streambed. This boulder garden may be an obstruction to fish passage, even during high stage flow events.</p>		

m/m = metres per metre; ha = hectare; m = metre; masl = metres above sea level; < = less than; % = percent; LiDAR = light detection and ranging; GIS = Geographic Information System.



14/08/13: Lakes G15 (top) and G14 (bottom)  
Photo #: P8140722



14/0813: Lakes G15 (left) and G14 (right)  
Photo #: P814721



14/08/13: Lakes G15 (bottom left) and G14 with 2 islands  
(top right)  
Photo #: P8140720



14/08/13: Upstream view of channel flowing from G15 (top) to  
G14 (bottom)  
Photo #: P8140723

## E2.13 Lake G18 Outlet

Channel Name: Stream G18

Reconnaissance Date: August 14, 2013

Coordinates: (UTM Zone 12, NAD 83) 529409 m E, 7198356 m N \*

\* Because Lake G18 has two outlets, the coordinates shown are for the one channel mapped in GIS (straight boulder garden).

**Table E2-13 Reconnaissance Observations and GIS Parameters for Stream G18**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	G18	
Upstream Lake Area (ha)	187	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	330	Estimated from LiDAR data
Upstream Lake Elevation (masl)	480.6	Estimated from LiDAR data
Number of Outlet Channels	2	Determined in field reconnaissance
Channel Connectivity	LDB channel not connected with surface water flows (straight boulder garden) RDB channel continuous (braided channel)	LDB (left downstream bank) RDB (right downstream bank)
Channel Type	Straight (boulder garden) for left downstream bank channel (LDB channel) from G18; braided for right downstream bank channel (RDB channel)	Boulder garden
Sinuosity	Degree 1 (1.00 to 1.05) for LDB channel Degree 2 (1.06 to 1.25) for RDB channel	
Streambed Material	Boulders and cobbles	
Streambank Material	There is no obvious morphology for the LDB channel, as it is a very short (~ 100 m) boulder garden. The RDB channel is braided with very narrow (~ 5 m) segments flowing around tiny vegetation islands	
Stream bed/bank Vegetation	Dwarf-shrub tundra	
Channel Slope (m/m)	0.0090 (straight boulder garden)	Estimated from LiDAR data
Potential Obstructions to Fish Passage	The boulder garden (LDB channel) is potentially cut off by a lateral strip of land close to G18 outlet; the RDB channel has a dense boulder garden at the channel midpoint	Flow might be subterranean at the lateral strip of land location
<p><b>General Notes/Observations:</b> There are two G18-G17 flow paths, but only one (the straight boulder garden) is labelled in the NTDB. At this location, there is simply a short boulder garden (~ 100 m) at the G18 outlet that appears to be disconnected from G17. There is a lateral strip of land with low-shrub tundra near G18 that divides the boulder garden into two segments. Although there could be subsurface flow at this location, an obstruction for fish passage may exist. The lateral strip of land is clearly visible as the streambank vegetation is dwarf-shrub tundra for the rest of the boulder garden. The unlabelled channel is braided, but visible water is discontinuous as there is a dense boulder garden at the midpoint.</p>		

m/m = metres per metre; ha = hectare; m = metre; masl = metres above sea level; RDB = right downstream bank; LDB = left downstream bank; ~ = approximately; LiDAR = light detection and ranging; GIS = Geographic Information System.



14/08/13: RDB Channel flowing from G18 (top) to G17 (bottom)  
Photo #: P8140741



14/0813: Upstream segment of RDB Channel flowing from  
G18 (top)  
Photo #: P8140742



14/08/13: LDB Channel boulder garden between lakes G18  
(right) and G18 (left)  
Photo #: P8140746



14/08/13: Boulder garden between lakes G18 (bottom) and  
G17 (top)  
Photo #: P8140747

## E2.14 Lake G101 Outlet

Channel Name: Stream G101

Reconnaissance Date: August 14, 2013

Coordinates: (UTM Zone 12, NAD 83) 528047 m E, 7194445 m N

**Table E2-14 Reconnaissance Observations and GIS Parameters for Stream G101**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	G101	
Upstream Lake Area (ha)	0.48	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	22	Estimated from LiDAR data
Upstream Lake Elevation (masl)	488.4	Estimated from LiDAR data
Number of Outlet Channels	2	Possibly 2, but more aerial photos are needed
Channel Connectivity	Continuous	G101 outlet is connected to G100 inlet
Channel Type	Straight	Boulder garden
Sinuosity	Degree 1 (1.00 to 1.05)	
Streambed Material	Boulders and cobbles	
Streambank Material	Boulders and cobbles	
Stream bed/bank Vegetation	Dwarf-shrub to low-shrub tundra	
Stage	Low	No visible water
Channel Slope (m/m)	0.020	Estimated from LiDAR data
Potential Obstructions to Fish Passage	Continuous boulder garden with no visible water flow	
<p><b>General Notes/Observations:</b> In photo P8140756, G101 appears to have two outlet channels (both are boulder gardens), but more aerial reconnaissance imagery is needed to see if the channel potentially connecting lakes G101 and G99 is continuous. The longitudinal slope of the G101 outlet channel is high and the boulder garden is approximately 750 m long.</p>		

m/m = metres per metre; ha = hectare; masl = metres above sea level; LiDAR = light detection and ranging; GIS = Geographic Information System; m = metre.



14/08/13: Boulder garden with potential subsurface water flowing downstream from lake G101 (smallest lake in middle of photo). Lake G99 is visible in the top right and lake G14 is visible in the top left.  
Photo #: P8140756

## E2.15 Lake G222 Outlet

Channel Name: Stream G222

Reconnaissance Date: August 12, 2013

Coordinates: (UTM Zone 12, NAD 83) 538379 m E, 7194553 m N

**Table E2-15 Reconnaissance Observations and GIS Parameters for Stream G222**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	G222	
Upstream Lake Area (ha)	85	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	262	Estimated from LiDAR data
Upstream Lake Elevation (masl)	453.2	Estimated from LiDAR data
Number of Outlet Channels	1	
Channel Connectivity	Continuous	G222 outlet is connected to G205 inlet
Channel Type	Straight	
Sinuosity	Degree 1 (1.00 to 1.05)	
Streambed Material	Boulders and cobbles	
Streambank Material	Boulders	
Stream bed/bank Vegetation	High shrub tundra along banks, absence of organics in streambed	
Channel Slope (m/m)	0.020	Estimated from LiDAR data
Potential Obstructions to Fish Passage	None observed at time of survey	
<p><b>General Notes/Observations:</b> The G222 outlet is a short (&lt;200 m) straight channel whereby boulders and cobbles occupy &gt;50% of the surface area for the current flow stage (the remaining area being visible water). The channel is narrow (estimated at &lt;10 m) and its width remains fairly constant. The latter could be due to the riparian high-shrub tundra that borders the stream. Note that there is a small pool adjacent to the riparian vegetation on the left downstream bank in the middle of the channel that is collecting some flow from G222.</p>		

m/m = metres per metre; ha = hectare; m = metre; masl = metres above sea level; > = greater than; < = less than; % = percent; LiDAR = light detection and ranging; GIS = Geographic Information System.



12/08/13: Lakes G222 (left) and G205 (right)  
Photo #: P8120512



12/0813: Lakes G222 (left) and G205 (right)  
Photo #: P8120514



12/08/13: G222 (bottom) flowing into G205 (top). The small pool adjacent to the left downstream bank is indicated by the red arrow.  
Photo #: P8120516



12/08/13: G222 (bottom right) flowing into G205  
Photo #: P8120518

## E2.16 Lake G312 Outlet

Channel Name: Stream G312

Reconnaissance Date: August 12, 2013

Coordinates: (UTM Zone 12, NAD 83) 536383 m E, 7187608 m N

**Table E2-16 Reconnaissance Observations and GIS Parameters for Stream G312**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	G312	
Upstream Lake Area (ha)	0.13	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	3	Estimated from LiDAR data
Upstream Lake Elevation (masl)	445.1	Estimated from LiDAR data
Number of Outlet Channels	1	
Channel Connectivity	Continuous	G312 outlet is connected to G311 inlet
Channel Type	Sinuuous	
Sinuosity	Degree 2 (1.06 to 1.25)	
Streambed Material	Fine-grained material	Inferred from absence of boulders
Streambank Material	Fine-grained material	Inferred from channel's narrow and uniform width
Stream bed/bank Vegetation	Graminoids	
Channel Slope (m/m)	~ 0	Estimated from LiDAR data
Potential Obstructions to Fish Passage	None observed at time of survey	
<p><b>General Notes/Observations:</b> Although Lake G312 is considered an individual lake, it might be best to consider it as part of one channel connecting lakes G313 and G311. Lake G312 resembles a pool at a wide bend for a sinuous stream and is only double to triple the size of other pools between G313 and G312. However, the channel morphology downstream of G312 is distinct from its upstream counterpart. The G312 outlet channel is narrow, more consistent in terms of width and depth, contains no visible boulders, and is bounded by low-lying graminoids instead of low-shrub tundra. As a result, the G312 outlet channel likely contains fines in its streambed and streambank.</p>		

m/m = metres per metre; ha = hectare; masl = metres above sea level; ~ = approximately; LiDAR = light detection and ranging; GIS = Geographic Information System.



12/08/13: Upstream view of lakes G313 (top), G312 (middle), and G311 (bottom)

Photo #: P8120490



12/08/13: Upstream view of lakes G313 (top), G312 (middle), and G311 (bottom)

Photo #: P8120491



12/08/13: G313 channel flowing downstream towards lake G312 (smaller lake in top-left of image)

Photo #: P8120495



12/08/13: Lake G312 (centre of image) and Lake G311 (centre-right of image)

Photo #: P8120496

## E2.17 Lake G313 Outlet

Channel Name: Stream G313

Reconnaissance Date: August 12, 2013

Coordinates: (UTM Zone 12, NAD 83) 535987 m E, 7187962 m N

**Table E2-17 Reconnaissance Observations and GIS Parameters for Stream G313**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	G313	
Upstream Lake Area (ha)	36	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	111	Estimated from LiDAR data
Upstream Lake Elevation (masl)	456.2	Estimated from LiDAR data
Number of Outlet Channels	1	
Channel Connectivity	Continuous	G313 outlet is connected to G312 inlet
Channel Type	Anastomosed (at G313 outlet) and braided (further downstream towards G312 inlet)	
Sinuosity	Degree 3 (>1.26)	
Streambed Material	Boulders, cobbles, organic material	
Streambank Material	Coarse-grained deposits	
Stream bed/bank Vegetation	Low shrub tundra	
Channel Slope (m/m)	0.010	Estimated from LiDAR data
Potential Obstructions to Fish Passage	None observed at time of survey	
<p><b>General Notes/Observations:</b> At the G313 outlet, the channel immediately splits into two streams separated by a large vegetation island (maximum width ~ 50 to 100 m). The island might not get regularly flooded during high stage events due to the presence and absence of low-shrub tundra and graminoids, respectively. Further downstream, the two streams converge into one low-degree braiding channel that flows through boulder gardens increasing in size and density towards G312. The bankfull width appears to have approximately 1.5 times the current channel width where flowing water is clearly visible.</p>		

m/m = metres per metre; ha = hectare; m = metre; masl = metres above sea level; > = greater than; ~ = approximately; LiDAR = light detection and ranging; GIS = Geographic Information System.



12/08/13: G313 outlet (right of image)  
Photo #: P8120493



12/0813: Convergence of two streams downstream of  
G313 outlet  
Photo #: P8120494



12/08/13: G313 channel flowing downstream towards lake G312  
(smaller lake in top-left of image)  
Photo #: P8120495



12/08/13: Lake G312 (centre of image) and Lake G311  
(centre-right of image)  
Photo #: P8120496

## E2.18 Lake I41 Outlet

Channel Name: Stream I41

Reconnaissance Date: August 16, 2013

Coordinates: (UTM Zone 12, NAD 83) 566410 m E, 7178986 m N

**Table E2-18 Reconnaissance Observations and GIS Parameters for Stream I41**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	I41	
Upstream Lake Area (ha)	4	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	54	Estimated from LiDAR data
Upstream Lake Elevation (masl)	440.7	Estimated from LiDAR data
Number of Outlet Channels	1	
Channel Connectivity	Not connected with surface water flows at the time of reconnaissance	I41 outlet not connected to Sterlet Lake inlet by surface water flows
Channel Type	Straight	Boulder garden
Sinuosity	Degree 1 (1.00 to 1.05)	
Streambed Material	Boulders and cobbles	
Streambank Material	No defined banks	
Stream bed/bank Vegetation	Dwarf-shrub tundra except for low-shrub tundra at I3 (Sterlet Lake) inlet	
Channel Slope (m/m)	0.0030	Estimated from LiDAR data
Potential Obstructions to Fish Passage	Unconnected channel	
<b>General Notes/Observations:</b> There are boulder gardens at the I41 outlet and I3 (Sterlet Lake) inlets, but both are separated by a 100% vegetated zone with no defined banks or channel geometry. Hence, the I41 outlet and Sterlet Lake inlet are not connected with observable surface water flows.		

m/m = metres per metre; ha = hectare; masl = metres above sea level; % = percent; LiDAR = light detection and ranging; GIS = Geographic Information System.



16/08/13: Lakes 141 (left) and Sterlet Lake (right)  
Photo #: P8160935

## E2.19 Lake I84 Outlet

Channel Name: Stream I84

Reconnaissance Date: August 13, 2013

Coordinates: (UTM Zone 12, NAD 83) 566292 m E, 7176405 m N

**Table E2-19 Reconnaissance Observations and GIS Parameters for Stream I84**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	I84	
Upstream Lake Area (ha)	2.3	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	25	Estimated from LiDAR data
Upstream Lake Elevation (masl)	441.3	Estimated from LiDAR data
Number of Outlet Channels	1	
Channel Connectivity	Possible connection through boulder garden	I84 outlet connected to I3 (Sterlet Lake) inlet likely through interstitial boulder or sub-surface flow
Channel Type	Straight	Boulder garden
Sinuosity	Degree 1 (1.00 to 1.05)	
Streambed Material	Boulders and cobbles at I3 (Sterlet Lake) inlet	
Streambank Material	Boulders and cobbles at I3 (Sterlet Lake) inlet	
Stream bed/bank Vegetation	Low-shrub tundra separates boulder garden at I3 (Sterlet Lake) inlet from I84 outlet, but dwarf-shrub tundra is dominant everywhere else	
Channel Slope (m/m)	0.010	Estimated from LiDAR data
Potential Obstructions to Fish Passage	Unconnected channel	
<p><b>General Notes/Observations:</b> Although there is a clear boulder garden indicating a possible Sterlet Lake inlet, the latter is not connected to the I84 outlet location specified in the NTDB maps. In addition, a short strip of low-shrub tundra separates the I84 outlet location (specified in GIS) from the boulder garden. However, because the distance between I84 and Lake I3 (Sterlet Lake) is so short, there could be subsurface flow connecting the two lakes.</p>		

m/m = metres per metre; ha = hectare; masl = metres above sea level; LiDAR = light detection and ranging; GIS = Geographic Information System.



16/08/13: Lakes I84 (bottom right) and I3 (Sterlet Lake) (middle of image)  
Photo #: P8160925

## E2.20 Lake I86 Outlet

Channel Name: Stream I86

Reconnaissance Date: August 16, 2013

Coordinates: (UTM Zone 12, NAD 83) 566083 m E, 7177208 m N

**Table E2-20 Reconnaissance Observations and GIS Parameters for Stream I86**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	I86	
Upstream Lake Area (ha)	26	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	77	Estimated from LiDAR data
Upstream Lake Elevation (masl)	441.8	Estimated from LiDAR data
Number of Outlet Channels	1	
Channel Connectivity	Continuous	I86 outlet is connected to Lake I3 (Sterlet Lake)
Channel Type	Sinuuous	
Sinuosity	Degree 1 (1.00 to 1.05)	
Streambed Material	Boulders and cobbles are visible near I86 inlet	Seasonal or relict channel
Streambank Material	Fine-grained material	Inferred from minimal amount of boulders and cobbles
Stream bed/bank Vegetation	Flat low-lying regularly flooded tundra (predominant), dense high-shrub tundra at Lake I3 (Sterlet Lake)	
Channel Slope (m/m)	~ 0	Estimated from LiDAR data
Potential Obstructions to Fish Passage	Potentially at heavily vegetated area	Flow is masked by vegetation
<p><b>General Notes/Observations:</b> Lake I86 outlet channel is very narrow (&lt;5 m width) fairly straight stream with a very broad floodplain, particularly on the left downstream bank. The floodplain is defined by mainly flat low-lying light-coloured tundra (suggests frequent inundation) with a few pockets of dwarf shrubs. The floodplain is bounded by ice-wedge polygonal terrain with lots of boulders.</p>		

m/m = metres per metre; ha = hectare; masl = metres above sea level.; ~ = approximately; m = metre; < = less than; LiDAR = light detection and ranging; GIS = Geographic Information System.



16/08/13: Lake I86 (right) and Sterlet Lake (left)  
Photo #: P8160928



16/08/13: Lake I86 (top right) and Sterlet Lake (middle)  
Photo #: P8160926



16/08/13: Lake I86 (bottom right) and Sterlet Lake (top left)  
Photo #: P8160929



16/08/13: Lake I86 (bottom left) and Sterlet Lake (top)  
Photo #: P8160930

## E2.21 Lake I91 Outlet

Channel Name: Stream I91

Reconnaissance Date: August 16, 2013

Coordinates: (UTM Zone 12, NAD 83) 565169 m E, 7175771 m N

**Table E2-21 Reconnaissance Observations and GIS Parameters for Stream I91**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	I91	
Upstream Lake Area (ha)	34	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	158	Estimated from LiDAR data
Upstream Lake Elevation (masl)	438.2	Estimated from LiDAR data
Number of Outlet Channels	1	
Channel Connectivity	Continuous	I91 outlet is connected to I2 inlet
Channel Type	Straight	Vegetated boulder garden
Sinuosity	Degree 1 (1.00 to 1.05)	
Streambed Material	Boulders and cobbles	
Streambank Material	Boulders and cobbles	
Stream bed/bank Vegetation	Dwarf-shrub and low-shrub tundra	
Channel Slope (m/m)	0.0070	Estimated from LiDAR data
Potential Obstructions to Fish Passage	Boulder garden	
<b>General Notes/Observations:</b> Lake I91 outlet channel is very short and although there is no visible water, water movement beneath the boulders is highly likely. The width of the channel, as well as the vegetation density/height generally increases downstream.		

m/m = metres per metre; ha = hectare; masl = metres above sea level; LiDAR = light detection and ranging; GIS = Geographic Information System.



16/08/13: Lake I2 (top right)  
Photo #: P8160922



16/0813: Lakes I91 (bottom) and I2 (top)  
Photo #: P8160923



16/08/13: Lakes I91 (bottom left) and I2 (top)  
Photo #: P8160924

## E2.22 Lake I101 Outlet

Channel Name: Stream I101

Reconnaissance Date: August 16, 2013

Coordinates: (UTM Zone 12, NAD 83) 570415 m E, 7185578 m N

**Table E2-22 Reconnaissance Observations and GIS Parameters for Stream I101**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	I101	
Upstream Lake Area (ha)	68	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	197	Estimated from LiDAR data
Upstream Lake Elevation (masl)	437.8	
Number of Outlet Channels	1	
Channel Connectivity	Continuous	I101 outlet is connected to I100 inlet
Channel Type	Straight	Boulder garden
Sinuosity	Degree 1 (1.00 to 1.05)	
Streambed Material	Boulders and cobbles	
Streambank Material	Boulders and cobbles	
Stream bed/bank Vegetation	Dwarf-shrub tundra is predominant	
Channel Slope (m/m)	0.0048	Estimated from LiDAR data
Potential Obstructions to Fish Passage	Boulder garden	
<b>General Notes/Observations:</b> The visible water flow narrows downstream from Lake I101 outlet until it reaches a small boulder garden vegetated with low-shrub tundra. Downstream of the boulder garden, the visible water flow begins to expand again until the I100 inlet is reached. Furthermore, boulder gardens border the effective flow area for the stage observed.		

m/m = metres per metre; ha = hectare; masl = metres above sea level; LiDAR = light detection and ranging; GIS = Geographic Information System.



16/08/13: Lakes I101 (bottom lake with island) and I100 (top)  
Photo #: P8160945



16/0813: Lakes I101 (bottom lake with island) and I100  
(top centre)  
Photo #: P8160946



16/08/13: Lakes I101 (bottom left) and I100 (top right)  
Photo #: P8160947



16/08/13: Lakes I101 (left) and I100 (right)  
Photo #: P8160948

## E2.23 Lake I102 Outlet

Channel Name: Stream I102

Reconnaissance Date: August 16, 2013

Coordinates: (UTM Zone 12, NAD 83) 570856 m E, 7186413 m N

**Table E2-23 Reconnaissance Observations and GIS Parameters for Stream I102**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	I102	
Upstream Lake Area (ha)	4.2	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	27	Estimated from LiDAR data
Upstream Lake Elevation (masl)	438.3	Estimated from LiDAR data
Number of Outlet Channels	1	
Channel Connectivity	Continuous	I102 outlet is connected to I101 inlet
Channel Type	Straight	
Sinuosity	Degree 1 (1.00 to 1.05)	
Streambed Material	Fine-grained material with a few boulders and cobbles (Photo #: P8160970)	
Streambank Material	Fine-grained material	
Stream bed/bank Vegetation	Flat low-lying grassy vegetation bordered by low-shrub tundra that defines bankfull width	
Channel Slope (m/m)	0.0040	Estimated from LiDAR data
Potential Obstructions to Fish Passage	None observed at time of survey	
<b>General Notes/Observations:</b> Stream I102 is very straight and narrow with a trace of boulders and cobbles. The bankfull width is well defined by the low-shrub/grassy vegetation (light green) boundary and appears to be approximately twice the observed wetted channel width.		

m/m = metres per metre; ha = hectare; masl = metres above sea level; # = number; LiDAR = light detection and ranging; GIS = Geographic Information System.



16/08/13: Lakes I101 (bottom), I102 (middle), and I103 (top)  
Photo #: P8160949



16/0813: Lakes I101 (bottom), I102 (middle), and I103 (top)  
Photo #: P8160950



16/08/13: Lakes I101 (bottom), I102 (middle), and I103 (top)  
Photo #: P8160951



16/08/13: I102-I101 downstream direction (towards right of  
image)  
Photo #: P8160970

## E2.24 Lake I104 Outlet

Channel Name: Stream I104

Reconnaissance Date: August 16, 2013

Coordinates: (UTM Zone 12, NAD 83) 574703 m E, 7189433 m N

**Table E2-24 Reconnaissance Observations and GIS Parameters for Stream I104**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	I104	
Upstream Lake Area (ha)	657	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	1331	Estimated from LiDAR data
Upstream Lake Elevation (masl)	442.8	Estimated from LiDAR data
Number of Outlet Channels	1	
Channel Connectivity	Continuous	I104 outlet is connected to I103 inlet
Channel Type	Sinuous	Boulder garden
Sinuosity	Degree 1 (1.00 to 1.05)	
Streambed Material	Boulders and cobbles	
Streambank Material	Boulders and cobbles	
Stream bed/bank Vegetation	Dwarf-shrub tundra	
Channel Slope (m/m)	0.020	Estimated from LiDAR data
Potential Obstructions to Fish Passage	100% boulder garden	
<p><b>General Notes/Observations:</b> The I104-103 channel is a slightly sinuous and reasonably wide (20 to 30 m) boulder garden with boulders and cobbles occupying 100% of the surface area. Hence, the boulder concentration is significantly higher compared to the I103 outlet channel. Unlike the I103 and I102 outlet channels, there is no low-shrub/grassy vegetation (light green) boundary indicating bankfull width. Therefore, high stage flow could be concentrated within the width of the current boulder garden. Furthermore, the boulder garden for this channel looks like it contains multiple layers of coarse-grained deposits.</p>		

m/m = metres per metre; ha = hectare; m = metre; masl = metres above sea level; % = percent; LiDAR = light detection and ranging; GIS = Geographic Information System.



16/08/13: Lakes I104 (top) and I103 (bottom)  
Photo #: P8160961



16/0813: Lakes I104 (top right) and I103 (bottom)  
Photo #: P8160962



16/08/13: Lakes I104 (bottom left) and I103 (top right)  
Photo #: P8160963



16/08/13: Lakes I104 (left) and I103 (middle right)  
Photo #: P8160965

## E2.25 Lake I135 Outlet

Channel Name: Stream I135

Reconnaissance Date: August 16, 2013

Coordinates: (UTM Zone 12, NAD 83) 572350 m E, 7187865 m N \*

\* Because I135 has two outlets, the coordinates shown are for the one channel mapped in GIS (meandering stream).

**Table E2-25 Reconnaissance Observations and GIS Parameters for Stream I135**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	I135	
Upstream Lake Area (ha)	8.1	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	29	Estimated from LiDAR data
Upstream Lake Elevation (masl)	440.7	Estimated from LiDAR data
Number of Outlet Channels	2	Determined in field reconnaissance
Channel Connectivity	Continuous	I135 outlet is connected to Lake I103
Channel Type	Meandering (right downstream bank (RDB channel)); braided (left downstream bank (LDB channel))	
Sinuosity	Degree 2 (1.06 to 1.25)	
Streambed Material	Fine-grained material	Inferred from absence of boulders and cobbles
Streambank Material	Fine-grained material	Inferred from absence of boulders and cobbles
Stream bed/bank Vegetation	Flat low-lying tundra	
Channel Slope (m/m)	0.0081	Estimated from LiDAR data
Potential Obstructions to Fish Passage	None observed at time of survey	
<p><b>General Notes/Observations:</b> Although the NTDB maps only record one outlet channel (the meandering stream), the braided channel (LDB channel) consists of an interconnected network of extremely narrow (perhaps 1 to 2 m wide) pathways that terminate only ~ 200 m to the left of the RDB channel. The meandering stream is wider (2 to 3 m) than the braided channel near the I135 outlet and contains no visible boulders or cobbles. In general, the width of the meandering and braided channels decreases downstream.</p>		

m/m = metres per metre; ha = hectare; m = metre; masl = metres above sea level; RDB = right downstream bank; LDB = left downstream bank; ~ = approximately; LiDAR = light detection and ranging; GIS = Geographic Information System.



16/08/13: Lakes I135 (right) and I103 (left)  
Photo #: P8160956



16/0813: Lakes I135 (bottom left) and I103 (top right)  
Photo #: P8160967



16/08/13: Lakes I135 (bottom right) and I103 (top)  
Photo #: P8160957

## E2.26 Lake I174 Outlet

Channel Name: Stream I174

Reconnaissance Date: August 16, 2013

Coordinates: (UTM Zone 12, NAD 83) 566302 m E, 7183236 m N

**Table E2-26 Reconnaissance Observations and GIS Parameters for Stream I174**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	I174	
Upstream Lake Area (ha)	81	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	298	Estimated from LiDAR data
Upstream Lake Elevation (masl)	441.5	Estimated from LiDAR data
Number of Outlet Channels	1	
Channel Connectivity	Not connected through observable surface water flow	I174 outlet is not connected to I100 inlet with observable surface water flow
Channel Type	Sinuuous	Boulder garden
Sinuosity	Degree 2 (1.06 to 1.25)	
Streambed Material	Boulders and cobbles	
Streambank Material	Boulders and cobbles	
Stream bed/bank Vegetation	Low-shrub tundra	
Channel Slope (m/m)	0.0080	Estimated from LiDAR data
Potential Obstructions to Fish Passage	No channel connectivity	
<p><b>General Notes/Observations:</b> Instead of a well-defined channel, there are four boulder gardens, each separated by low-shrub tundra. The longest boulder garden connects to I100, while the three remaining boulder gardens are small circular/oval shaped pockets situated further upslope towards I174. Given the fact that the boulder gardens are discontinuous, lack well-defined channel geometry, and contain no visible water flow, it is reasonable to conclude that I174 and I100 are not connected through surface water flows, but rather possibly interstitial boulder flow or sub-surface flow. However, flow was observed between I174 and I173 (small circular lake in Photo #: 160972).</p>		

m/m = metres per metre; ha = hectare; masl = metres above sea level; # = number; LiDAR = light detection and ranging; GIS = Geographic Information System.



16/08/13: Lakes I174 (bottom), I100 (top), and I173 (small lake in middle of photo)  
Photo #: P8160972

## E2.27 Lake I180 Outlet

Channel Name: Stream I180

Reconnaissance Date: August 16, 2013

Coordinates: (UTM Zone 12, NAD 83) 561708 m E, 7184399 m N

**Table E2-27 Reconnaissance Observations and GIS Parameters for Stream I180**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	I180	
Upstream Lake Area (ha)	285	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	609	Estimated from LiDAR data
Upstream Lake Elevation (masl)	439.9	Estimated from LiDAR data
Number of Outlet Channels	1	
Channel Connectivity	Continuous	I180 outlet is connected to I2 inlet
Channel Type	Sinuuous	
Sinuosity	Degree 1 (1.00 to 1.05)	
Streambed Material	Boulders and cobbles	100% boulder garden
Streambank Material	Boulders and cobbles	
Stream bed/bank Vegetation	Low-shrub tundra along left downstream bank, dwarf-shrub tundra on right downstream bank	
Channel Slope (m/m)	0.014	Estimated from LiDAR data
Potential Obstructions to Fish Passage	Boulder garden	
<b>General Notes/Observations:</b> The I180-I2 channel is a slightly sinuous boulder garden with only one bend. Its width is consistent (~10 to 20 m) and boulders occupy almost 100% of the surface area. Hence, this channel is an obstruction for fish passage at the flows observed at the time of the survey.		

m/m = metres per metre; ha = hectare; m = metre; masl = metres above sea level; ~ = approximately; % = percent; LiDAR = light detection and ranging; GIS = Geographic Information System.



16/08/13: Lakes I180 (bottom right)  
Photo #: P8160984



16/08/13: Lake I180 (bottom)  
Photo #: P8160985



16/08/13: Lake I2 (top right)  
Photo #: P8160982



16/08/13: Lake I2 (top right) and I180 (bottom left)  
Photo #: P8160981

## E2.28 Lake I181 Outlet

Channel Name: Stream I181

Reconnaissance Date: August 16, 2013

Coordinates: (UTM Zone 12, NAD 83) 561150 m E, 7184152 m N

**Table E2-28 Reconnaissance Observations and GIS Parameters for Stream I181**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	I181	
Upstream Lake Area (ha)	10	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	41	Estimated from LiDAR data
Upstream Lake Elevation (masl)	442.5	Estimated from LiDAR data
Number of Outlet Channels	1	
Channel Connectivity	Continuous	I181 outlet is connected to I180 inlet
Channel Type	Straight	Boulder garden
Sinuosity	Degree 1 (1.00 to 1.05)	
Streambed Material	Boulders and cobbles	
Streambank Material	Poorly defined banks, but boulders and cobbles are present along all water edges	
Stream bed/bank Vegetation	Scattered pockets of low-shrub tundra along streambed, dwarf-shrub tundra adjacent to streambanks	
Channel Slope (m/m)	0.010	Estimated from LiDAR data
Potential Obstructions to Fish Passage	Boulder garden	
<b>General Notes/Observations:</b> Compared to the I182 outlet channel, I181 is a lot wider (perhaps as wide as 100 m) and at least twice as long. Unlike I182, the streambed is characterized by scattered pockets of low-shrub tundra that decrease in concentration downstream.		

m/m = metres per metre; ha = hectare; m = metre; masl = metres above sea level; LiDAR = light detection and ranging; GIS = Geographic Information System.



16/08/13: Lakes I181 (left) and I180 (right)  
Photo #: P8160991



16/0813: Lakes I181 (bottom left) and I180 (top right)  
Photo #: P8160990



16/08/13: Lakes I181 (right) and I180 (left)  
Photo #: P8160988



16/08/13: Lakes I180 (bottom), I181 (middle), and I182  
(top right)  
Photo #: P8160886

## E2.29 Lake I182 Outlet

Channel Name: Stream I182

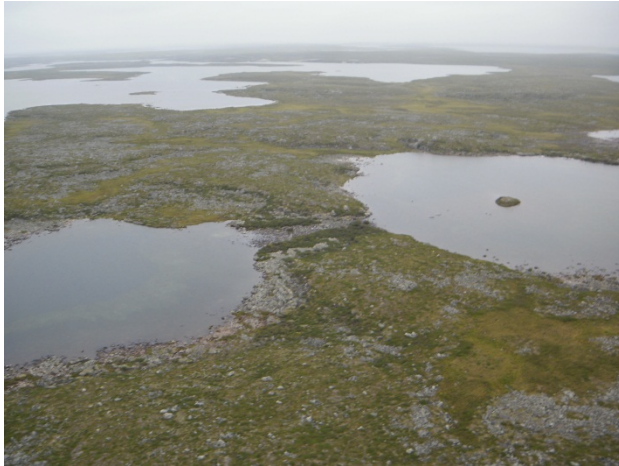
Reconnaissance Date: August 16, 2013

Coordinates: (UTM Zone 12, NAD 83) 558790 m E, 7185220 m N

**Table E2-29 Reconnaissance Observations and GIS Parameters for Stream I182**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	I182	
Upstream Lake Area (ha)	478	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	1171	Estimated from LiDAR data
Upstream Lake Elevation (masl)	443.3	Estimated from LiDAR data
Number of Outlet Channels	1	
Channel Connectivity	Continuous	I182 outlet is connected to I181 inlet
Channel Type	Straight	Boulder garden
Sinuosity	Degree 1 (1.00 to 1.05)	
Streambed Material	Boulders and cobbles	
Streambank Material	Boulders and cobbles	
Stream bed/bank Vegetation	Boulder garden is generally bordered by thick high-shrub tundra	
Channel Slope (m/m)	0.014	Estimated from LiDAR data
Potential Obstructions to Fish Passage	Boulder garden is present, but might have sufficient breaks to allow fish migration	
<p><b>General Notes/Observations:</b> The I182 outlet channel is a very short (&lt;100 m) boulder garden that narrows slightly in the downstream direction. Boulders and cobbles occupy ~75% to 80% of the surface area, so water is visible and thus continuous flow is obvious. The channel is bordered by thick lines of high-shrub tundra. The longitudinal gradient between lakes I182 and I181 is very gentle, so flow velocities are probably very slow.</p>		

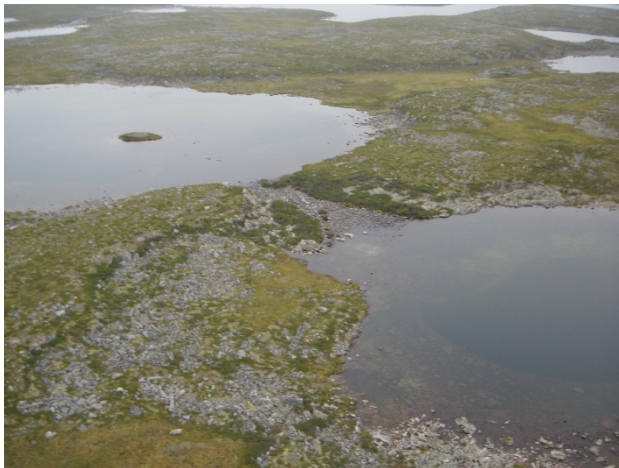
m/m = metres per metre; ha = hectare; m = metre; masl = metres above sea level; < = less than; % = percent; ~ = approximately; LiDAR = light detection and ranging; GIS = Geographic Information System.



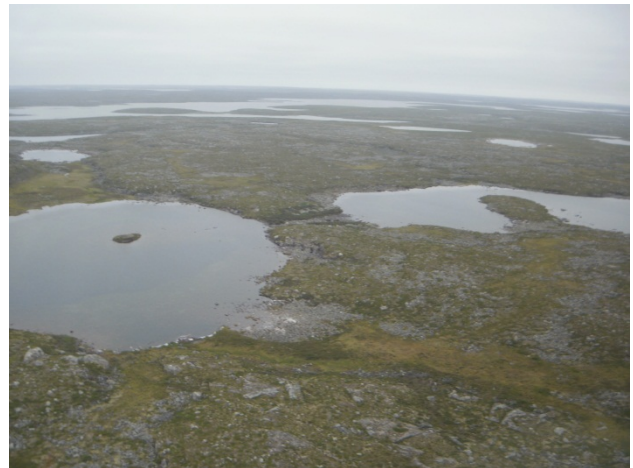
16/08/13: Lakes I182 (left) and I181 (right)  
Photo #: P8160996



16/0813: Lakes I182 (bottom) and I181 (lake with tiny island in middle)  
Photo #: P8160995



16/08/13: Lakes I182 (bottom right) and I181 (top left)  
Photo #: P8160994



16/08/13: Lakes I182 (right) and I181 (left)  
Photo #: P8160993

## E2.30 Lake J54 Outlet

Channel Name: Stream J54

Reconnaissance Date: August 18, 2013

Coordinates: (UTM Zone 12, NAD 83) 561124 m E, 7165719 m N

**Table E2-30 Reconnaissance Observations and GIS Parameters for Stream J54**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	J54	
Upstream Lake Area (ha)	101	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	317	Estimated from LiDAR data
Upstream Lake Elevation (masl)	424.4	Estimated from LiDAR data
Number of Outlet Channels	1	
Channel Connectivity	Estimated to be continuous	J53's properties suggest that J54 outlet is connected to J53 inlet; J53's outlet connection to J1 is uncertain
Channel Type	Sinuuous	
Sinuosity	Uncertain	
Streambed Material	Primarily subsurface flow between J54 and J53	
Streambank Material	Primarily subsurface flow between J54 and J53	
Stream bed/bank Vegetation	High-shrub tundra dominates the flow direction between J54 and J53 (perhaps masking the water)	
Channel Slope (m/m)	0.0070	Estimated from LiDAR data
Potential Obstructions to Fish Passage	Subsurface flow	
<p><b>General Notes/Observations:</b> The multi-coloured mossy-like vegetation pattern adjacent to J53 is very similar to the previously flooded E379 (refer to E381 factsheet). Furthermore, a similar area exists adjacent to J54 (Photo #: P8181266), which suggests that this area has relatively high water level fluctuations. The sinuous nature of the J54 stream indicates that it is receiving flow from J54. Because no water is visible, the flow is either subterranean or masked by the high-shrub tundra. The same scenario might exist downstream of J53 as well, which would mean that subsurface flow connects J53 and J1.</p>		

m/m = metres per metre; ha = hectare; masl = metres above sea level; LiDAR = light detection and ranging; GIS = Geographic Information System.



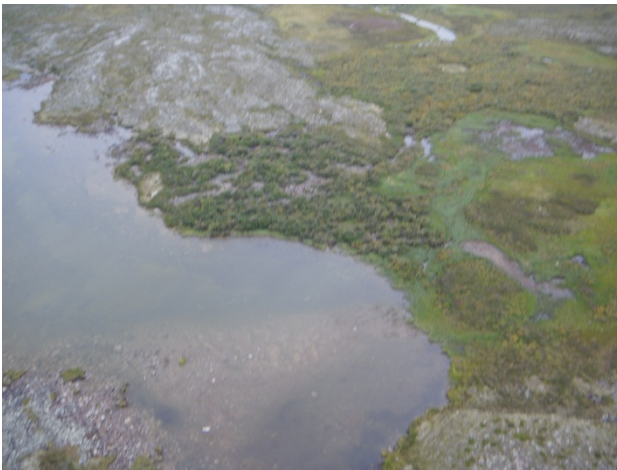
18/08/13: Lakes J1 (top) and J53 (half-moon lake in middle of image)

Photo #: P8181268



18/0813: Lakes J1 (top) and J53 (half-moon lake in middle of image)

Photo #: P8181267



18/08/13: Lake J54 (bottom left)

Photo #: P8181266

## E2.31 Lake J75 Outlet

Channel Name: Stream J75

Reconnaissance Date: August 18, 2013

Coordinates: (UTM Zone 12, NAD 83) 566631 m E, 7168992 m N

**Table E2-31 Reconnaissance Observations and GIS Parameters for Stream J75**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	J75	
Upstream Lake Area (ha)	43	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	272	Estimated from LiDAR data
Upstream Lake Elevation (masl)	418.1	Estimated from LiDAR data
Number of Outlet Channels	1	
Channel Connectivity	Continuous	J75 outlet is connected to J1 inlet
Channel Type	Straight	Almost a boulder garden
Sinuosity	Degree 1 (1.00 to 1.05)	
Streambed Material	Boulders and cobbles	
Streambank Material	Boulders and cobbles	
Stream bed/bank Vegetation	High-shrub tundra	
Channel Slope (m/m)	0.0070	Estimated from LiDAR data
Potential Obstructions to Fish Passage	None observed at time of survey	Channel is developing into a fish migration obstacle
<p><b>General Notes/Observations:</b> The J75-J1 outlet channel is a very short channel characterized by high-shrub tundra, as well as lots of boulders and cobbles on the streambed. Despite these obstacles, flowing water is continuously visible, and so some impediments to fish migration may exist. However, the boulder deposit at the J1 inlet is thick and the continuous high-shrub tundra vegetation along the streambanks merges close to the J1 inlet. Therefore, one might expect overland J75-J1 discharge to decrease over time.</p>		

m/m = metres per metre; ha = hectare; masl = metres above sea level; LiDAR = light detection and ranging; GIS = Geographic Information System.



18/08/13: Lakes J75 (top) and J1 (bottom)  
Photo #: P8181241



18/0813: Lakes J75 (right) and J1 (left)  
Photo #: P8181242

## E2.32 Lake J78 Outlet

Channel Name: Stream J78

Reconnaissance Date: August 18, 2013

Coordinates: (UTM Zone 12, NAD 83) 568992 m E, 7165193 m N

**Table E2-32 Reconnaissance Observations and GIS Parameters for Stream J78**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	J78	
Upstream Lake Area (ha)	62	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	178	Estimated from LiDAR data
Upstream Lake Elevation (masl)	434.9	Estimated from LiDAR data
Number of Outlet Channels	1	
Channel Connectivity	Continuous	J78 outlet is connected to J77 inlet
Channel Type	Sinuuous	Boulder garden
Sinuosity	Degree 2 (1.06 to 1.25)	
Streambed Material	Boulders and cobbles	
Streambank Material	Boulders and cobbles	
Stream bed/bank Vegetation	Low-shrub tundra	
Channel Slope (m/m)	0.013	Estimated from LiDAR data
Potential Obstructions to Fish Passage	Boulder garden, particularly near J78 outlet	
<p><b>General Notes/Observations:</b> The J78-J77 outlet channel is a moderately sinuous boulder garden bounded by low-shrub tundra. At the J78 outlet, the main boulder garden passage begins with a width of approximately 50 m and is approximately 60% free of organic matter. Downstream, the boulder garden narrows to less than 10 m and the streambed is nearly 100% boulders and cobbles. As the channel approaches the J77 inlet, it expands to a width of &gt;50 m and the streambed is scattered with multiple vegetation islands (larger and more numerous than the J78 outlet).</p>		

m/m = metres per metre; ha = hectare; m = metre; masl = metres above sea level; % = percent; > = greater than; LiDAR = light detection and ranging; GIS = Geographic Information System.



18/08/13: Lakes J77 (left) and J78 (right)  
Photo #: P8181256



18/08/13: Lakes J77 (top left) and J78 (bottom right)  
Photo #: P8181257



18/08/13: Lakes J78 (bottom left) and J77 (top left)  
Photo #: P8181258



18/08/13: Lakes J77 (bottom right) and J78 (top left)  
Photo #: P8181260

## E2.33 Lake J135 Outlet

Channel Name: Stream J135

Reconnaissance Date: August 18, 2013

Coordinates: (UTM Zone 12, NAD 83) 566492 m E, 7171303 m N

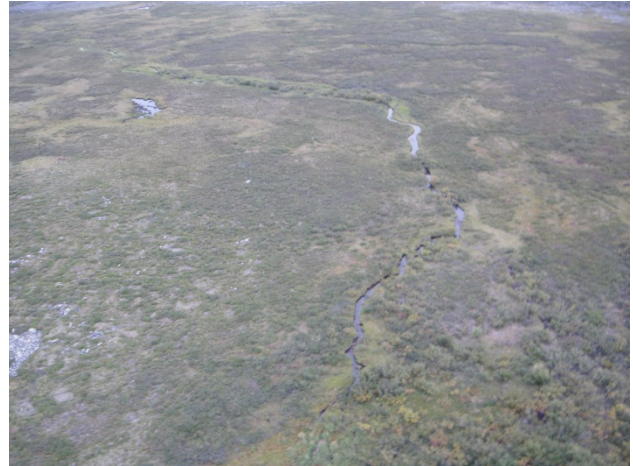
**Table E2-33 Reconnaissance Observations and GIS Parameters for Stream J135**

Description	Aerial Reconnaissance or GIS Analysis Result	Notes
Upstream Lake Name	J135	
Upstream Lake Area (ha)	40	Source: National Topographic Database (NTDB) data
Drainage Area (ha)	159	Estimated from LiDAR data
Upstream Lake Elevation (masl)	428.0	Estimated from LiDAR data
Number of Outlet Channels	1	
Channel Connectivity	Continuous	J135 outlet is connected to J1 inlet
Channel Type	Meandering	Long wavelengths
Sinuosity	Degree 1 (1.00 to 1.05) or Degree 2 (1.06 to 1.25)	Multi-phase sinuosity
Streambed Material	Fine-grained material	Inferred from lack of boulders and cobbles
Streambank Material	Fine-grained material	Inferred from lack of boulders and cobbles
Stream bed/bank Vegetation	Mainly dwarf-shrub tundra, but there are light green grassy zones near the channel midpoint and low to high-shrub tundra areas at the J1 inlet	
Channel Slope (m/m)	~ 0	Estimated from LiDAR data
Potential Obstructions to Fish Passage	None observed at time of survey	
<p><b>General Notes/Observations:</b> In general, the J135-J1 outlet channel is a multi-phase meandering stream. As shown in Photo #: P8181237, the first degree of sinuosity is moderate, but the latter is embedded within a gentle meandering pattern defined by long wavelengths. For the most part, the channel width is uniform and narrow (5 to 10 m). However, it potentially braids into a heavily vegetated area of low to high-shrub tundra at the J1 inlet. Due to the predominantly low-lying streambank vegetation and absence of visible boulders/cobbles, this site is an ideal location for an on-the-ground survey.</p>		

m/m = metres per metre; ha = hectare; m = metre; masl = metres above sea level; ~ = approximately; LiDAR = light detection and ranging; GIS = Geographic Information System.



18/08/13: Lake J135 (top)  
Photo #: P8181238



18/0813: J135 outlet channel (downstream direction towards  
top of image)  
Photo #: P8181237



18/08/13: J135 outlet channel (downstream direction towards left  
of image)  
Photo #: P8181236



18/08/13: Lake J1 (top)  
Photo #: P8181239

## E3 HYDROLOGY SURVEYS

Hydrology surveys were completed at 32 sites within the Lac du Sauvage watershed and at the outlet of Paul Lake, as shown in Map 3.3-1. The lake and outlet channels selected for one discrete hydrology survey during August or September 2013 were primarily terminal sub-basin lakes and mainstem lakes with larger storage capacities, with additional smaller or upper-watershed lakes and outlet channels selected to provide spatial coverage and information for outlet channels over the entire range of drainage basin sizes. Information collected included general observations, detailed channel surveys (to an installed benchmark), and discharge and water level measurements that provide a basis for developing a stage-discharge rating curve based on measured geometry and a minimum of one discharge measurement. When possible, site benchmarks were referenced to geodetic base stations installed by Aurora Geosciences Ltd.

Actions or data collected at each of these sites included the following:

- oblique aerial and land-based geo-referenced photographs;
- installation of a permanent or temporary benchmark (typically an anchor installed into overburden rock or into bedrock where available);
- detailed channel survey including cross-sections sufficient to characterize the control section of the outlet channel in HEC-RAS (when combined with additional LiDAR elevation data), stream and lake water levels, and local water surface slopes using either a self-levelling level and rod with spatial coordinates measured using a handheld GPS unit (sites in August) or a Real Time Kinematic (RTK) satellite navigation system (sites in September);
- stream discharge measurements performed according to the Water Survey of Canada standard, using a top-setting wading rod and either a Marsh-McBirney FLO-MATE Model 2000 or a SonTek Flow Tracker current velocity meter; and,
- observations of channel geomorphology including bed and bank material types, vegetation, sinuosity, high-water marks, and bankfull locations.

Summaries of the relevant field data from the hydrology survey for each site are provided below.

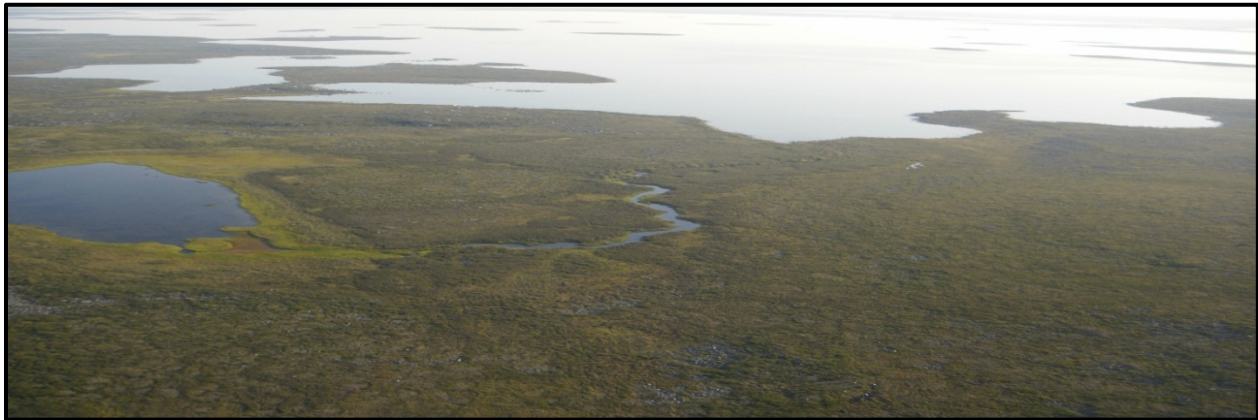
### E3.1 Lake B0 Outlet

Survey Date: 16-Aug-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 539933 m E, 7163817 m N

Outlet Coordinates (Geographic) : 64°35'49"N, 110°09'56"W



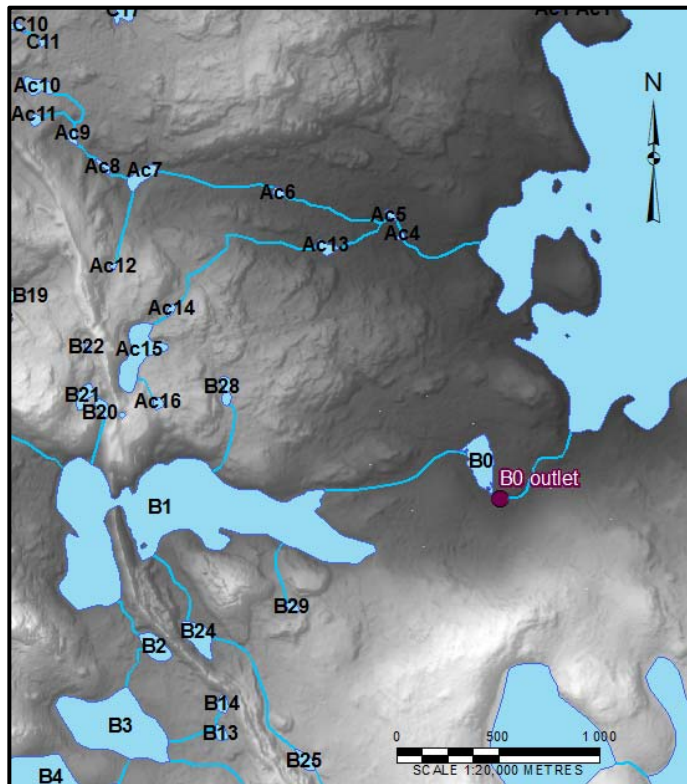
Downstream view of Lake B0 outlet looking northeast (Lac du Sauvage at top)



Lake B0 downstream view of downstream cross-section



Lake B0 upstream view of upstream cross-section



NTS Mapping of Area

**Table E3-1 Summary of Coordinates at Lake B0 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Geodetic)	540863.50	7163880.07
Outlet	539933	7163817

**Table E3-2 2013 Hydrometric Data at Lake B0 and Outlet Station**

Date	Time	Benchmark Elevation (m)	Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
16-Aug-13	15:25	421.46	420.53	0.12 (Estimated)	0.009

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-3 Geomorphic Parameters at Lake B0 and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	49.5	ha	
Drainage Area (DEM) <sup>(a)</sup>	1301.0	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	427.90	m	
Surveyed Local Stream Slope	0.00022	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.0099	m/m	
Average Bankfull Width	4.6	m	
Channel Material	50% silt, 25% clay, 15% boulder, 10% cobble		
Bank Material	55% silt, 30% clay, 10% boulder, 5% cobble		
Vegetation	Grass		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

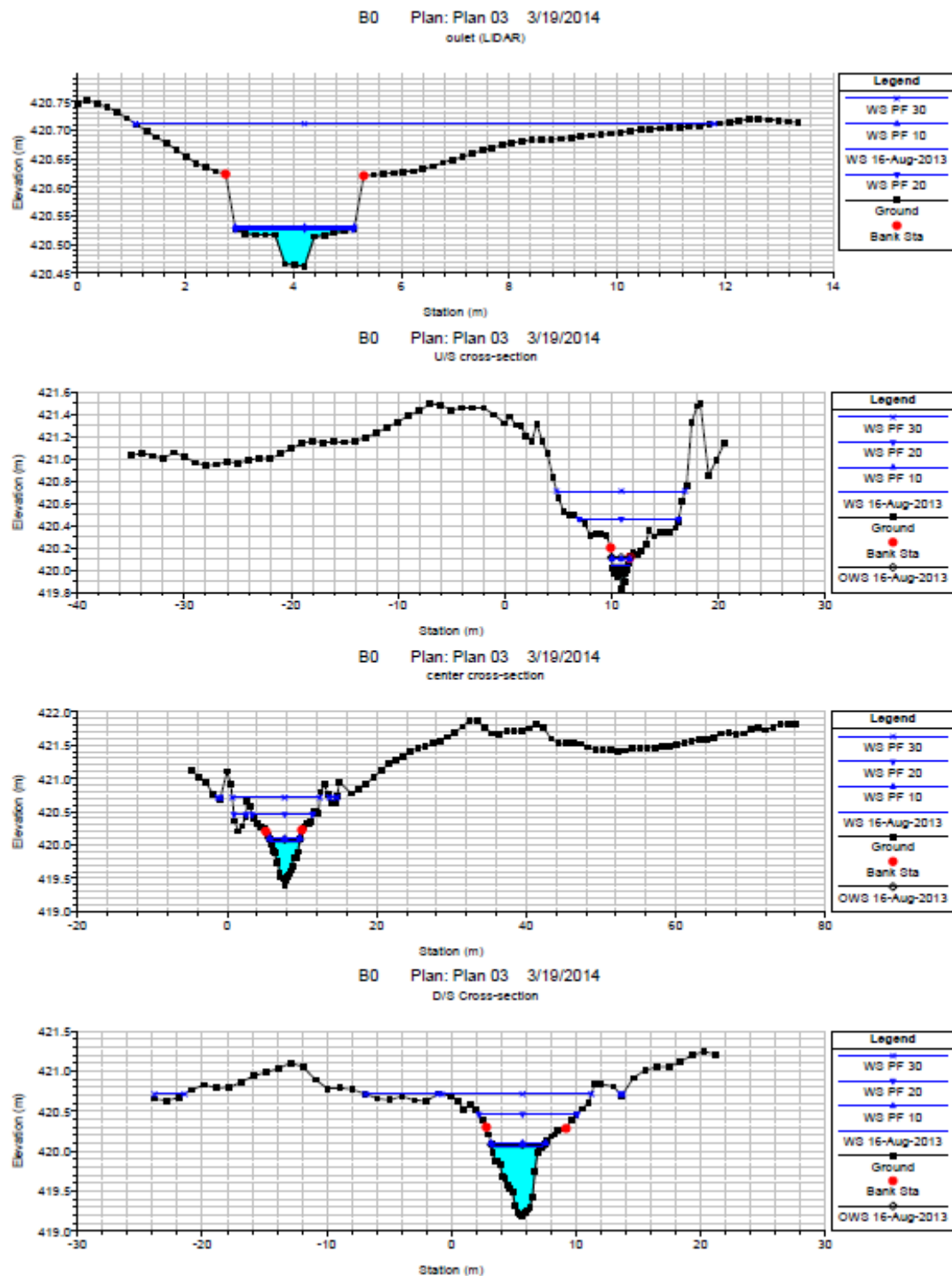
ha = hectare; DEM = Digital Elevation Model; m = metre; m/m = metres per metre; % = percent.

**Table E3-4 Stream B0 Discharge Data**

Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	15:25		<b>Location</b>	Centre cross-section, approximately 900 m downstream of outlet			
<b>Lake Name</b>	Lake B0		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	Marsh-McBirney FLO-MATE Model 2000			
<b>Date Monitored</b>	16-Aug-13		<b>Flow Meter Type</b>	Handheld electromagnetic sensor flowmeter		<b>Instrument Serial #</b>	2005872			
<b>Personnel</b>	MA, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	540870	7163783	10.0		0.00	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.12		10.1	0.10	0.01	0.01	-	-	0.0001	1.14
<b>Discharge (m<sup>3</sup>/s)</b>	0.009		10.2	0.12	0.01	0.00	-	-	0.0000	0.00
<b>Notes</b>			10.3	0.15	0.01	0.01	-	-	0.0002	1.71
			10.4	0.14	0.02	0.01	-	-	0.0001	1.60
			10.5	0.18	0.02	0.03	-	-	0.0005	6.17
			10.6	0.16	0.01	0.06	-	-	0.0010	10.97
			10.7	0.10	0.01	0.08	-	-	0.0008	9.15
			10.8	0.09	0.02	0.04	-	-	0.0004	4.12
			10.9	0.28	0.02	0.04	-	-	0.0011	12.80
			11.0	0.10	0.01	0.07	-	-	0.0007	8.00
			11.1	0.10	0.02	0.08	-	-	0.0008	9.15
			11.2	0.22	0.02	0.05	-	-	0.0011	12.58
			11.3	0.15	0.01	0.05	-	-	0.0008	8.57
			11.4	0.12	0.01	0.06	-	-	0.0007	8.23
			11.5	0.11	0.01	0.05	-	-	0.0005	6.29
			11.6	0.06	0.01	0.00	-	-	0.0000	0.00
			11.7	0.05	0.00	-0.01	-	-	0.0000	-0.49
			11.8	-	-	Edge of Water (RDB)				
			<b>Total</b>		<b>0.22</b>				<b>0.009</b>	<b>100</b>

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-1 Stream B0 Transects Used for Hydraulic Modelling



**Table E3-5 Stream B0 Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	(m)	
B0	4	16-Aug-13	0.009	420.46	420.529	-	60 (To Stn 3)	0.035	-	420.53	0.00487	0.17	0.1	2.2	Estimated
B0	4	PF 10	0.010	420.46	420.531	-	60 (To Stn 3)	0.035	-	420.53	0.00523	0.18	0.1	2.2	
B0	4	PF 20	0.025	420.46	420.527	-	60 (To Stn 3)	0.035	420.53	420.54	0.05735	0.53	0.1	2.2	
B0	4	PF 30	0.045	420.46	420.711	-	60 (To Stn 3)	0.029	-	420.71	0.00007	0.05	0.8	10.7	Surveyed
B0	3	16-Aug-13	0.009	419.84	420.048	420.114	62 (To Stn 2)	0.050	-	420.05	0.00071	0.08	0.1	1.5	
B0	3	PF 10	0.010	419.84	420.098	-	62 (To Stn 2)	0.050	-	420.10	0.00017	0.05	0.2	1.7	
B0	3	PF 20	0.025	419.84	420.461	-	62 (To Stn 2)	0.057	-	420.46	0.00000	0.01	2.0	9.3	Surveyed
B0	3	PF 30	0.045	419.84	420.711	-	62 (To Stn 2)	0.072	-	420.71	0.00000	0.01	4.8	12.0	
B0	2	16-Aug-13	0.009	419.39	420.046	420.084	116 (To Stn 1)	0.060	-	420.05	0.00000	0.01	1.3	3.8	
B0	2	PF 10	0.010	419.39	420.098	-	116 (To Stn 1)	0.060	-	420.10	0.00000	0.01	1.5	4.1	Surveyed
B0	2	PF 20	0.025	419.39	420.461	-	116 (To Stn 1)	0.051	-	420.46	0.00000	0.01	4.0	9.7	
B0	2	PF 30	0.045	419.39	420.711	-	116 (To Stn 1)	0.056	-	420.71	0.00000	0.01	6.8	13.1	
B0	1	16-Aug-13	0.009	419.18	420.046	420.081	-	0.120	419.24	420.05	0.00000	0.01	1.9	4.1	Surveyed
B0	1	PF 10	0.010	419.18	420.098	-	-	0.120	419.24	420.10	0.00000	0.01	2.1	4.4	
B0	1	PF 20	0.025	419.18	420.461	-	-	0.110	419.27	420.46	0.00000	0.01	4.3	7.9	
B0	1	PF 30	0.045	419.18	420.711	-	-	0.078	419.29	420.71	0.00000	0.01	7.2	20.4	

Notes:

Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.

All other profiles are used to represent a possible range of discharges to estimate a lake outlet rating curve (100 flow profiles computed in total, only select profiles shown).

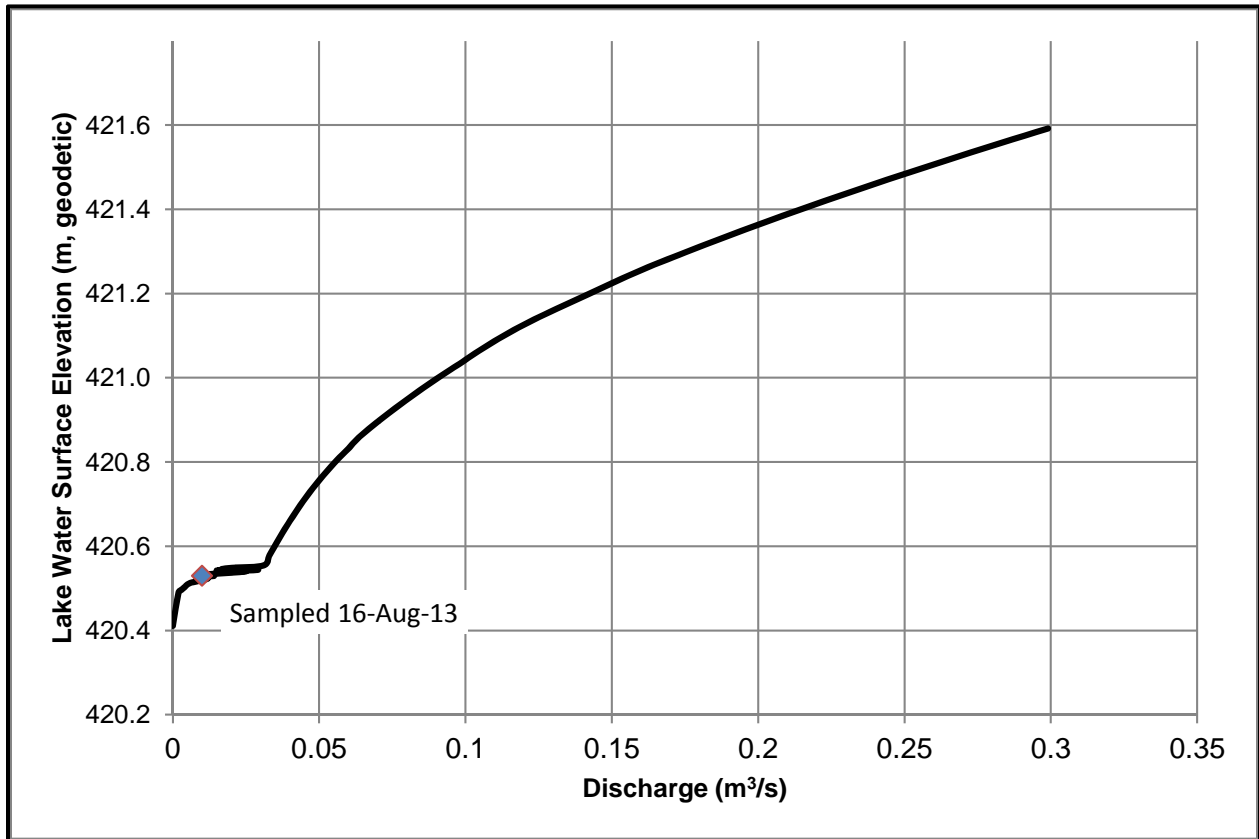
River station values decrease in the downstream direction.

Additional interpolated cross-sections were used for hydraulic modelling, but are not included in the summary tables.

Outlet cross-section is estimated from field photos and notes. No survey was completed at the outlet due to time and weather constraints.

m/m = metres per metre; m = metre; m<sup>3</sup>/s = cubic metres per second; m<sup>2</sup> = square metre; m/s = metres per second; - = no data available.

Figure E3-2 Stream B0 Lake Outlet Rating Curve



m³/s = cubic metres per second; m = metre.

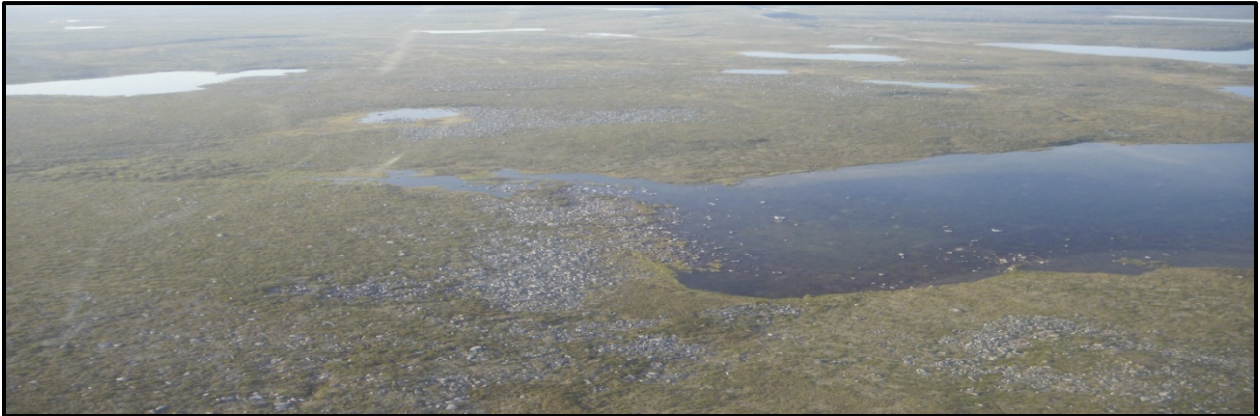
## E3.2 Lake C1 Outlet

Survey Date: 13-Aug-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 538532 m E, 7166615 m N

Outlet Coordinates (Geographic) : 64°37'20"N , 110°11'39"W



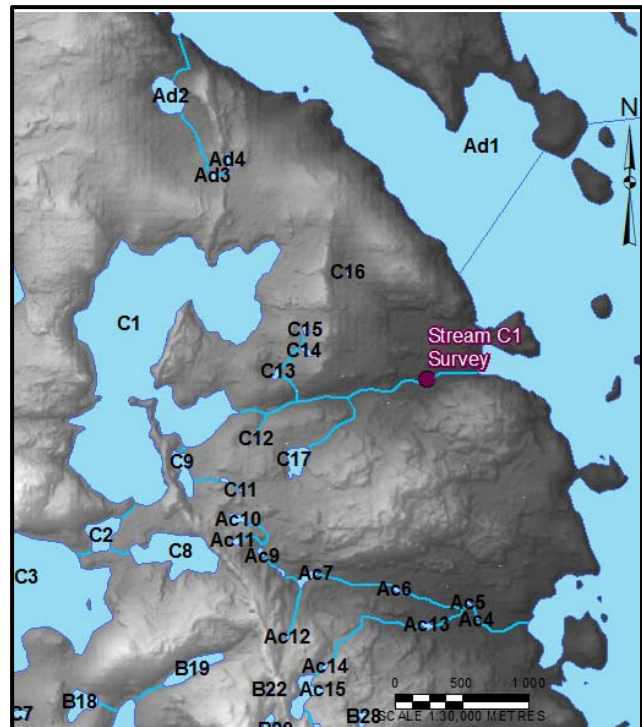
Right downstream bank view of Lake C1 outlet looking southeast



Lake C1 Upstream view of upstream cross-section



Lake C1 downstream view of downstream cross-section



NTS Mapping of Area

**Table E3-6 Summary of Coordinates at Lake C1 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Geodetic)	539990.36	7166960.20
Outlet	538532	7166615

**Table E3-7 2013 Hydrometric Data at Lake C1 and Outlet Station**

Date	Time	Benchmark Elevation (m)	Lake Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
13-Aug-13	15:00	419.72	Not Surveyed	Not surveyed	0.011

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-8 Geomorphic Parameters at Lake C1 and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	163.3	ha	
Drainage Area (DEM) <sup>(a)</sup>	915.3	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	435.40	m	
Surveyed Local Stream Slope	0.0042	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.011	m/m	
Average Bankfull Width	3.1	m	
Channel Material	70% silt, 20% clay, 10% boulder		
Bank Material	75% silt, 20% clay, 5% boulder		
Vegetation	Grass		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

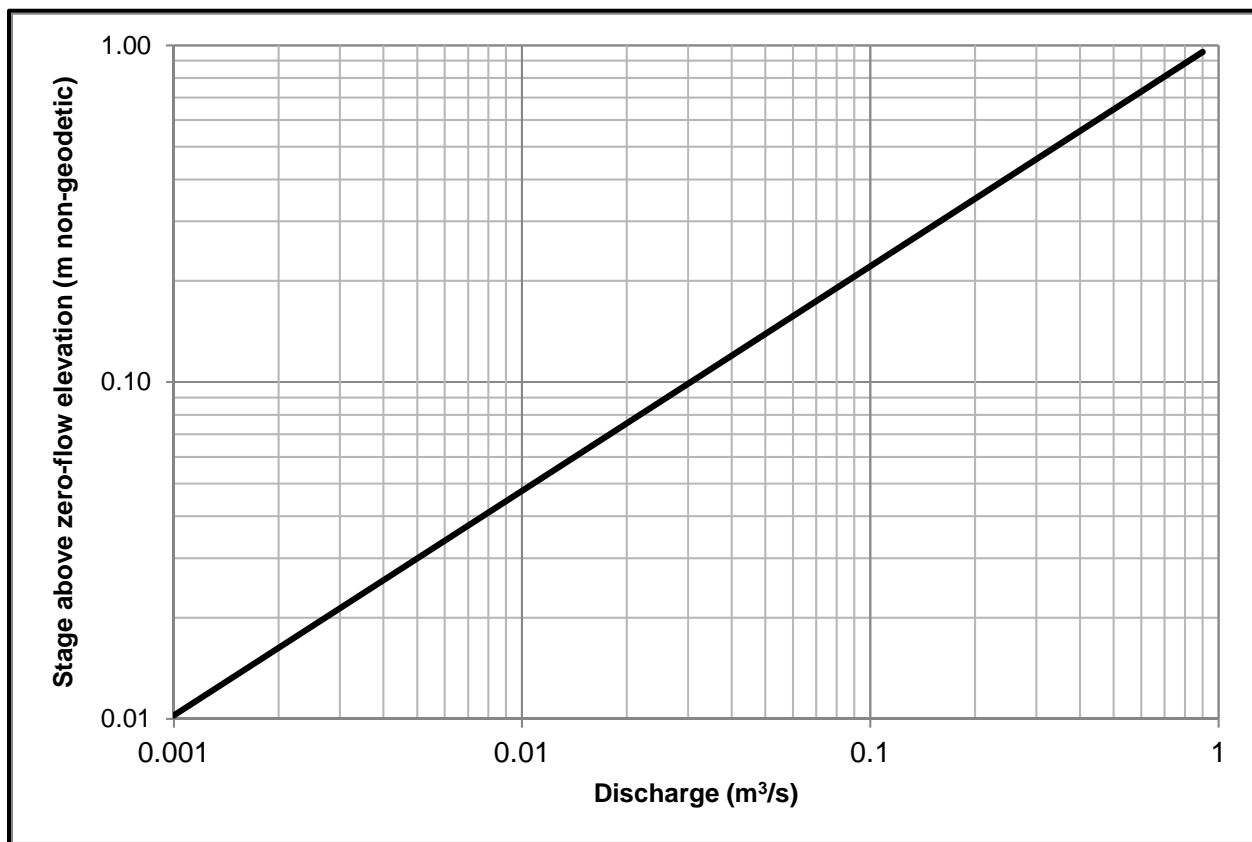
ha = hectare; m = metre; m/m = metres per metre; % = percent; DEM = Digital Elevation Model.

**Table E3-9 Stream C1 Discharge Data**

Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	15:00		<b>Location</b>	Centre cross-section, approximately 1.5 km downstream from lake outlet			
<b>Lake Name</b>	Lake C1		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	Marsh-McBirney FLO-MATE Model 2000			
<b>Date Monitored</b>	13-Aug-13		<b>Flow Meter Type</b>	Handheld electromagnetic sensor flowmeter		<b>Instrument Serial #</b>	2005872			
<b>Personnel</b>	MA, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	540033	7166922	4.8		0.02	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	Not surveyed		4.9	0.46	0.05	0.01	-	-	0.0005	4.19
<b>Discharge (m<sup>3</sup>/s)</b>	0.011		5.0	0.50	0.05	0.03	-	-	0.0015	13.67
<b>Notes</b>			5.1	0.52	0.05	0.02	-	-	0.0010	9.48
			5.2	0.54	0.05	0.03	-	-	0.0016	14.77
			5.3	0.55	0.06	0.02	-	-	0.0011	10.03
			5.4	0.55	0.05	0.03	-	-	0.0017	15.04
			5.5	0.50	0.05	0.02	-	-	0.0010	9.12
			5.6	0.48	0.05	0.02	-	-	0.0010	8.75
			5.7	0.46	0.03	0.02	-	-	0.0009	8.39
			5.8	0.14	0.01	0.03	-	-	0.0004	3.83
			5.9	0.10	0.01	0.02	-	-	0.0002	1.82
			6.0	0.10	0.01	0.01	-	-	0.0001	0.91
Ineffective flow area			6.1	0.08	0.01	-	-	-	-	-
Ineffective flow area			6.2	0.07	0.01	-	-	-	-	-
Ineffective flow area			6.3	0.05	0.00	-	-	-	-	-
			6.4	0.03	0.10	Edge of Water (RDB)				
<b>Total</b>					<b>0.61</b>				<b>0.011</b>	<b>100</b>

hr = hour; m = metre; m<sup>3</sup>/s = cubic metres per second; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-3 Stream C1 Lake Outlet Rating Curve



Note: Cross-sections were measured downstream of the lake outlet; therefore, rating curve was not developed based on survey data, but rather the regional lake outlet relationship.

m = metre; m<sup>3</sup>/s = cubic metres per second.

### E3.3 Lake D3 (Counts Lake) Outlet

Survey Date: 20-Aug-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 535021 m E, 7169656 m N

Outlet Coordinates (Geographic) : 64°39'00" N, 110°16'00" W



Upstream view of Lake D3 (Counts Lake) outlet looking northwest



Lake D3 (Counts Lake) Upstream view of upstream cross-section and existing hydrometric station



Lake D3 (Counts Lake) downstream view of downstream cross-section



NTS Mapping of Area

**Table E3-10 Summary of Coordinates at Lake D3 (Counts Lake) and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Geodetic)	535212.53	7169698.79
Outlet	535021	7169656

**Table E3-11 2013 Hydrometric Data at Lake D3 (Counts Lake) and Outlet Station**

Date	Time (24-hour)	Benchmark Elevation (m)	Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
20-Aug-13	9:15	440.69	440.58	0.18	0.03

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-12 Geomorphic Parameters at Lake D3 (Counts Lake) and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	115.3	ha	
Drainage Area (DEM) <sup>(a)</sup>	432.4	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	440.70	m	
Surveyed Local Stream Slope	0.0012	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.011	m/m	
Average Bankfull Width	5.0	m	
Channel Material	20% boulder, 20% coarse gravel, 20% medium gravel, 10% cobble, 10% fine gravel, 10% coarse sand, 10% fine sand		
Bank Material	40% silt, 20% boulder, 20% cobble, 10% fine sand, 10% clay		
Vegetation	Grass		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

ha = hectare; m = metre; m/m = metres per metre; % percent; DEM = Digital Elevation Model.

**Table E3-13 Stream D3 Discharge Data**

Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	10:00		<b>Location</b>	Cross-section #3, approximately 250 m downstream of lake outlet			
<b>Lake Name</b>	Lake D3 (Counts Lake)		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	Marsh-McBirney FLO-MATE Model 2000			
<b>Date Monitored</b>	20-Aug-13		<b>Flow Meter Type</b>	Handheld electromagnetic sensor flowmeter		<b>Instrument Serial #</b>	2005872			
<b>Personnel</b>	MA, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	535290	7169687	3.6	0.00	0.01	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.18		3.7	0.15	0.02	0.018	-	-	0.000	0.99
<b>Discharge (m<sup>3</sup>/s)</b>	0.03		3.8	0.21	0.02	0.101	-	-	0.002	7.62
<b>Notes</b>			3.9	0.20	0.02	0.122	-	-	0.002	8.79
			4.0	0.20	0.02	0.101	-	-	0.002	7.25
			4.1	0.18	0.02	0.140	-	-	0.003	9.10
			4.2	0.17	0.02	0.122	-	-	0.002	7.47
			4.3	0.17	0.02	0.110	-	-	0.002	6.73
			4.4	0.17	0.02	0.131	-	-	0.002	8.03
			4.5	0.17	0.02	0.149	-	-	0.003	9.15
			4.6	0.16	0.02	0.146	-	-	0.002	8.44
			4.7	0.16	0.02	0.143	-	-	0.002	8.26
			4.8	0.17	0.02	0.113	-	-	0.002	6.91
			4.9	0.18	0.02	0.088	-	-	0.002	5.74
			5.0	0.18	0.02	0.052	-	-	0.001	3.36
			5.1	0.16	0.02	0.027	-	-	0.000	1.58
			5.2	0.14	0.01	0.006	-	-	0.000	0.31
			5.3	0.10	0.01	0.000	-	-	0.000	0.00
			5.4	0.08	0.00	0.009	-	-	0.000	0.26
			5.5	0.00	0.00	Edge of Water (RDB)				
			<b>Total</b>		<b>0.30</b>				<b>0.03</b>	<b>100</b>

hr = hour; # = number; m = metre; m<sup>2</sup> = square metre; % = percent; m/s = metres per second; m<sup>3</sup>/s = cubic metres per second; LDB = left downstream bank; RDB = right downstream bank; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-4 Stream D3 Transects Used for Hydraulic Modelling (1 of 2)

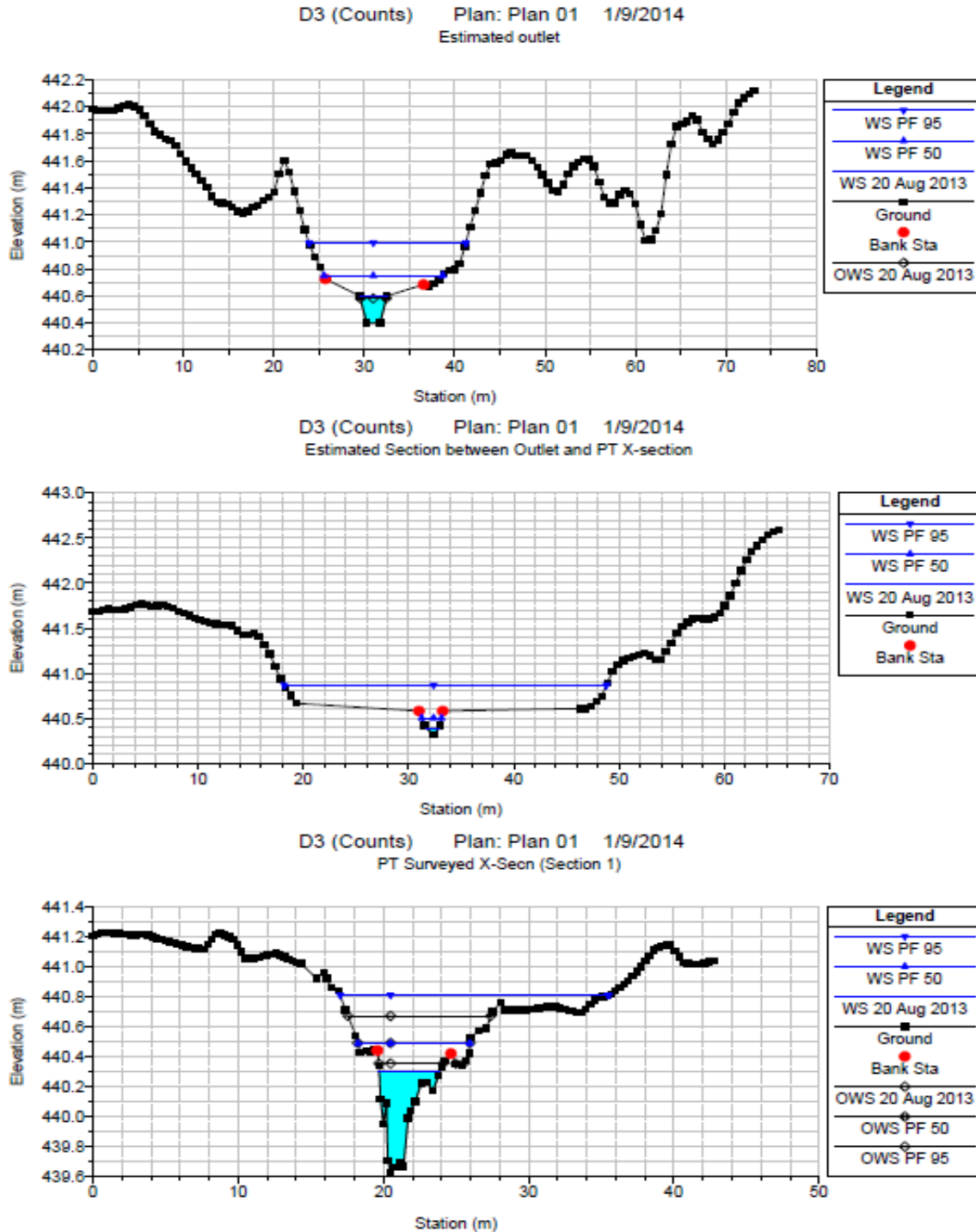
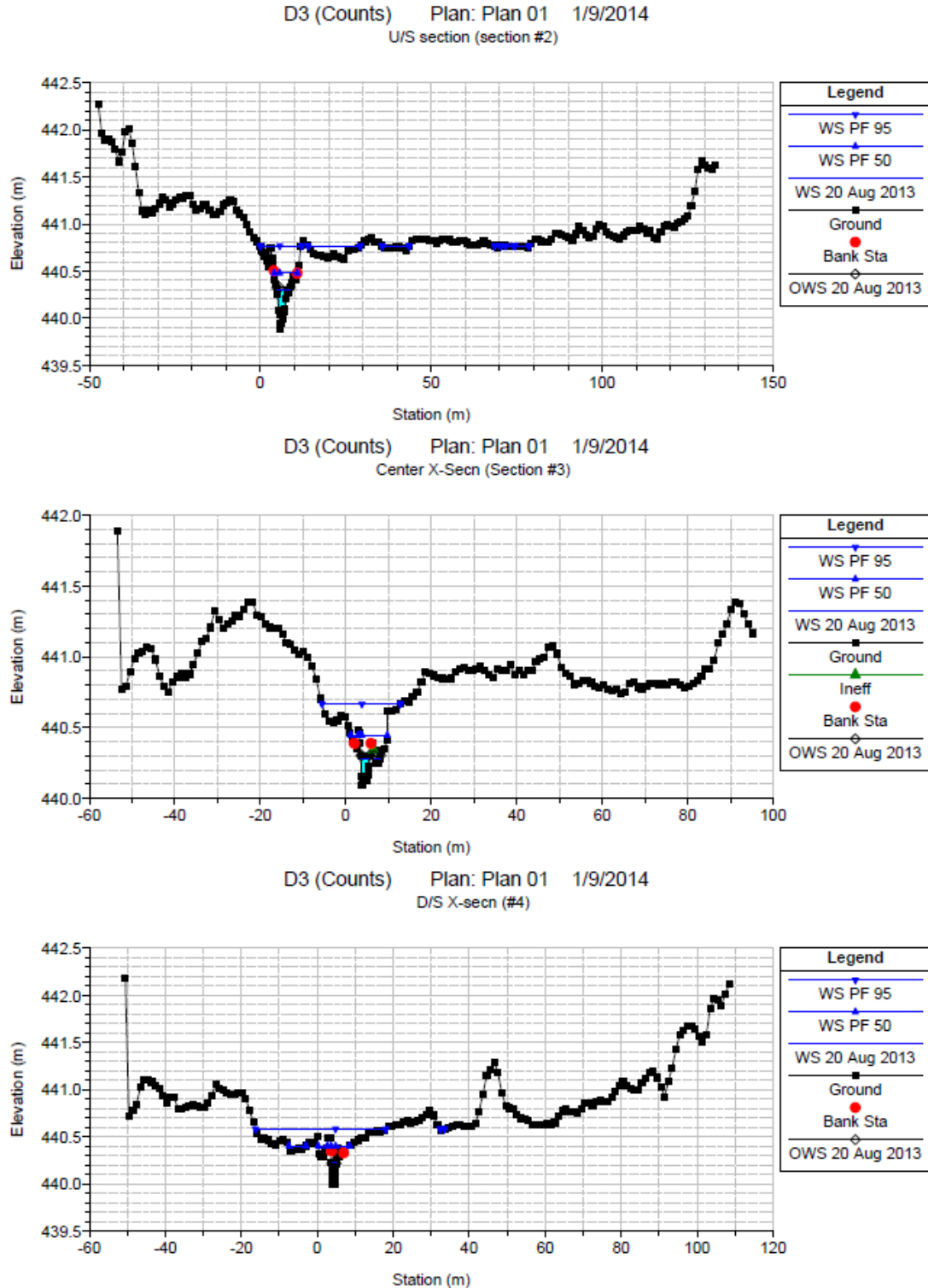


Figure E3-5 Stream D3 Transects Used for Hydraulic Modelling (2 of 2)



**Table E3-14 Stream D3 Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	(m)	
D3 Outlet	6	20-Aug-13	0.028	440.40	440.597	440.582	100	0.100	-	440.60	0.00052	0.06	0.4	3.0	Estimated
D3 Outlet	6	PF 50	0.130	440.40	440.750	-	100	0.096	-	440.75	0.00070	0.07	1.8	13.1	
D3 Outlet	6	PF 95	1.000	440.40	440.994	-	100	0.098	-	441.00	0.00136	0.18	5.6	17.3	
D3 Outlet	5	20-Aug-13	0.028	440.32	440.390	-	60	0.100	440.39	440.41	0.23159	0.58	0.1	1.1	Estimated (Interpolated)
D3 Outlet	5	PF 50	0.130	440.32	440.503	-	60	0.100	-	440.52	0.05666	0.57	0.2	1.9	
D3 Outlet	5	PF 95	1.000	440.32	440.869	-	60	0.113	-	440.87	0.00116	0.12	8.1	30.6	
D3 Outlet	4	20-Aug-13	0.028	439.63	440.302	440.354	38	0.100	-	440.30	0.00003	0.02	1.3	4.2	Surveyed
D3 Outlet	4	PF 50	0.130	439.63	440.486	440.490	38	0.088	-	440.49	0.00013	0.06	2.4	7.7	
D3 Outlet	4	PF 95	1.000	439.63	440.809	440.670	38	0.081	-	440.81	0.00085	0.17	6.1	18.5	
D3 Outlet	3	20-Aug-13	0.028	439.89	440.299	440.325	39	0.100	-	440.30	0.00019	0.04	0.7	3.7	Surveyed
D3 Outlet	3	PF 50	0.130	439.89	440.478	-	39	0.100	-	440.48	0.00049	0.08	1.6	6.8	
D3 Outlet	3	PF 95	1.000	439.89	440.766	-	39	0.056	-	440.77	0.00150	0.18	5.6	43.5	
D3 Outlet	2	20-Aug-13	0.028	440.09	440.282	440.302	18	0.100	440.16	440.28	0.00172	0.11	0.3	3.1	Surveyed
D3 Outlet	2	PF 50	0.130	440.09	440.445	-	18	0.099	440.22	440.45	0.00159	0.11	1.2	8.1	
D3 Outlet	2	PF 95	1.000	440.09	440.666	-	18	0.098	440.42	440.67	0.00505	0.26	3.9	18.3	
D3 Outlet	1	20-Aug-13	0.028	440.0	440.231	440.217	-	0.100	440.11	440.23	0.00465	0.16	0.2	1.2	Surveyed
D3 Outlet	1	PF 50	0.130	440.0	440.400	-	-	0.084	440.18	440.40	0.00465	0.14	0.9	11.6	
D3 Outlet	1	PF 95	1.000	440.0	440.580	-	-	0.103	440.43	440.58	0.00465	0.19	5.4	35.5	

Notes:

Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.

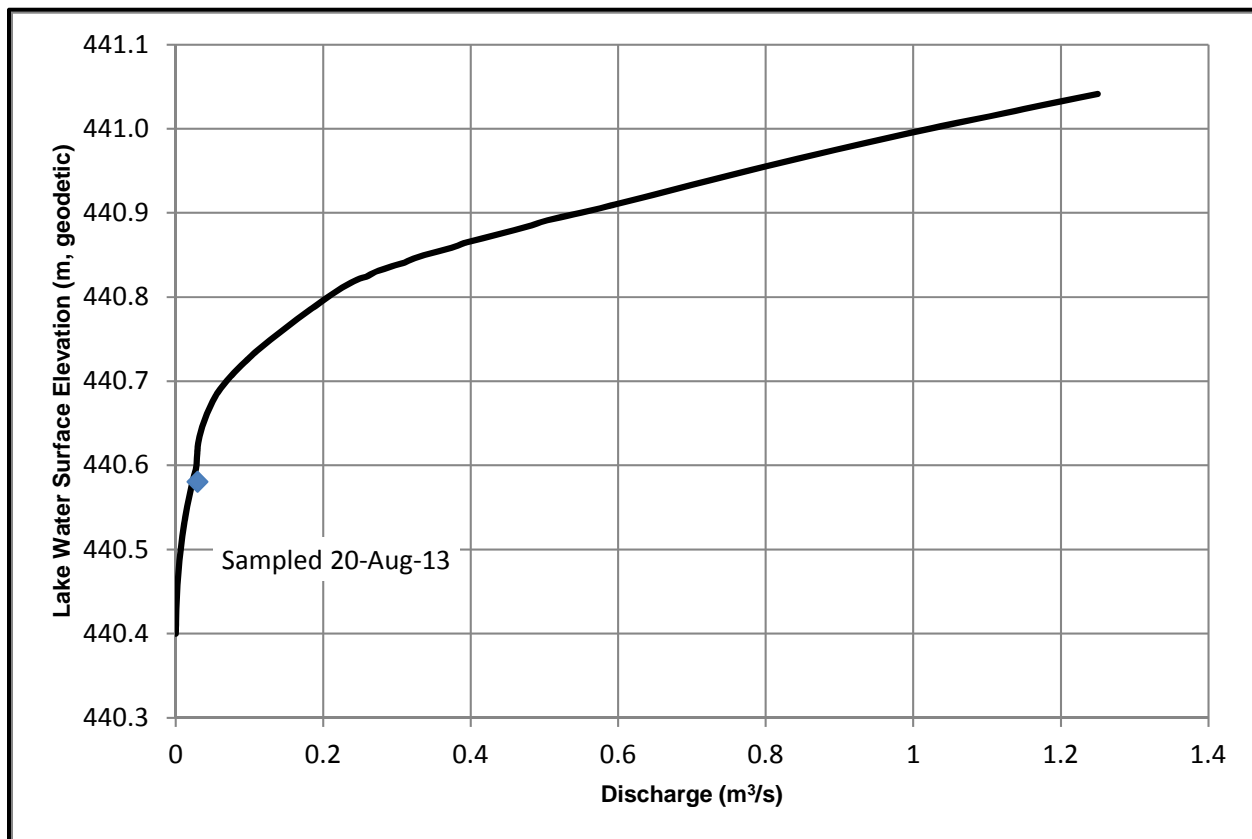
All other profiles are used to represent a possible range of discharges to estimate a lake outlet rating curve (100 flow profiles computed in total, only select profiles shown).

River station values decrease in the downstream direction.

Outlet cross-section is estimated from field photos and notes. No survey was completed at the outlet due to time and weather constraints.

m<sup>3</sup>/s = cubic metres per second; m = metre; m/m = metres per metre; m/s = metres per second; m<sup>2</sup> = square metre; - = no data available.

Figure E3-6 Lake D3 (Counts Lake) Outlet Rating Curve



m = metre; m³/s = cubic metres per second.

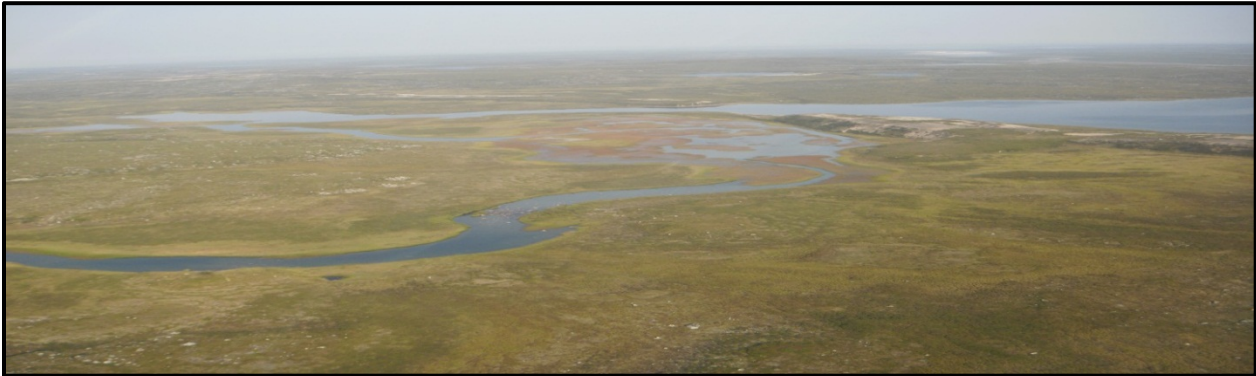
### E3.4 Lake E2 Outlet

Survey Date: 17-Aug-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 535632 m E, 7180512 m N

Outlet Coordinates (Geographic) : 64°44'50"N, 110°15'05"W



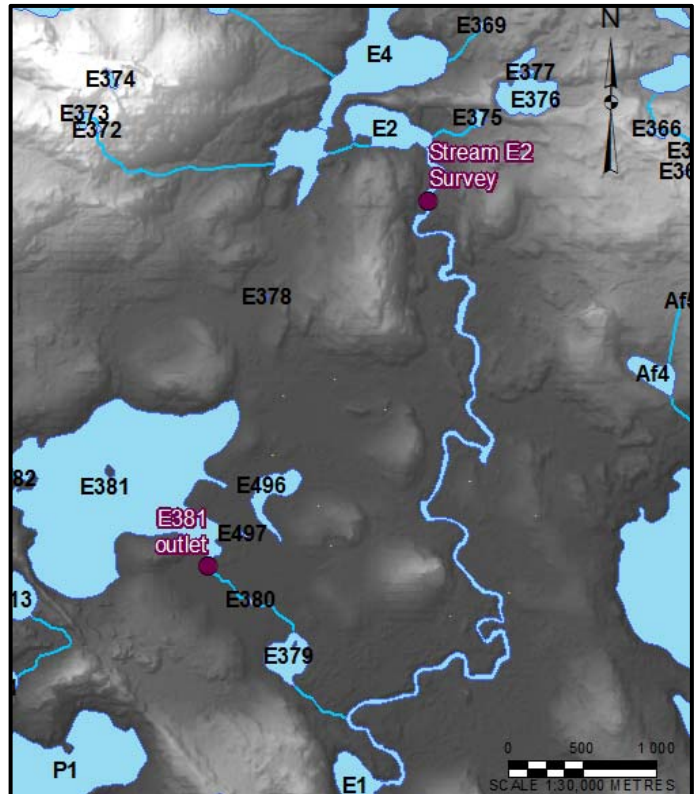
Upstream view of Lake E2 outlet looking northwest



Lake E2 Upstream view of upstream cross-section



Lake E2 downstream view of downstream cross-section



NTS Mapping of Area

**Table E3-15 Summary of Coordinates at Lake E2 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Geodetic)	535654.10	7180172.60
Outlet	535632	7180512

**Table E3-16 2013 Hydrometric Data at Lake E2 and Outlet Station**

Date	Time (24-hour)	Benchmark Elevation (m)	Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
17-Aug-13	11:30	422.58	Not Measured	Not measured	0.63

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-17 Geomorphic Parameters for Lake E2**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	11.7	ha	
Drainage Area (DEM) <sup>(a)</sup>	17792.3	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	421.90	m	
Surveyed Local Stream Slope	0.0090	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.00053	m/m	
Average Bankfull Width	17.7	m	
Channel Material	35% cobble, 20% boulder, 20% coarse gravel, 15% medium gravel, 5% fine gravel, 5% coarse sand		
Bank Material	40% silt, 20% boulder, 20% cobble, 20% clay		
Vegetation	Grass		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

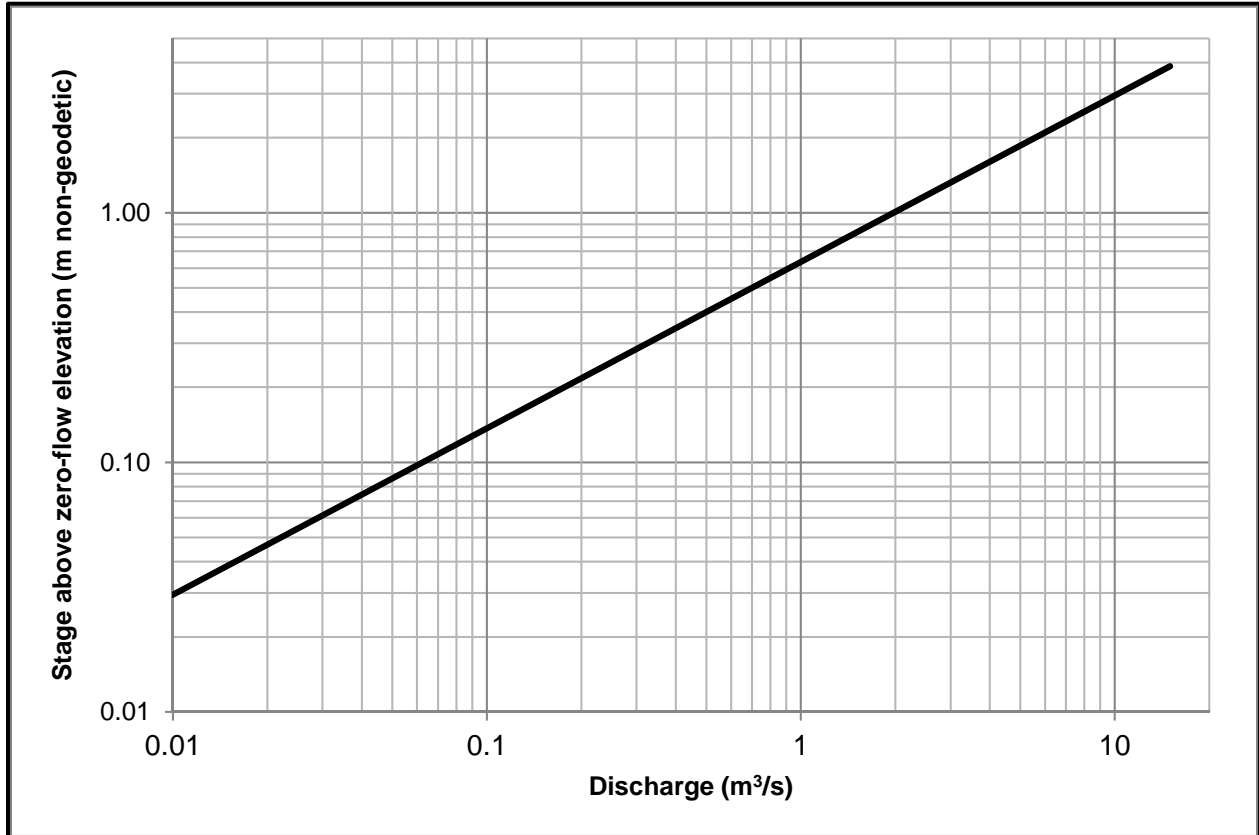
ha = hectare; m = metre; m/m = metres per metre; % = percent; DEM = Digital Elevation Model.

**Table E3-18 Stream E2 Discharge Data**

Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	N/A		<b>Location</b>	Centre cross-section , approximately 350 m downstream of Lake outlet			
<b>Lake Name</b>	Lake E2		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	Marsh-McBirney FLO-MATE Model 2000			
<b>Date Monitored</b>	17-Aug-13		<b>Flow Meter Type</b>	Handheld electromagnetic sensor flowmeter		<b>Instrument Serial #</b>	2005872			
<b>Personnel</b>	MA, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	535631	7180161	1.8	0.00	0.060	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	Not measured		2.1	0.40	0.200	0.00	-	-	0.000	0.00
<b>Discharge (m<sup>3</sup>/s)</b>	0.63		2.6	0.40	0.190	0.09	-	-	0.018	2.86
<b>Notes</b>			3.1	0.36	0.175	0.52	-	-	0.094	14.88
			3.6	0.34	0.173	0.47	-	-	0.080	12.70
			4.1	0.35	0.163	0.41	-	-	0.072	11.41
			4.6	0.30	0.140	0.32	-	-	0.048	7.63
			5.1	0.26	0.110	0.39	-	-	0.051	8.06
			5.6	0.18	0.130	0.56	-	-	0.050	8.01
			6.1	0.34	0.163	0.35	-	-	0.060	9.46
			6.6	0.31	0.143	0.23	-	-	0.036	5.67
			7.1	0.26	0.133	0.22	-	-	0.029	4.55
			7.6	0.27	0.113	0.04	-	-	0.005	0.86
			8.1	0.18	0.075	0.25	-	-	0.023	3.58
			8.6	0.12	0.080	0.28	-	-	0.017	2.67
			9.1	0.20	0.093	0.12	-	-	0.012	1.91
			9.6	0.17	0.068	0.14	-	-	0.012	1.89
			10.1	0.10	0.025	0.26	-	-	0.013	2.07
			10.6	Boulder	0.044	-	-	-	0.000	0.00
			11.0	0.22	0.066	0.04	-	-	0.004	0.70
			11.6	Boulder	0.048	-	-	-	0.000	0.00
			12.2	0.16	0.024	0.09	-	-	0.007	1.09
			12.5	0.00	0.000	Edge of Water (RDB)				
<b>Total</b>					<b>2.41</b>				<b>0.63</b>	<b>100</b>

hr = hour; N/A = not applicable; m = metre; # = number; m/s = metres per second; m<sup>2</sup> = square metre; % = percent; m<sup>3</sup>/s = cubic metres per second; LDB = left downstream bank; RDB = right downstream bank; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-7 Lake E2 Outlet Rating Curve



m = metre; m<sup>3</sup>/s = metres per second.

Note: Cross-sections were measured downstream of the lake outlet; therefore, the rating curve was not developed based on survey data, but rather the regional lake outlet relationship.

### E3.5 Lake E8 Outlet

Survey Date: 6-Sep-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 532878 m E, 7183128 m N

Outlet Coordinates (Geographic) : 64°46'16"N, 110°18'31"W



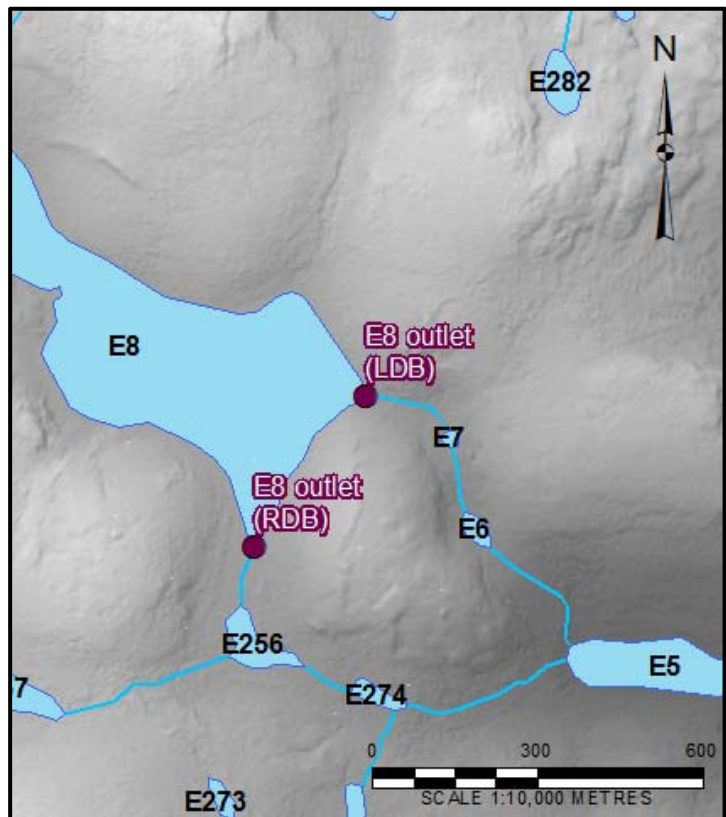
Upstream view of Lake E8 outlets looking northwest



Lake E8 upstream view of upstream narrows



Lake E8 downstream view of upstream narrows



NTS Mapping of Area

**Table E3-19 Summary of Coordinates at Lake E8 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Geodetic)	532758.84	7183578.39
Outlet	532878	7183128

**Table E3-20 2013 Hydrometric Data at Lake E8 and Outlet Station**

Date	Time (24-hour)	Benchmark Elevation (m)	Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
6-Sep-13	13:30	447.22	446.02	0.38	0.04

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-21 Geomorphic Parameters for Lake E8**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	30.1	ha	
Drainage Area (DEM) <sup>(a)</sup>	10121.3	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	446.40	m	
Surveyed Local Stream Slope	0.020	m/m	Slope at RDB outlet channel
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.022	m/m	
Average Bankfull Width	66.1	m	
Channel Material	80% boulder, 10% medium gravel, 10% fine gravel		
Bank Material	80% boulder, 10% fine gravel, 5% coarse gravel, 5% medium gravel		
Vegetation	Low shrub tundra		

a) DEM from light detection and ranging (LiDAR) data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

m = metre; m/m = metres per metre; ha = hectare; DEM = Digital Elevation Model; % = percent; RDB = right downstream bank.



**Table E3-22 Stream E8 Discharge Data**

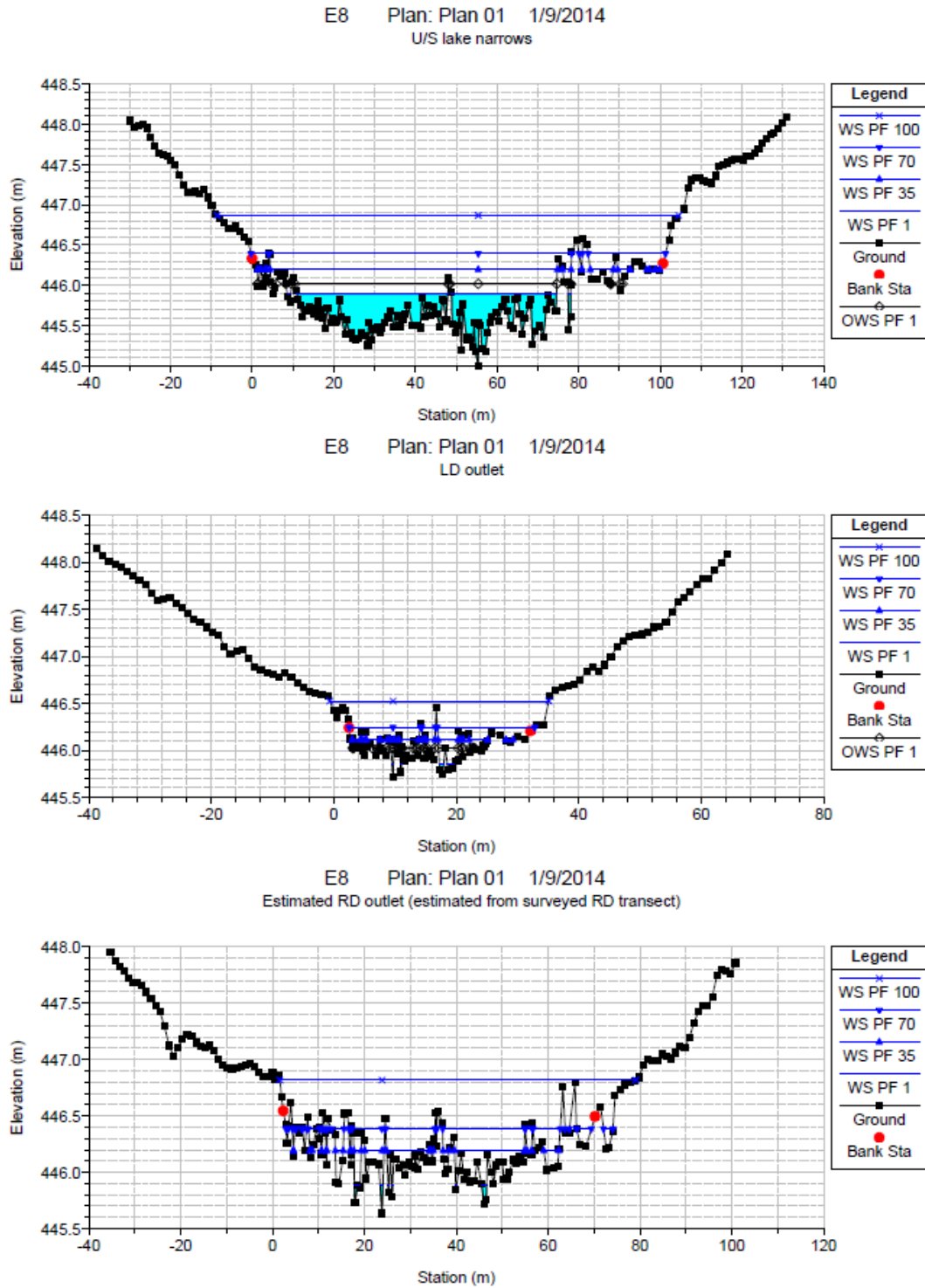
Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	13:30		<b>Location</b>	Lake E8 narrows, approximately 590 m upstream of Lake outlet			
<b>Lake Name</b>	Lake E8 (2 outlets)		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	Marsh-McBirney FLO-MATE Model 2000			
<b>Date Monitored</b>	6-Sep-13		<b>Flow Meter Type</b>	Handheld electromagnetic sensor flowmeter		<b>Instrument Serial #</b>	2005872			
<b>Personnel</b>	DC, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	532557	7183658	1.4	0.00	0.99	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.38		8.5	0.28	0.58	0.0006	-	-	0.0007	1.90
<b>Discharge (m<sup>3</sup>/s)</b>	0.04		10.5	0.30	0.64	0.0014	-	-	0.0009	2.24
<b>Notes</b>			12.5	0.34	0.74	0.0020	-	-	0.0013	3.55
			14.5	0.40	0.84	0.0011	-	-	0.0009	2.39
			16.5	0.44	0.80	0.0014	-	-	0.0012	3.28
			18.5	0.36	0.90	0.0014	-	-	0.0010	2.69
			20.5	0.54	1.12	0.0014	-	-	0.0015	4.03
			22.5	0.58	1.16	0.0028	-	-	0.0033	8.66
			24.5	0.58	0.88	0.0014	-	-	0.0016	4.33
			26.5	0.30	0.76	0.0028	-	-	0.0017	4.48
			28.5	0.46	0.90	0.0017	-	-	0.0016	4.12
			30.5	0.44	0.90	0.0009	-	-	0.0007	1.97
			32.5	0.46	0.84	0.0037	-	-	0.0034	8.93
			34.5	0.38	0.58	0.0045	-	-	0.0034	9.08
			36.5	0.20	0.36	0.0043	-	-	0.0017	4.48
			38.5	0.16	0.40	0.0034	-	-	0.0011	2.87
			40.5	0.24	0.70	0.0045	-	-	0.0022	5.73
			42.5	0.46	0.46	0.0003	-	-	0.0003	0.69
			44.5	0.00	0.03	0.0000	-	-	0.0000	0.00
			46.5	0.03	0.73	0.0014	-	-	0.0001	0.25
			48.5	0.70	1.30	0.0014	-	-	0.0020	5.23

**Table E3-22 Stream E8 Discharge Data**

Site Information	Discharge Measurement							
Notes	Station (m)	Depth (m)	Area (m <sup>2</sup> )	Velocity at Specified Depth (m/s) 60%	Qi 20%	% of Total Q 80%	Station (m)	Depth (m)
	50.5	0.60	0.60	0.0023	-	-	0.0027	7.17
	52.5	0.00	0.48	0.0000	-	-	0.0000	0.00
	54.5	0.48	0.78	0.0023	-	-	0.0022	5.73
	56.5	0.30	0.60	0.0014	-	-	0.0009	2.24
	58.5	0.30	0.62	0.0003	-	-	0.0002	0.45
	60.5	0.32	0.62	0.0003	-	-	0.0002	0.48
	62.5	0.30	0.52	0.0006	-	-	0.0003	0.90
	64.5	0.22	0.72	0.0006	-	-	0.0002	0.66
	66.5	0.50	0.50	0.0006	-	-	0.0006	1.49
	68.5	0.00	0.00	0.0000	-	-	0.0000	0.00
	70.5	0.00	0.00	0.0000	-	-	0.0000	0.00
	72.5	0.00	0.00	0.0000	-	-	0.0000	0.00
	74.5	0.00	0.00	Edge of Water (RDB)				
	<b>Total</b>		<b>22.06</b>				<b>0.038</b>	<b>100</b>

m = metre; m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-8 Stream E8 Transects Used for Hydraulic Modelling



**Table E3-23 Stream E8 Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	(m)		
E8 Lake	5	6-Sep-13	0.04	445.00	445.892	446.018	530 (To Outlet Channels)	0.120	-	445.89	0.00000	0.002	21.2	64.1	Surveyed
E8 Lake	5	PF 35	1.40	445.00	446.194	-	530 (To Outlet Channels)	0.120	-	446.19	0.00004	0.03	42.9	84.9	
E8 Lake	5	PF 70	4.90	445.00	446.395	-	530 (To Outlet Channels)	0.119	-	446.40	0.00018	0.08	61.8	98.2	
E8 Lake	5	PF 100	25.00	445.00	446.867	-	530 (To Outlet Channels)	0.115	-	446.87	0.00074	0.23	111.3	113.0	
E8 LDB Outlet	2	6-Sep-13	0.01	445.72	445.856	446.023	35 (to most downstream cross-section)	0.250	-	445.86	0.00454	0.04	0.1	2.2	Surveyed
E8 LDB Outlet	2	PF 35	0.17	445.72	446.111	-	35 (to most downstream cross section)	0.250	-	446.11	0.00533	0.07	2.5	19.7	
E8 LDB Outlet	2	PF 70	0.59	445.72	446.244	-	35 (to most downstream cross-section)	0.247	-	446.25	0.00574	0.10	6.0	29.8	
E8 LDB Outlet	2	PF 100	3.00	445.72	446.524	-	35 (to most downstream cross-section)	0.230	-	446.53	0.00720	0.20	15.3	35.8	

**Table E3-23 Stream E8 Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	(m)		
E8 RDB Outlet	2	6-Sep-13	0.03	445.64	445.891	-	50 (to most downstream cross-section)	0.120	-	445.89	0.00684	0.12	0.3	3.5	Surveyed Channel reproduced upstream using channel gradient
E8 RDB Outlet	2	PF 35	1.23	445.64	446.191	-	50 (to most downstream cross-section)	0.120	-	446.19	0.00695	0.20	6.3	39.0	
E8 RDB Outlet	2	PF 70	4.31	445.64	446.386	-	50 (to most downstream cross-section)	0.119	-	446.39	0.00698	0.27	15.8	59.6	
E8 RDB Outlet	2	PF 100	22.00	445.64	446.818	-	50 (to most downstream cross-section)	0.117	-	446.83	0.00706	0.48	46.0	77.5	

Notes:

Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.

All other profiles are used to represent a possible range of discharges to estimate a lake outlet rating curve (100 flow profiles computed in total, only select profiles shown).

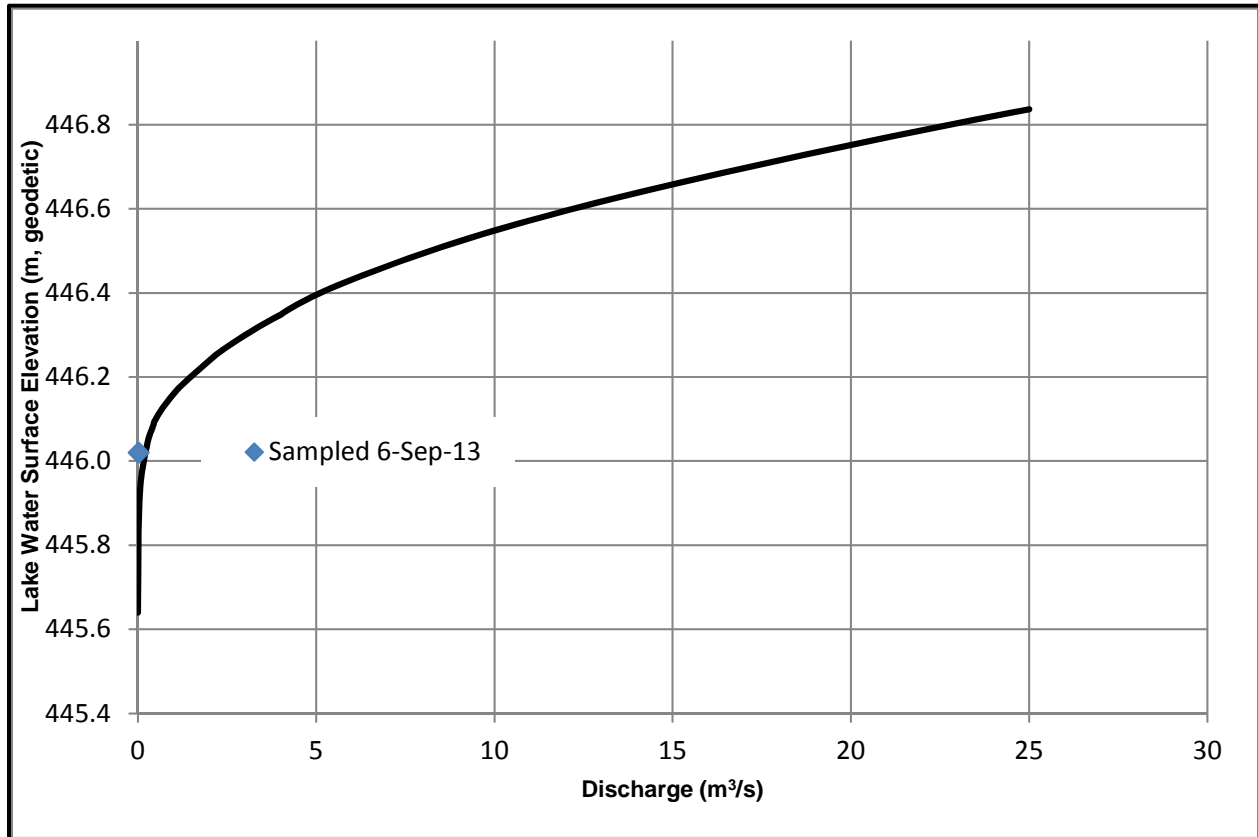
River station values decrease in the downstream direction.

Additional estimated lake and channel cross-sections were used for hydraulic modelling, but are not included in the summary tables.

This reach contains two outlets, each having one cross-section surveyed near the outlet location.

A cross-section survey and gauging were completed in the Lake E8 narrows.

m<sup>3</sup>/s = cubic metres per second; m = metre; m/m = metres per metre; m/s = metres per second; m<sup>2</sup> = square metre; RDB = right downstream bank; - = no data available.

**Figure E3-9 Lake E8 Outlet Rating Curve (considering two outlets)**

m = metre; m<sup>3</sup>/s = cubic metres per second.

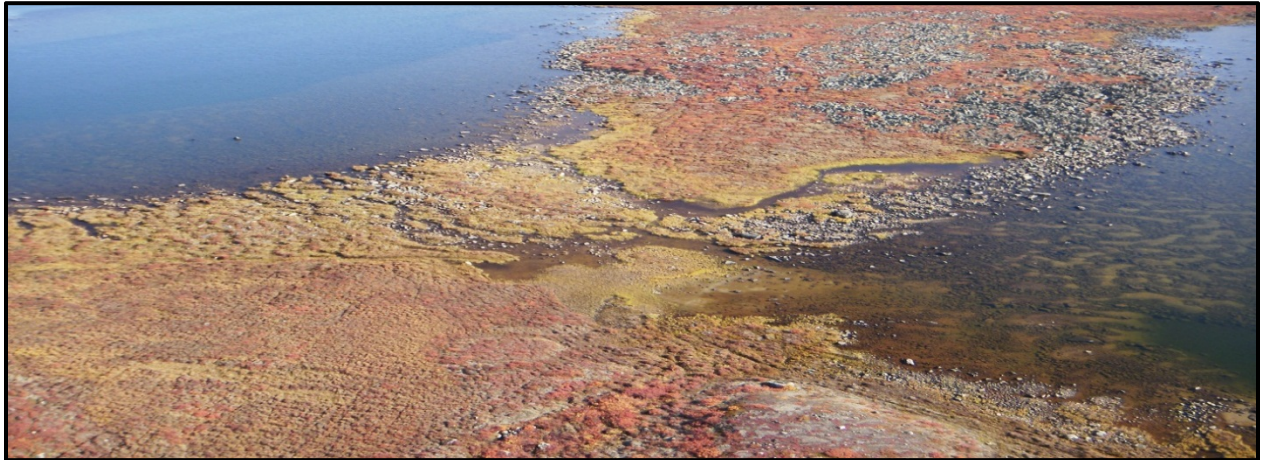
### E3.6 Lake E12 Outlet

Survey Date: 7-Sep-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 522393 m E, 7182849 m N

Outlet Coordinates (Geographic) : 64°46'10" N, 110°31'45" W



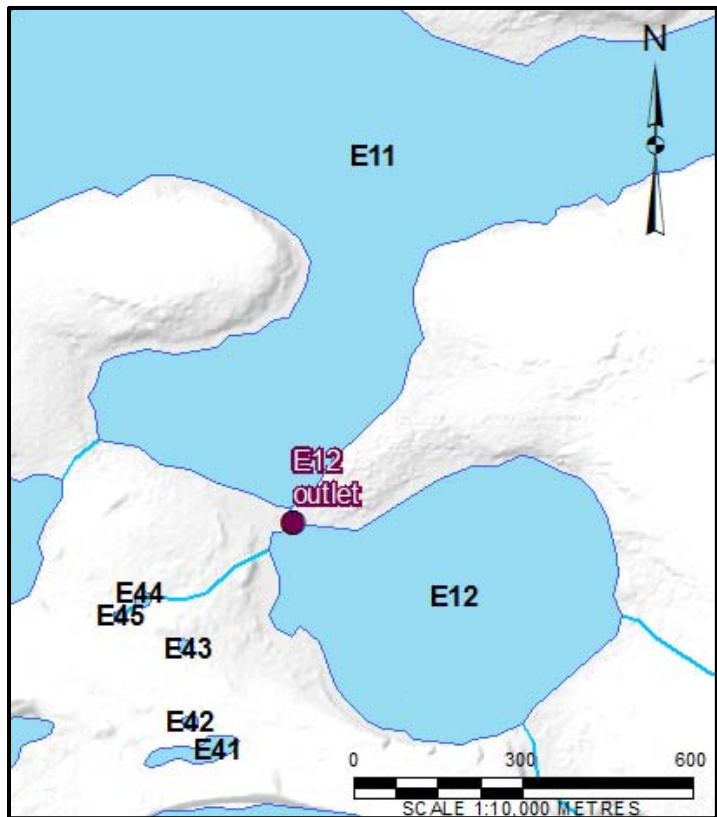
Right downstream bank view of Lake E12 outlet looking northeast (Lake E12 at right, Lake E11 at top left)



Lake E12 upstream view of outlet



Lake E12 upstream view of E12 cross-section



NTS Mapping of Area

**Table E3-24 Summary of Coordinates at Lake E12 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (non-geodetic)	522314.21	7182877.86
Outlet	522393	7182849

**Table E3-25 2013 Hydrometric Data at Lake E12 and Outlet Station**

Date	Time (24-hour)	Non-geodetic Benchmark Elevation <sup>(a)</sup> (m)	Non-geodetic Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
7-Sep-13	11:00	470.61	470.28	0.81	0.01 (Poor data)

a) Elevation of the Benchmark set to 470.61 m to match lake elevations with LiDAR Water Surface Elevation of Lake E12.  
m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-26 Geomorphic Parameters at Lake E12 and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	21.8	ha	
Drainage Area (DEM) <sup>(a)</sup>	709.6	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	469.80	m	
Surveyed Local Stream Slope	0.00097	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.00021	m/m	
Average Bankfull Width	38.6	m	
Channel Material	20% boulder, 20% medium gravel, 20% fine sand, 20% silt, 10% cobble, 10% coarse gravel		
Bank Material	30% boulder, 20% fine sand, 20% silt 15% cobble, 15% coarse sand		
Vegetation	Low shrub tundra		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

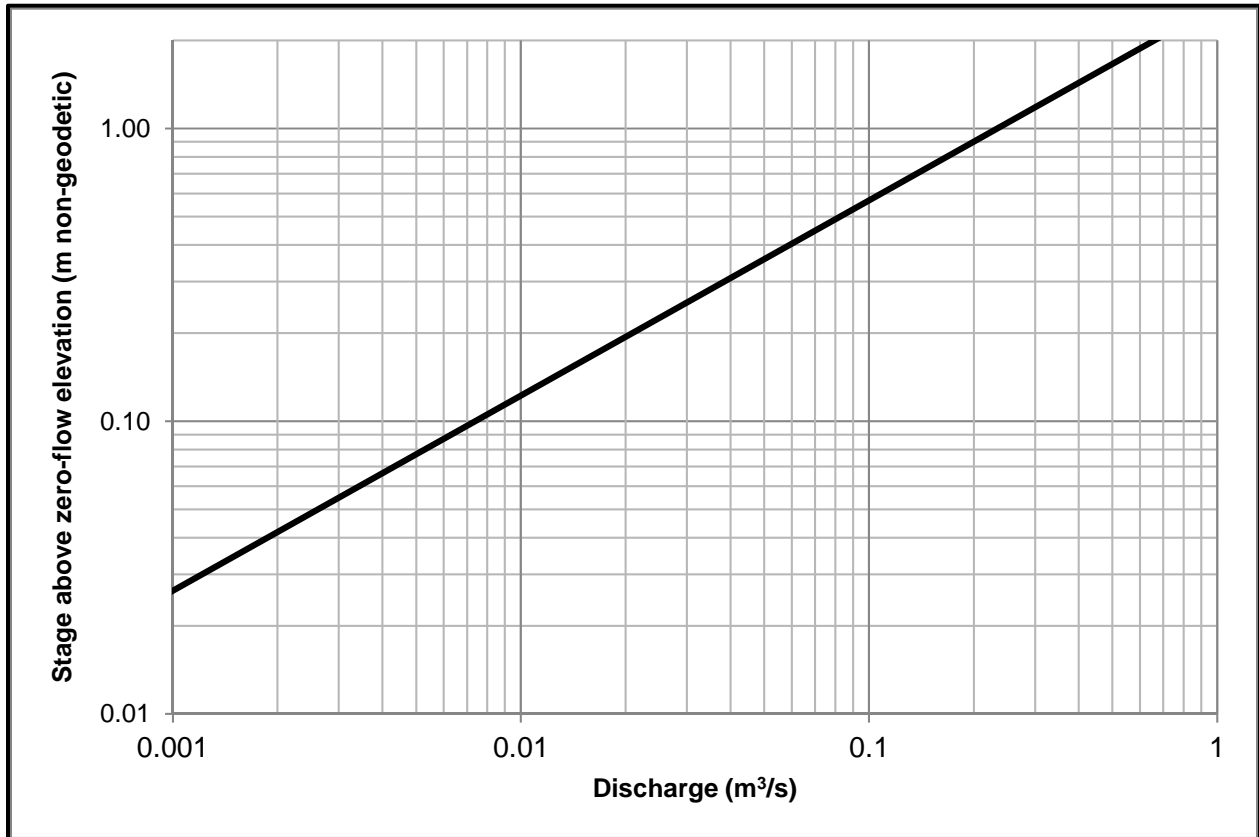
m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E3-27 Stream E12 Discharge Data**

Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	11:00			<b>Location</b>		Lake Outlet	
<b>Lake Name</b>	Lake E12		<b>Method</b>	Velocity – Area (Mid-section)			<b>Instrument Model</b>		SonTek FlowTracker	
<b>Date Monitored</b>	7-Sep-13		<b>Flow Meter Type</b>	Handheld ADV flowmeter			<b>Instrument Serial #</b>		P4017	
<b>Personnel</b>	DC, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	522393	7182849	0.3	0.00	0.30	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.81		3.3	0.20	0.12	0.000	-	-	0.012	N/A
<b>Discharge (m<sup>3</sup>/s)</b>	0.01 (Neglect - flow too low )		3.8	0.28	0.14	0.034	-	-	N/A	N/A
<b>Notes</b>			4.3	0.28	0.14	0.001	-	-	0.000	N/A
All velocity readings are very small (less than 0.01 m/s) except at station 3.8 m, and fluctuate around 0.00 m/s. The discharge was very small during the survey; therefore, the final resulting discharge should be neglected as it is not significantly different than 0.00 m <sup>3</sup> /s.			4.8	0.26	0.13	-0.003	-	-	0.000	N/A
			5.3	0.26	0.14	0.003	-	-	0.000	N/A
			5.8	0.30	0.15	-0.003	-	-	0.000	N/A
			6.3	0.30	0.13	0.000	-	-	0.000	N/A
			6.8	0.20	0.12	-0.001	-	-	0.001	N/A
			7.3	0.28	0.11	0.005	-	-	0.000	N/A
			7.8	0.16	0.07	0.003	-	-	-0.001	N/A
			8.3	0.10	1.54	-0.007	-	-	0.000	N/A
			22.3	0.12	0.09	0.000	-	-	-0.002	N/A
			22.8	0.22	0.11	-0.002	-	-	0.000	N/A
			23.3	0.22	0.13	0.003	-	-	0.000	N/A
			23.8	0.30	0.14	-0.003	-	-	-0.001	N/A
			24.3	0.26	0.14	-0.005	-	-	0.000	N/A
			24.8	0.30	0.14	-0.001	-	-	0.000	N/A
25.3	0.24	0.11	0.001	-	-	0.000	N/A			
25.8	0.20	0.05	-0.004	-	-	-0.001	N/A			
26.3	0.00	0.00	-0.008	-	-	0.000	N/A			
26.8	0.00	0.00	0.000	-	-	0.000	N/A			
			37.8	0.00	0.00	Edge of Water (RDB)				
			<b>Total</b>		<b>3.98</b>				<b>0.01</b>	<b>-</b>

m = metre; m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; N/A = not available; m = metres per second; - = no data available.

Figure E3-10 Lake E12 Outlet Rating Curve



Note: Cross-sections and water levels were surveyed at Lake E12 outlet, but due to very low flow during the time of survey, no significant discharge measurement was possible. Therefore, the outlet rating curve was not developed based on survey data, but rather the regional lake outlet relationship.

m = metre; m<sup>3</sup>/s = cubic metres per second.

### E3.7 Lake E381 Outlet

Survey Date: 6-Sep-2013

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 534112 m E, 717770 m N

Outlet Coordinates (Geographic) : 64°43'22" N, 110°17'02" W



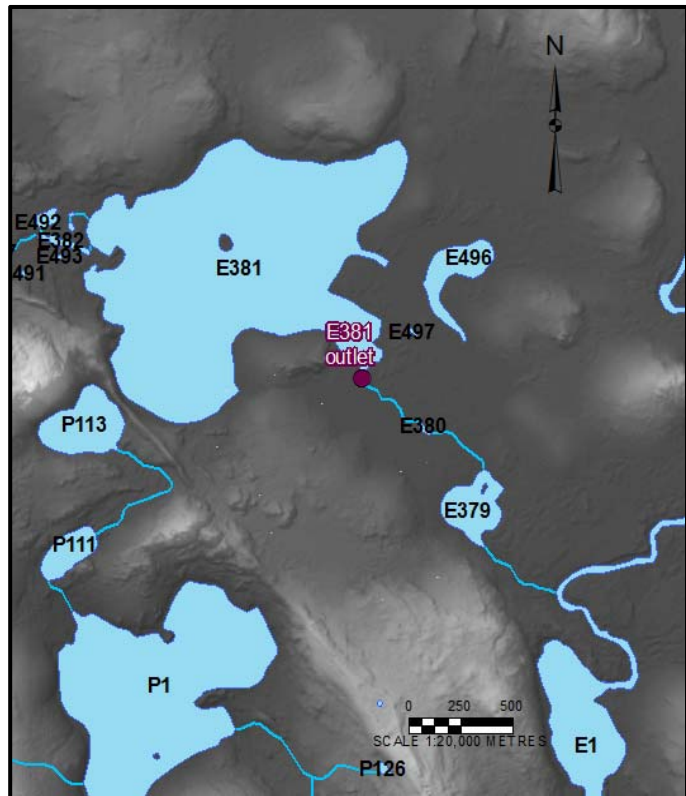
Left downstream bank view of Lake E381 outlet looking northeast



Lake E381 upstream view of Lake outlet



Lake E381 downstream view of downstream cross-section



NTS Mapping of Area

**Table E3-28 Summary of Coordinates at Lake E381 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Geodetic)	533998.38	7177806.90
Outlet	534112	7177770

**Table E3-29 2013 Hydrometric Data at Lake E381 and Outlet Station**

Date	Time (24-hour)	Benchmark Elevation (m)	Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
6-Sep-2013	13:30	420.17	419.31	0.24	0.05

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-30 Geomorphic Parameters at Lake E381 and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	125.7	ha	
Drainage Area (DEM) <sup>(a)</sup>	3504.6	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	419.50	m	
Surveyed Local Stream Slope	0.0013	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.00021	m/m	
Average Bankfull Width	12.8	m	
Channel Material	30% fine sand, 30% silt, 20% clay, 10% fine gravel, 10% coarse sand		
Bank Material	30% fine sand, 30% silt, 20% clay, 10% fine gravel, 10% coarse sand		
Vegetation	Grass		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

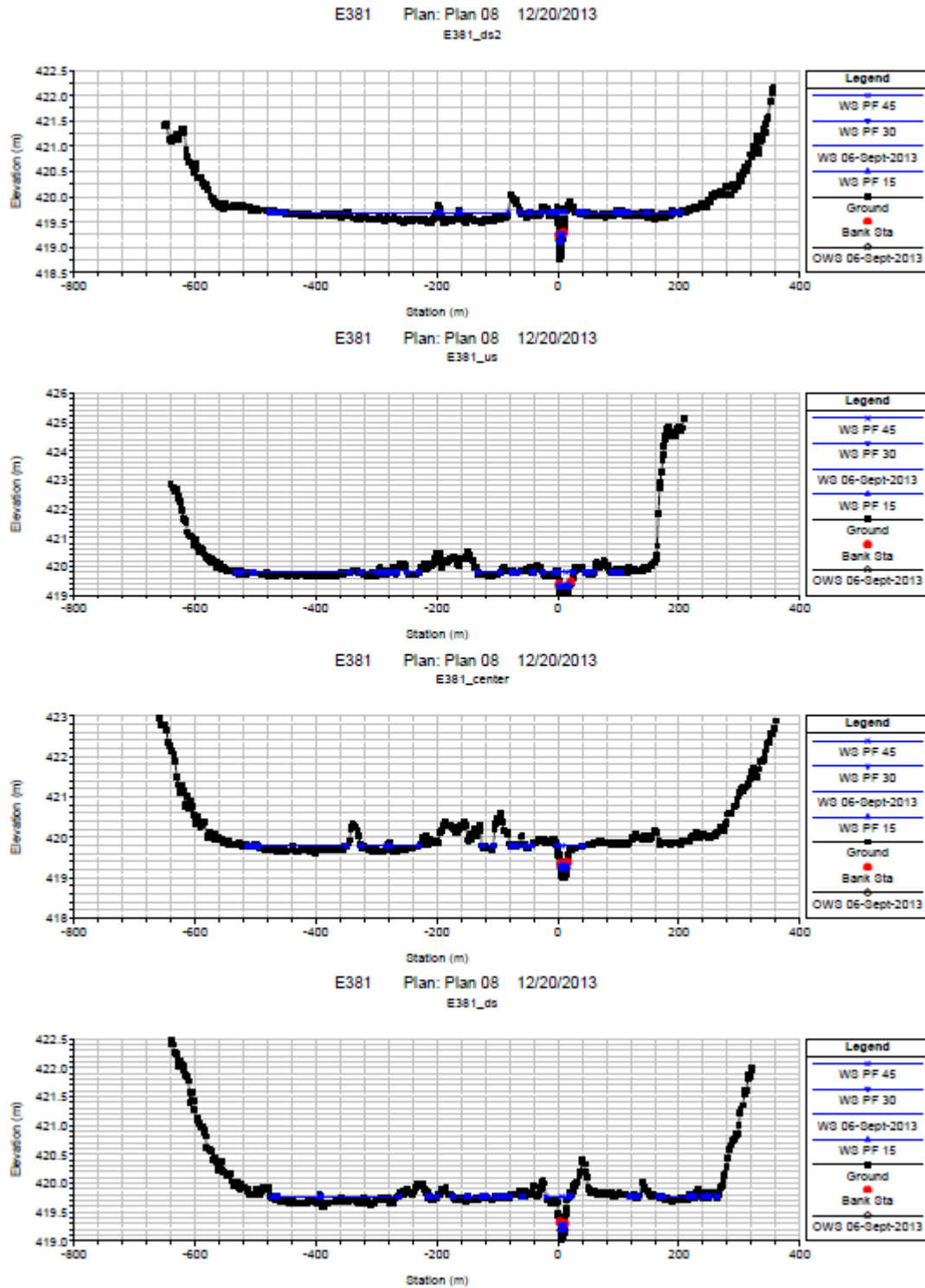
m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E3-31 Stream E381 Discharge Data**

Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	13:30		<b>Location</b>	5 m downstream of most downstream cross-section, approximately 315 m downstream of lake outlet			
<b>Lake Name</b>	Lake E381		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	Marsh-McBirney FLO-MATE Model 2000			
<b>Date Monitored</b>	6-Sep-2013		<b>Flow Meter Type</b>	Handheld electromagnetic sensor flowmeter		<b>Instrument Serial #</b>	2005872			
<b>Personnel</b>	DC, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	534175	7177685	0.6	0.00	0.01	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.24		0.7	0.08	0.02	0.000	-	-	0.000	0.00
<b>Discharge (m<sup>3</sup>/s)</b>	0.05		0.9	0.16	0.02	0.003	-	-	0.000	0.14
<b>Notes</b>			1.0	0.16	0.03	0.009	-	-	0.000	0.42
			1.2	0.20	0.04	0.009	-	-	0.000	0.53
			1.3	0.28	0.04	0.009	-	-	0.000	0.74
			1.5	0.28	0.04	0.030	-	-	0.001	2.45
			1.6	0.26	0.04	0.049	-	-	0.002	3.64
			1.8	0.26	0.04	0.095	-	-	0.004	7.06
			1.9	0.32	0.05	0.107	-	-	0.005	9.81
			2.1	0.32	0.05	0.171	-	-	0.008	15.70
			2.2	0.32	0.05	0.137	-	-	0.007	12.61
			2.4	0.35	0.05	0.125	-	-	0.007	12.57
			2.5	0.34	0.05	0.146	-	-	0.007	14.29
			2.7	0.32	0.05	0.104	-	-	0.005	9.53
			2.8	0.30	0.04	0.070	-	-	0.003	6.04
			3.0	0.28	0.04	0.034	-	-	0.001	2.70
			3.1	0.24	0.03	0.012	-	-	0.000	0.84
			3.3	0.18	0.03	0.009	-	-	0.000	0.47
			3.4	0.20	0.02	0.006	-	-	0.000	0.35
			3.6	0.12	0.01	0.003	-	-	0.000	0.11
			3.7	0.00	0.00	Edge of Water (RDB)				
			<b>Total</b>		<b>0.75</b>				<b>0.05</b>	<b>100</b>

m = metre; m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-11 Stream E381 Transects Used for Hydraulic Modelling

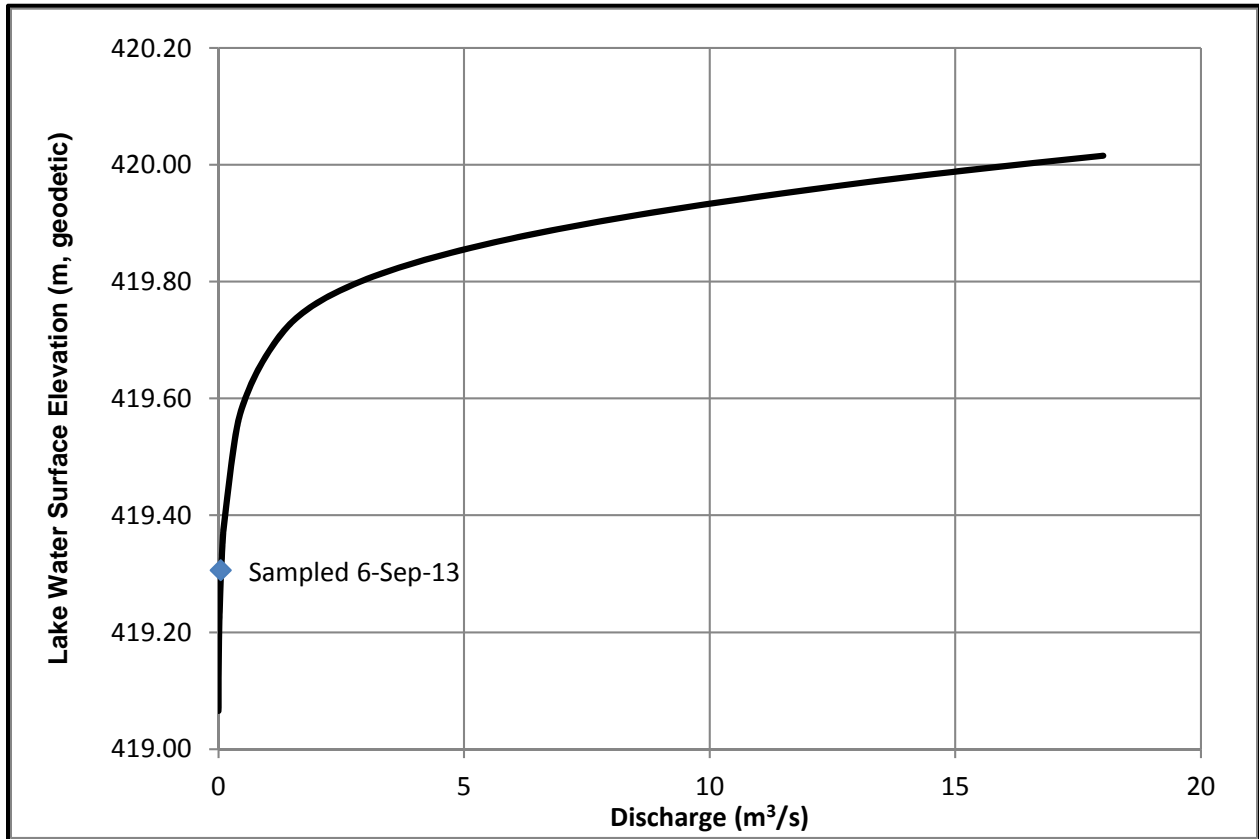


**Table E3-32 Stream E381 Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	(m)	
E381	4	6-Sep-13	0.05	419.06	419.302	419.304	52 (To Stn 3)	0.440	-	419.30	0.00062	0.02	2.9	15.5	Surveyed
E381	4	PF 15	0.04	419.06	419.285	-	52 (To Stn 3)	0.440	-	419.29	0.00060	0.02	2.6	15.4	
E381	4	PF 30	0.09	419.06	419.360	-	52 (To Stn 3)	0.400	-	419.36	0.00063	0.02	3.8	16.7	
E381	4	PF 45	2.89	419.06	419.799	-	52 (To Stn 3)	0.040	-	419.80	0.00016	0.07	40.0	368.9	
E381	3	6-Sep-13	0.05	418.99	419.241	419.241	53 (To Stn 2)	0.440	-	419.24	0.00177	0.03	1.7	8.6	Surveyed
E381	3	PF 15	0.04	418.99	419.227	-	53 (To Stn 2)	0.440	-	419.23	0.00161	0.03	1.5	8.5	
E381	3	PF 30	0.09	418.99	419.304	-	53 (To Stn 2)	0.397	-	419.30	0.00179	0.04	2.2	9.7	
E381	3	PF 45	2.89	418.99	419.787	-	53 (To Stn 2)	0.043	-	419.79	0.00027	0.09	34.2	325.5	
E381	2	6-Sep-13	0.05	419.02	419.194	419.184	189 (To Stn 1)	0.135	-	419.19	0.00249	0.08	0.6	6.0	Surveyed
E381	2	PF 15	0.04	419.02	419.181	-	189 (To Stn 1)	0.140	-	419.18	0.00292	0.08	0.6	5.9	
E381	2	PF 30	0.09	419.02	419.281	-	189 (To Stn 1)	0.107	-	419.28	0.00069	0.07	1.2	7.3	
E381	2	PF 45	2.89	419.02	419.764	-	189 (To Stn 1)	0.042	-	419.77	0.00050	0.09	30.9	423.8	
E381	1	6-Sep-13	0.05	418.77	419.135	419.140	-	0.098	418.85	419.14	0.00023	0.06	0.9	3.9	Surveyed
E381	1	PF 15	0.04	418.77	419.110	-	-	0.098	418.85	419.11	0.00023	0.06	0.8	3.8	
E381	1	PF 30	0.09	418.77	419.260	-	-	0.098	418.87	419.26	0.00023	0.06	1.6	7.6	
E381	1	PF 45	2.89	418.77	419.691	-	-	0.059	419.29	419.69	0.00023	0.05	54.3	577.7	

Notes: Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.  
 All other profiles are used to represent a possible range of discharges to estimate a lake outlet rating curve (100 flow profiles computed in total, only select profiles shown).  
 River station values decrease in the downstream direction.  
 Manning's n varies vertically for this reach according to the large-scale roughness resistance equation developed by Bathurst (1978 and 2002).  
 Additional interpolated cross-sections were used for hydraulic modelling, but are not included in the summary tables.  
 m = metre; m<sup>3</sup>/s = cubic metres per second; m/m = metres per metre; m<sup>2</sup> = square metre; m/s = metres per second; - = no data available.

Figure E3-12 Lake E381 Outlet Rating Curve



m = metre; m³/s = cubic metres per second.

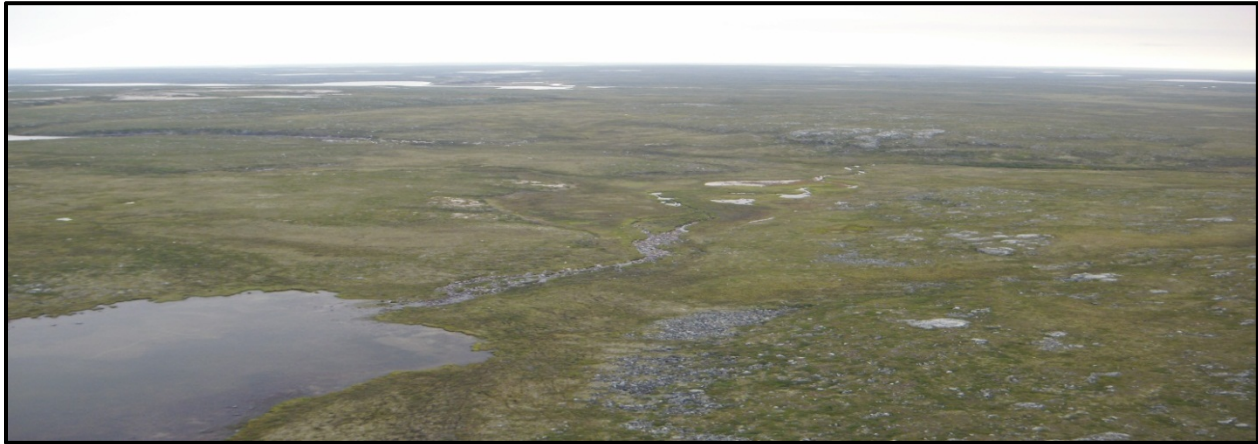
### E3.8 Lake E387 Outlet

Survey Date: 7-Sep-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 531867 m E, 7180238 m N

Outlet Coordinates (Geographic) : 64°44'43" N, 110°19'50" W



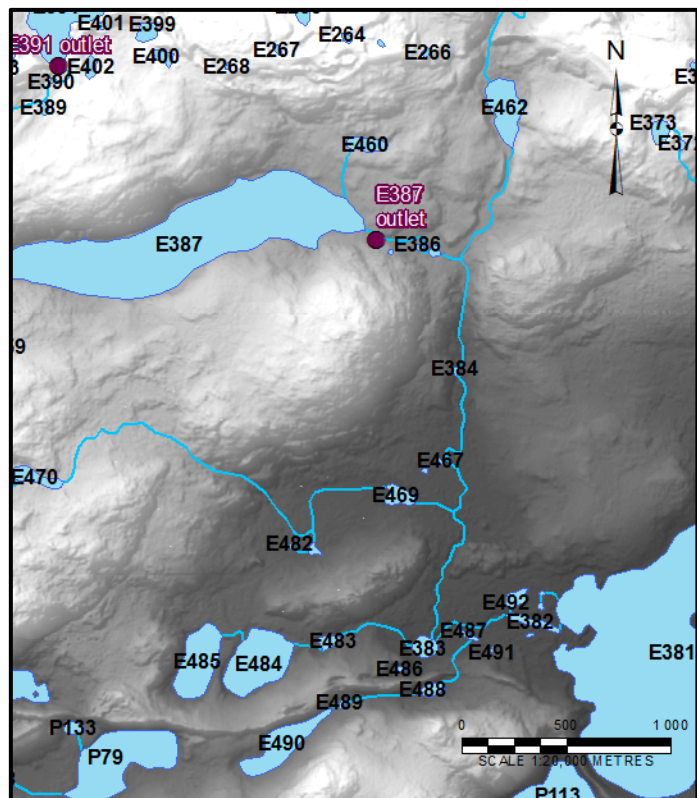
Downstream view of Lake E387 outlet looking northeast



Lake E387 upstream view of downstream cross-section



Lake E387 upstream view of Lake outlet



NTS Mapping of Area

**Table E3-33 Summary of Coordinates at Lake E387 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Geodetic)	531929.95	7180205.64
Outlet	531867	7180238

**Table E3-34 2013 Hydrometric Data at Lake E387 and Outlet Station**

Date	Time (24-hour)	Benchmark Elevation (m)	Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
7-Sep-13	13:30	443.64	443.50	0.43	0.03

m<sup>3</sup>/s = cubic metres per second; m = metre.

**Table E3-35 Geomorphic Parameters at Lake E387 and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	48.9	ha	
Drainage Area (DEM) <sup>(a)</sup>	1878.3	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	443.60	m	
Surveyed Local Stream Slope	0.012	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.017	m/m	
Average Bankfull Width	6.4	m	
Channel Material	50% boulder, 20% cobble, 20% silt, 10% fine sand		
Bank Material	30% boulder, 20% cobble, 20% silt, 10% fine gravel, 10% coarse sand, 10% fine sand		
Vegetation	Low shrub tundra		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E3-36 Stream E387 Discharge Data**

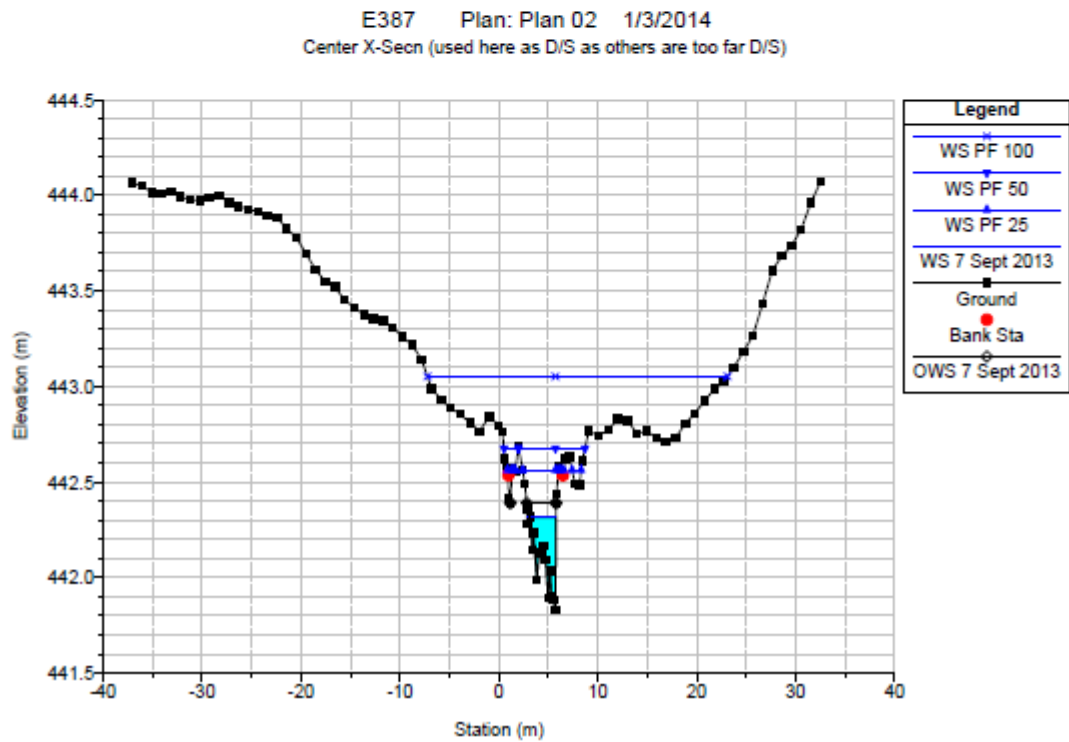
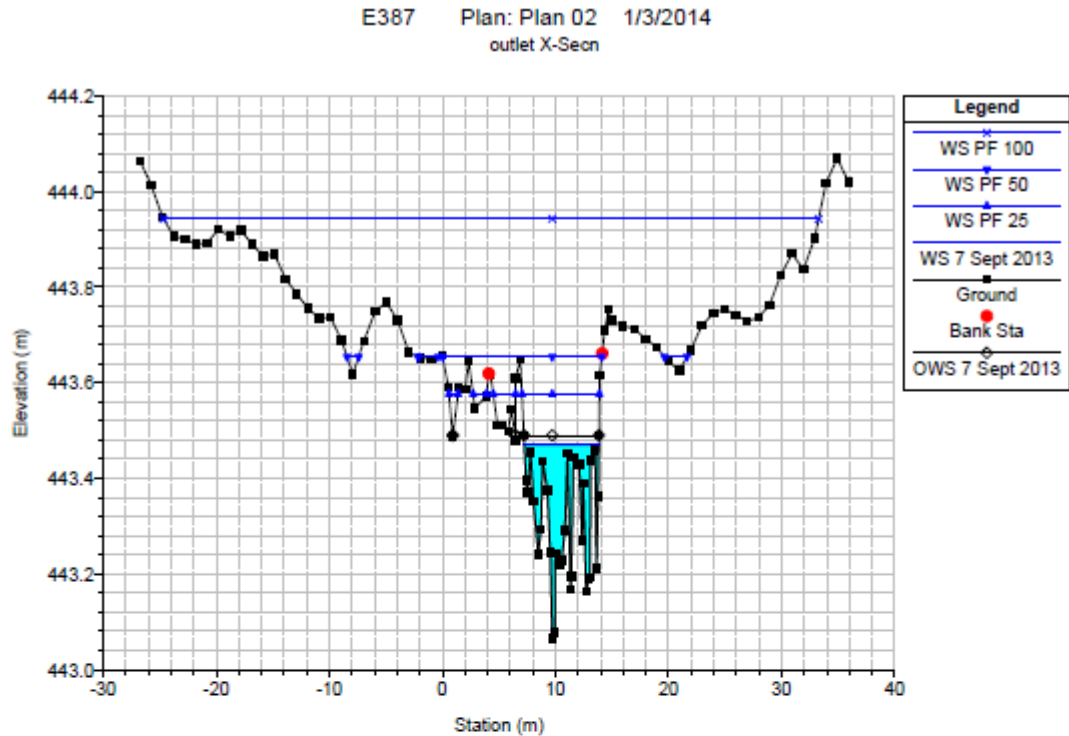
Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	13:30		<b>Location</b>	Approximately 450 m downstream of lake outlet			
<b>Lake Name</b>	Lake E387		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	Marsh-McBirney FLO-MATE Model 2000			
<b>Date Monitored</b>	7-Sep-13		<b>Flow Meter Type</b>	Handheld electromagnetic sensor flowmeter		<b>Instrument Serial #</b>	2005872			
<b>Personnel</b>	DC, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	532276	7180085	0.3	0.00	0.000	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.43		1.1	0.00	0.033	0.00	-	-	0.000	0.00
<b>Discharge (m<sup>3</sup>/s)</b>	0.03		1.3	0.44	0.063	0.00	-	-	0.000	0.00
<b>Notes</b>			1.4	0.40	0.057	0.00	-	-	0.001	3.52
			1.6	0.36	0.054	0.02	-	-	0.001	3.17
			1.7	0.36	0.060	0.02	-	-	0.002	6.33
			1.9	0.44	0.065	0.04	-	-	0.003	7.74
			2.0	0.42	0.063	0.04	-	-	0.003	7.39
			2.2	0.42	0.062	0.04	-	-	0.003	7.39
			2.3	0.40	0.060	0.04	-	-	0.004	12.31
			2.5	0.40	0.060	0.07	-	-	0.001	1.76
			2.6	0.40	0.057	0.01	-	-	0.001	1.76
			2.8	0.36	0.056	0.01	-	-	0.001	1.58
			2.9	0.38	0.059	0.01	-	-	0.003	10.03
			3.1	0.40	0.062	0.06	-	-	0.004	10.55
			3.2	0.42	0.060	0.06	-	-	0.003	9.23
			3.4	0.38	0.063	0.05	-	-	0.003	8.36
			3.5	0.46	0.065	0.05	-	-	0.001	2.02
			3.7	0.40	0.060	0.01	-	-	0.001	1.76
			3.8	0.40	0.060	0.01	-	-	0.001	1.76
			4.0	0.40	0.057	0.01	-	-	0.001	1.76
			4.1	0.36	0.059	0.01	-	-	0.001	1.58
			4.3	0.42	0.063	0.01	-	-	0.000	0.00

**Table E3-36 Stream E387 Discharge Data**

Site Information		Discharge Measurement						
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)	Qi	% of Total Q	Station	Depth
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m)	(m)
	4.4	0.42	0.063	0.00	-	-	0.000	0.00
	4.6	0.42	0.059	0.00	-	-	0.000	0.00
	4.7	0.36	0.036	0.00	-	-	0.000	0.00
	4.9	0.00	0.000	Edge of Water (RDB)				
	<b>Total</b>		<b>1.45</b>				<b>0.03</b>	<b>100</b>

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-13 Stream E387 Transects Used for Hydraulic Modelling



**Table E3-37 Stream E387 Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	(m)	
E387	2	7-Sep-13	0.05	419.06	419.302	419.304	52 (To Stn 3)	0.440		419.30	0.00062	0.02	2.9	15.5	Surveyed
E387	2	PF 25	0.04	419.06	419.285		52 (To Stn 3)	0.440		419.29	0.00060	0.02	2.6	15.4	
E387	2	PF 50	0.09	419.06	419.360		52 (To Stn 3)	0.400		419.36	0.00063	0.02	3.8	16.7	
E387	2	PF 100	2.89	419.06	419.799		52 (To Stn 3)	0.040		419.80	0.00016	0.07	40.0	368.9	
E387	1	7-Sep-13	0.05	418.99	419.241	419.241	53 (To Stn 2)	0.440		419.24	0.00177	0.03	1.7	8.6	Surveyed
E387	1	PF 25	0.04	418.99	419.227		53 (To Stn 2)	0.440		419.23	0.00161	0.03	1.5	8.5	
E387	1	PF 50	0.09	418.99	419.304		53 (To Stn 2)	0.397		419.30	0.00179	0.04	2.2	9.7	
E387	1	PF 100	2.89	418.99	419.787		53 (To Stn 2)	0.043		419.79	0.00027	0.09	34.2	325.5	

Notes:

Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.

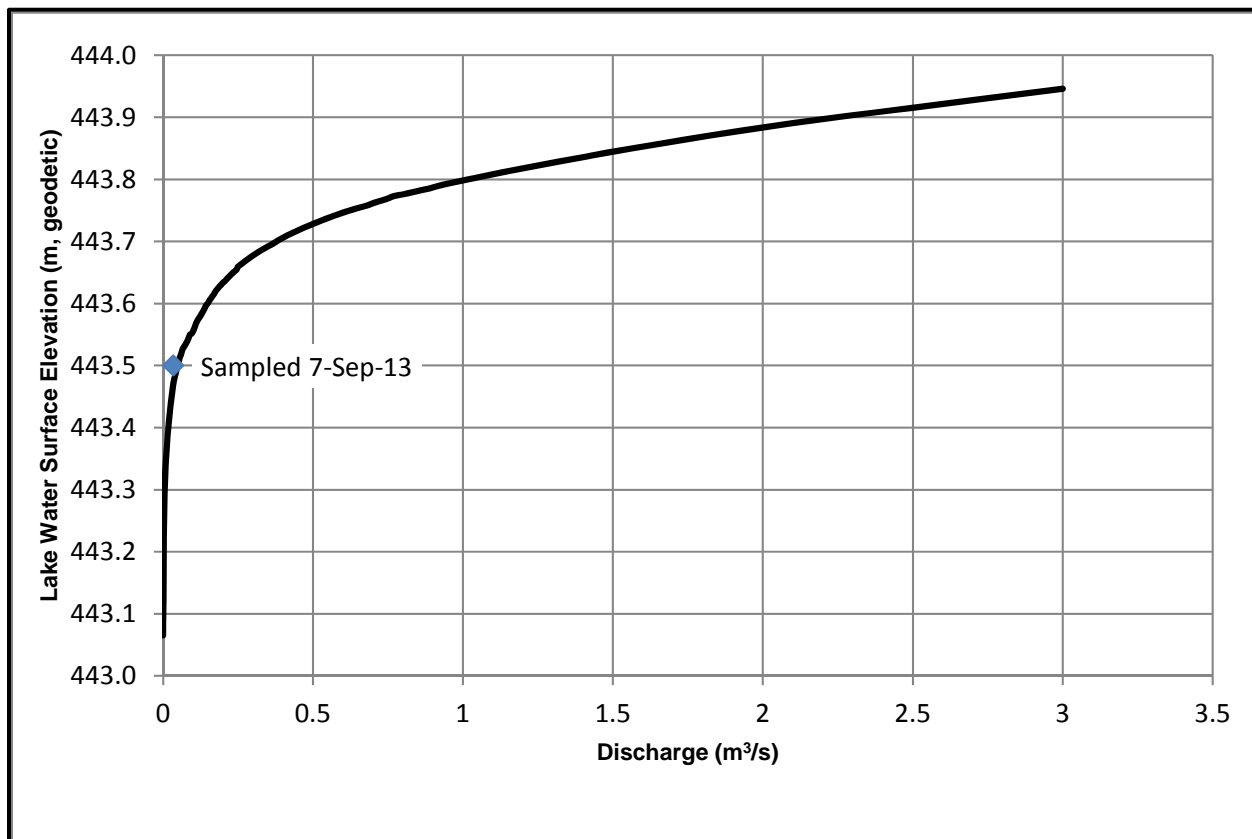
All other profiles are used to represent a possible range of discharges to estimate a lake outlet rating curve (100 flow profiles computed in total, only select profiles shown).

River station values decrease in the downstream direction.

Manning's n varies vertically for this reach according to the large-scale roughness resistance equation developed by Bathurst (1978 and 2002).

Additional interpolated cross-sections were used for hydraulic modelling, but are not included in the summary tables.

m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre.

**Figure E3-14 Lake E387 Outlet Rating Curve**

m = metre; m<sup>3</sup>/s = cubic metres per second.

## E3.9 Lake E391 Outlet

Survey Date: 5-Sep-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 530396 m E, 7181044 m N

Outlet Coordinates (Geographic): 64°45'09" N, 110°21'40" W



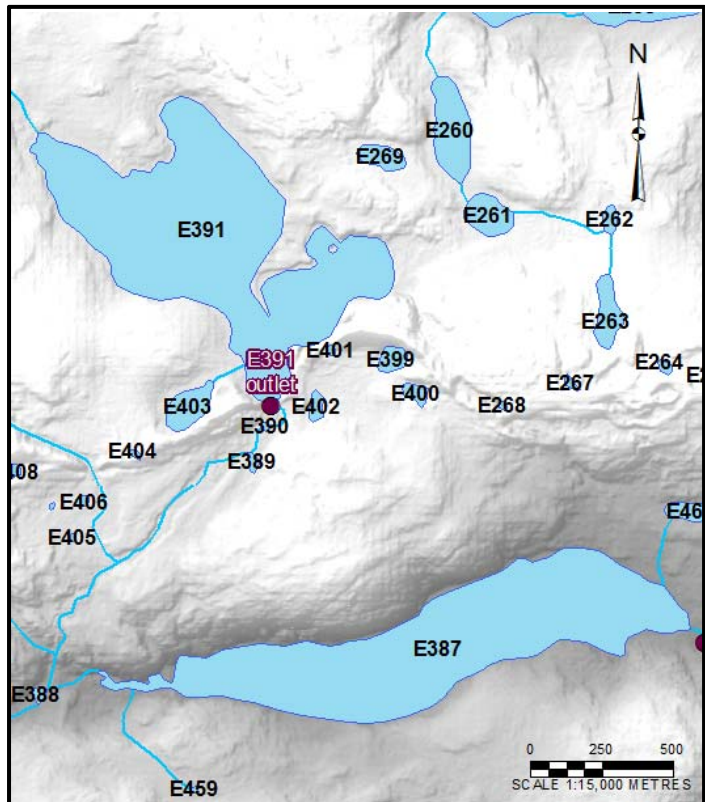
Downstream view of Lake E391 outlet looking southwest (Lake E391 at bottom)



Upstream view of Lake 391 outlet



Downstream view of Lake E391 outlet



NTS Mapping of Area

**Table E3-38 Summary of Coordinates at Lake E391 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Non-geodetic)	530382.87	7181016.24
Outlet	530396	7181044

**Table E3-39 2013 Hydrometric Data at Lake E391 and Outlet Station**

Date	Time (24 hour)	Non-geodetic Benchmark Elevation <sup>(a)</sup> (m)	Non-geodetic Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
5-Sep-13	16:45	469.20	467.10	0.05	0.02

a) Elevation of the Benchmark set to 469.20 m to match lake elevations with LiDAR Water Surface Elevation of Lake E391.  
m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-40 Geomorphic Parameters at Lake E391 and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	54.2	ha	
Drainage Area (DEM) <sup>(a)</sup>	472.8	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	467.10	m	
Surveyed Local Stream Slope	0.025	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.0095	m/m	
Average Bankfull Width	3.5	m	
Channel Material	20% boulder, 15% fine gravel, 15% coarse sand, 15% fine sand, 15% silt, 10% cobble, 10% medium gravel		
Bank Material	30% coarse sand, 20% boulder, 15% fine gravel, 15% fine sand, 10% medium gravel, 10% silt		
Vegetation	High shrub tundra		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

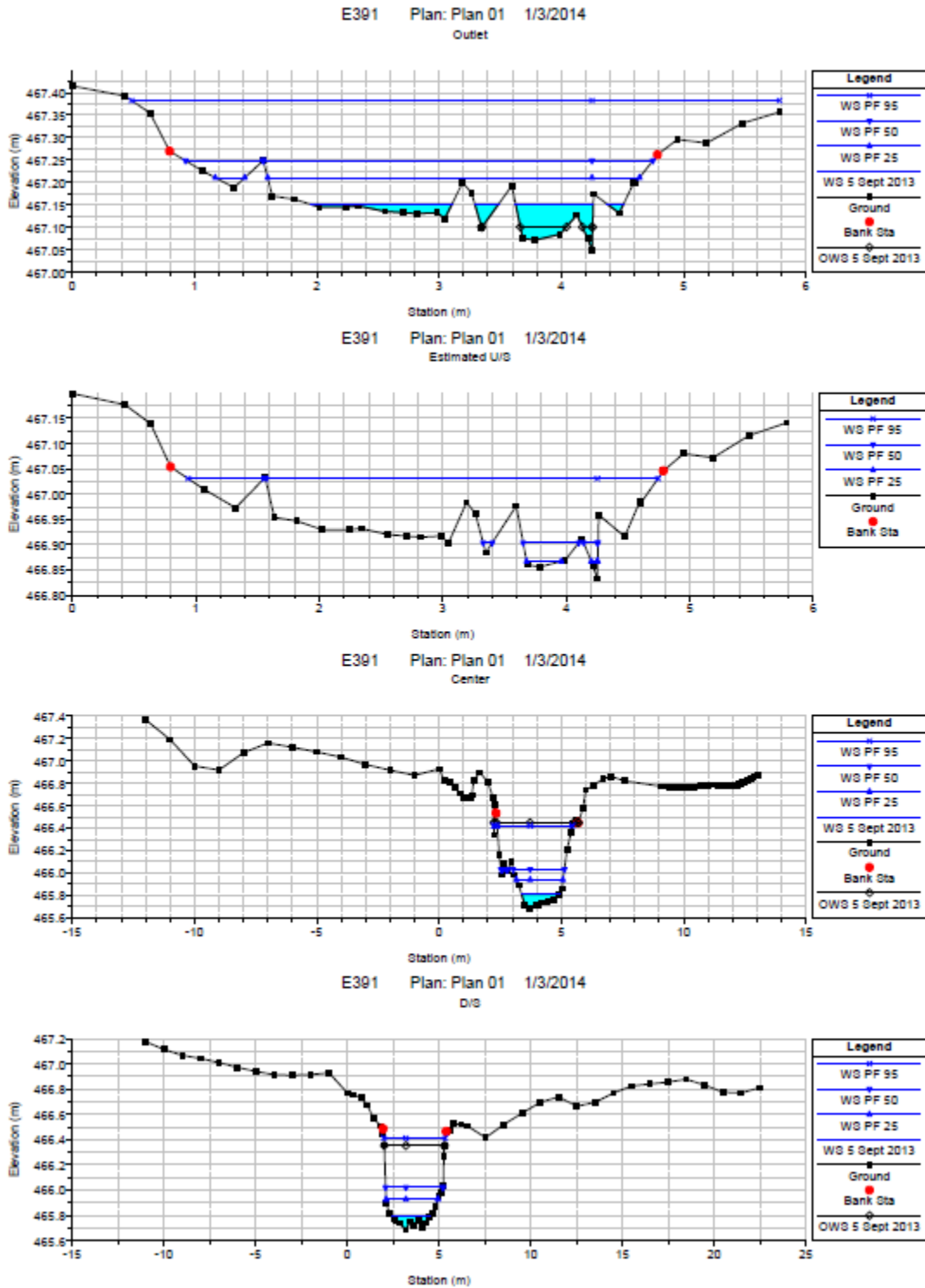
m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E3-41 Stream E391 Discharge Data**

Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	16:45		<b>Location</b>	Center cross-section, approximately 500 m downstream of lake outlet			
<b>Lake Name</b>	Lake E391		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	Marsh-McBirney FLO-MATE Model 2000			
<b>Date Monitored</b>	5-Sep-13		<b>Flow Meter Type</b>	Handheld electromagnetic sensor flowmeter		<b>Instrument Serial #</b>	2005872			
<b>Personnel</b>	DC, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	530409	7181019	0.05	0.00	0.011	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.05		0.15	0.22	0.038	0.012	-	-	0.0003	1.92
<b>Discharge (m<sup>3</sup>/s)</b>	0.02		0.30	0.28	0.041	0.006	-	-	0.0003	1.47
<b>Notes</b>			0.45	0.26	0.045	0.009	-	-	0.0004	2.04
			0.60	0.34	0.056	0.012	-	-	0.0006	3.57
			0.75	0.40	0.069	0.012	-	-	0.0007	4.19
			0.90	0.52	0.078	0.009	-	-	0.0007	4.09
			1.05	0.52	0.077	0.009	-	-	0.0007	4.09
			1.20	0.50	0.087	0.012	-	-	0.0009	5.24
			1.35	0.66	0.097	0.012	-	-	0.0012	6.92
			1.50	0.64	0.096	0.015	-	-	0.0015	8.39
			1.65	0.64	0.098	0.012	-	-	0.0012	6.71
			1.80	0.66	0.096	0.012	-	-	0.0012	6.92
			1.95	0.62	0.092	0.012	-	-	0.0011	6.50
			2.10	0.60	0.088	0.015	-	-	0.0014	7.86
			2.25	0.58	0.087	0.012	-	-	0.0011	6.08
			2.40	0.58	0.081	0.012	-	-	0.0011	6.08
			2.55	0.50	0.075	0.009	-	-	0.0007	3.93
			2.70	0.50	0.125	0.012	-	-	0.0012	6.99
			2.95	0.50	0.038	0.012	-	-	0.0012	6.99
			3.10	0.00	0.000	Edge of Water (RDB)				
			<b>Total</b>		<b>1.47</b>				<b>0.02</b>	<b>100</b>

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-15 Stream E391 Transects Used for Hydraulic Modelling

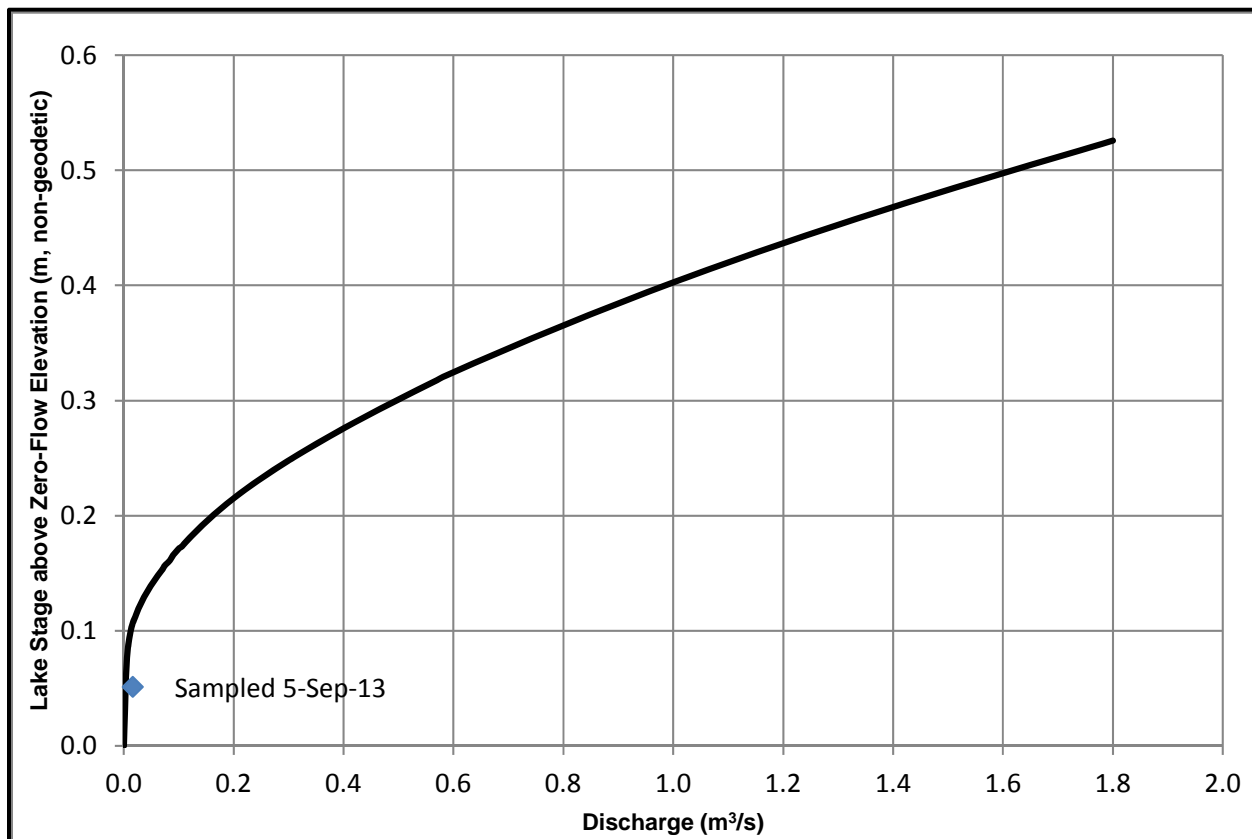


**Table E3-42 Stream E391 Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	(m)	
E391	5	5-Sep-13	0.02	467.05	467.152	467.101	18 (To Stn 4)	0.040	-	467.16	0.01691	0.29	0.1	2.1	Estimated
E391	5	PF 25	0.12	467.05	467.211	-	18 (To Stn 4)	0.040	-	467.23	0.01847	0.53	0.2	3.3	
E391	5	PF 50	0.25	467.05	467.249	-	18 (To Stn 4)	0.040	-	467.27	0.01963	0.68	0.4	3.8	
E391	5	PF 95	1.10	467.05	467.383	-	18 (To Stn 4)	0.038	-	467.46	0.01933	1.13	1.0	5.3	
E391	4	5-Sep-13	0.02	466.70	466.807	-	40 (To Stn 3)	0.040	-	466.81	0.01531	0.28	0.1	2.1	Surveyed
E391	4	PF 25	0.12	466.70	466.867	-	40 (To Stn 3)	0.040	-	466.88	0.01702	0.52	0.2	3.3	
E391	4	PF 50	0.25	466.70	466.904	-	40 (To Stn 3)	0.040	-	466.93	0.01899	0.68	0.4	3.8	
E391	4	PF 95	1.10	466.70	467.031	-	40 (To Stn 3)	0.038	467.01	467.11	0.02115	1.16	1.0	5.3	
E391	3	5-Sep-13	0.02	465.69	465.811	466.448	6.7	0.045	-	465.81	0.00157	0.15	0.1	1.6	Surveyed
E391	3	PF 25	0.12	465.69	465.940	-	6.7	0.045	-	465.95	0.00276	0.35	0.3	1.9	
E391	3	PF 50	0.25	465.69	466.034	-	6.7	0.045	-	466.05	0.00343	0.46	0.5	2.2	
E391	3	PF 95	1.10	465.69	466.420	-	6.7	0.044	-	466.44	0.00303	0.68	1.6	3.1	
E391	2	5-Sep-13	0.02	465.69	465.800	466.353	-	0.045	465.75	465.80	0.00164	0.14	0.1	2.1	Surveyed
E391	2	PF 25	0.12	465.69	465.928	-	-	0.045	465.81	465.93	0.00164	0.26	0.5	2.8	
E391	2	PF 50	0.25	465.69	466.022	-	-	0.045	465.85	466.03	0.00164	0.33	0.7	3.1	
E391	2	PF 95	1.10	465.69	466.411	-	-	0.045	466.02	466.43	0.00164	0.55	2.0	3.3	

Notes: Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.  
 All other profiles are used to represent a possible range of discharges to estimate a lake outlet rating curve (100 flow profiles computed in total, only select profiles shown).  
 River station values decrease in the downstream direction.  
 Additional interpolated cross-sections were used for hydraulic modelling, but are not included in the summary tables.  
 Outlet cross-section is estimated from field photos and notes. No survey was completed at the outlet due to time and weather constraints.  
 m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre; - = no data available.

Figure E3-16 Lake E391 Outlet Rating Curve



m = metre; m<sup>3</sup>/s = cubic metres per second.

### E3.10 Lake E409 Outlet

Survey Date: 5-Sep-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 528979 m E, 7181040 m N

Outlet Coordinates (Geographic) : 64°45'09" N, 110°23'27" W



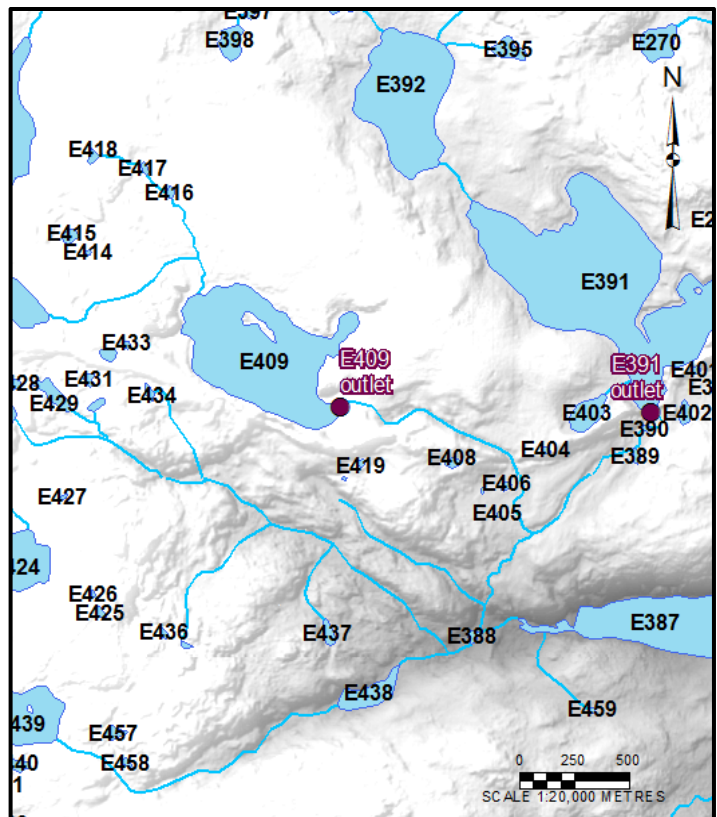
Upstream view of Lake E409 outlet



Lake E409 upstream view of upstream cross-section



Lake E409 downstream view of E409 cross-section



NTS Mapping of Area

**Table E3-43 Summary of Coordinates at Lake E409 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (non-geodetic)	529288.88	7181036.96
Outlet	528979	7181040

**Table E3-44 2013 Hydrometric Data at Lake E409 and Outlet Station**

Date	Time (24-hour)	Non-geodetic Benchmark Elevation <sup>(a)</sup> (m)	Non-geodetic Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
5-Sep-13	15:00	473.68	479.59	0.26	0.003

a) Elevation of the Benchmark set to 473.68 m to match lake elevations with LiDAR Water Surface Elevation of Lake E409.  
m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-45 Geomorphic Parameters at Lake E409 and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	29.4	ha	
Drainage Area (DEM) <sup>(a)</sup>	447.3	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	479.60	m	
Surveyed Local Stream Slope	0.0073	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.013	m/m	
Average Bankfull Width	1.8	m	
Channel Material	30% coarse sand, 20% fine sand, 15% medium gravel, 10% cobble, 10% coarse gravel, 10% fine gravel, 5% silt		
Bank Material	30% fine sand, 20% coarse sand, 10% fine gravel, 10% coarse gravel, 10% medium gravel, 10% silt, 10% cobble		
Vegetation	Grass and low shrub tundra		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

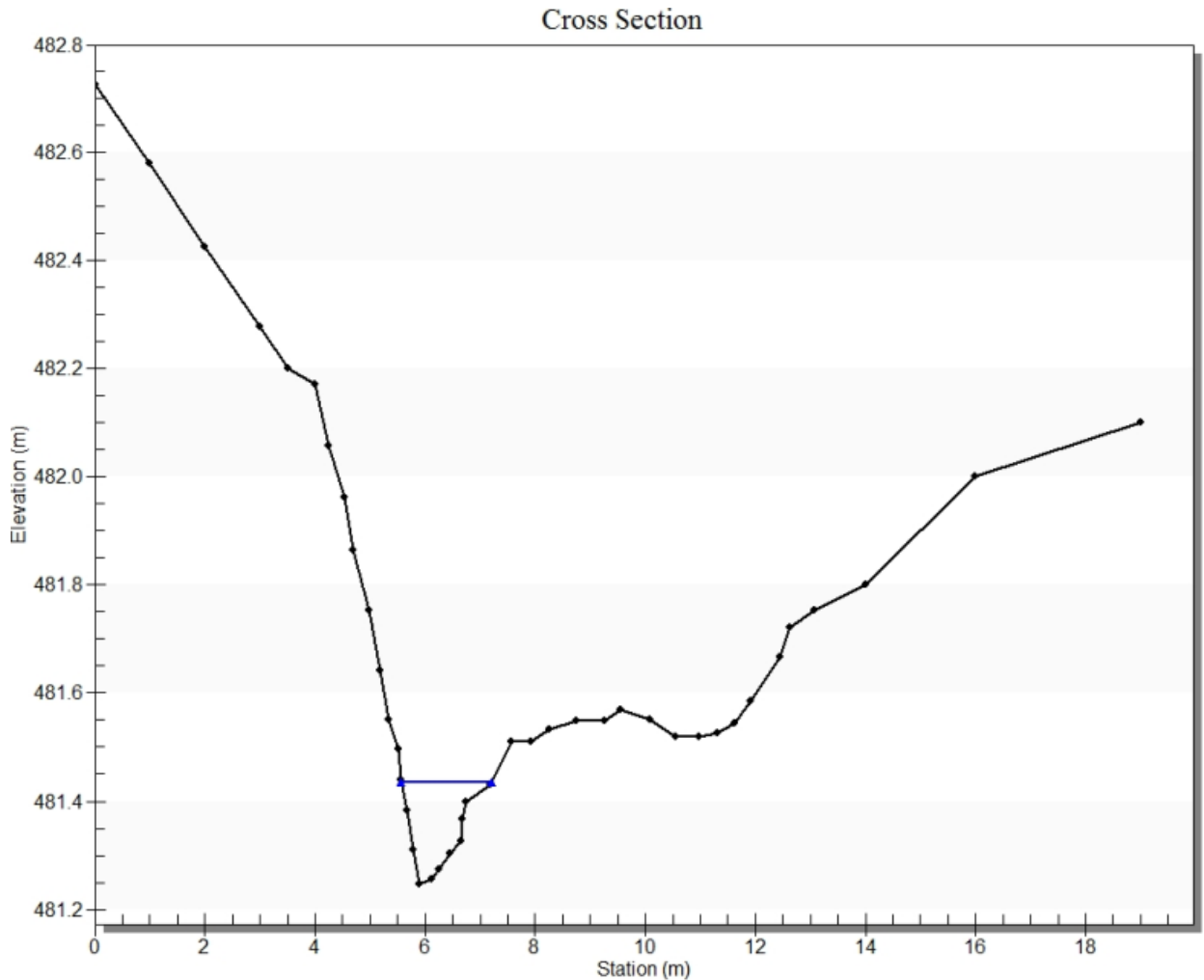
m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E3-46 Lake E409 Discharge Data**

Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	15:00		<b>Location</b>	Approximately 250 m downstream of Lake outlet			
<b>Lake Name</b>	Lake E409		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	Marsh-McBirney FLO-MATE Model 2000			
<b>Date Monitored</b>	5-Sep-13		<b>Flow Meter Type</b>	Handheld electromagnetic sensor flowmeter		<b>Instrument Serial #</b>	2005872			
<b>Personnel</b>	DC, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	529263	7181002	0.00	0.00	0.004	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.26		0.10	0.07	0.008	0.021	-	-	0.0001	5.95
<b>Discharge (m<sup>3</sup>/s)</b>	0.003		0.20	0.08	0.009	0.024	-	-	0.0002	7.77
<b>Notes</b>			0.30	0.11	0.012	0.034	-	-	0.0004	14.68
			0.40	0.12	0.012	0.024	-	-	0.0003	11.65
			0.50	0.12	0.012	0.024	-	-	0.0003	11.65
			0.60	0.12	0.011	0.024	-	-	0.0003	11.65
			0.70	0.10	0.011	0.027	-	-	0.0003	10.92
			0.80	0.12	0.011	0.015	-	-	0.0002	7.28
			0.90	0.10	0.013	0.006	-	-	0.0001	2.43
			1.00	0.15	0.010	0.021	-	-	0.0003	12.74
			1.10	0.05	0.007	0.000	-	-	0.0000	0.00
			1.20	0.09	0.006	0.009	-	-	0.0001	3.28
			1.30	0.04	0.002	0.000	-	-	0.0000	0.00
			1.40	0.00	0.000	Edge of Water (RDB)				
			<b>Total</b>		<b>0.13</b>				<b>0.003</b>	<b>100</b>

m = metre; m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

**Figure E3-17 Stream E409 Transects Used for Hydraulic Modelling**



Note: Discharge measured at the time of survey (5-Sep-13) with associated observed water surface elevations are used for calibration and shown above.

m = metre.

**Table E3-47 Stream E409 Hydraulic Modelling Output**

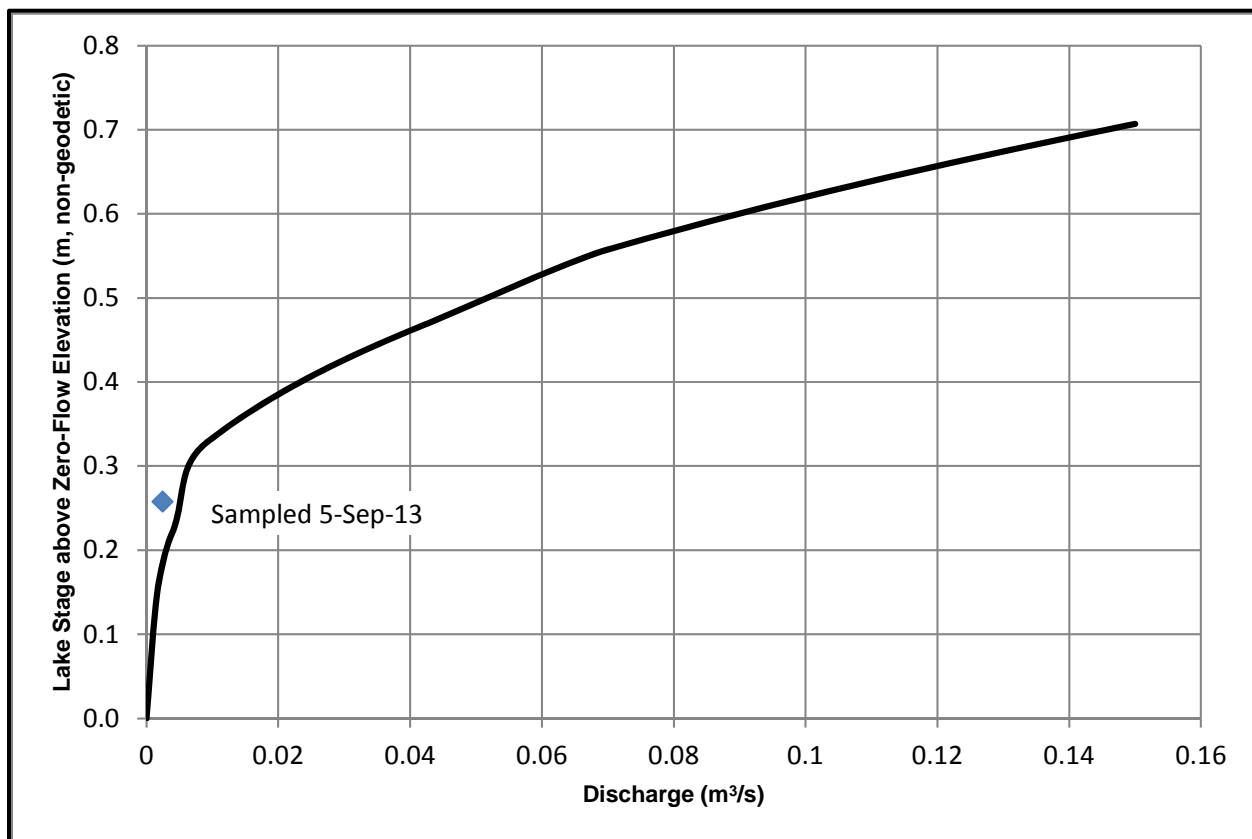
Attribute	Value	Unit
Calibration Discharge	0.003	m <sup>3</sup> /s
Maximum Depth	0.19	m
Area of Flow	0.2	m <sup>2</sup>
Wetted Perimeter	1.73	m
Hydraulic Radius	0.09	m
Average Velocity	0.02	m/s
Top Width	1.6	m
Froude Number	0.016	
Critical Depth	0.03	m
Critical Velocity	0.40	m/s
Critical Slope	0.196	m/m
Critical Top Width	0.4	m
Calculated Max Shear Stress	0.05	N/m <sup>2</sup>
Calculated Avg Shear Stress	0.03	N/m <sup>2</sup>
Composite Manning's n Equation	Lotter method	
Manning's Roughness	0.07	

Notes:

Discharge measured at the time of surveys with associated observed water surface elevations are used for calibration and shown above.

One cross-section was modelled at the outlet using the Manning's open channel flow equation.

m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre; N/m<sup>2</sup> = Newtons per square metre.

**Figure E3-18 Lake E409 Outlet Rating Curve**

m = metre; m<sup>3</sup>/s = cubic metres per second.

### E3.11 Lake F1 Outlet

Survey Date: 18-Aug-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 541076 m E, 7176302 m N

Outlet Coordinates (Geographic) : 64°42'32" N, 110°08'17" W



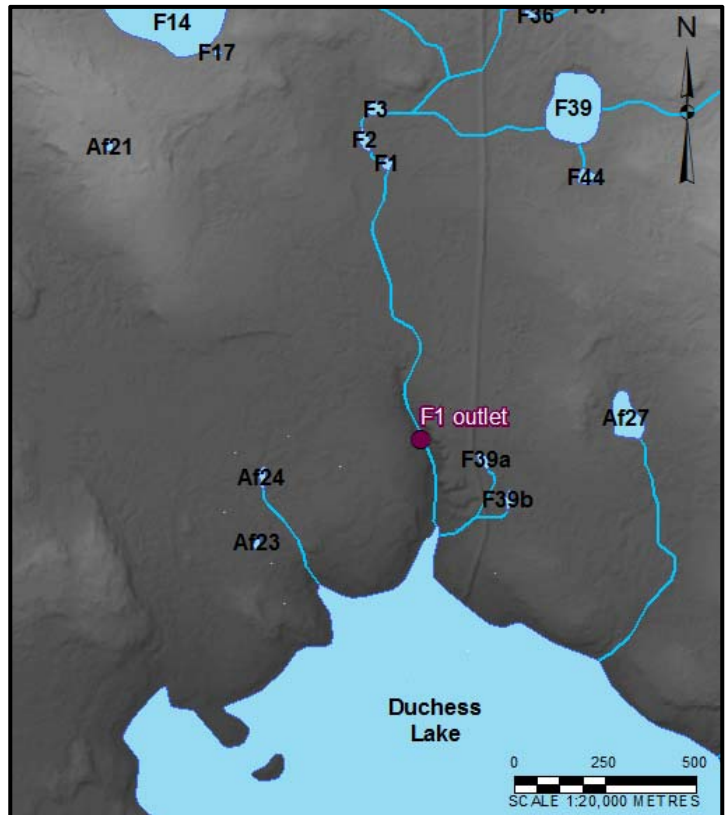
Left downstream view of Lake F1 outlet looking southeast



Stream F1 upstream view of centre cross-section



Stream F1 downstream view of downstream cross-section



NTS Mapping of Area

**Table E3-48 Summary of Coordinates at Lake F1 and Outlet Channel**

Location	Coordinates	
	Easting	Northing
Benchmark (Geodetic)	541042.31	7176546.77
Outlet	541076	7176302

**Table E3-49 2013 Hydrometric Data at Lake F1 and Outlet Channel**

Date	Time (24-hour)	Benchmark Elevation (m)	Lake Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
18-Aug-13	8:15	418.12	Not Surveyed	Not surveyed	0.005

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-50 Geomorphic Parameters at Lake F1 and Outlet Channel**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	0.1 (Estimate)	ha	Very small, poorly-defined lake
Drainage Area (DEM) <sup>(a)</sup>	0.2 (Estimate)	ha	Very small, poorly-defined lake
Upstream Lake Elevation (DEM) <sup>(a)</sup>	Indeterminable	m	Very small, poorly-defined lake
Surveyed Local Stream Slope	0.015	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	Indeterminable	m/m	Very small, poorly-defined lake
Average Bankfull Width	1.7	m	
Channel Material	25% cobble, 20% silt, 20% coarse gravel, 10% boulder, 10% medium gravel, 10% fine gravel, 5% coarse sand		
Bank Material	55% silt, 20% clay, 10% boulder, 10% fine gravel, 5% cobble		
Vegetation	Grass and low shrub tundra		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

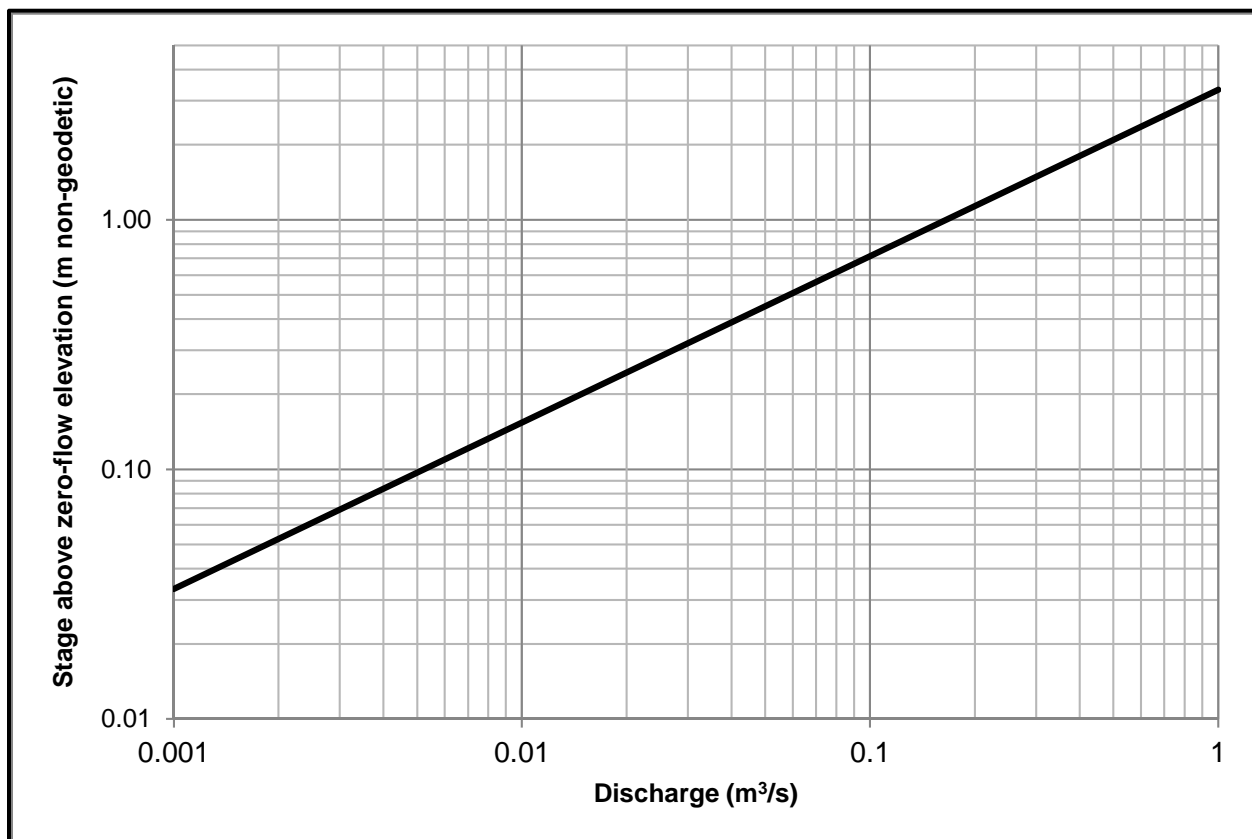
m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E3-51 Stream F1 Discharge Data**

Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	8:15		<b>Location</b>		Centre cross-section, approximately 250 m downstream of Lake F1 and Lake F2		
<b>Lake Name</b>	Lake F1 (Survey completed in stream downstream of Lakes F1 and F2)		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>		Marsh-McBirney FLO-MATE Model 2000		
<b>Date Monitored</b>	18-Aug-13		<b>Flow Meter Type</b>	Handheld electromagnetic sensor flowmeter		<b>Instrument Serial #</b>		2005872		
<b>Personnel</b>	MA, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	541033	7176549	0.00	0.00	0.003	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	Not measured, poorly defined lake and outlet		0.10	0.05	0.009	0.020	-	-	0.0001	2.17
<b>Discharge (m<sup>3</sup>/s)</b>	0.005		0.20	0.13	0.014	0.010	-	-	0.0001	2.83
<b>Notes</b>			0.30	0.14	0.014	0.020	-	-	0.0003	6.09
			0.40	0.13	0.015	0.030	-	-	0.0004	8.48
			0.50	0.16	0.016	0.070	-	-	0.0011	24.35
			0.60	0.16	0.016	0.080	-	-	0.0013	27.83
			0.70	0.15	0.013	0.060	-	-	0.0009	19.57
			0.80	0.10	0.005	0.040	-	-	0.0004	8.70
			0.90	0.00	0.000	Edge of Water (RDB)				
			<b>Total</b>		<b>0.10</b>				<b>0.005</b>	<b>100</b>

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

**Figure E3-19 Lake F1 Outlet Rating Curve**



Note: Cross-sections were measured downstream of the lake outlet in the stream downstream of lake F1 and F2; therefore, a lake outlet rating curve was not developed based on survey data, but rather the regional lake outlet relationship.

m = metre; m<sup>3</sup>/s = cubic metres per second.

### E3.12 Lake G1 Outlet

Survey Date: 15-Sep-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 575633 m E, 7173880 m N

Outlet Coordinates (Geographic) : 64°41'12" N, 110°02'36" W



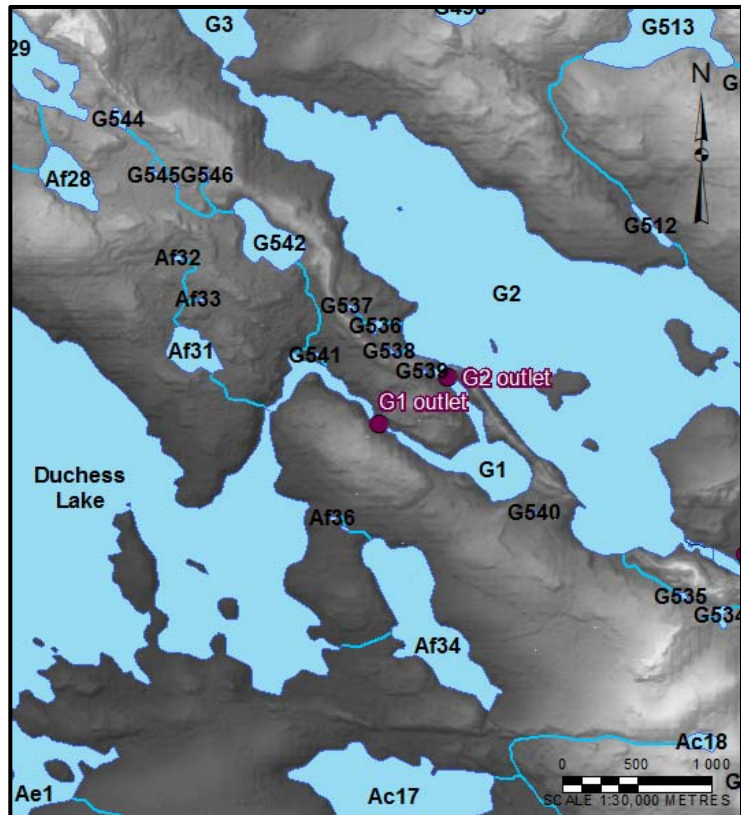
Upstream view of Lake G1 outlet



Lake G1 downstream view at downstream stream cross-section



Lake G1 downstream view at outlet cross-section



NTS Mapping of Area

**Table E3-52 Summary of Coordinates at Lake G1 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Geodetic)	545479.68	7174058.86
Outlet	575633	7173880

**Table E3-53 2013 Hydrometric Data at Lake G1 and Outlet Station**

Date	Time (24-hour)	Benchmark Elevation (m)	Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
15-Sep-13	12:30	420.82	422.41	0.98	1.40

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-54 Geomorphic Parameters at Lake G1 and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	18.3	ha	
Drainage Area (DEM) <sup>(a)</sup>	33471.8	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	422.60	m	
Surveyed Local Stream Slope	0.011	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.0042	m/m	
Average Bankfull Width	43.7	m	
Channel Material	40% boulder, 10% cobble, 10% coarse gravel, 10% medium gravel, 10% fine gravel, 10% coarse sand, 10% fine sand		
Bank Material	50% boulder, 20% cobble, 10% medium gravel, 10% fine gravel, 10% coarse sand		
Vegetation	Grass and low shrub tundra		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

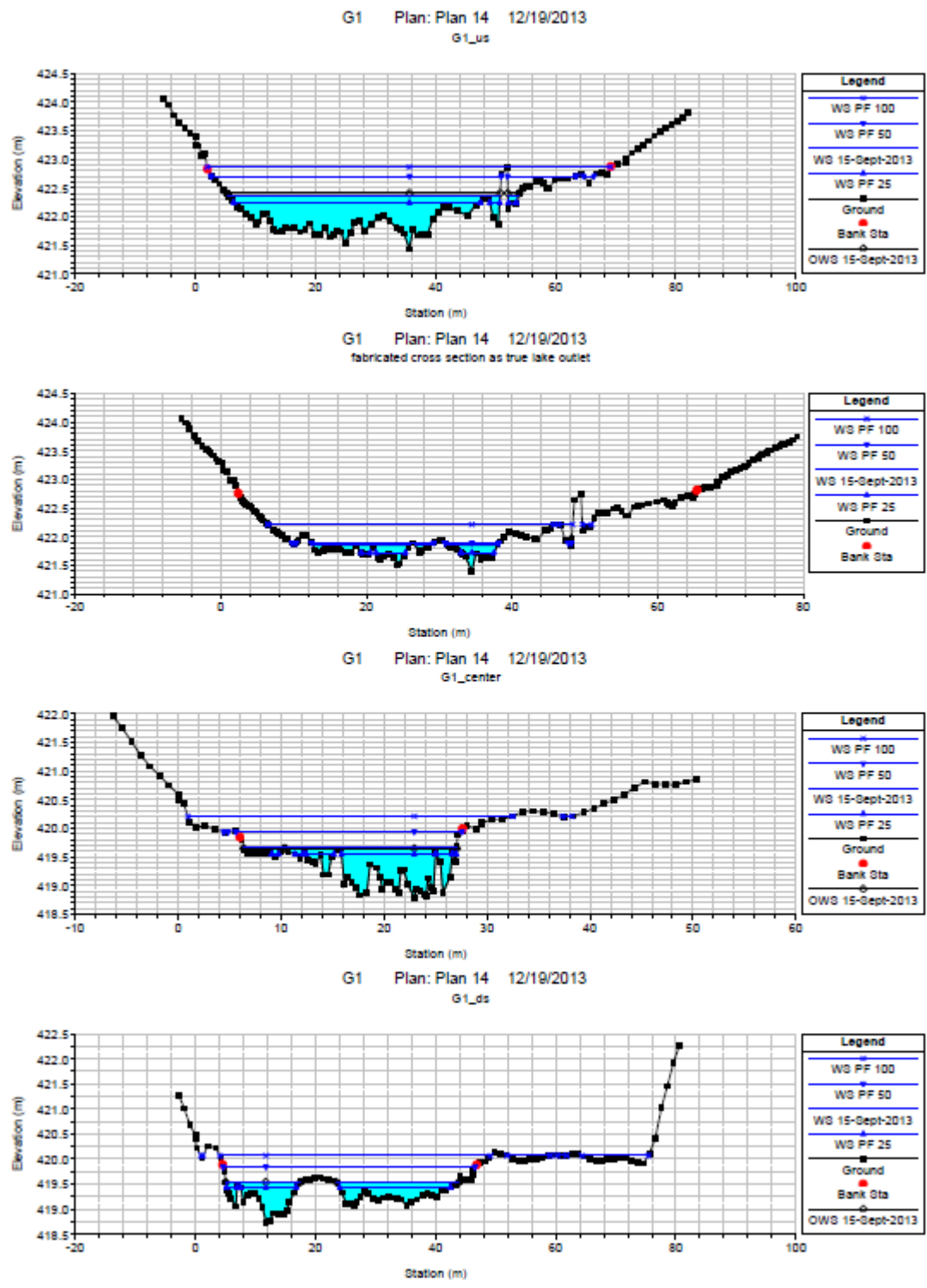
m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E3-55 Stream G1 Discharge Data**

Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	12:30			<b>Location</b>	Centre cross-section approximately 200 m downstream of Lake outlet		
<b>Lake Name</b>	Lake G1		<b>Method</b>	Velocity – Area (Mid-section)			<b>Instrument Model</b>	SonTek FlowTracker		
<b>Date Monitored</b>	15-Sep-13		<b>Flow Meter Type</b>	Handheld ADV flowmeter			<b>Instrument Serial #</b>	P4017		
<b>Personnel</b>	DC, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	545474	7174022	0.6		0.02	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.98		1.1	0.06	0.03	0.439	-	-	0.0132	0.96
<b>Discharge (m<sup>3</sup>/s)</b>	1.40		1.6	0.06	0.06	0.200	-	-	0.0090	0.66
<b>Notes</b>			2.6	0.06	0.09	0.184	-	-	0.0110	0.80
			3.6	0.12	0.06	0.199	-	-	0.0239	1.74
			4.6	0.00	0.08	0.000	-	-	0.0000	0.00
			5.6	0.16	0.16	0.189	-	-	0.0302	2.20
			6.6	0.16	0.18	0.072	-	-	0.0115	0.84
			7.6	0.20	0.340	0.259	-	-	0.0518	3.78
			8.6	0.48	0.28	0.324	-	-	0.1555	11.34
			9.6	0.08	0.26	0.159	-	-	0.0127	0.93
			10.6	0.44	0.59	0.324	-	-	0.1426	10.40
			11.6	0.74	0.67	0.206	-	-	0.1524	11.11
			12.6	0.6	0.63	0.301	-	-	0.1806	13.17
			13.6	0.66	0.65	0.205	-	-	0.1353	9.86
			15.6	0.58	0.59	0.264	-	-	0.1531	11.16
			16.6	0.6	0.70	0.119	-	-	0.0714	5.21
			14.6	0.64	0.61	0.088	-	-	0.0563	4.10
			17.6	0.8	0.76	0.042	-	-	0.0336	2.45
			18.6	0.72	0.57	0.176	-	-	0.1267	9.24
			19.6	0.42	0.21	0.002	-	-	0.0008	0.06
			20.6		0.00	Edge of Water (RDB)				
			<b>Total</b>		<b>7.53</b>				<b>1.40</b>	<b>100</b>

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-20 Stream G1 Transects Used for Hydraulic Modelling

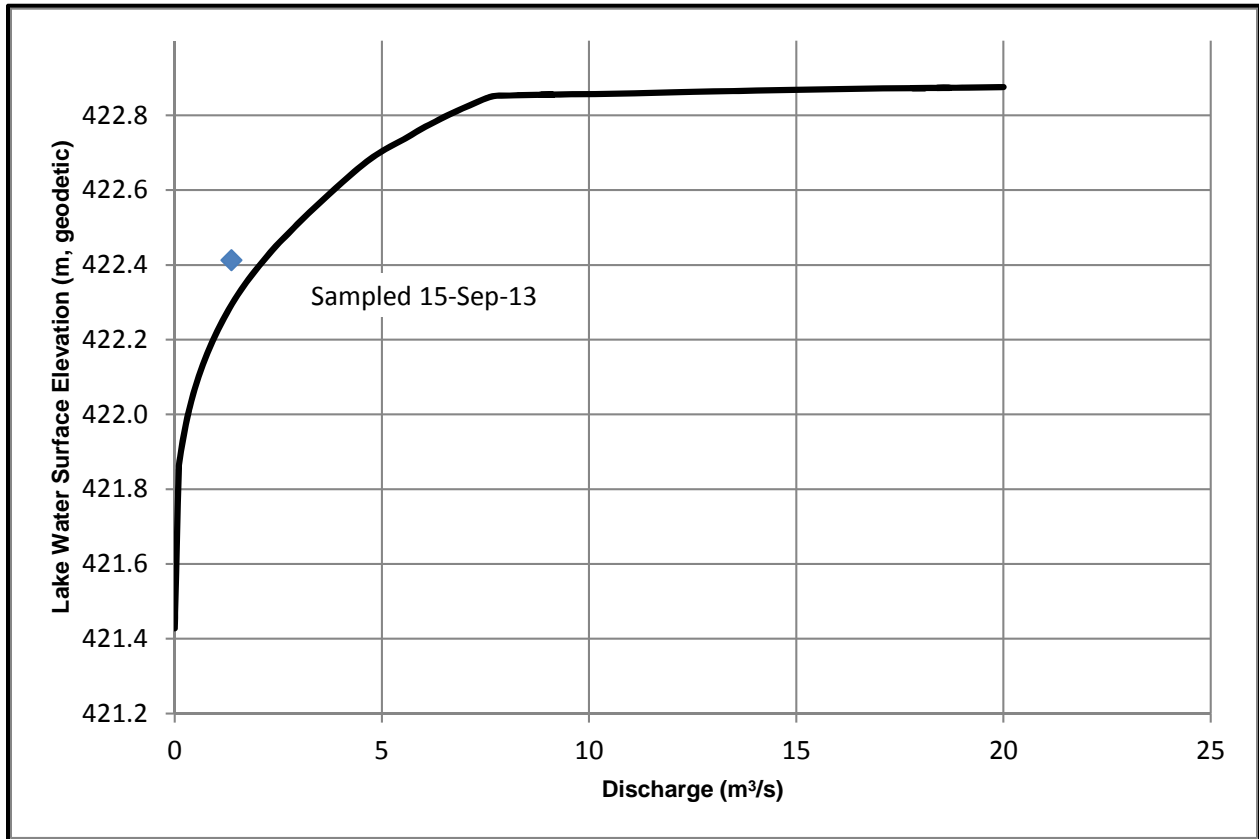


**Table E3-56 Stream G1 Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)		(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	
G1	3	15-Sep-13	1.37	421.43	422.364	422.405	20	0.750	-	422.37	0.00714	0.07	21.1	47.1	Surveyed
G1	3	PF 25	0.79	421.43	422.239	-	20	0.750	-	422.24	0.00619	0.05	15.4	44.1	
G1	3	PF 50	5.35	421.43	422.703	-	20	0.626	-	422.70	0.01440	0.14	38.7	61.5	
G1	3	PF 100	20.00	421.43	422.864	-	20	0.304	-	422.87	0.02405	0.41	49.2	67.2	
G1	2.91	15-Sep-13	1.37	421.39	421.852	-	193	0.750	-	421.86	1.53738	0.44	3.1	22.4	Estimated
G1	2.91	PF 25	0.79	421.39	421.720	-	193	0.750	421.72	421.76	12.16865	0.91	0.9	9.8	
G1	2.91	PF 50	5.35	421.39	421.892	-	193	0.100	421.89	421.98	0.19748	1.31	4.1	25.2	
G1	2.91	PF 100	20.00	421.39	422.211	-	193	0.070	422.12	422.30	0.03373	1.31	15.3	42.7	
G1	2	15-Sep-13	1.37	418.78	419.669	419.644	53	0.157	-	419.67	0.00311	0.17	8.0	20.7	Surveyed
G1	2	PF 25	0.79	418.78	419.546	-	53	0.160	-	419.55	0.00234	0.14	5.7	15.1	
G1	2	PF 50	5.35	418.78	419.936	-	53	0.065	-	419.94	0.00155	0.39	13.7	22.4	
G1	2	PF 100	20.00	418.78	420.207	-	53	0.053	-	420.26	0.00507	0.95	21.1	32.5	
G1	1	15-Sep-13	1.37	418.74	419.538	419.539	-	0.160	419.12	419.54	0.00201	0.13	10.6	32.8	Surveyed
G1	1	PF 25	0.79	418.74	419.431	-	-	0.160	419.04	419.43	0.00201	0.11	7.3	29.4	
G1	1	PF 50	5.35	418.74	419.847	-	-	0.126	419.32	419.85	0.00201	0.23	22.9	42.0	
G1	1	PF 100	20.00	418.74	420.069	-	-	0.049	419.55	420.09	0.00201	0.59	33.9	65.3	

Notes: Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.  
 All other profiles are used to represent a possible range of discharges to estimate a lake outlet rating curve (100 flow profiles computed in total, only select profiles shown).  
 River station values decrease in the downstream direction.  
 Manning's n varies vertically for this reach according to the large-scale roughness resistance equation developed by Bathurst (1978 and 2002).  
 m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre; - = no data available.

Figure E3-21 Lake G1 Outlet Rating Curve



m = metre; m³/s = cubic metres per second.

### E3.13 Lake G4 Outlet

Survey Date: 15-Sep-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 542724 m E, 7179131 m N

Outlet Coordinates (Geographic): 64°44'02"N, 110°06'08"W



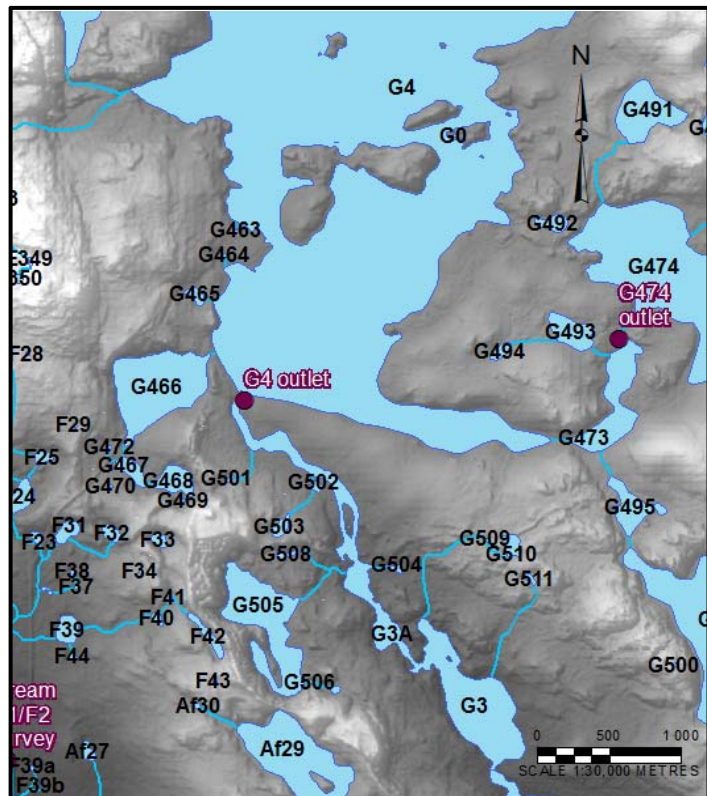
Left downstream bank view of Lake G4 outlet looking northeast



Lake G4 upstream view of centre cross-section



Lake G4 downstream view of downstream cross-section



NTS Mapping of Area

**Table E3-57 Summary of Coordinates at Lake G4 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Geodetic)	542685.44	7179013.07
Outlet	542724	7179131

**Table E3-58 2013 Hydrometric Data at Lake G4 and Outlet Station**

Date	Time (24-hour)	Benchmark Elevation (m)	Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
15-Sep-13	9:30	436.47	435.96	0.66	2.00

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-59 Geomorphic Parameters at Lake G4 and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	576.3	ha	
Drainage Area (DEM) <sup>(a)</sup>	30797.1	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	436.20	m	
Surveyed Local Stream Slope	0.0014	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	Indeterminable	m/m	
Average Bankfull Width	97.4	m	
Channel Material	50% boulder, 20% cobble, 10% coarse sand, 10% fine sand, 10% silt		
Bank Material	30% boulder, 30% cobble, 10% coarse gravel, 10% coarse sand, 10% fine sand, 10% silt		
Vegetation	Low shrub tundra		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E3-60 Stream G4 Discharge Data**

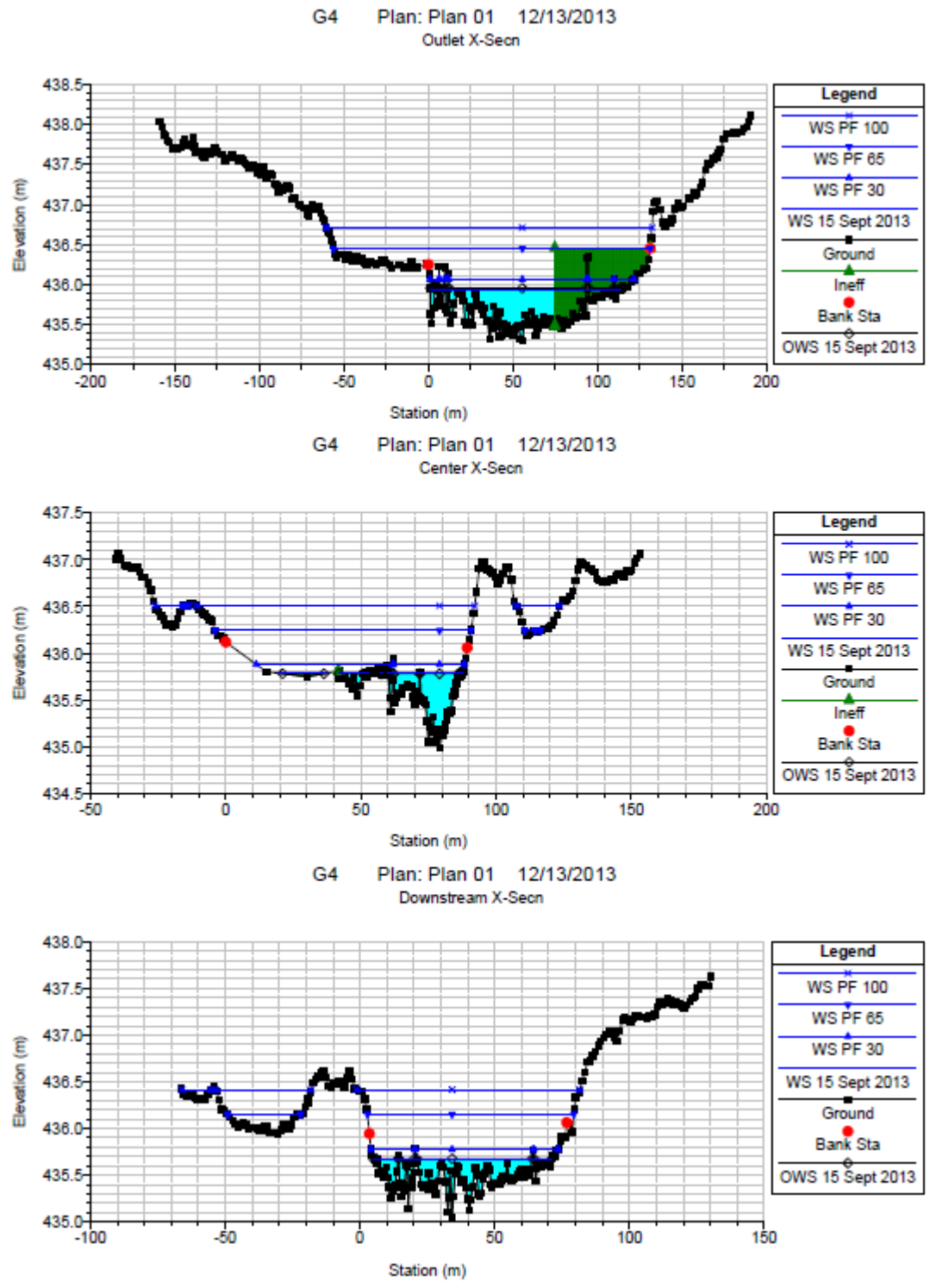
Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	9:30			<b>Location</b>	Downstream cross-section approximately 190 m downstream of Lake outlet		
<b>Lake Name</b>	Lake G4		<b>Method</b>	Velocity – Area (Mid-section)			<b>Instrument Model</b>	SonTek FlowTracker		
<b>Date Monitored</b>	15-Sep-13		<b>Flow Meter Type</b>	Handheld ADV flowmeter			<b>Instrument Serial #</b>	P4017		
<b>Personnel</b>	DC, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	542650	7178972	4.50	0.00	0.11	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.66		5.50	0.22	0.21	0.071	-	-	0.016	0.77
<b>Discharge (m<sup>3</sup>/s)</b>	2.00		6.50	0.20	0.44	0.074	-	-	0.022	1.10
<b>Notes</b>			8.50	0.24	0.44	0.120	-	-	0.058	2.85
			10.50	0.20	0.62	0.154	-	-	0.062	3.04
			12.50	0.42	1.00	0.107	-	-	0.090	4.44
			14.50	0.58	0.94	0.075	-	-	0.087	4.30
			16.50	0.36	0.88	0.077	-	-	0.055	2.74
			18.50	0.52	1.12	0.061	-	-	0.063	3.13
			20.50	0.60	1.18	0.096	-	-	0.115	5.69
			22.50	0.58	0.66	0.107	-	-	0.124	6.13
			24.50	0.08	0.62	0.072	-	-	0.012	0.57
			26.50	0.54	1.14	0.044	-	-	0.048	2.35
			28.50	0.60	1.26	0.054	-	-	0.065	3.20
			30.50	0.66	1.08	0.072	-	-	0.095	4.70
			32.50	0.42	0.98	0.050	-	-	0.042	2.08
			34.50	0.56	0.84	0.047	-	-	0.526	26.01
			36.50	0.28	0.54	0.052	-	-	0.029	1.44
			38.50	0.26	0.50	0.071	-	-	0.037	1.82
			40.50	0.24	0.52	0.068	-	-	0.033	1.61
			42.50	0.28	0.70	0.062	-	-	0.035	1.72
			44.50	0.42	0.92	0.078	-	-	0.066	3.24

**Table E3-60 Stream G4 Discharge Data**

Site Information	Discharge Measurement								
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)	Qi		% of Total Q	Station	Depth
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m)	(m)	
	46.50	0.50	1.00	0.024	-	-	0.024	1.19	
	48.50	0.50	0.98	0.055	-	-	0.055	2.72	
	50.50	0.48	0.88	0.032	-	-	0.031	1.52	
	52.50	0.40	1.02	0.057	-	-	0.046	2.25	
	54.50	0.62	1.32	0.033	-	-	0.041	2.02	
	56.50	0.70	1.44	0.021	-	-	0.029	1.45	
	58.50	0.74	1.44	0.035	-	-	0.052	2.56	
	60.50	0.70	1.34	0.028	-	-	0.039	1.94	
	62.50	0.64	0.84	0.019	-	-	0.024	1.20	
	64.50	0.20	0.10	0.015	-	-	0.005	0.22	
	65.50	0.00	0.00	Edge of Water (RDB)					
	<b>Total</b>		<b>27.06</b>				<b>2.00</b>	<b>100</b>	

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-22 Stream G4 Transects Used for Hydraulic Modelling



**Table E3-61 Stream G4 Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)		(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	
G4	3	15-Sep-13	2.02	435.3	435.94	435.956	67 (To Stn 2)	0.330	435.53	435.94	0.00303	0.08	24.6	105.6	Surveyed
G4	3	PF 30	3.80	435.3	436.066	-	67 (To Stn 2)	0.330	435.57	436.07	0.00401	0.11	33.6	118.1	
G4	3	PF 65	15.60	435.3	436.452	-	67 (To Stn 2)	0.237	435.72	436.45	0.00597	0.22	72.0	187.6	
G4	3	PF 100	29.60	435.3	436.711	-	67 (To Stn 2)	0.238	435.84	436.71	0.00283	0.19	154.8	193.2	
G4	2	15-Sep-13	2.02	434.99	435.785	435.78	135 (To Stn 2)	0.060	435.36	435.79	0.00098	0.21	9.8	56.4	Surveyed
G4	2	PF 30	3.80	434.99	435.880	-	135 (To Stn 2)	0.060	435.46	435.88	0.00139	0.23	16.9	76.8	
G4	2	PF 65	15.60	434.99	436.244	-	135 (To Stn 2)	0.056	435.79	436.25	0.00088	0.32	48.4	100.6	
G4	2	PF 100	29.60	434.99	436.507	-	135 (To Stn 2)	0.053	435.91	436.52	0.00079	0.38	78.9	130.6	
G4	1	15-Sep-13	2.02	435.05	435.673	435.676	-	0.068	435.43	435.67	0.00087	0.15	13.4	64.0	Surveyed
G4	1	PF 30	3.80	435.05	435.775	-	-	0.068	435.48	435.78	0.00088	0.19	20.2	69.4	
G4	1	PF 65	15.60	435.05	436.152	-	-	0.060	435.64	436.16	0.00088	0.31	51.2	103.7	
G4	1	PF 100	29.60	435.05	436.416	-	-	0.059	435.74	436.42	0.00087	0.36	81.2	129.3	

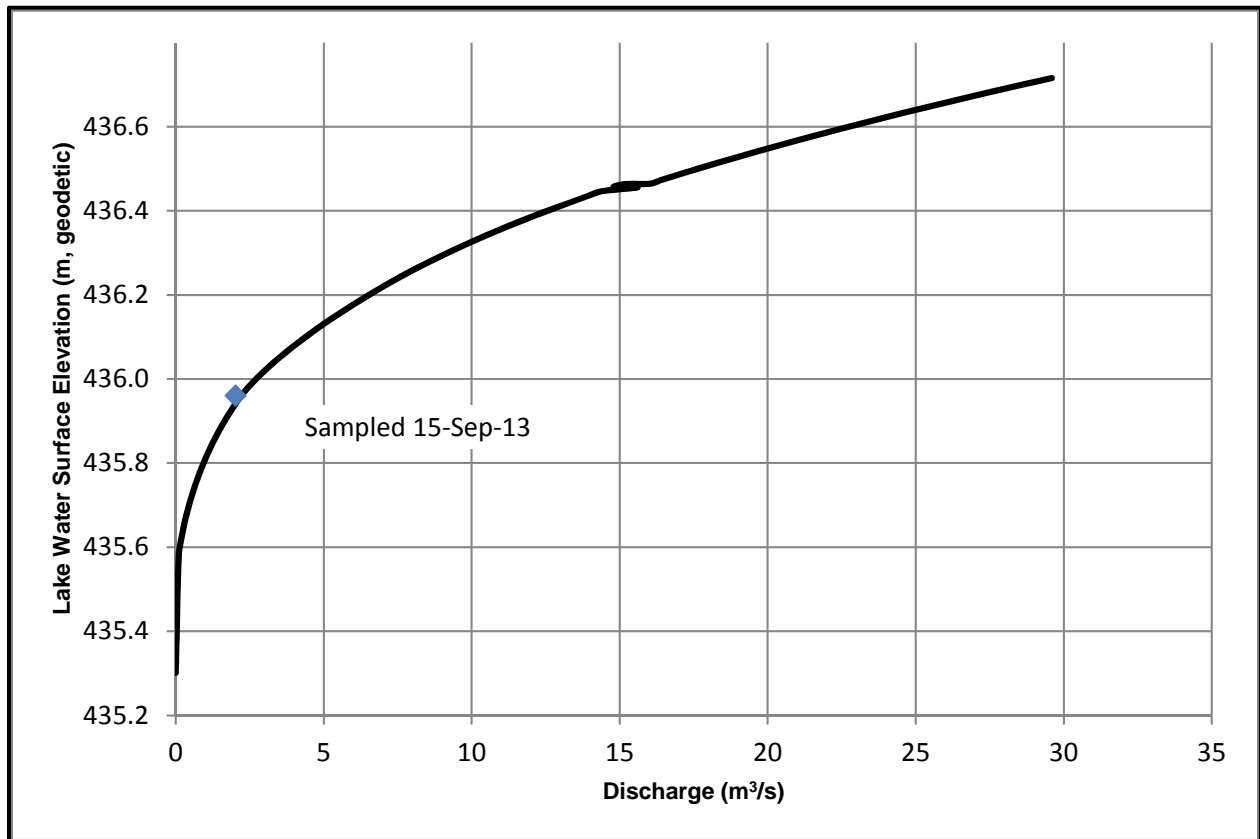
Notes: Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.  
All other profiles are used to represent a possible range of discharges to estimate a lake outlet rating curve (100 flow profiles computed in total, only select profiles shown).  
River station values decrease in the downstream direction.

Additional interpolated cross-sections were used for hydraulic modelling, but are not included in the summary tables.

Manning's n varies vertically for this reach according to the large-scale roughness resistance equation developed by Bathurst (1978 and 2002).

m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre; - = no data available.

Figure E3-23 Lake G4 Outlet Rating Curve



m = metre; m³/s = cubic metres per second.

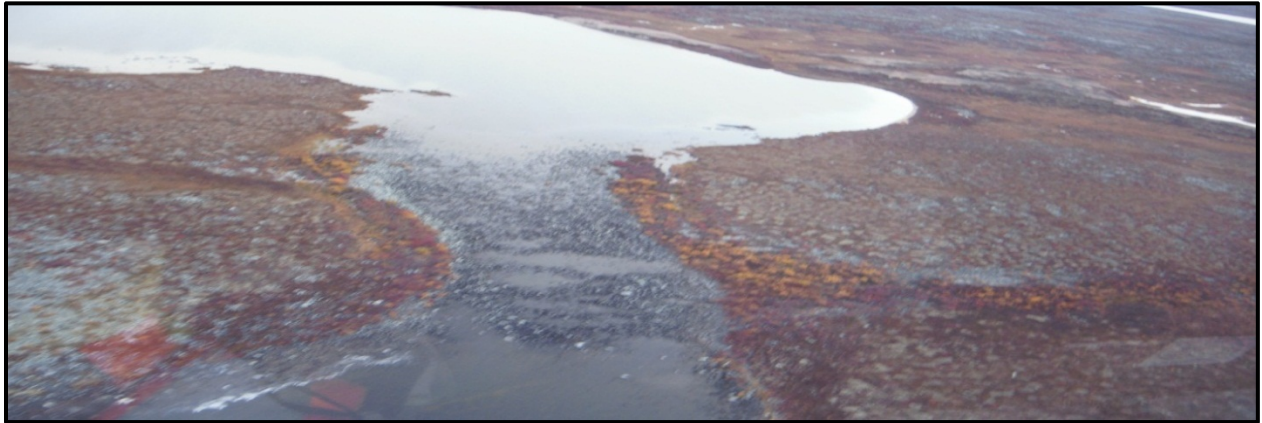
### E3.14 Lake G4A Outlet

Survey Date: 18-Sep-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 545238 m E, 7182577 m N

Outlet Coordinates (Geographic) : 64°45'53" N, 110°02'56" W



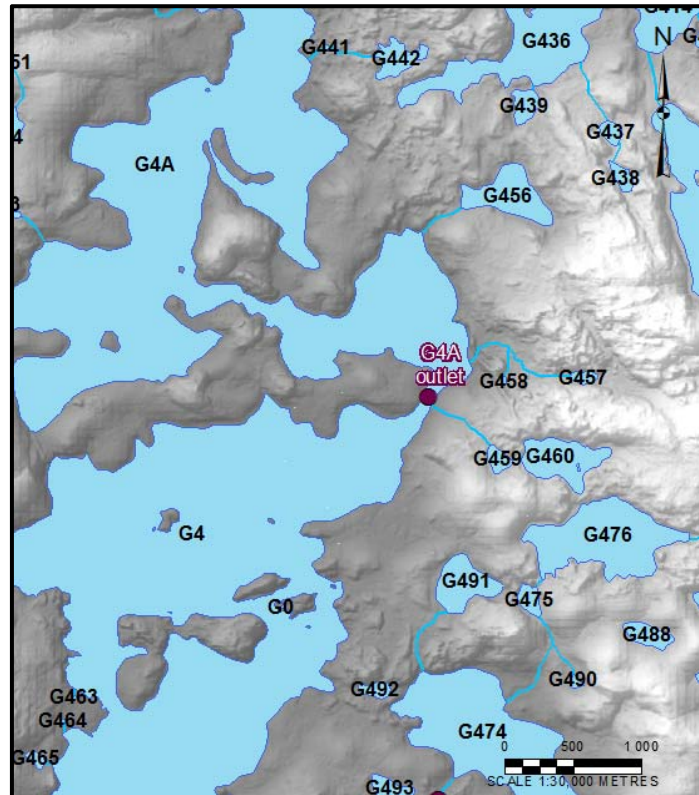
Upstream view of Lake G4A outlet looking northeast (Lake G4 at bottom)



Lake G4A outlet view downstream



Lake G4A downstream view of downstream cross-section



NTS Mapping of Area

**Table E3-62 Summary of Coordinates at Lake G4A and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Geodetic)	545165.52	7182516.73
Outlet	545238	7182577

**Table E3-63 2013 Hydrometric Data at Lake G4A and Outlet Station**

Date	Time (24-hour)	Benchmark Elevation (m)	Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
18-Sep-13	15:00	439.17	437.82	0.72	1.30

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-64 Geomorphic Parameters at Lake G4A and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	582.9	ha	
Drainage Area (DEM) <sup>(a)</sup>	27369.8	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	438.00	m	
Surveyed Local Stream Slope	0.0083	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.0032	m/m	
Average Bankfull Width	104.9	m	
Channel Material	60% boulder, 20% cobble, 10% coarse gravel, 10% medium gravel, 10% silt		
Bank Material	50% boulder, 20% cobble, 10% coarse gravel, 10% medium gravel, 10% silt		
Vegetation	Low shrub tundra		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E3-65 Stream G4A Discharge Data**

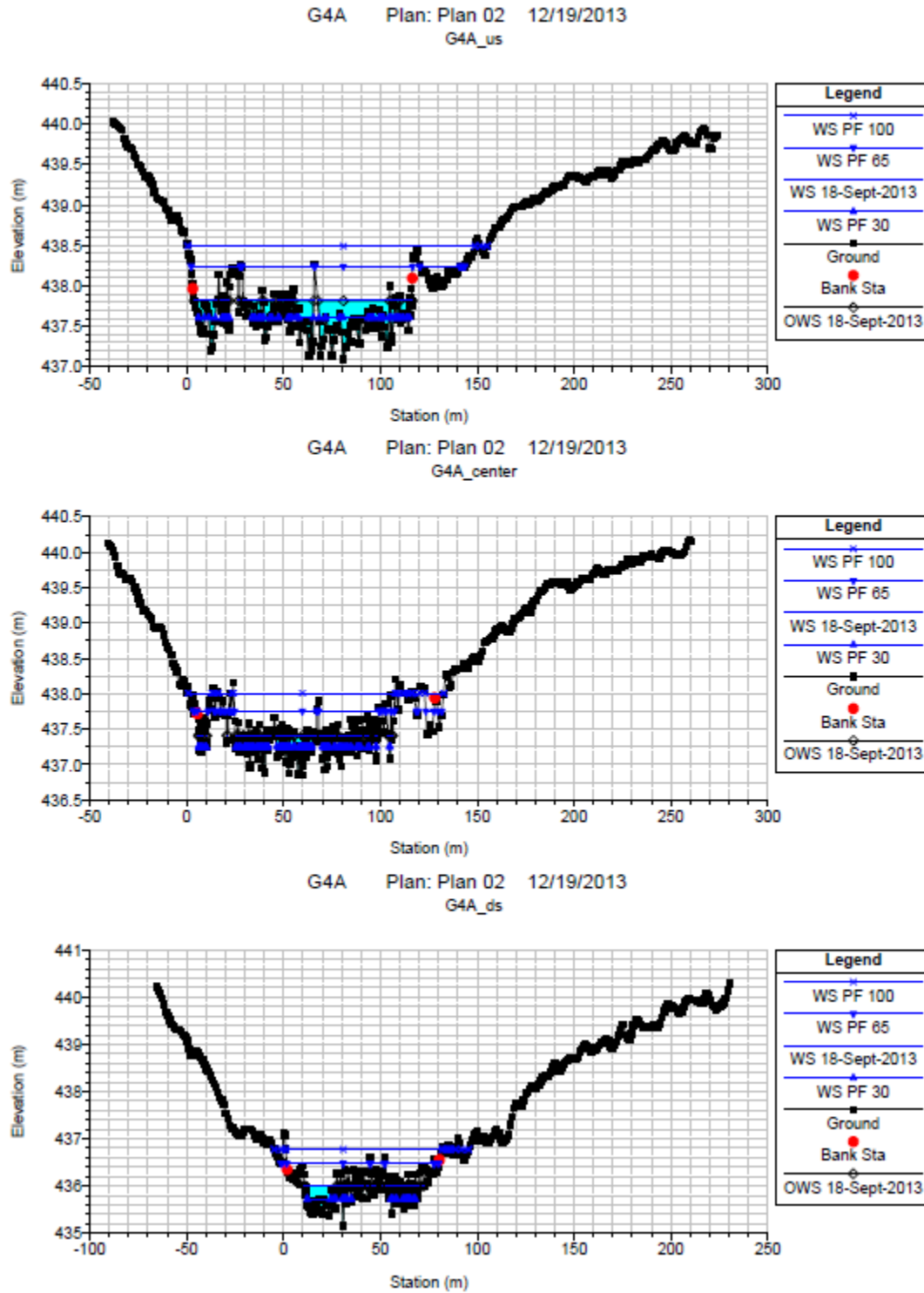
Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	15:00		<b>Location</b>		At Lake outlet		
<b>Lake Name</b>	Lake G4A		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>		SonTek FlowTracker		
<b>Date Monitored</b>	18-Sep-13		<b>Flow Meter Type</b>	Handheld ADV flowmeter		<b>Instrument Serial #</b>		P4017		
<b>Personnel</b>	NS, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	545238	7182577	0.0	0.00	0.004	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.72		0.1	0.08	0.247	0.11	-	-	0.017	1.29
<b>Discharge (m<sup>3</sup>/s)</b>	1.30		3.9	0.05	0.050	0.08	-	-	0.012	0.91
<b>Notes</b>			5.9	0.00	0.000	0.00	-	-	0.000	0.00
			13.3	0.00	0.036	0.00	-	-	0.000	0.00
			14.5	0.06	0.045	0.05	-	-	0.003	0.19
			15.0	0.12	0.120	0.13	-	-	0.020	1.47
			17.0	0.00	0.000	0.00	-	-	0.000	0.00
			17.9	0.00	0.007	0.00	-	-	0.000	0.00
			18.0	0.14	0.091	0.08	-	-	0.005	0.34
			18.7	0.12	0.155	0.09	-	-	0.009	0.69
			19.7	0.19	0.038	0.05	-	-	0.006	0.45
			20.1	0.00	0.145	0.00	-	-	0.000	0.00
			21.1	0.29	0.178	0.05	-	-	0.010	0.76
			21.6	0.42	0.084	0.07	-	-	0.013	0.96
			22.0	0.00	0.040	0.00	-	-	0.000	0.00
			22.4	0.20	0.390	0.07	-	-	0.017	1.24
			24.3	0.21	0.248	0.05	-	-	0.017	1.28
			25.8	0.12	0.209	0.15	-	-	0.023	1.69
			26.9	0.26	0.117	0.86	-	-	0.224	16.71
			27.8	0.00	0.000	0.00	-	-	0.000	0.00
			30.4	0.00	0.385	0.00	-	-	0.000	0.00
			31.5	0.70	0.172	0.14	-	-	0.071	5.34
			31.9	0.16	0.192	0.14	-	-	0.018	1.31

**Table E3-65 Stream G4A Discharge Data**

Site Information		Discharge Measurement							
Notes	Station	Depth	Area	Velocity at Specified Depth	Qi	% of Total Q	Station	Depth	
	(m)	(m)	(m <sup>2</sup> )	60% (m/s)	20%	80%	(m)	(m)	
	33.1	0.16	0.180	0.07	-	-	0.012	0.87	
	34.1	0.20	0.273	0.11	-	-	0.025	1.86	
	35.4	0.22	0.299	0.12	-	-	0.034	2.56	
	36.7	0.24	0.414	0.14	-	-	0.051	3.78	
	38.5	0.22	0.594	0.08	-	-	0.035	2.63	
	40.7	0.32	0.891	0.10	-	-	0.068	5.10	
	42.9	0.49	0.814	0.05	-	-	0.052	3.87	
	45.1	0.25	0.675	0.12	-	-	0.068	5.09	
	47.6	0.29	0.123	0.12	-	-	0.052	3.87	
	48.1	0.20	0.460	0.15	-	-	0.042	3.16	
	50.4	0.20	0.315	0.08	-	-	0.030	2.27	
	51.9	0.22	0.325	0.04	-	-	0.014	1.01	
	53.2	0.28	0.725	0.04	-	-	0.020	1.51	
	55.7	0.30	0.270	0.23	-	-	0.125	9.33	
	56.9	0.15	0.476	0.05	-	-	0.014	1.01	
	59.7	0.19	0.428	0.10	-	-	0.043	3.24	
	61.6	0.26	0.399	0.09	-	-	0.043	3.21	
	63.5	0.16	0.880	0.14	-	-	0.057	4.24	
	66.7	0.39	0.214	0.05	-	-	0.044	3.26	
	67.8	0.00	0.143	0.00	-	-	0.000	0.00	
	68.9	0.26	0.247	0.08	-	-	0.032	2.42	
	70.8	0.00	0.081	0.00	-	-	0.000	0.00	
	71.7	0.18	0.054	0.09	-	-	0.012	0.90	
	72.3	0.00	0.000	0.06	-	-	0.000	0.00	
	76.4	0.00	0.045	0.00	-	-	0.000	0.00	
	77.0	0.15	0.090	0.01	-	-	0.001	0.07	
	77.6	0.15	0.113	0.01	-	-	0.002	0.12	
	79.1	0.00	0.000	Edge of Water (RDB)					
	<b>Total</b>		<b>12.48</b>				<b>1.30</b>	<b>100</b>	

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-24 Stream G4A Transects Used for Hydraulic Modelling



**Table E3-66 Stream G4A Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)		(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	
G4A	3	18-Sep-13	1.34	437.10	437.819	437.816	81	0.450	-	437.82	0.00303	0.05	26.6	95.9	Surveyed
G4A	3	PF 30	0.28	437.10	437.606	-	81	0.450	-	437.61	0.00232	0.03	9.4	61.4	
G4A	3	PF 65	8.28	437.10	438.242	-	81	0.390	-	438.24	0.00457	0.11	74.1	135.6	
G4A	3	PF 100	18.00	437.10	438.493	-	81	0.330	-	438.50	0.00474	0.16	110.3	151.7	
G4A	2	18-Sep-13	1.34	436.85	437.412	437.41	141	0.200	-	437.41	0.00994	0.14	9.7	57.7	Surveyed
G4A	2	PF 30	0.28	436.85	437.249	-	141	0.200	-	437.25	0.01170	0.10	2.7	27.8	
G4A	2	PF 65	8.28	436.85	437.756	-	141	0.197	-	437.76	0.00823	0.22	37.1	95.0	
G4A	2	PF 100	18.00	436.85	438.009	-	141	0.191	-	438.01	0.00775	0.28	64.7	121.9	
G4A	1	18-Sep-13	1.34	435.15	436.006	436.002	-	0.280	435.62	436.01	0.00997	0.13	10.3	40.1	Surveyed
G4A	1	PF 30	0.28	435.15	435.725	-	-	0.280	435.50	435.73	0.00998	0.10	2.8	17.0	
G4A	1	PF 65	8.28	435.15	436.481	-	-	0.279	435.86	436.48	0.00997	0.21	39.8	77.2	
G4A	1	PF 100	18.00	435.15	436.773	-	-	0.256	436.02	436.78	0.00997	0.28	64.4	93.0	

Notes:

Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.

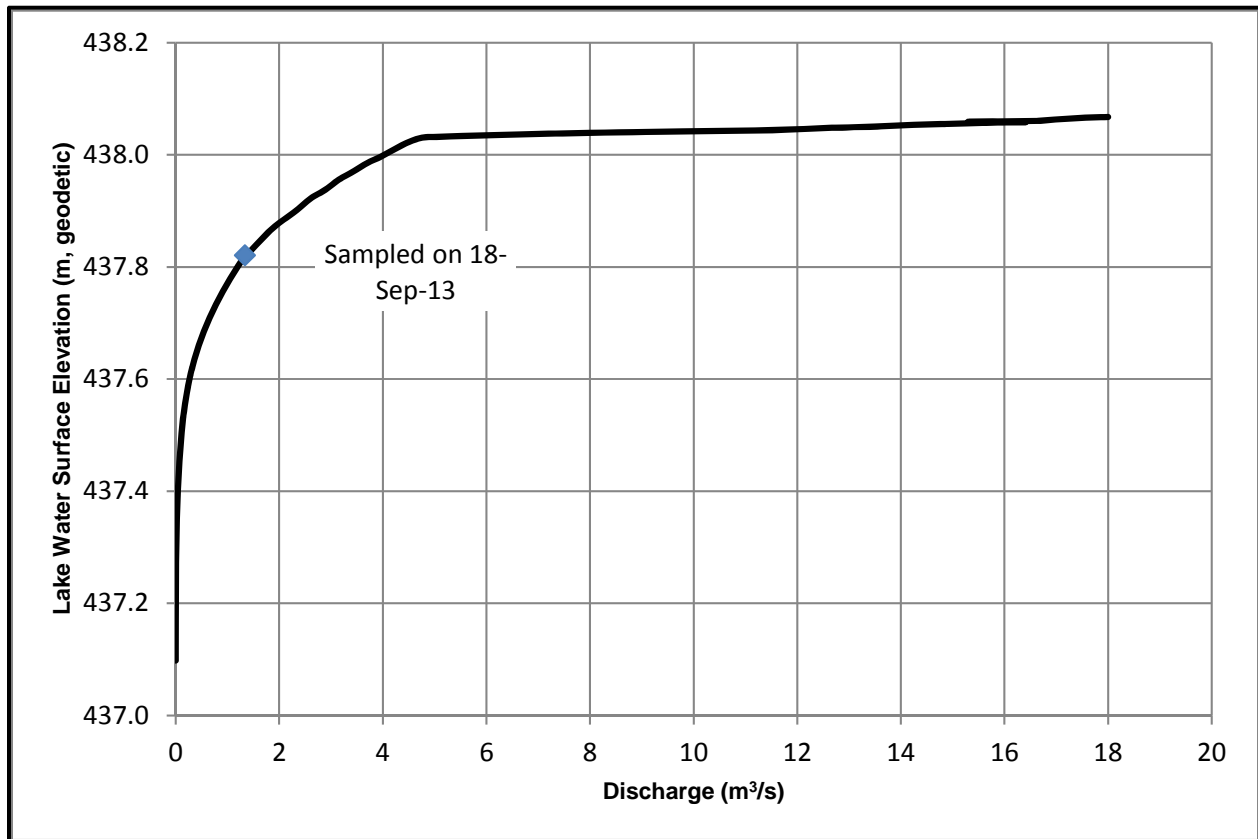
All other profiles are used to represent a possible range of discharges to estimate a lake outlet rating curve (100 flow profiles computed in total, only select profiles shown).

River station values decrease in the downstream direction.

Manning's n varies vertically for these cross-sections according to the large-scale roughness resistance equation developed by Bathurst (1978 and 2002).

m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre; - = no data available.

Figure E3-25 Lake G4A Outlet Rating Curve



m = metre; m³/s = cubic metres per second.

### E3.15 Lake G5 Outlet

Survey Date: 10-Sep-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 543142 m E, 7186710 m N

Outlet Coordinates (Geographic) : 64°48'07" N, 110°05'30" W



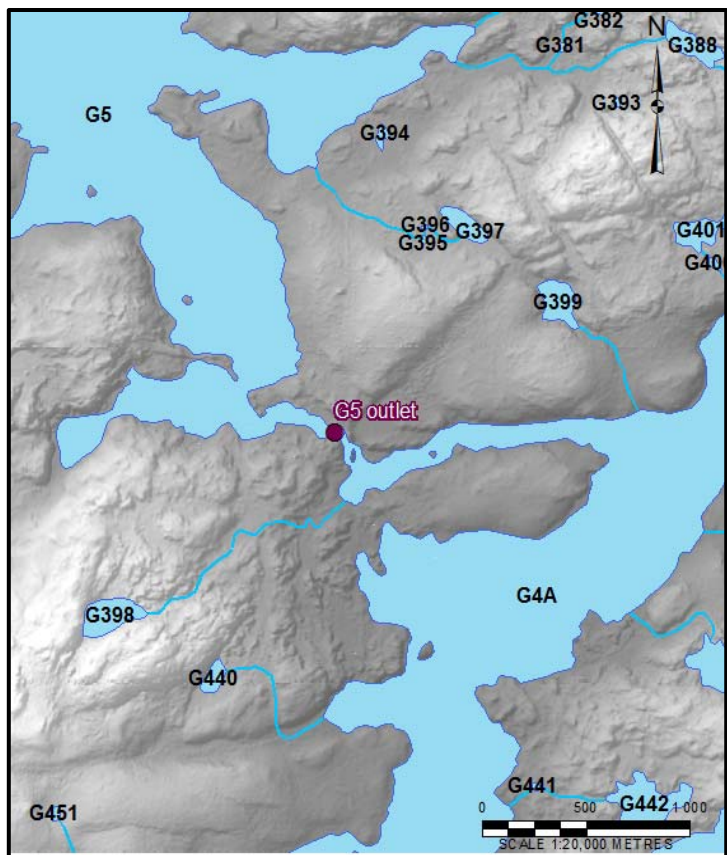
Downstream view of Lake G5 outlet looking northeast



Lake G5 upstream view of upstream cross-section



Downstream view of Lake G5 outlet



NTS Mapping of Area

**Table E3-67 Summary of Coordinates at Lake G5 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (non-geodetic)	543495.28	7186695.07
Outlet	543142	7186710

**Table E3-68 2013 Hydrometric Data at Lake G5 and Outlet Station**

Date	Time (24-hour)	Non-geodetic Benchmark Elevation <sup>(a)</sup> (m)	Non-geodetic Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
10-Sep-13	13:00	445.58	443.17	1.14	1.00

a) Elevation of the Benchmark set to 445.58 m to match lake elevations with LiDAR Water Surface Elevation of Lake G5.  
m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-69 Geomorphic Parameters at Lake G5 and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	1318.0	ha	
Drainage Area (DEM) <sup>(a)</sup>	22801.9	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	443.20	m	
Surveyed Local Stream Slope	1.03	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.0074	m/m	
Average Bankfull Width	80.0	m	
Channel Material	60% boulder, 20% cobble, 10% fine gravel, 10% coarse sand		
Bank Material	50% boulder, 10% cobble, 10% coarse gravel, 10% medium gravel, 10% fine gravel, 10% coarse sand		
Vegetation	Low shrub tundra		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E3-70 Stream G5 Discharge Data**

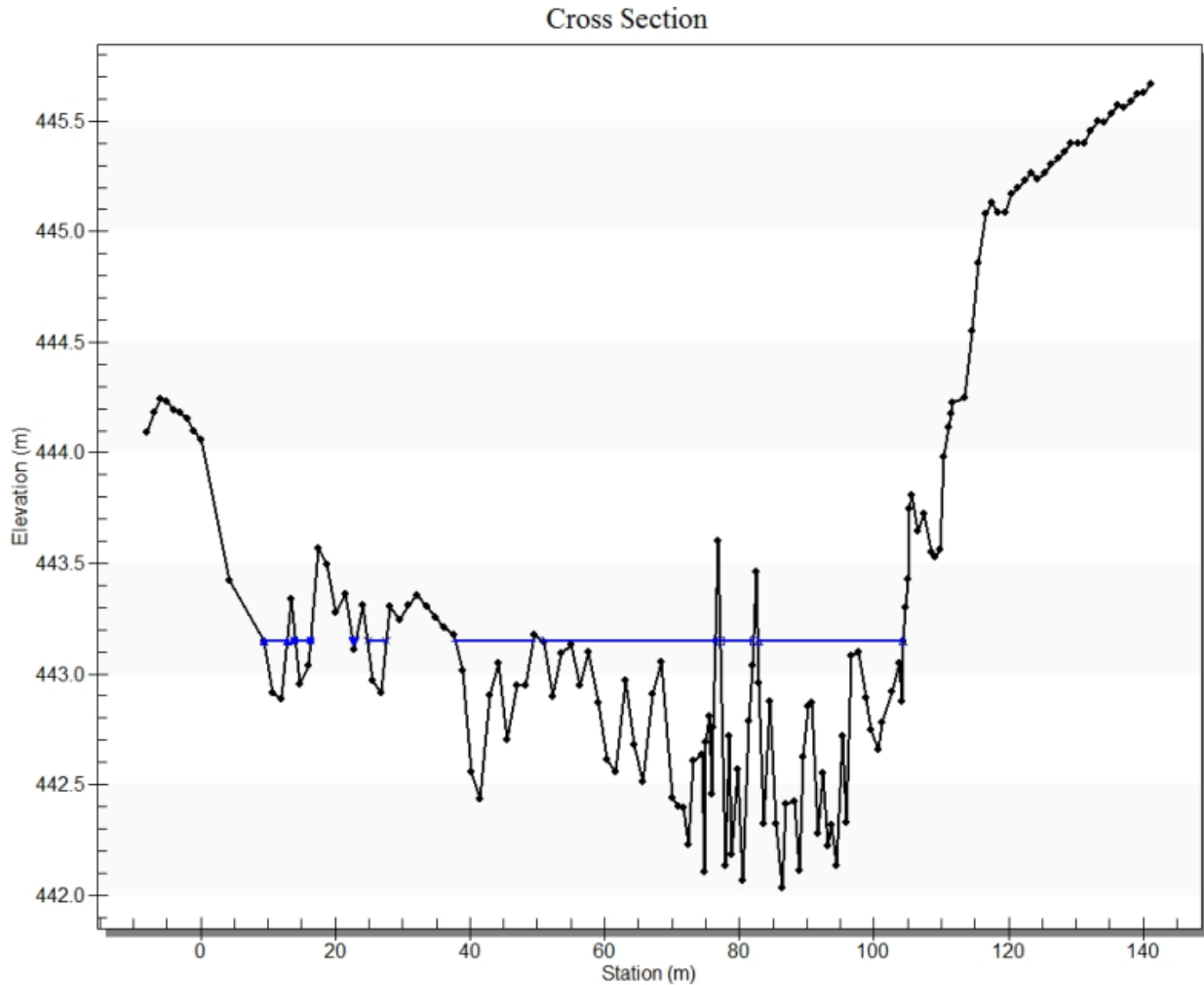
Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	13:00		<b>Location</b>	Centre cross-section approximately 350 m downstream of Lake outlet			
<b>Lake Name</b>	Lake G5		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	Marsh-McBirney FLO-MATE Model 2000			
<b>Date Monitored</b>	10-Sep-13		<b>Flow Meter Type</b>	Handheld electromagnetic sensor flowmeter		<b>Instrument Serial #</b>	2005872			
<b>Personnel</b>	DC, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	543510	7186728	0.70	0.00	0.000	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	1.14		1.00	boulder	0.048	-	-	-	0.000	0.00
<b>Discharge (m<sup>3</sup>/s)</b>	1.00		1.30	0.32	0.111	0.32	-	-	0.031	2.98
<b>Notes</b>			1.60	0.42	0.129	0.28	-	-	0.035	3.42
			1.90	0.44	0.147	0.16	-	-	0.021	2.05
			2.20	0.54	0.171	0.08	-	-	0.013	1.26
			2.50	0.60	0.165	0.55	-	-	0.099	9.61
			2.80	0.50	0.141	1.30	-	-	0.195	18.93
			3.10	0.44	0.135	1.50	-	-	0.198	19.22
			3.40	0.46	0.174	1.10	-	-	0.152	14.73
			3.70	0.70	0.150	0.76	-	-	0.160	15.49
			4.00	0.30	0.132	0.32	-	-	0.029	2.80
			4.30	0.58	0.177	0.12	-	-	0.021	2.03
			4.60	0.60	0.147	0.09	-	-	0.016	1.57
			4.90	0.38	0.108	0.14	-	-	0.016	1.55
			5.20	0.34	0.075	0.15	-	-	0.015	1.48
			5.50	0.16	0.051	0.17	-	-	0.008	0.79
			5.80	0.18	0.045	0.21	-	-	0.011	1.10
			6.10	0.12	0.036	0.10	-	-	0.004	0.35
			6.40	0.12	0.036	0.09	-	-	0.003	0.31
			6.70	0.12	0.033	0.05	-	-	0.002	0.17

**Table E3-70 Stream G5 Discharge Data**

Site Information	Discharge Measurement							
Notes	Station (m)	Depth (m)	Area (m <sup>2</sup> )	Velocity at Specified Depth (m/s) 60%	Qi 20%	% of Total Q 80%	Station (m)	Depth (m)
	7.00	0.10	0.024	0.04	-	-	0.001	0.12
	7.30	0.06	0.009	0.02	-	-	0.0004	0.03
	7.60	0.00	0.000	Edge of Water (RDB)				
	<b>Total</b>		<b>2.24</b>				<b>1.00</b>	<b>100</b>

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

**Figure E3-26 Stream G5 Transects Used for Hydraulic Modelling**



**Note:**

Discharge measured at the time of survey (10-Sep-13) with associated observed water surface elevations are used for calibration and shown above for the outlet cross-section.

Arbitrary datum chosen so that lake levels match those generated from LiDAR data.

m = metre.

**Table E3-71 Stream G5 Hydraulic Modelling Output**

Attribute	Value	Unit
Calibration Discharge	1.03	m <sup>3</sup> /s
Maximum Depth	1.11	m
Area of Flow	28.6	m <sup>2</sup>
Wetted Perimeter	78.89	m
Hydraulic Radius	0.36	m
Average Velocity	0.04	m/s
Top Width	72.9	m
Froude Number	0.018	
Critical Depth	0.34	m
Critical Velocity	1.09	m/s
Critical Slope	4.024	m/m
Critical Top Width	7.9	m
Calculated Max Shear Stress	8.74	N/m <sup>2</sup>
Calculated Avg Shear Stress	2.85	N/m <sup>2</sup>
Composite Manning's n Equation	Lotter method	
Manning's Roughness	0.40	

Notes:

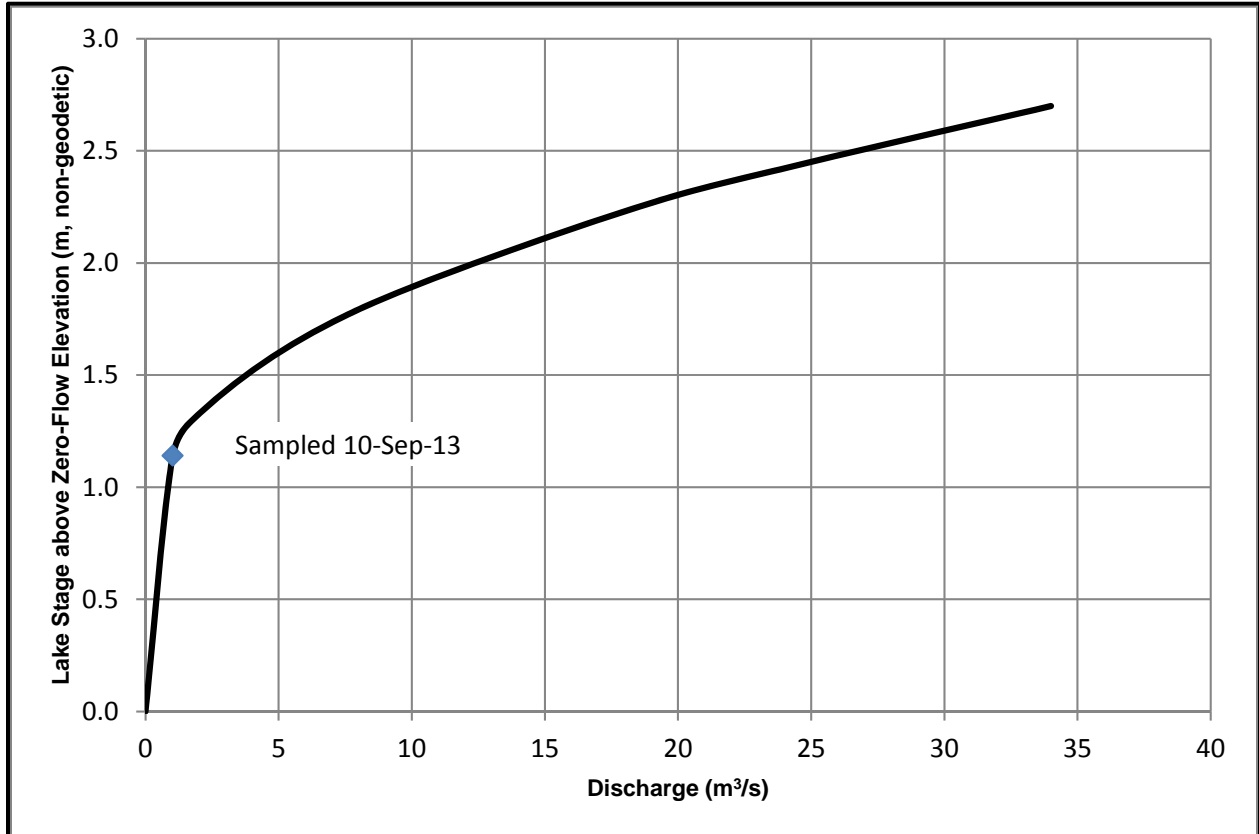
Discharge measured at the time of surveys with associated observed water surface elevations are used for calibration and shown above.

One cross-section was modelled at the outlet using the Manning's open channel flow equation.

Manning's n varies vertically for this cross-section (0.40 to 0.20) according to the large-scale roughness resistance equation developed by Bathurst (1978 and 2002).

m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre.; N/m<sup>2</sup> = Newtons per square metre.

Figure E3-27 Lake G5 Outlet Rating Curve



m = metre; m³/s = cubic metres per second.

### E3.16 Lake G6 Outlet

Survey Date: 14-Aug-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 538306 m E, 7190335 m N

Outlet Coordinates (Geographic) : 64°50'06" N, 110°11'33" W



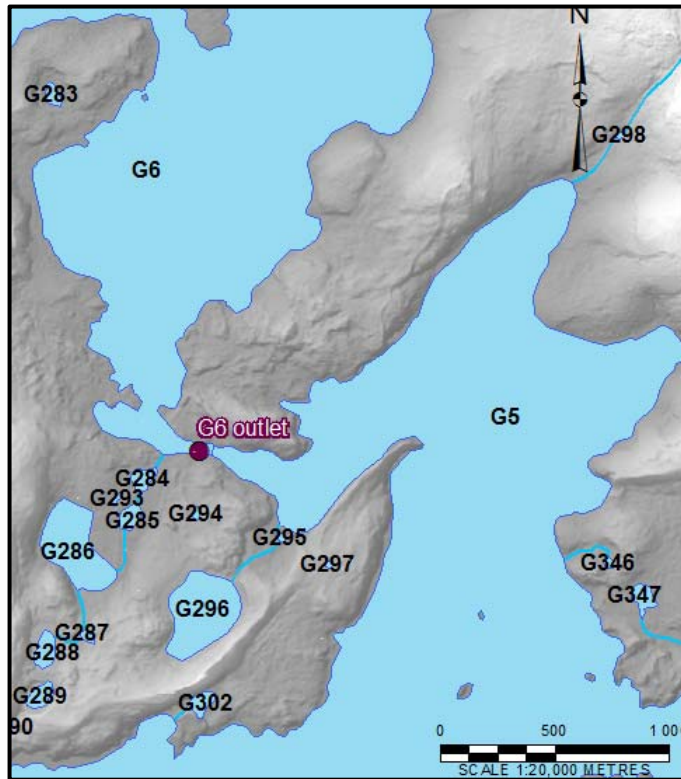
Upstream view of Lake G6 outlet looking northwest (Lake G5 at bottom)



Lake G6 upstream view of upstream cross-section



Lake G6 downstream view of downstream cross-section



NTS Mapping of Area

**Table E3-72 Summary of Coordinates at Lake G6 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (non-geodetic)	538528.79	7190179.91
Outlet	538306	7190335

**Table E3-73 2013 Hydrometric Data at Lake G6 and Outlet Station**

Date	Time (24-hour)	Non-geodetic Benchmark Elevation <sup>(a)</sup> (m)	Non-geodetic Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
14-Aug-13	8:15	444.64	443.77	0.38	0.98

a) Elevation of the Benchmark set to 444.64 m to match lake elevations with LiDAR Water Surface Elevation of Lake G6.

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-74 Geomorphic Parameters at Lake G6 and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	1025.3	ha	
Drainage Area (DEM) <sup>(a)</sup>	15720.6	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	443.80	m	
Surveyed Local Stream Slope	0.0048	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.0032	m/m	
Average Bankfull Width	46.0	m	
Channel Material	45% cobble, 30% boulder, 10% coarse gravel, 5% medium gravel, 5% fine gravel, 5% coarse sand		
Bank Material	50% silt, 20% boulder, 20% cobble, 10% clay		
Vegetation	Low shrub tundra		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E3-75 Stream G6 Discharge Data**

Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	8:15		<b>Location</b>	Centre cross-section approximately 300 m downstream of Lake outlet			
<b>Lake Name</b>	Lake G6		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	SonTek FlowTracker			
<b>Date Monitored</b>	14-Aug-13		<b>Flow Meter Type</b>	Handheld ADV flowmeter		<b>Instrument Serial #</b>	P4017			
<b>Personnel</b>	MA, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	538524	7190148	7.00	0.00	0.030	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.38		8.00	0.06	0.018	0.17	-	-	0.008	0.83
<b>Discharge (m<sup>3</sup>/s)</b>	0.98		8.60	0.00	0.000	0.00	-	-	0.000	0.00
<b>Notes</b>			9.20	0.00	0.005	0.00	-	-	0.000	0.00
			9.30	0.10	0.014	0.17	-	-	0.003	0.26
			9.50	0.04	0.045	0.00	-	-	0.000	0.00
			10.00	0.14	0.065	0.01	-	-	0.001	0.07
			10.50	0.12	0.063	0.48	-	-	0.029	2.93
			11.00	0.13	0.083	0.13	-	-	0.008	0.86
			11.50	0.20	0.020	0.29	-	-	0.020	2.06
			11.70	0.00	0.000	0.00	-	-	0.000	0.00
			12.35	0.00	0.011	0.00	-	-	0.000	0.00
			12.50	0.14	0.007	0.58	-	-	0.010	1.03
			12.60	0.00	0.000	0.00	-	-	0.000	0.00
			13.15	0.00	0.003	0.00	-	-	0.000	0.00
			13.20	0.14	0.021	0.27	-	-	0.007	0.67
			13.50	0.00	0.070	0.00	-	-	0.000	0.00
			14.00	0.28	0.200	0.32	-	-	0.067	6.83

**Table E3-75 Stream G6 Discharge Data**

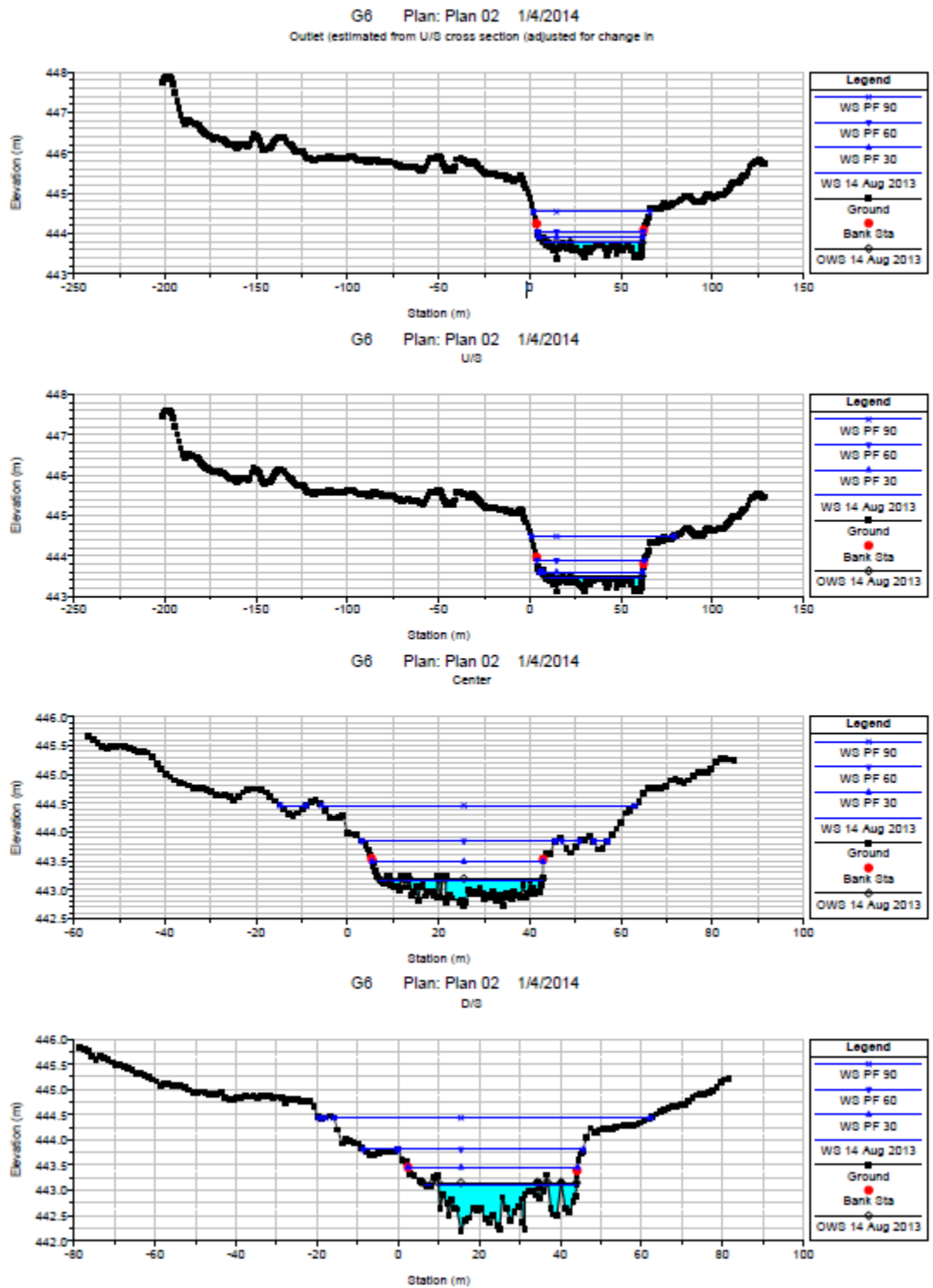
Site Information	Discharge Measurement							
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)	Qi	% of Total Q	Station	Depth
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m)	(m)
	15.00	0.12	0.120	0.08	-	-	0.010	0.98
	16.00	0.12	0.205	0.31	-	-	0.037	3.78
	17.00	0.29	0.245	0.10	-	-	0.029	2.95
	18.00	0.20	0.240	0.26	-	-	0.052	5.29
	19.00	0.28	0.240	0.05	-	-	0.013	1.28
	19.80	0.32	0.048	0.05	-	-	0.009	0.89
	20.10	0.00	0.015	0.00	-	-	0.000	0.00
	20.20	0.30	0.186	0.02	-	-	0.002	0.21
	20.80	0.32	0.064	0.02	-	-	0.003	0.33
	21.20	0.00	0.000	0.00	-	-	0.000	0.00
	21.50	0.00	0.020	0.00	-	-	0.000	0.00
	21.60	0.39	0.142	0.00	-	-	0.000	0.00
	22.00	0.32	0.320	0.25	-	-	0.056	5.69
	23.00	0.32	0.568	0.27	-	-	0.112	11.42
	24.60	0.39	0.152	-0.03	-	-	-0.012	-1.19
	25.00	0.37	0.385	0.02	-	-	0.005	0.53
	26.00	0.40	0.320	0.19	-	-	0.076	7.73
	27.00	0.24	0.220	0.15	-	-	0.036	3.66
	28.00	0.20	0.175	0.02	-	-	0.004	0.41
	29.00	0.15	0.250	0.10	-	-	0.015	1.53
	30.00	0.35	0.335	0.04	-	-	0.014	1.42
	31.00	0.32	0.270	0.09	-	-	0.029	2.93
	32.00	0.22	0.280	0.22	-	-	0.048	4.92

**Table E3-75 Stream G6 Discharge Data**

Site Information	Discharge Measurement								
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)	Qi	% of Total Q	Station	Depth	
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m)	(m)	
	33.00	0.34	0.395	0.19	-	-	0.065	6.57	
	34.00	0.45	0.350	0.09	-	-	0.041	4.12	
	35.00	0.25	0.295	0.10	-	-	0.025	2.54	
	36.00	0.34	0.310	0.05	-	-	0.017	1.73	
	37.00	0.28	0.290	0.05	-	-	0.014	1.42	
	38.00	0.30	0.305	0.19	-	-	0.057	5.80	
	39.00	0.31	0.338	0.01	-	-	0.004	0.39	
	40.50	0.14	0.180	0.20	-	-	0.035	3.56	
	41.50	0.22	0.160	0.10	-	-	0.022	2.24	
	42.50	0.10	0.015	0.20	-	-	0.013	1.32	
	42.80	0.00	0.000	Edge of Water (RDB)					
	<b>Total</b>		<b>8.09</b>				<b>0.98</b>	<b>100</b>	

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-28 Stream G6 Transects Used for Hydraulic Modelling

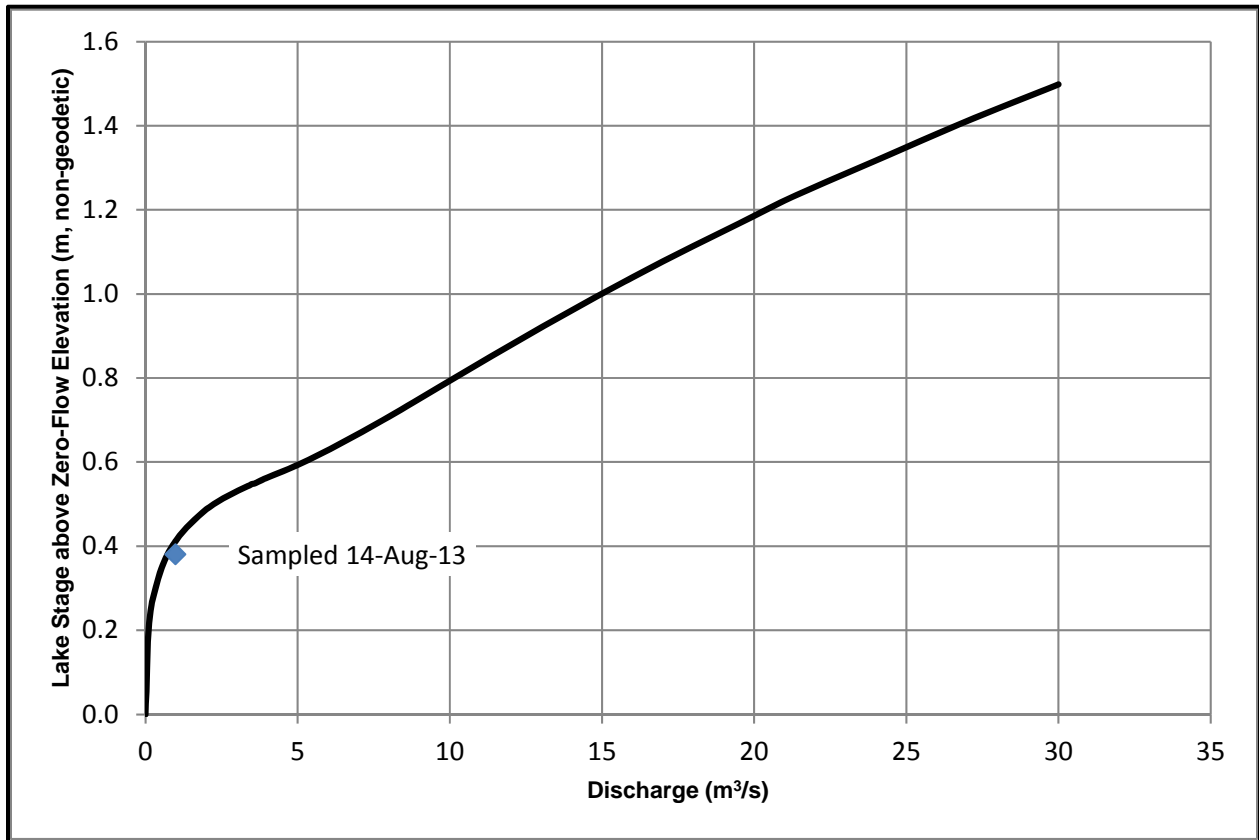


**Table E3-76 Stream G6 Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)		(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	
G6	4	14-Aug-13	0.98	443.39	443.801	443.773	65	0.171	-	443.80	0.00300	0.10	9.7	53.9	Estimated
G6	4	PF 30	2.90	443.39	443.915	-	65	0.142	-	443.92	0.00365	0.18	16.0	56.9	
G6	4	PF 60	6.80	443.39	444.045	-	65	0.124	-	444.05	0.00441	0.29	23.5	58.1	
G6	4	PF 90	19.00	443.39	444.533	-	65	0.091	-	444.54	0.00136	0.36	53.1	63.8	
G6	3	14-Aug-13	0.98	443.11	443.466	443.496	35	0.180	-	443.47	0.01087	0.15	6.6	50.7	Surveyed
G6	3	PF 30	2.90	443.11	443.595	-	35	0.151	-	443.60	0.00688	0.21	13.5	55.1	
G6	3	PF 60	6.80	443.11	443.885	-	35	0.113	-	443.89	0.00158	0.23	30.3	58.9	
G6	3	PF 90	19.00	443.11	444.482	-	35	0.077	-	444.49	0.00054	0.28	68.9	78.3	
G6	2	14-Aug-13	0.98	442.72	443.17	443.191	35	0.220	-	443.17	0.00665	0.13	7.4	32.4	Surveyed
G6	2	PF 30	2.90	442.72	443.487	-	35	0.163	-	443.49	0.00172	0.15	18.9	37.5	
G6	2	PF 60	6.80	442.72	443.839	-	35	0.121	-	443.84	0.00108	0.20	33.5	49.4	
G6	2	PF 90	19.00	442.72	444.459	-	35	0.099	-	444.46	0.00075	0.27	71.8	74.5	
G6	1	14-Aug-13	0.98	442.20	443.118	443.153	-	0.220	442.49	443.12	0.00063	0.06	15.5	34.6	Surveyed
G6	1	PF 30	2.90	442.20	443.453	-	-	0.183	442.61	443.45	0.00063	0.10	28.6	41.8	
G6	1	PF 60	6.80	442.20	443.811	-	-	0.140	442.74	443.81	0.00063	0.15	44.7	53.9	
G6	1	PF 90	19.00	442.20	444.436	-	-	0.114	442.95	444.44	0.00063	0.22	85.0	79.8	

Notes: Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.  
 All other profiles are used to represent a possible range of discharges to estimate a lake outlet rating curve (100 flow profiles computed in total, only select profiles shown).  
 River station values decrease in the downstream direction.  
 Manning's n varies vertically for this reach according to the large-scale roughness resistance equation developed by Bathurst (1978 and 2002).  
 m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre; - = no data available.

Figure E3-29 Lake G6 Outlet Rating Curve



m = metre; m<sup>3</sup>/s = cubic metres per second.

## E3.17 Lake G13 Outlet

Survey Date: 12-Sep-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 529293 m E, 7191917 m N

Outlet Coordinates (Geographic): 64°51'01" N 110°22'56" W



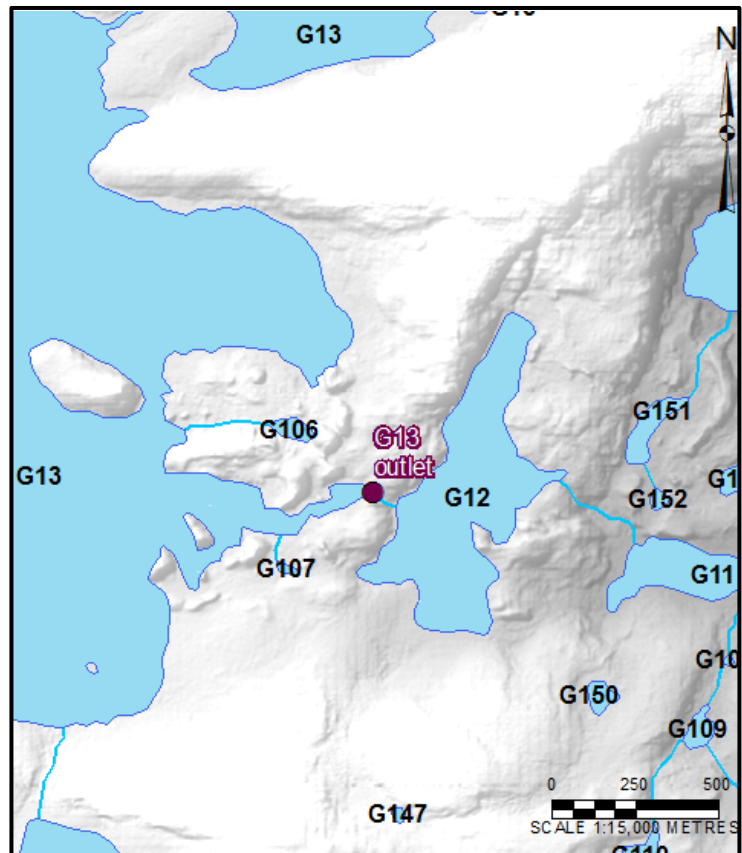
Downstream view of Lake G13 outlet looking east



Lake G13 upstream view of downstream cross-section



Lake G13 downstream view of downstream cross-section



NTS Mapping of Area

**Table E3-77 Summary of Coordinates at Lake G13 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (non-geodetic)	7173921.34	547387.80
Outlet	529293	7191917

**Table E3-78 2013 Hydrometric Data at Lake G13 and Outlet Station**

Date	Time (24-hour)	Non-geodetic Benchmark Elevation <sup>(a)</sup> (m)	Non-geodetic Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
12-Sep-13	12:30	443.57	467.78	0.48	0.29

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-79 Geomorphic Parameters at Lake G13 and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	294.0	ha	
Drainage Area (DEM) <sup>(a)</sup>	5855.5	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	447.30	m	
Surveyed Local Stream Slope	0.043	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.012	m/m	
Average Bankfull Width	29.2	m	Bankfull spanned both the main and side channels
Channel Material	60% boulder, 30% cobble, 20% silt		
Bank Material	60% boulder, 15% cobble, 10% silt, 5% coarse gravel, 5% medium gravel, 5% coarse sand		
Vegetation	Low shrub tundra		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre.

**Table E3-80 Stream G13 Discharge Data**

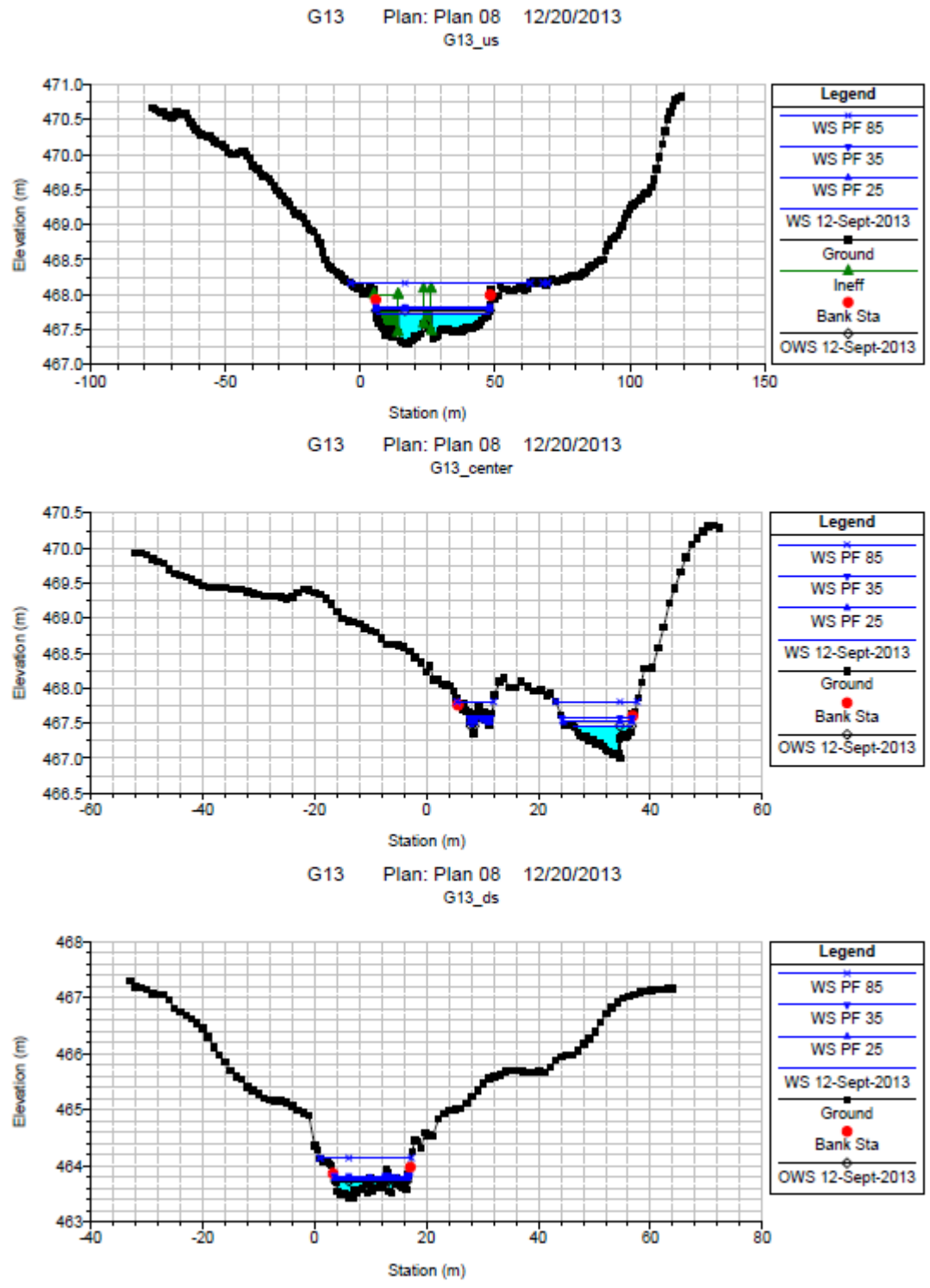
Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	12:30		<b>Location</b>	Centre cross-section approximately 50 m downstream of lake outlet			
<b>Lake Name</b>	Lake G13		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	SonTek FlowTracker			
<b>Date Monitored</b>	12-Sep-13		<b>Flow Meter Type</b>	Handheld ADV flowmeter		<b>Instrument Serial #</b>	P4017			
<b>Personnel</b>	DC, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	529329	7191920	0.3	0.00	0.006	Edge of Water (LDB of left downstream side channel)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.48		0.4	0.12	0.012	0.207	-	-	0.0025	0.85
<b>Discharge (m<sup>3</sup>/s)</b>	0.29		0.5	0.12	0.010	0.244	-	-	0.0029	1.00
<b>Notes</b>			0.6	0.08	0.008	0.310	-	-	0.0025	0.85
Station 0.3 m to 1.0 m was a side channel that was also gauged to determine the total outflow from Lake G13.			0.7	0.08	0.006	0.307	-	-	0.0025	0.84
			0.8	0.04	0.004	0.300	-	-	0.0012	0.41
			0.9	0.04	0.002	0.196	-	-	0.0008	0.27
			1.0	0.00	0.000	Edge of Water (RDB of left downstream side channel)				
			0.0	0.00	0.114	Edge of Water (LDB of right downstream main channel)				
			3.8	0.06	0.021	0.000	-	-	0.0000	0.00
			4.1	0.08	0.024	0.000	-	-	0.0000	0.00
			4.4	0.08	0.027	-0.007	-	-	-0.0002	0.00
			4.7	0.10	0.030	0.009	-	-	0.0003	-0.06
			5.0	0.10	0.030	0.001	-	-	0.0000	0.09
			5.3	0.10	0.030	0.023	-	-	0.0007	0.01
			5.6	0.10	0.033	0.030	-	-	0.0009	0.24
			5.9	0.12	0.039	0.080	-	-	0.0029	0.31
			6.2	0.14	0.045	0.134	-	-	0.0056	0.98
			6.5	0.16	0.048	0.230	-	-	0.0110	1.92
			6.8	0.16	0.048	0.409	-	-	0.0196	3.77
			7.1	0.16	0.051	0.477	-	-	0.0229	6.71
			7.4	0.18	0.057	0.509	-	-	0.0275	7.82

**Table E3-80 Stream G13 Discharge Data**

Site Information	Discharge Measurement								
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)	Qi	% of Total Q	Station	Depth	
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m)	(m)	
	7.7	0.20	0.066	0.539	-	-	0.0323	9.39	
	8.0	0.24	0.060	0.342	-	-	0.0246	11.05	
	8.3	0.16	0.051	0.407	-	-	0.0195	8.41	
	8.6	0.18	0.057	0.234	-	-	0.0126	6.67	
	8.9	0.20	0.048	0.191	-	-	0.0115	4.32	
	9.2	0.12	0.081	0.310	-	-	0.0112	3.92	
	9.5	0.42	0.081	0.124	-	-	0.0156	3.81	
	9.8	0.12	0.060	-0.028	-	-	-0.0010	5.34	
	10.1	0.28	0.084	0.314	-	-	0.0264	-0.34	
	10.4	0.28	0.096	0.381	-	-	0.0320	9.01	
	10.7	0.36	0.054	0.040	-	-	0.0043	10.93	
	11.0	0.00	0.000	Edge of Water (RDB of right downstream main channel)					
	<b>Total</b>		<b>1.38</b>				<b>0.29</b>	<b>100</b>	

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-30 Stream G13 Transects Used for Hydraulic Modelling



**Table E3-81 Stream G13 Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)		(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	
G13	3	12-Sep-13	0.29	467.30	467.730	467.772	33 (To Stn 2)	0.650	467.39	467.73	0.00346	0.04	8.0	41.5	Surveyed
G13	3	PF 25	0.47	467.30	467.796	-	33 (To Stn 2)	0.632	467.42	467.80	0.00395	0.05	10.0	42.2	
G13	3	PF 35	0.67	467.30	467.823	-	33 (To Stn 2)	0.440	467.44	467.82	0.00304	0.06	10.8	42.2	
G13	3	PF 85	15.52	467.30	468.165	-	33 (To Stn 2)	0.049	467.77	468.18	0.00171	0.50	31.1	68.4	
G13	2	12-Sep-13	0.29	466.99	467.456	467.46	62 (To Stn 1)	0.650	-	467.46	0.05613	0.13	2.3	10.9	Surveyed
G13	2	PF 25	0.47	466.99	467.521	-	62 (To Stn 1)	0.591	-	467.52	0.05814	0.15	3.1	13.5	
G13	2	PF 35	0.67	466.99	467.575	-	62 (To Stn 1)	0.556	-	467.58	0.05897	0.17	3.9	14.7	
G13	2	PF 85	15.52	466.99	467.805	-	62 (To Stn 1)	0.059	467.81	468.00	0.05122	1.93	8.0	21.1	
G13	1	12-Sep-13	0.29	463.41	463.732	463.729	-	0.398	463.57	463.73	0.05990	0.17	1.7	10.7	Surveyed
G13	1	PF 25	0.47	463.41	463.775	-	-	0.365	463.60	463.78	0.05999	0.21	2.2	11.2	
G13	1	PF 35	0.67	463.41	463.82	-	-	0.340	463.63	463.82	0.05998	0.25	2.7	12.5	
G13	1	PF 85	15.52	463.41	464.14	-	-	0.056	464.14	464.38	0.04664	2.13	7.3	16.3	

Notes:

Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.

All other profiles are used to represent a possible range of discharges to estimate a lake outlet rating curve (100 flow profiles computed in total, only select profiles shown).

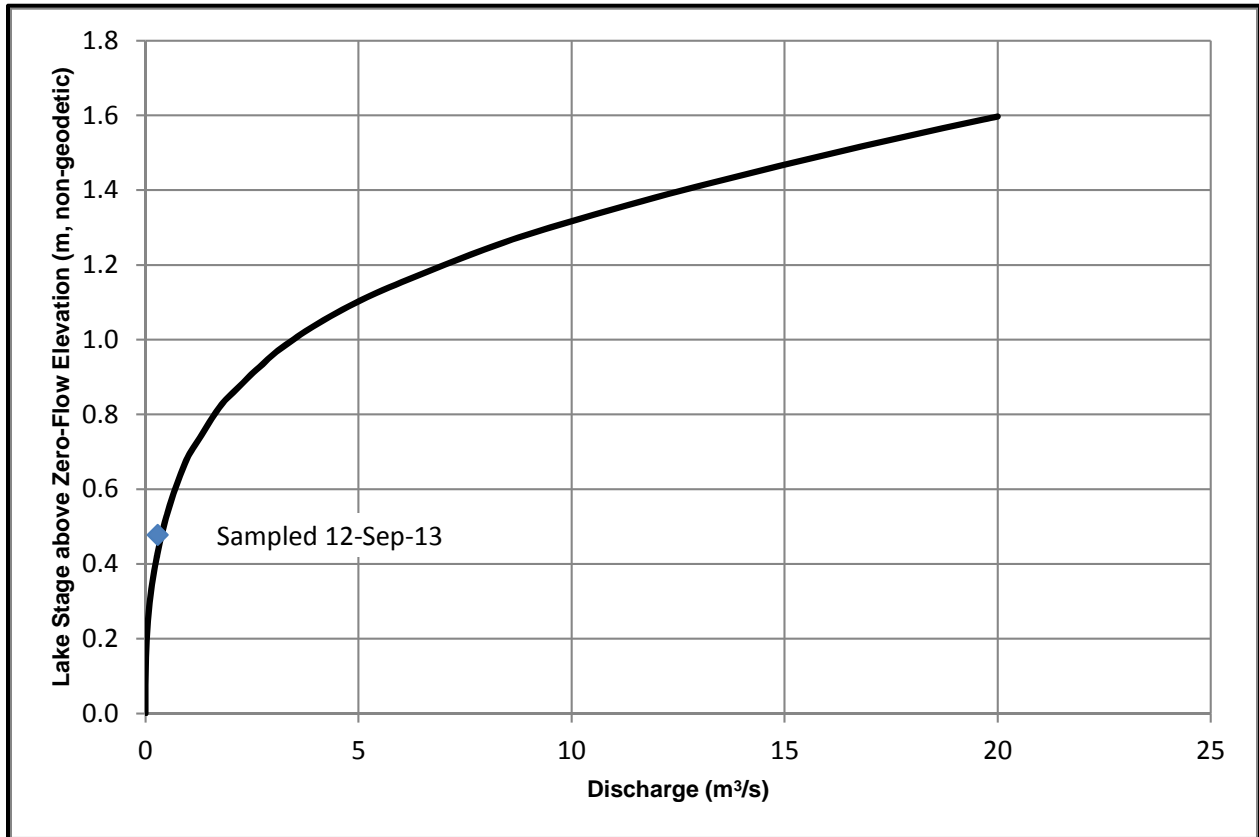
River station values decrease in the downstream direction.

Manning's n varies vertically for this reach according to the large-scale roughness resistance equation developed by Bathurst (1978 and 2002).

Additional interpolated cross-sections were used for hydraulic modelling, but are not included in the summary tables.

m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre; - = no data available.

Figure E3-31 Lake G13 Outlet Rating Curve



m = metre; m³/s = cubic metres per second.

### E3.18 Lake G17 Outlet

Survey Date: 7-Sep-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 526954 m E, 7196801 m N

Outlet Coordinates (Geographic): 64°53'39" N, 110°25'52" W



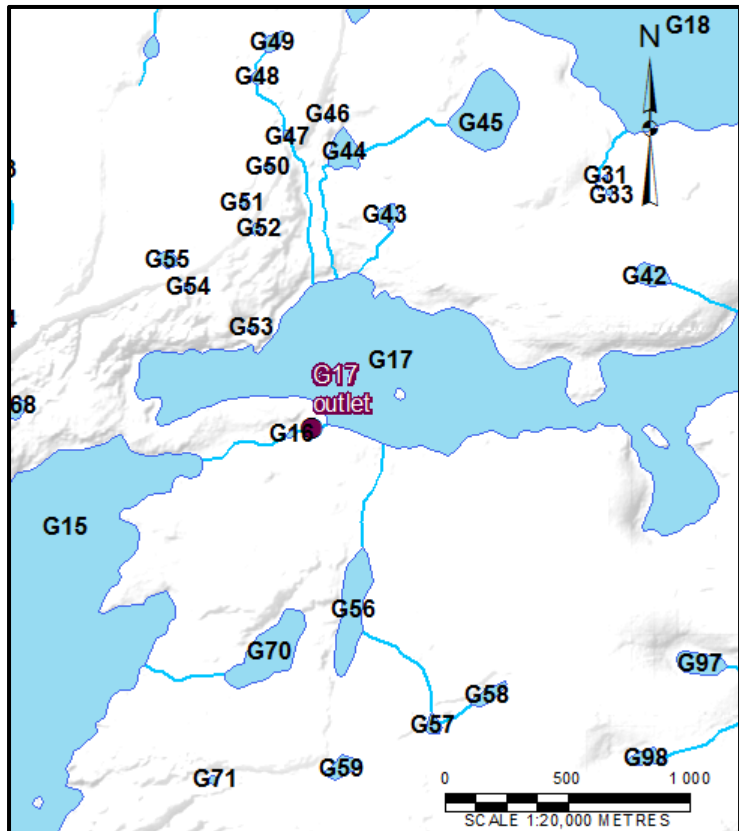
Downstream view of Lake G17 outlet looking west.



Lake G17 upstream view of centre cross-section



Lake G17 downstream view of downstream cross-section



NTS Mapping of Area

**Table E3-82 Summary of Coordinates at Lake G17 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (non-geodetic)	526877.20	7196808.15
Outlet	526954	7196801

**Table E3-83 2013 Hydrometric Data at Lake G17 and Outlet Station**

Date	Time (24-hour)	Non-geodetic Benchmark Elevation <sup>(a)</sup> (m)	Non-geodetic Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
7-Sep-13	15:00	478.36	477.00	0.32	0.03

a) Elevation of the Benchmark set to 478.36 m to match lake elevations with LiDAR Water Surface Elevation of Lake G17.  
m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-84 Geomorphic Parameters at Lake G17 and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	140.5	ha	
Drainage Area (DEM) <sup>(a)</sup>	1417.8	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	477.00	m	
Surveyed Local Stream Slope	0.0014	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.0011	m/m	
Average Bankfull Width	15.6	m	
Channel Material	80% boulder, 10% fine sand, 10% silt		
Bank Material	40% boulder, 20% fine sand, 20% cobble, 10% coarse sand, 10% silt		
Vegetation	Grass and low shrub tundra		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E3-85 Stream G17 Discharge Data**

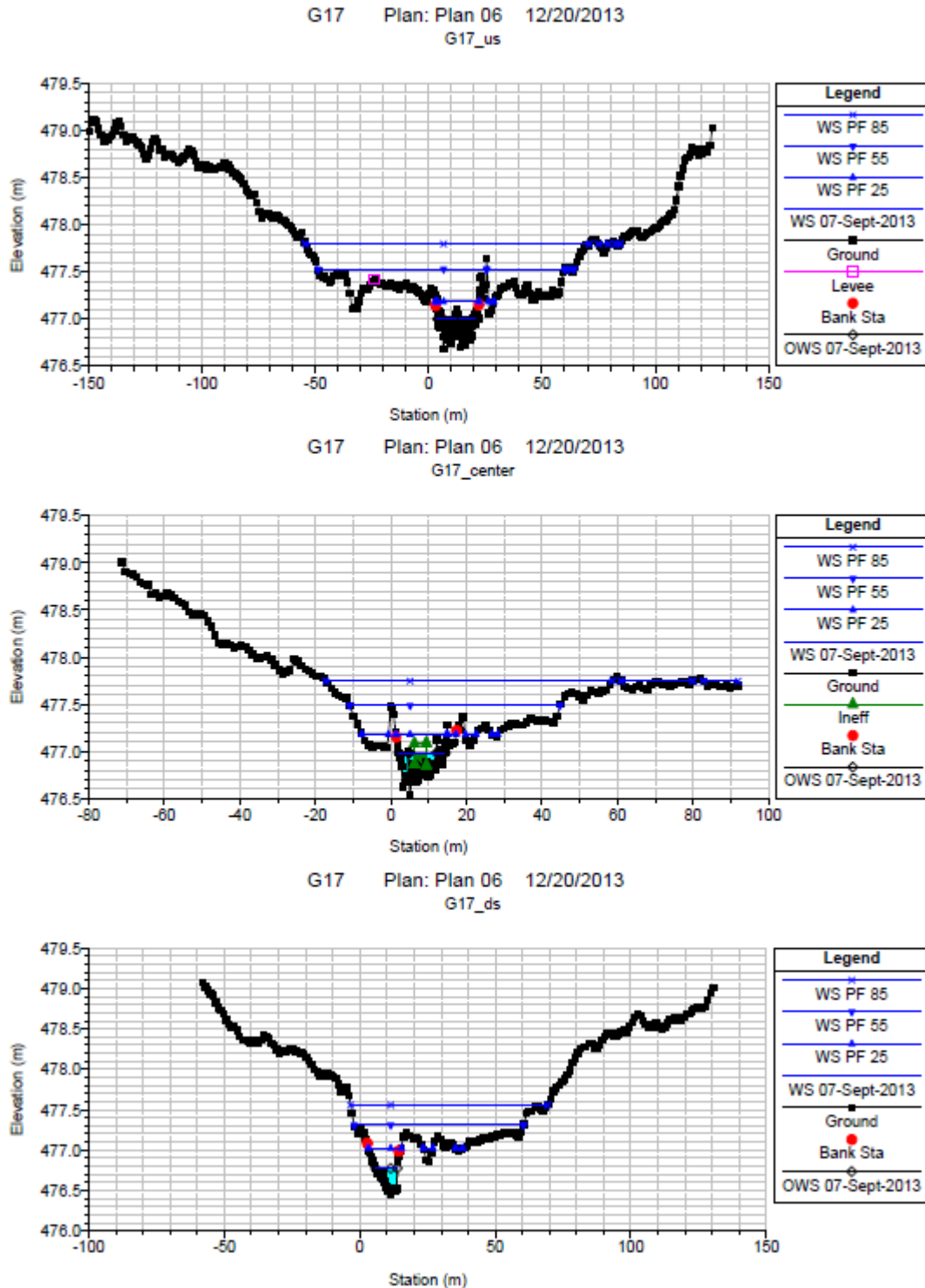
Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	15:00		<b>Location</b>	Approximately 400 m downstream of Lake outlet			
<b>Lake Name</b>	Lake G17		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	SonTek FlowTracker			
<b>Date Monitored</b>	7-Sep-13		<b>Flow Meter Type</b>	Handheld ADV flowmeter		<b>Instrument Serial #</b>	P4017			
<b>Personnel</b>	DC, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	526579	7196732	1.4	0.00	0.014	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.32		1.6	0.18	0.026	0.030	-	-	0.0008	2.40
<b>Discharge (m<sup>3</sup>/s)</b>	0.03		1.7	0.16	0.024	0.030	-	-	0.0007	2.14
<b>Notes</b>			1.9	0.16	0.026	0.050	-	-	0.0012	3.56
			2.0	0.18	0.047	0.060	-	-	0.0016	4.81
			2.2	0.45	0.068	0.000	-	-	0.0000	0.00
			2.3	0.46	0.069	0.000	-	-	0.0000	0.00
			2.5	0.46	0.056	0.017	-	-	0.0012	3.48
			2.6	0.28	0.050	0.007	-	-	0.0003	0.87
			2.8	0.38	0.060	0.016	-	-	0.0009	2.71
			2.9	0.42	0.062	0.015	-	-	0.0009	2.80
			3.1	0.40	0.057	0.006	-	-	0.0004	1.07
			3.2	0.36	0.054	0.004	-	-	0.0002	0.64
			3.4	0.36	0.050	0.035	-	-	0.0019	5.61
			3.5	0.30	0.044	0.025	-	-	0.0011	3.34
			3.7	0.28	0.039	0.027	-	-	0.0011	3.37
			3.8	0.24	0.033	0.024	-	-	0.0009	2.56
			4.0	0.20	0.028	0.024	-	-	0.0007	2.14
			4.1	0.18	0.041	0.060	-	-	0.0016	4.81

**Table E3-85 Stream G17 Discharge Data**

Site Information	Discharge Measurement								
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)			Qi	% of Total Q	
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%	
	4.3	0.36	0.048	0.069	-	-	0.0037	11.06	
	4.4	0.28	0.042	0.070	-	-	0.0029	8.73	
	4.6	0.28	0.035	0.097	-	-	0.0041	12.09	
	4.7	0.18	0.025	0.102	-	-	0.0028	8.17	
	4.9	0.16	0.023	0.050	-	-	0.0012	3.56	
	5.0	0.14	0.027	0.070	-	-	0.0015	4.36	
	5.2	0.22	0.022	0.050	-	-	0.0019	5.71	
	5.4	0.00	0.000	Edge of Water (RDB)					
	<b>Total</b>		<b>1.07</b>				<b>0.03</b>	<b>100</b>	

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-32 Stream G17 Transects Used for Hydraulic Modelling



**Table E3-86 Stream G17 Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)		(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	
G17	3	7-Sep-13	0.03	476.69	477.001	476.999	45 (To Stn 2)	0.248	476.78	477.00	0.00034	0.02	1.9	14.7	Surveyed
G17	3	PF 25	0.24	476.69	477.183	-	45 (To Stn 2)	0.058	476.86	477.18	0.00005	0.05	5.3	21.7	
G17	3	PF 55	5.58	476.69	477.53	-	45 (To Stn 2)	0.056	477.12	477.53	0.00060	0.18	30.4	110.9	
G17	3	PF 85	13.68	476.69	477.797	-	45 (To Stn 2)	0.061	477.32	477.80	0.00051	0.22	62.1	131.9	Surveyed
G17	2	7-Sep-13	0.03	476.54	476.982	476.985	115 (To Stn 2)	0.600	476.69	476.98	0.00211	0.02	1.5	11.2	
G17	2	PF 25	0.24	476.54	477.180	-	115 (To Stn 2)	0.267	476.79	477.18	0.00106	0.04	5.7	26.9	
G17	2	PF 55	5.58	476.54	477.486	-	115 (To Stn 2)	0.058	477.21	477.49	0.00117	0.29	19.4	55.7	
G17	2	PF 85	13.68	476.54	477.748	-	115 (To Stn 2)	0.052	477.23	477.76	0.00136	0.36	37.9	104.0	Surveyed
G17	1	7-Sep-13	0.03	476.46	476.772	476.774	-	0.580	476.52	476.77	0.00183	0.02	1.5	8.0	
G17	1	PF 25	0.24	476.46	477.022	-	-	0.286	476.58	477.02	0.00183	0.06	4.3	18.4	
G17	1	PF 55	5.58	476.46	477.309	-	-	0.053	476.91	477.32	0.00183	0.33	16.7	62.5	
G17	1	PF 85	13.68	476.46	477.556	-	-	0.061	477.24	477.57	0.00183	0.42	32.9	72.6	

**Notes:**

Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.

All other profiles are used to represent a possible range of discharges to estimate a lake outlet rating curve (100 flow profiles computed in total, only select profiles shown).

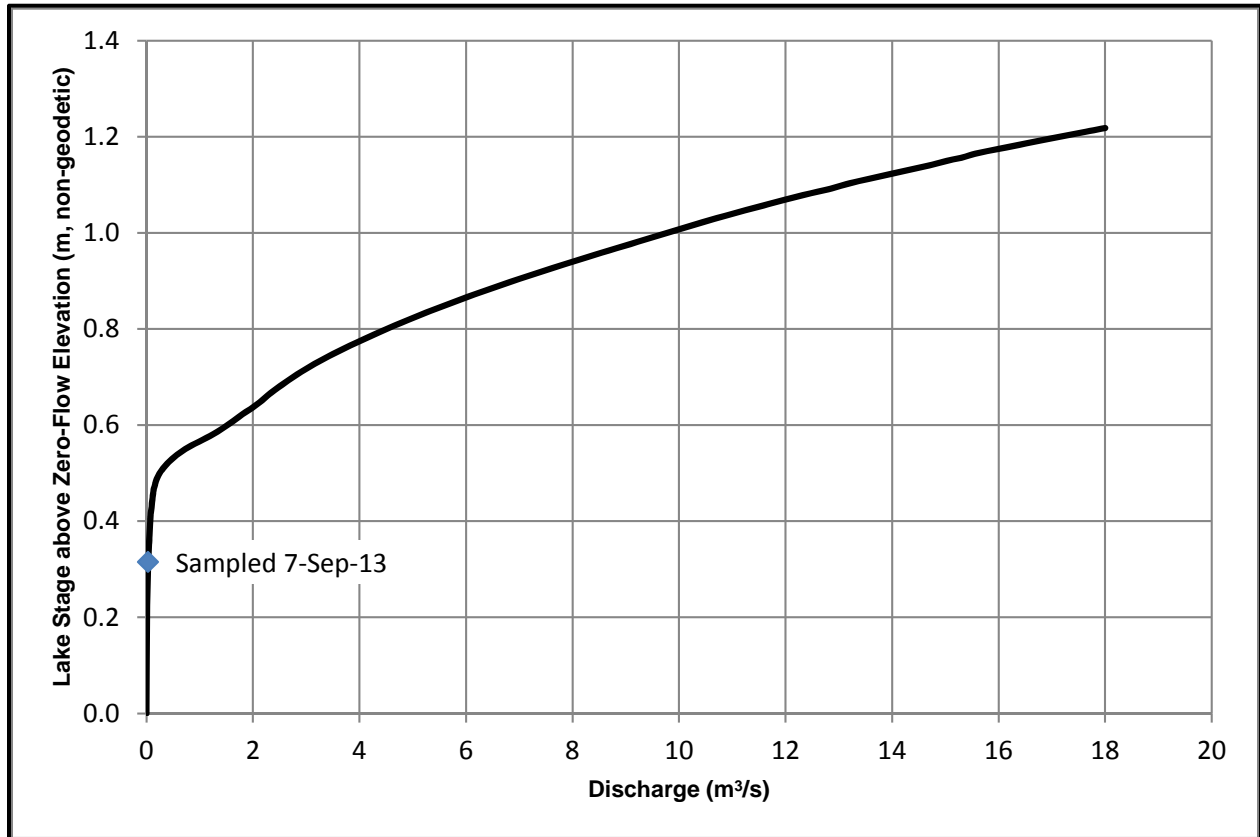
River station values decrease in the downstream direction.

Manning's n varies vertically for this reach according to the large-scale roughness resistance equation developed by Bathurst (1978 and 2002).

Additional interpolated cross-sections were used for hydraulic modelling, but are not included in the summary tables.

m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre; - = no data available.

Figure E3-33 Lake G17 Outlet Rating Curve



m = metre; m³/s = cubic metres per second.

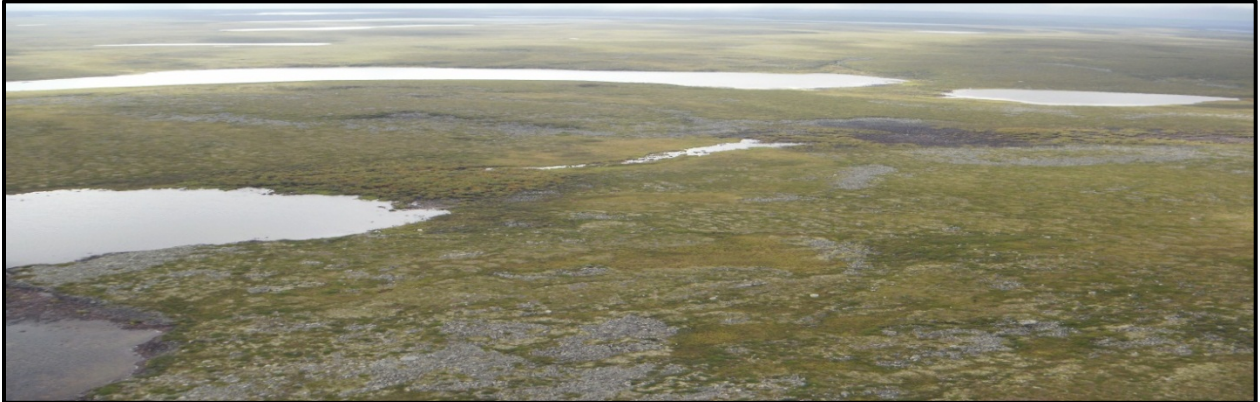
### E3.19 Lake G474 Outlet

Survey Date: 15-Sep-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 545413 m E, 7179684 m N

Outlet Coordinates (Geographic) : 64°44'19" N, 110°02'46" W



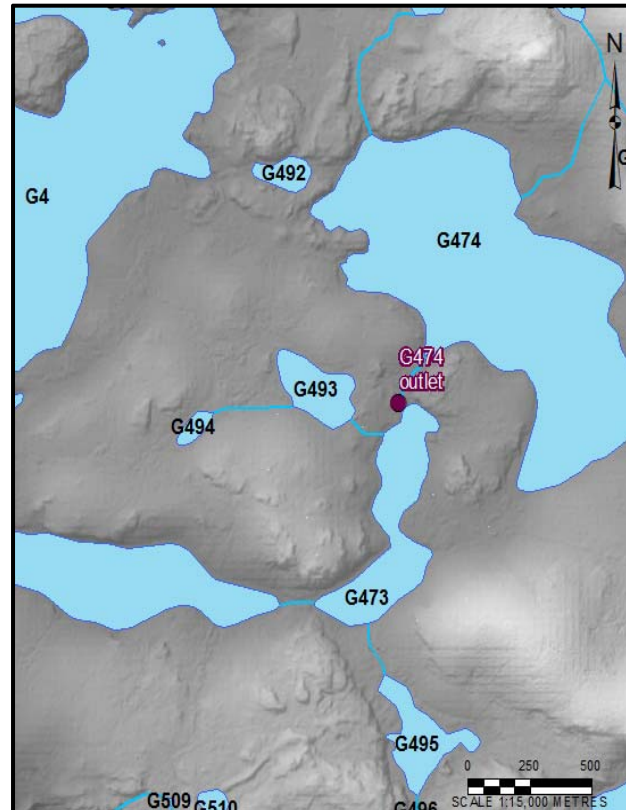
Downstream view of Lake G474 outlet looking southwest (Lake G473 at top left)



Lake G474 upstream view of centre cross-section



Lake G474 downstream view of outlet



NTS Mapping of Area

**Table E3-87 Summary of Coordinates at Lake G474 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (geodetic)	545337.25	7179638.81
Outlet	545413	7179684

**Table E3-88 2013 Hydrometric Data at Lake G474 and Outlet Station**

Date	Time (24-hour)	Benchmark Elevation (m)	Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
15-Sep-13	12:00	439.57	438.05	Not measured	0.03

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-89 Geomorphic Parameters at Lake G474 and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	82.5	ha	
Drainage Area (DEM) <sup>(a)</sup>	1186.5	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	438.20	m	
Surveyed Local Stream Slope	0.0022	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.0022	m/m	
Average Bankfull Width	3.8	m	
Channel Material	60% boulder, 20% silt, 10% cobble, 10% clay		
Bank Material	50% boulder, 20% silt, 20% clay, 10% cobble		
Vegetation	Grass		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

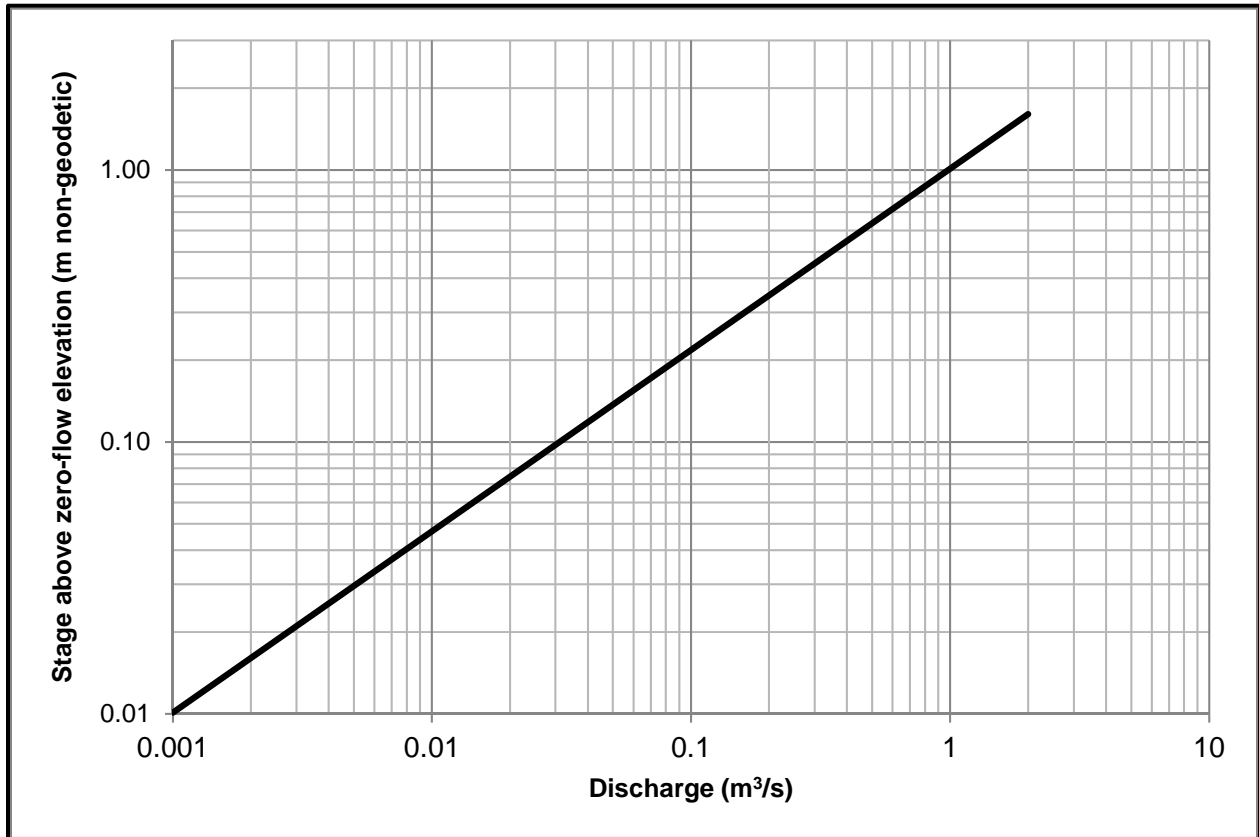
m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E3-90 Stream G474 Discharge Data**

Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	12:00		<b>Location</b>	Centre cross-section, approximately 200 m downstream of Lake outlet			
<b>Lake Name</b>	Lake G474		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	Marsh-McBirney FLO-MATE Model 2000			
<b>Date Monitored</b>	15-Sep-13		<b>Flow Meter Type</b>	Handheld electromagnetic sensor flowmeter		<b>Instrument Serial #</b>	2005872			
<b>Personnel</b>	DC, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	545311	719513	0.70	0.00	0.005	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	Not measured		0.85	0.06	0.011	0.02	-	-	0.0002	0.53
<b>Discharge (m<sup>3</sup>/s)</b>	0.03		1.00	0.08	0.044	0.04	-	-	0.0005	1.42
<b>Notes</b>			1.15	0.50	0.077	0.05	-	-	0.0038	11.10
			1.30	0.52	0.078	0.11	-	-	0.0086	25.40
			1.45	0.52	0.077	0.11	-	-	0.0086	25.40
			1.60	0.50	0.074	0.08	-	-	0.0060	17.76
			1.75	0.48	0.067	0.02	-	-	0.0014	4.26
			1.90	0.42	0.050	0.04	-	-	0.0025	7.46
			2.05	0.24	0.035	0.03	-	-	0.0011	3.20
			2.20	0.22	0.026	0.03	-	-	0.0010	2.93
			2.35	0.12	0.009	0.01	-	-	0.0002	0.53
			2.50	0.00	0.00	Edge of Water (RDB)				
			<b>Total</b>		<b>0.55</b>				<b>0.03</b>	<b>100</b>

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-34 Lake G474 Outlet Rating Curve



Note: Cross-sections were measured downstream of the lake outlet; therefore, a lake outlet rating curve was not developed based on survey data, but rather the regional lake outlet relationship.

m = metre; m<sup>3</sup>/s = cubic metres per second.

## E3.20 Lake G521 Outlet

Survey Date: 12-Sep-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 547935 m E, 7173106 m N

Outlet Coordinates (Geographic) : 64°40'45" N, 109°59'43"



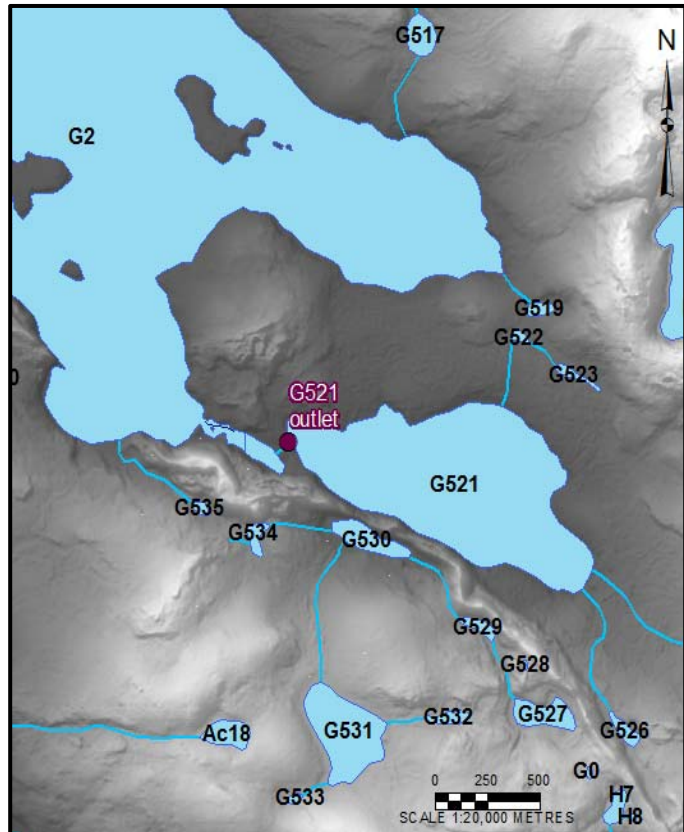
Upstream view of Lake G521 outlet looking northeast (Lake G520 at bottom)



Downstream view of Lake G521 outlet



Lake G521 downstream view of downstream cross-section (Lake G520 inlet)



NTS Mapping of Area

**Table E3-91 Summary of Coordinates at Lake G521 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Geodetic)	547906.07	7173137.59
Outlet	547935	7173106

**Table E3-92 2013 Hydrometric Data at Lake G521 and Outlet Station**

Date	Time (24-hour)	Benchmark Elevation (m)	Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
12-Sep-13	15:00	424.06	422.66	0.16	0.04

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-93 Geomorphic Parameters at Lake G521 and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	68.4	ha	
Drainage Area (DEM) <sup>(a)</sup>	493.4	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	422.80	m	
Surveyed Local Stream Slope	0.00097	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.00092	m/m	
Average Bankfull Width	10.2	m	
Channel Material	30% fine gravel, 20% medium gravel, 20% coarse sand, 20% fine sand, 10% coarse gravel		
Bank Material	20% fine gravel, 20% medium gravel, 20% coarse sand, 20% fine sand, 10% coarse gravel, 10% silt		
Vegetation	Low shrub tundra		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

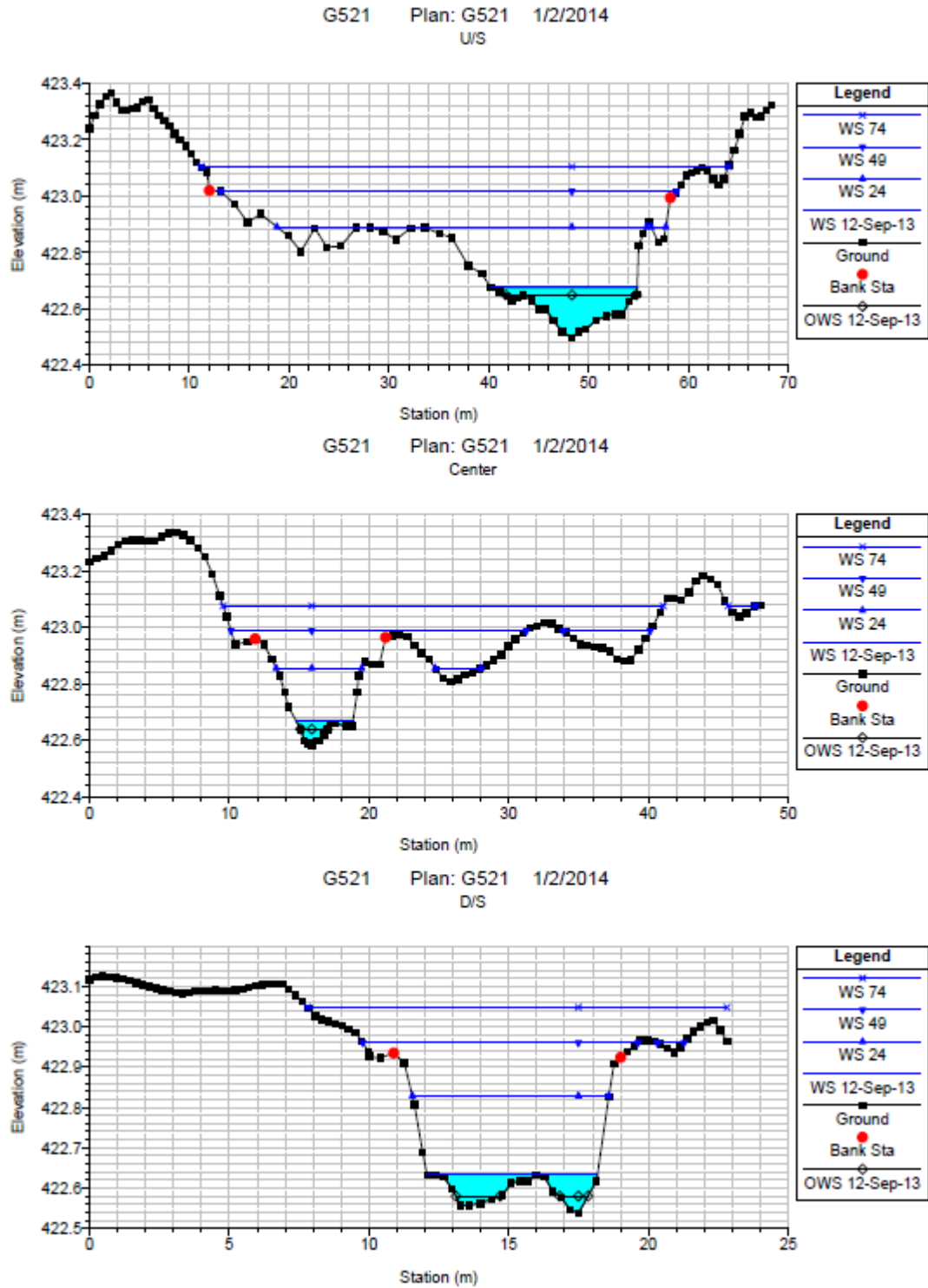
m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre.

**Table E3-94 Stream G521 Discharge Data**

Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	15:00		<b>Location</b>	Downstream cross-section approximately 200 m downstream of lake outlet			
<b>Lake Name</b>	Lake G521		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	SonTek FlowTracker			
<b>Date Monitored</b>	12-Sep-13		<b>Flow Meter Type</b>	Handheld ADV flowmeter		<b>Instrument Serial #</b>	P4017			
<b>Personnel</b>	DC, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	547704	7172965	1.3	0.00	0.004	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.16		1.5	0.04	0.012	0.000	-	-	0.0000	0.00
<b>Discharge (m<sup>3</sup>/s)</b>	0.04		1.7	0.08	0.018	0.002	-	-	0.0000	0.08
<b>Notes</b>			1.9	0.10	0.024	0.005	-	-	0.0001	0.24
			2.1	0.14	0.030	0.025	-	-	0.0007	1.67
			2.3	0.16	0.034	0.032	-	-	0.0010	2.45
			2.5	0.18	0.036	0.500	-	-	0.0180	43.00
			2.7	0.18	0.036	0.520	-	-	0.0187	44.72
			2.9	0.18	0.036	0.034	-	-	0.0012	2.92
			3.1	0.18	0.034	0.029	-	-	0.0010	2.49
			3.3	0.16	0.032	0.011	-	-	0.0004	0.84
			3.5	0.16	0.030	0.011	-	-	0.0004	0.84
			3.7	0.14	0.028	0.008	-	-	0.0002	0.54
			3.9	0.14	0.024	0.003	-	-	0.0001	0.20
			4.1	0.10	0.018	0.000	-	-	0.0000	0.00
			4.3	0.08	0.014	0.000	-	-	0.0000	0.00
			4.5	0.06	0.010	0.000	-	-	0.0000	0.00
			4.7	0.04	0.006	0.000	-	-	0.0000	0.00
			4.9	0.02	0.004	0.000	-	-	0.0000	0.00
			5.1	0.02	0.003	0.000	-	-	0.0000	0.00
			5.4	0.00	0.000	Edge of Water (RDB)				
			<b>Total</b>		<b>0.43</b>				<b>0.04</b>	<b>100</b>

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-35 Stream G521 Transects Used for Hydraulic Modelling



**Table E3-95 Stream G521 Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)		(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	
E387	2	7-Sep-13	0.05	419.06	419.302	419.304	52 (To Stn 3)	0.440	-	419.30	0.00062	0.02	2.9	15.5	Surveyed
E387	2	PF 25	0.04	419.06	419.285	-	52 (To Stn 3)	0.440	-	419.29	0.00060	0.02	2.6	15.4	
E387	2	PF 50	0.09	419.06	419.360	-	52 (To Stn 3)	0.400	-	419.36	0.00063	0.02	3.8	16.7	
E387	2	PF 100	2.89	419.06	419.799	-	52 (To Stn 3)	0.040	-	419.80	0.00016	0.07	40.0	368.9	
E387	1	7-Sep-13	0.05	418.99	419.241	419.241	53 (To Stn 2)	0.440	-	419.24	0.00177	0.03	1.7	8.6	Surveyed
E387	1	PF 25	0.04	418.99	419.227	-	53 (To Stn 2)	0.440	-	419.23	0.00161	0.03	1.5	8.5	
E387	1	PF 50	0.09	418.99	419.304	-	53 (To Stn 2)	0.397	-	419.30	0.00179	0.04	2.2	9.7	
E387	1	PF 100	2.89	418.99	419.787	-	53 (To Stn 2)	0.043	-	419.79	0.00027	0.09	34.2	325.5	

Notes:

Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.

All other profiles are used to represent a possible range of discharges to estimate a lake outlet rating curve (100 flow profiles computed in total, only select profiles shown).

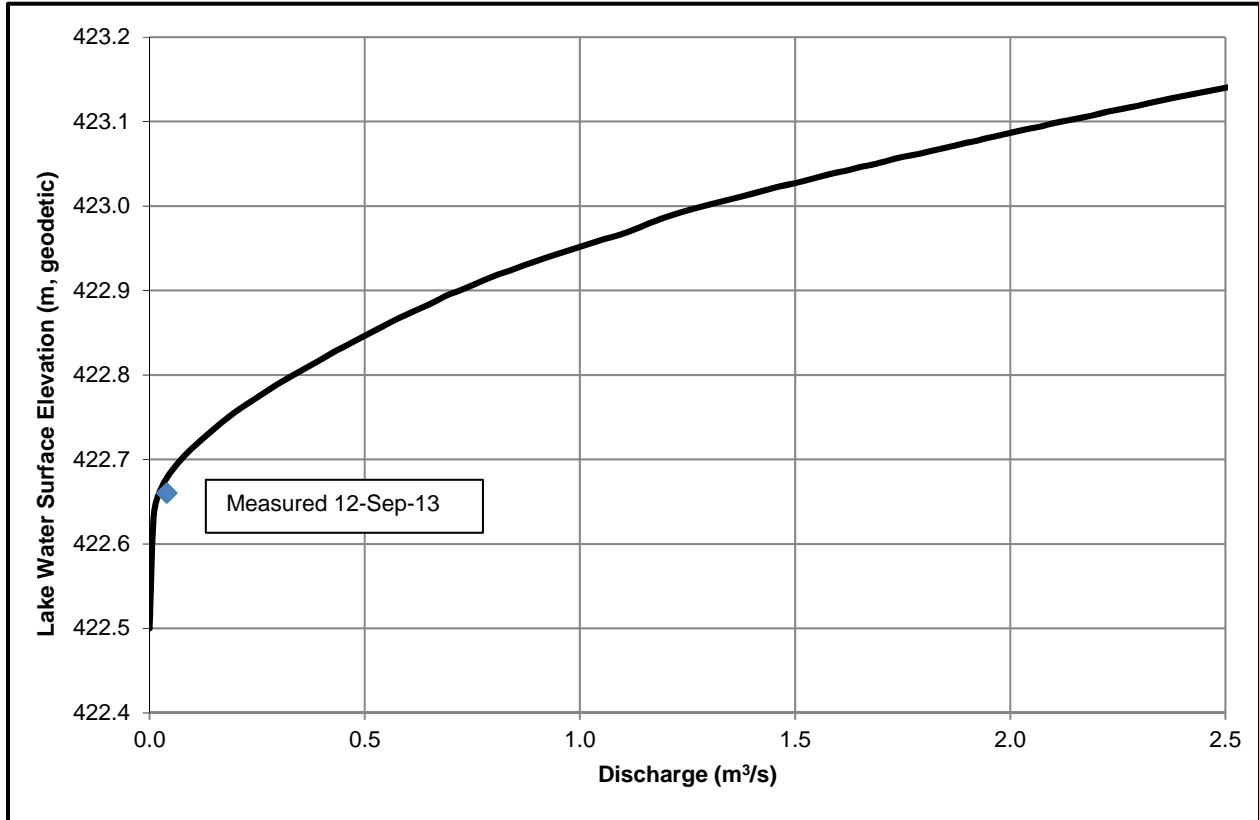
River station values decrease in the downstream direction.

Manning's n varies vertically for this reach according to the large-scale roughness resistance equation developed by Bathurst (1978 and 2002).

Additional interpolated cross-sections were used for hydraulic modelling, but are not included in the summary tables.

m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre; - = no data available.

Figure E3-36 Lake G521 Outlet Rating Curve



m = metre; m<sup>3</sup>/s = cubic metres per second.

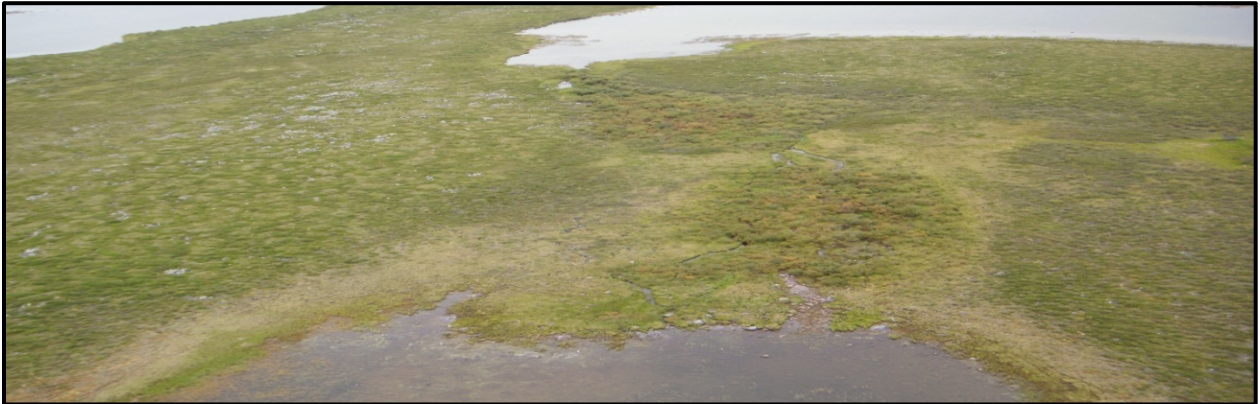
### E3.21 Lake H1 Outlet

Survey Date: 17-Sep-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 550591 m E, 7169146 m N

Outlet Coordinates (Geographic) : 64°38'36" N, 109°56'28" W



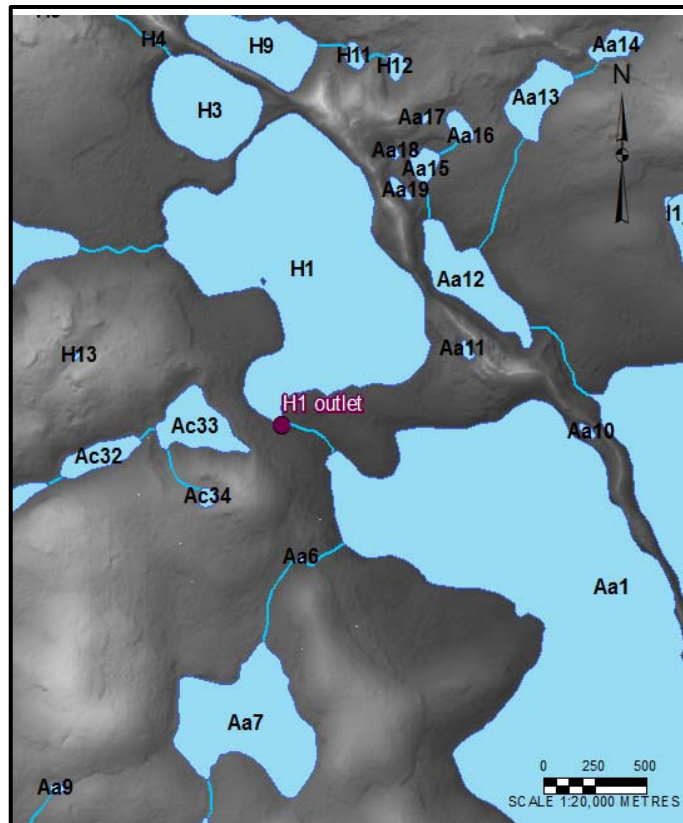
Upstream view of Lake H1 outlet looking northwest (Lac du Sauvage at bottom)



Lake H1 upstream view at upstream cross-section



Lake H1 downstream view at outlet



NTS Mapping of Area

**Table E3-96 Summary of Coordinates at Lake H1 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Geodetic)	550606.46	7169133.98
Outlet	550591	7169146

**Table E3-97 2013 Hydrometric Data at Lake H1 and Outlet Station**

Date	Time (24-hour)	Benchmark Elevation (m)	Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
17-Sep-13	9:00	419.64	418.92	0.11	0.01

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-98 Geomorphic Parameters at Lake H1 and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	101.5	ha	
Drainage Area (DEM) <sup>(a)</sup>	458.9	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	419.0	m	
Surveyed Local Stream Slope	0.0230	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.0097	m/m	
Average Bankfull Width	9.1	m	
Channel Material	80% silt, 20% boulder		
Bank Material	70% silt, 20% boulder, 10% cobble		
Vegetation	Grass		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

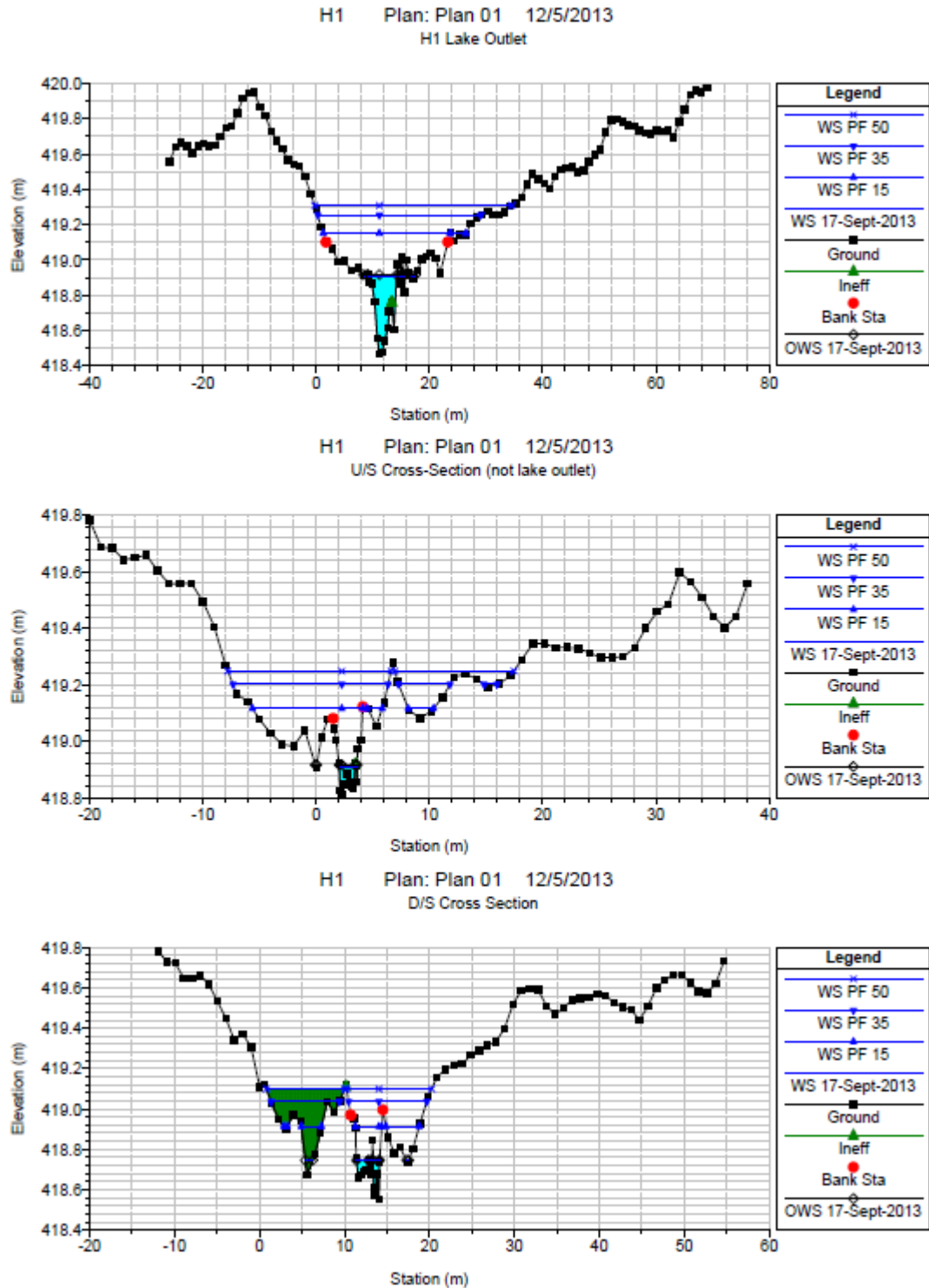
m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E3-99 Stream H1 Discharge Data**

Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	9:00		<b>Location</b>	Upstream cross-section, approximately 20 m downstream of the Lake outlet			
<b>Lake Name</b>	Lake H1		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	SonTek FlowTracker			
<b>Date Monitored</b>	17-Sep-13		<b>Flow Meter Type</b>	Handheld ADV flowmeter		<b>Instrument Serial #</b>	P4017			
<b>Personnel</b>	DC, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	550608	7169154	0.7	0.00	0.004	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.11		0.8	0.08	0.008	-	-	-	0.0000	0.00
<b>Discharge (m<sup>3</sup>/s)</b>	0.01		0.9	0.08	0.008	-	-	--	0.0010	8.48
<b>Notes</b>			1.0	0.08	0.008	-	-	-	0.0012	10.04
			1.1	0.08	0.008	-	-	-	0.0016	13.77
			1.2	0.08	0.008	-	-	-	0.0023	19.87
			1.3	0.08	0.008	-	-	-	0.0003	2.64
			1.4	0.08	0.008	-	-	-	0.0008	6.92
			1.5	0.08	0.008	-	-	-	0.0018	15.26
			1.6	0.08	0.008	-	-	-	0.0010	8.68
			1.7	0.08	0.008	-	-	-	0.0010	8.41
			1.8	0.08	0.008	-	-	-	0.0000	0.41
			1.9	0.08	0.007	-	-	-	0.0001	0.54
			2.0	0.06	0.006	-	-	-	0.0004	3.31
			2.1	0.06	0.006	-	-	-	0.0002	1.68
			2.2	0.06	0.006	-	-	-	0.0000	0.00
			2.3	0.06	0.003	-	-	-	0.0000	0.00
			2.4	0.00	0.000	Edge of Water (RDB)				
			<b>Total</b>		<b>0.12</b>				<b>0.01</b>	<b>100</b>

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-37 Stream H1 Transects Used for Hydraulic Modelling



**Table E3-100 Stream H1 Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)		(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	
H1	3	17-Sep-13	0.01	418.47	418.911	418.917	11 (To Stn 2)	0.110	418.51	418.91	0.00001	0.01	1.2	6.4	Surveyed
H1	3	PF 15	0.40	418.47	419.151	-	11 (To Stn 2)	0.101	418.68	419.15	0.00046	0.08	5.3	25.1	
H1	3	PF 35	1.00	418.47	419.255	-	11 (To Stn 2)	0.100	418.80	419.26	0.00085	0.12	8.1	28.8	
H1	3	PF 50	1.45	418.47	419.308	-	11 (To Stn 2)	0.095	418.86	419.31	0.00107	0.15	9.9	34.8	
H1	2	17-Sep-13	0.01	418.81	418.907	418.917	8 (To Stn 1)	0.110	418.86	418.91	0.01197	0.15	0.1	1.5	Surveyed
H1	2	PF 15	0.40	418.81	419.117	-	8 (To Stn 1)	0.096	419.03	419.12	0.01979	0.31	1.3	13.3	
H1	2	PF 35	1.00	418.81	419.202	-	8 (To Stn 1)	0.102	419.11	419.21	0.02046	0.37	2.7	19.4	
H1	2	PF 50	1.45	418.81	419.249	-	8 (To Stn 1)	0.101	419.14	419.26	0.01950	0.39	3.7	24.9	
H1	1	17-Sep-13	0.01	418.55	418.746	418.746	-	0.106	418.64	418.75	0.00196	0.06	0.2	3.6	Surveyed
H1	1	PF 15	0.40	418.55	418.913	-	-	0.109	418.82	418.92	0.02233	0.37	1.1	9.8	
H1	1	PF 35	1.00	418.55	419.036	-	-	0.111	418.89	419.05	0.02235	0.48	2.1	17.3	
H1	1	PF 50	1.45	418.55	419.100	-	-	0.111	418.93	419.12	0.02236	0.54	2.7	19.3	

Notes:

Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.

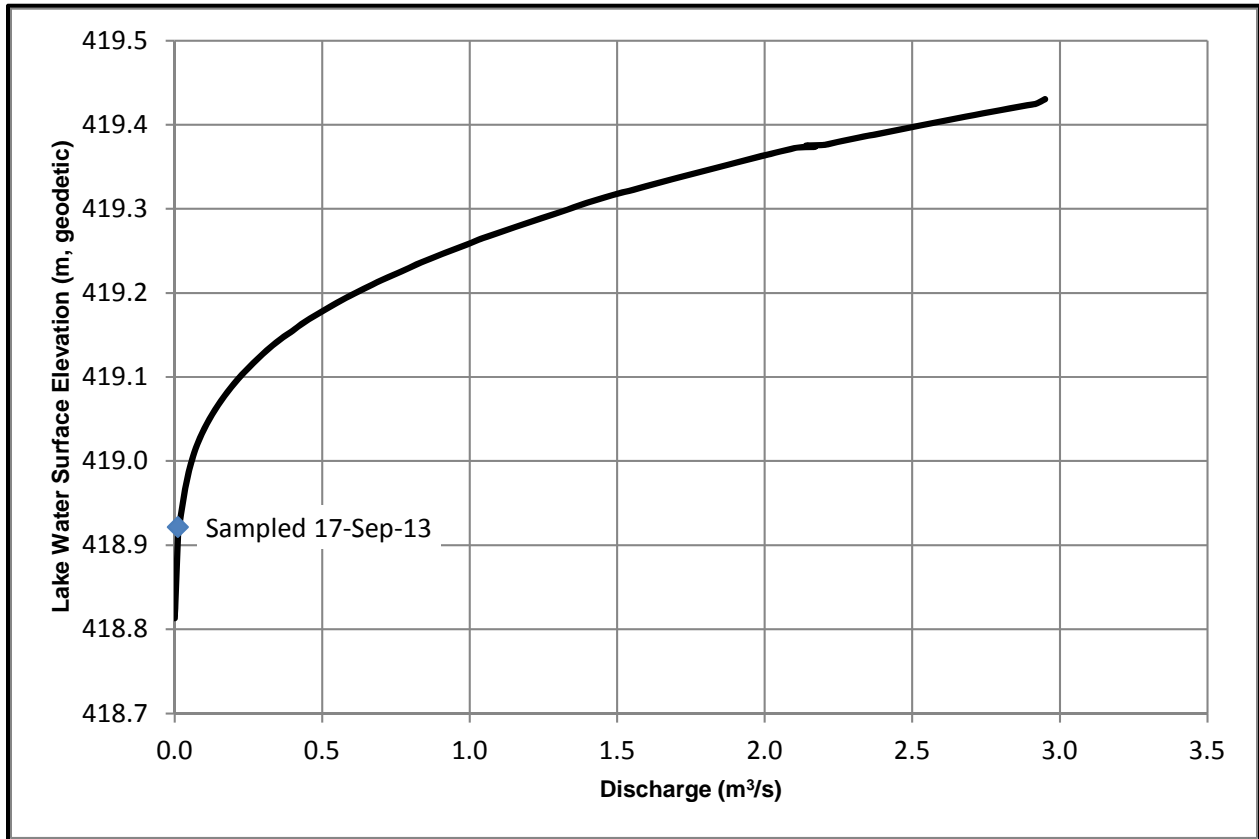
All other profiles are used to represent a possible range of discharges to estimate a lake outlet rating curve (100 flow profiles computed in total, only select profiles shown).

River station values decrease in the downstream direction.

Additional interpolated cross-sections were used for hydraulic modelling, but are not included in the summary table.

m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre; - = no data available.

Figure E3-38 Lake H1 Outlet Rating Curve



m = metre; m<sup>3</sup>/s = cubic metres per second.

## E3.22 Lake I1B Outlet

Survey Date: 13-Sep-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 553711 m E, 7173415 m N

Outlet Coordinates (Geographic) : 64°40'52" N, 109°52'27" W



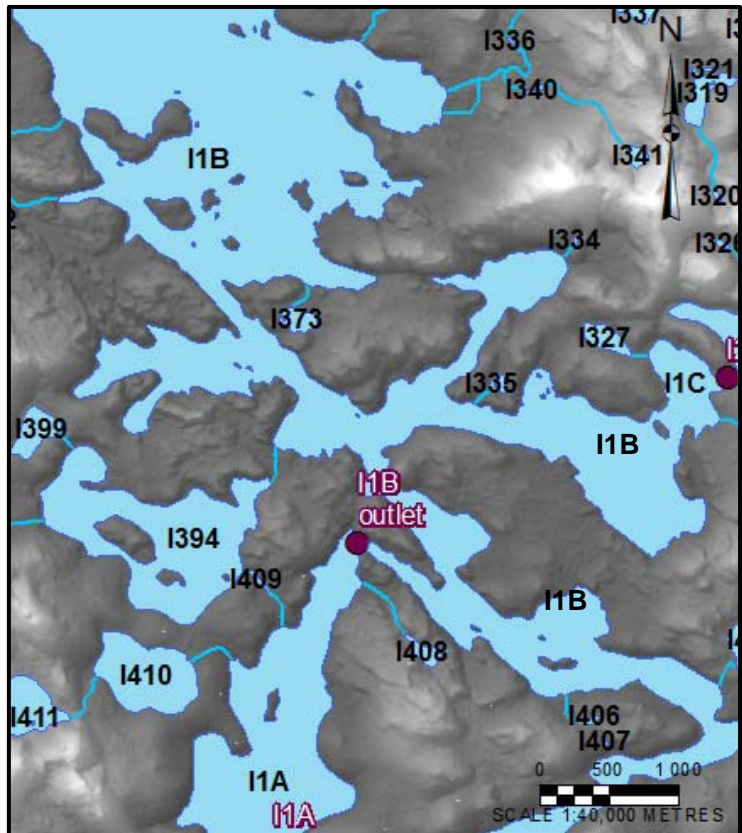
Upstream view of Lake I1B outlet looking east



Lake I1B upstream view of centre cross-section



Lake I1B downstream view of downstream cross-section



NTS Mapping of Area

**Table E3-101 Summary of Coordinates at Lake I1B and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Geodetic)	553630.16	7173341.61
Outlet	553711	7173415

**Table E3-102 2013 Hydrometric Data at Lake I1B and Outlet Station**

Date	Time (24-hour)	Benchmark Elevation (m)	Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
13-Sep-13	8:30	427.09	426.21	0.92	2.25

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-103 Geomorphic Parameters at Lake I1B and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	974.9	ha	
Drainage Area (DEM) <sup>(a)</sup>	41851.8	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	426.40	m	
Surveyed Local Stream Slope	0.015	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.018	m/m	
Average Bankfull Width	64.0	m	
Channel Material	80% boulder, 20% silt		
Bank Material	40% boulder, 20% silt, 20% cobble, 10% coarse sand, 10% fine sand		
Vegetation	Low shrub tundra		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E3-104 Stream I1B Discharge Data**

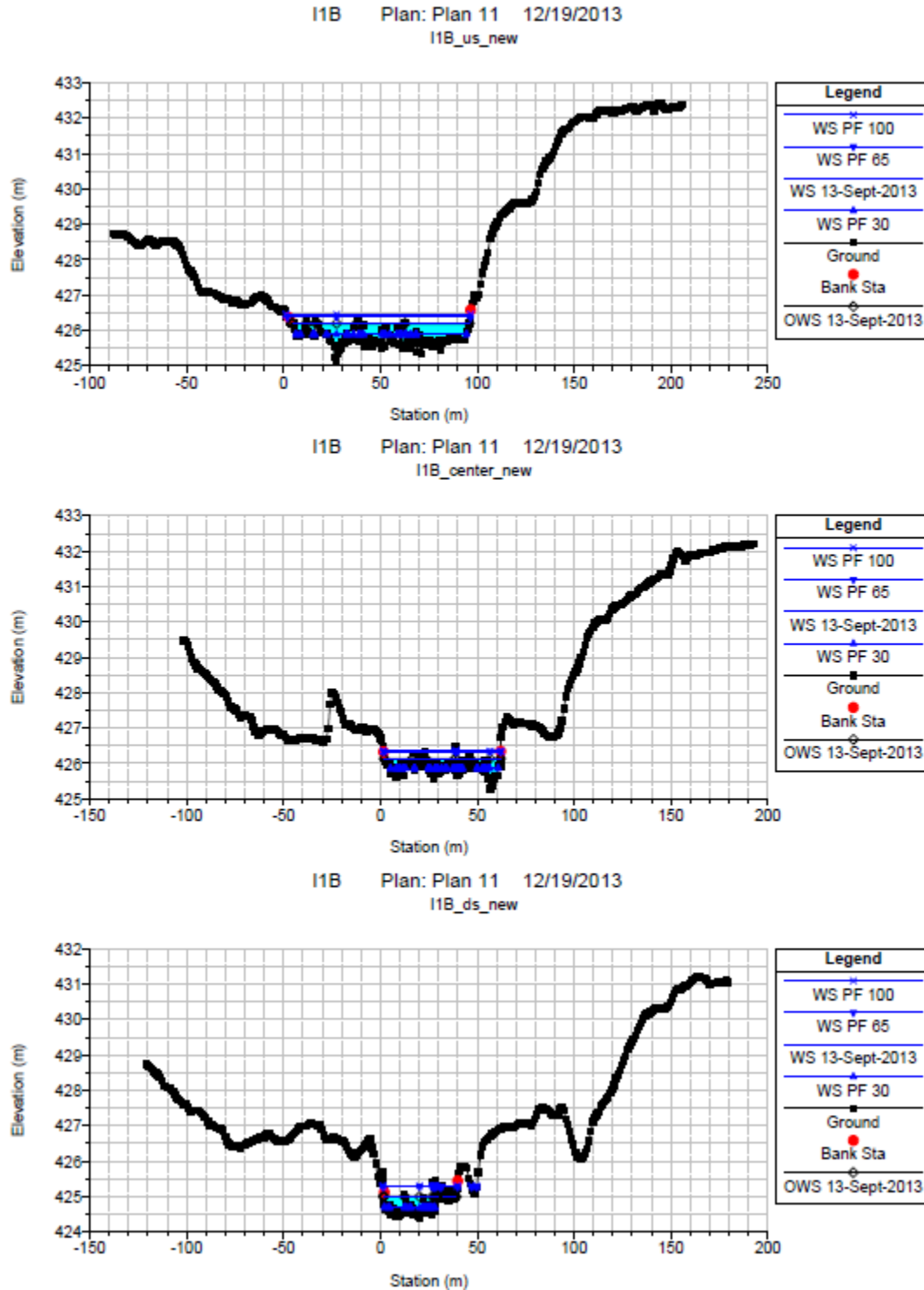
Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	8:30		<b>Location</b>		Outlet cross-section		
<b>Lake Name</b>	Lake I1B		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>		SonTek FlowTracker		
<b>Date Monitored</b>	13-Sep-13		<b>Flow Meter Type</b>	Handheld ADV flowmeter		<b>Instrument Serial #</b>		P4017		
<b>Personnel</b>	DC, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	553711	7173415	0.5	0.00	0.30	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.92		2.5	0.30	0.62	0.011	-	-	0.007	0.30
<b>Discharge (m<sup>3</sup>/s)</b>	2.25		4.5	0.32	0.58	0.019	-	-	0.012	0.55
<b>Notes</b>			6.5	0.26	0.52	0.066	-	-	0.034	0.47
			8.5	0.26	0.50	0.054	-	-	0.028	1.60
			10.5	0.24	0.46	0.049	-	-	0.024	1.22
			12.5	0.22	0.22	0.010	-	-	0.005	0.20
Possible depth recording error			14.5	0.00	0.24	0.011	-	-	0.000	0.00
			16.5	0.24	0.54	0.086	-	-	0.004	1.84
			18.5	0.30	0.78	0.076	-	-	0.045	2.02
			20.5	0.48	0.98	0.031	-	-	0.029	1.31
			22.5	0.50	1.30	0.069	-	-	0.069	3.07
			24.5	0.80	1.46	0.062	-	-	0.099	4.39
			26.5	0.66	1.16	0.034	-	-	0.044	1.97
			28.5	0.50	0.98	0.009	-	-	0.009	0.38
			30.5	0.48	0.96	0.022	-	-	0.021	0.92
			32.5	0.48	0.48	0.120	-	-	0.115	5.13
Possible depth recording error			34.5	0.00	0.52	0.109	-	-	0.000	0.00
			36.5	0.52	0.74	0.193	-	-	0.200	8.91
			38.5	0.22	0.82	0.209	-	-	0.092	4.09
			40.5	0.60	1.06	0.154	-	-	0.185	8.22
			42.5	0.46	0.90	0.165	-	-	0.152	6.76
			44.5	0.44	0.82	0.121	-	-	0.107	4.75
			46.5	0.38	0.74	0.054	-	-	0.041	1.82

**Table E3-104 Stream I1B Discharge Data**

Site Information		Discharge Measurement						
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)			Qi	% of Total Q
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%
	48.5	0.36	0.36	0.103	-	-	0.074	3.31
	50.5	0.00	0.44	0.004	-	-	0.000	0.00
	52.5	0.44	0.88	0.074	-	-	0.065	2.91
	54.5	0.44	0.44	0.075	-	-	0.066	2.92
Possible depth recording error	56.5	0.00	0.70	-0.004	-	-	0.000	0.00
	58.5	0.70	1.08	0.046	-	-	0.064	2.87
	60.5	0.38	0.80	0.039	-	-	0.029	1.31
	62.5	0.42	0.98	0.024	-	-	0.020	0.90
	64.5	0.56	1.12	0.071	-	-	0.079	3.53
	66.5	0.56	0.96	0.051	-	-	0.057	2.55
	68.5	0.40	0.82	0.045	-	-	0.036	1.60
	70.5	0.42	1.02	0.112	-	-	0.094	4.18
	72.5	0.60	1.10	0.027	-	-	0.033	1.46
	74.5	0.50	0.88	-0.007	-	-	-0.007	-0.30
	76.5	0.38	0.96	0.085	-	-	0.065	2.87
	78.5	0.58	0.88	0.053	-	-	0.062	2.75
	80.5	0.30	0.54	0.044	-	-	0.026	1.17
	82.5	0.24	0.50	0.064	-	-	0.031	1.36
	84.5	0.26	0.58	0.034	-	-	0.018	0.79
	86.5	0.32	0.70	0.061	-	-	0.039	1.74
	88.5	0.38	0.70	0.037	-	-	0.028	1.26
	90.5	0.32	0.52	0.016	-	-	0.010	0.45
	92.5	0.20	0.05	-0.012	-	-	-0.003	-0.13
	93.0	0.00	0.00	Edge of Water (RDB)				
	<b>Total</b>		<b>34.7</b>				<b>2.25</b>	<b>100</b>

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-39 Stream I1B Transects Used for Hydraulic Modelling



**Table E3-105 Stream I1B Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)		(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	
I1B	3	13-Sep-13	2.25	425.16	426.190	426.198	41 (To Stn 2)	0.180	-	426.19	0.00037	0.06	38.0	88.2	Surveyed
I1B	3	PF 30	0.29	425.16	425.887	-	41 (To Stn 2)	0.180	-	425.89	0.00012	0.02	13.9	64.9	
I1B	3	PF 65	9.20	425.16	426.377	-	41 (To Stn 2)	0.159	-	426.38	0.00153	0.17	55.2	94.6	
I1B	3	PF 100	20.00	425.16	426.453	-	41 (To Stn 2)	0.149	-	426.46	0.00424	0.32	62.4	95.2	
I1B	2	13-Sep-13	2.25	425.29	426.137	426.138	41 (To Stn 1)	0.470	-	426.14	0.03004	0.15	15.3	57.3	Surveyed
I1B	2	PF 30	0.29	425.29	425.859	-	41 (To Stn 1)	0.470	-	425.86	0.02639	0.09	3.1	20.5	
I1B	2	PF 65	9.20	425.29	426.340	-	41 (To Stn 1)	0.224	-	426.35	0.01787	0.34	27.3	60.3	
I1B	2	PF 100	20.00	425.29	426.345	-	41 (To Stn 1)	0.081	-	426.37	0.01082	0.73	27.5	60.3	
I1B	1	13-Sep-13	2.25	424.37	425.001	424.997	-	0.348	424.67	425.00	0.02791	0.22	10.1	29.7	Surveyed
I1B	1	PF 30	0.29	424.37	424.690	-	-	0.350	424.53	424.69	0.02793	0.11	2.6	21.1	
I1B	1	PF 65	9.20	424.37	425.280	-	-	0.212	424.83	425.29	0.02790	0.47	19.7	38.9	
I1B	1	PF 100	20.00	424.37	425.300	-	-	0.102	425.02	425.35	0.02789	0.98	20.5	40.1	

Notes:

Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.

All other profiles are used to represent a possible range of discharges to estimate a lake outlet rating curve (100 flow profiles computed in total, only select profiles shown).

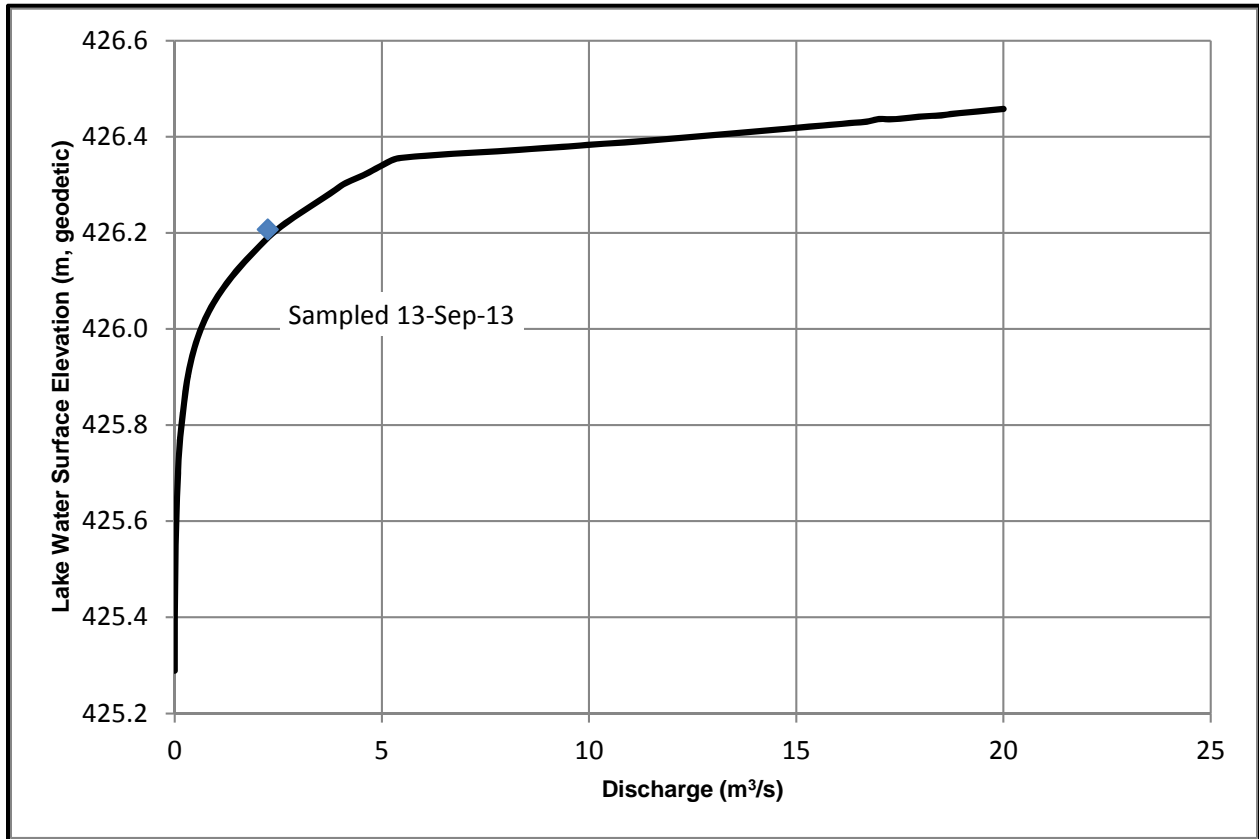
River station values decrease in the downstream direction.

Manning's n varies vertically for this reach according to the large-scale roughness resistance equation developed by Bathurst (1978 and 2002).

Additional interpolated cross-sections were used for hydraulic modelling, but are not included in the summary tables.

m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre; - = no data available.

**Figure E3-40 Lake I1B Outlet Rating Curve**



m = metre; m³/s = cubic metres per second.

### E3.23 Lake I2 Outlet

Survey Date: 17-Aug-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 561823 m E, 7178832 m N

Outlet Coordinates (Geographic) : 64°43'42" N, 109°42'07" W



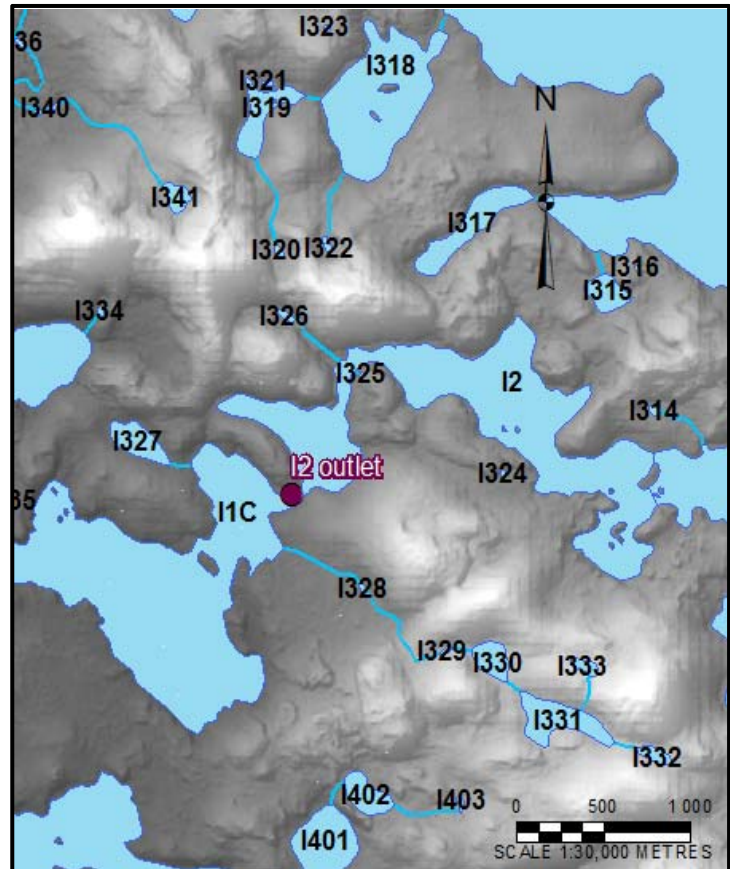
Downstream view of Lake I2 outlet looking southwest



Lake I2 upstream view of cross-section



Lake I2 downstream view of cross-section



NTS Mapping of Area

**Table E3-106 Summary of Coordinates at Lake I2 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Geodetic)	556312.46	7174641.57
Outlet	561823	7178832

**Table E3-107 2013 Hydrometric Data at Lake I2 and Outlet Station**

Date	Time (24-hour)	Benchmark Elevation (m)	Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
17-Aug-13	14:15	434.96	433.45	0.53	1.20

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-108 Geomorphic Parameters at Lake I2 and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	93.2	ha	
Drainage Area (DEM) <sup>(a)</sup>	35083.9	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	435.40	m	
Surveyed Local Stream Slope	0.023	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.023	m/m	
Average Bankfull Width	90.0	m	
Channel Material	40% cobble, 35% boulder, 10% coarse gravel, 10% medium gravel, 5% fine gravel		
Bank Material	50% boulder, 20% cobble, 20% silt, 10% coarse gravel		
Vegetation	High shrub tundra		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E3-109 Stream I2 Discharge Data**

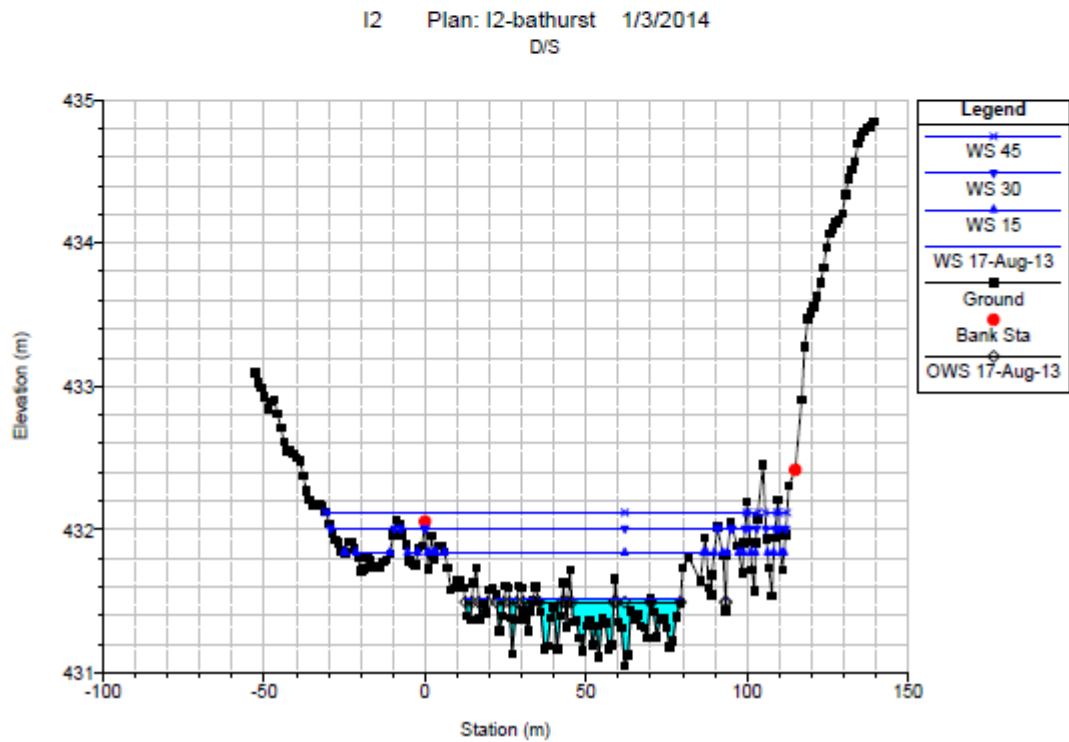
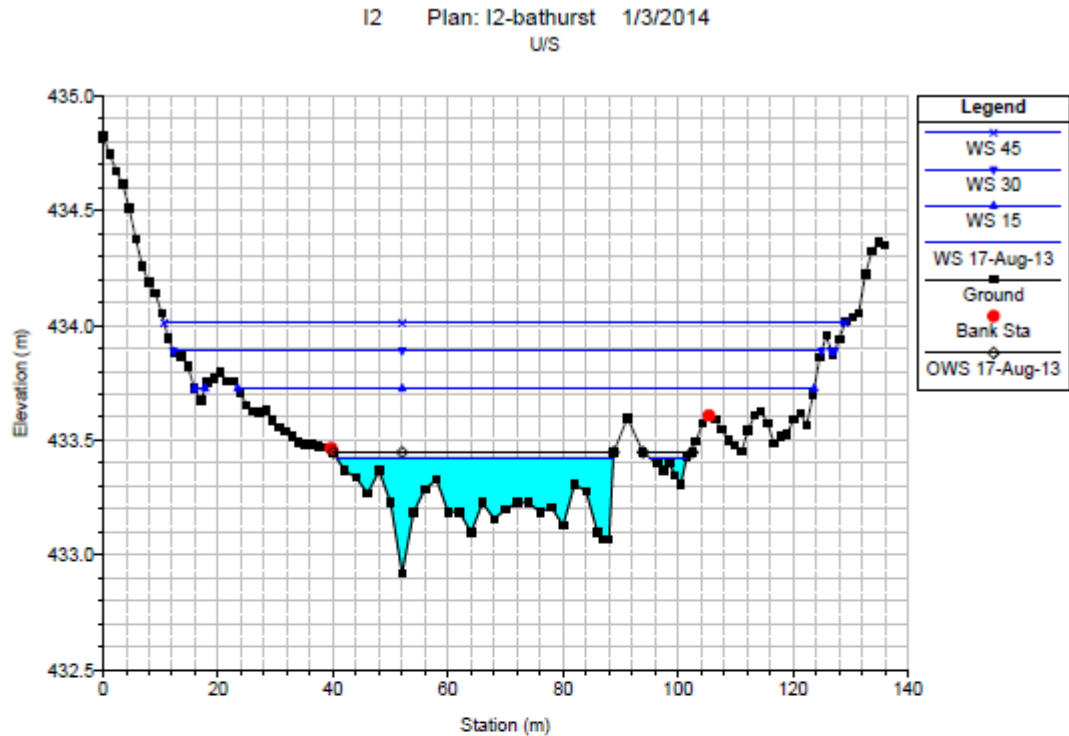
Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	14:15		<b>Location</b>		Lake outlet (u/s cross-section)		
<b>Lake Name</b>	Lake I2		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>		Marsh-McBirney FLO-MATE Model 2000		
<b>Date Monitored</b>	17-Aug-13		<b>Flow Meter Type</b>	Handheld electromagnetic sensor flowmeter		<b>Instrument Serial #</b>		2005872		
<b>Personnel</b>	MA, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	561823	7178832	0.0	0.00	0.08	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.53		2.0	0.08	0.19	0.11	-	-	0.000	0.00
<b>Discharge (m<sup>3</sup>/s)</b>	1.20		4.0	0.11	0.29	0.11	-	-	0.024	1.92
<b>Notes</b>			6.0	0.18	0.26	0.06	-	-	0.040	3.15
			8.0	0.08	0.30	0.09	-	-	0.010	0.76
			10.0	0.22	0.75	0.13	-	-	0.040	3.15
			12.0	0.53	0.79	0.02	-	-	0.138	10.96
			14.0	0.26	0.42	0.12	-	-	0.010	0.83
			16.0	0.16	0.28	0.20	-	-	0.038	3.05
			18.0	0.12	0.38	0.16	-	-	0.048	3.82
			20.0	0.26	0.52	0.02	-	-	0.083	6.61
			22.0	0.26	0.61	0.24	-	-	0.010	0.83
			24.0	0.35	0.57	0.04	-	-	0.168	13.36
			26.0	0.22	0.51	0.10	-	-	0.018	1.40
			28.0	0.29	0.54	0.04	-	-	0.058	4.61
			30.0	0.25	0.47	0.03	-	-	0.020	1.59
			32.0	0.22	0.44	0.27	-	-	0.013	1.05
			34.0	0.22	0.48	0.05	-	-	0.119	9.45

**Table E3-109 Stream I2 Discharge Data**

Site Information	Discharge Measurement								
	36.0	0.26	0.50	0.22			0.026	2.07	
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)			Qi	% of Total Q	
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%	
	38.0	0.24	0.56	0.23	-	-	0.106	8.40	
	40.0	0.32	0.46	0.21	-	-	0.147	11.70	
	42.0	0.14	0.31	0.13	-	-	0.059	4.67	
	44.0	0.17	0.52	0.01	-	-	0.044	3.51	
	46.0	0.35	0.37	0.01	-	-	0.005	0.42	
	47.0	0.38	0.38	0.01	-	-	0.004	0.30	
	48.0	0.38	-	0.18	-	-	0.003	0.27	
	48.8	Boulder edge	-	0.00	-	-	-	-	
	53.9	Boulder edge	-	0.00	-	-	-	-	
	56.4	0.05	0.07	0.00	-	-	0.000	0.00	
	57.5	0.08	0.07	0.09	-	-	0.000	0.00	
	58.5	0.05	0.08	0.10	-	-	0.005	0.36	
	59.5	0.10	0.12	0.08	-	-	0.010	0.80	
	60.5	0.14	0.08	0.05	-	-	0.011	0.89	
	61.5	0.02	0.01	0.00	-	-	0.001	0.08	
	62.5	0.00	0.00	Edge of Water (RDB)					
	<b>Total</b>		<b>11.40</b>				<b>1.20</b>	<b>100</b>	

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-41 Stream I2 Transects Used for Hydraulic Modelling



**Table E3-110 Stream I2 Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)		(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	
I2	118	17-Aug-13	1.20	432.92	433.423	433.447	118	0.350	-	433.42	0.01579	0.12	10.2	54.5	Surveyed
I2	118	15	9.80	432.92	433.725	-	118	0.218	-	433.73	0.01543	0.28	35.1	102.1	
I2	118	30	20.30	432.92	433.891	-	118	0.196	-	433.90	0.01539	0.38	53.1	113.4	
I2	118	45	30.80	432.92	434.011	-	118	0.186	-	434.02	0.01557	0.46	67.1	118.4	
I2	0	17-Aug-13	1.20	431.05	431.518	431.495	-	0.339	431.29	431.52	0.01653	0.12	10.0	55.1	Surveyed
I2	0	15	9.80	431.05	431.840	-	-	0.217	431.48	431.84	0.01651	0.28	35.1	105.7	
I2	0	30	20.30	431.05	432.010	-	-	0.195	431.58	432.02	0.01652	0.37	55.6	133.1	
I2	0	45	30.80	431.05	432.120	-	-	0.185	431.66	432.13	0.01653	0.44	70.7	140.0	

Notes:

Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.

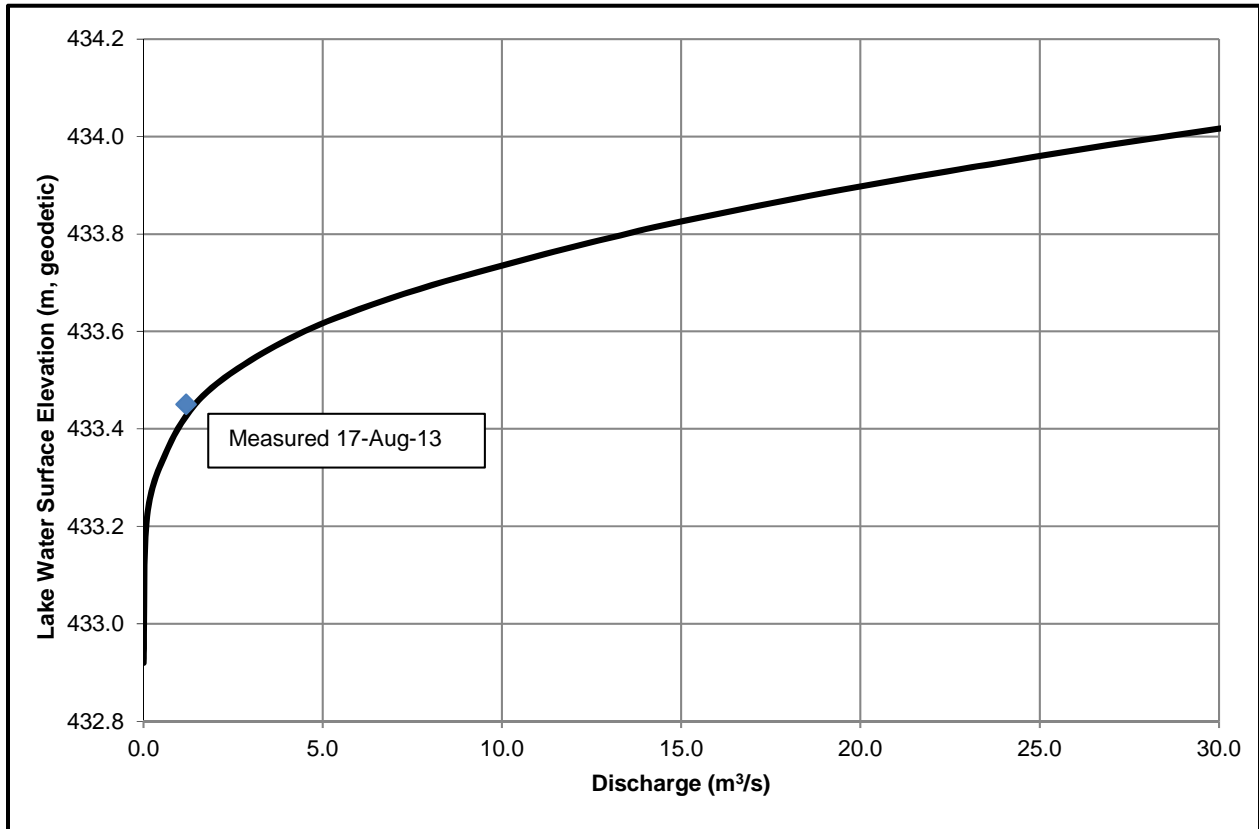
All other profiles are used to represent a possible range of discharges to estimate a lake outlet rating curve (100 flow profiles computed in total, only select profiles shown).

River station values decrease in the downstream direction.

Manning's n varies vertically for this reach according to the large-scale roughness resistance equation developed by Bathurst (1978 and 2002).

m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre; - = no data available.

Figure E3-42 Lake I2 Outlet Rating Curve



m = metre; m³/s = cubic metres per second.

## E3.24 Lake I2B Outlet

Survey Date: 14-Sep-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 560123 m E, 7174517 m N

Outlet Coordinates (Geographic) : 64°41'24" N, 109°44'22" W



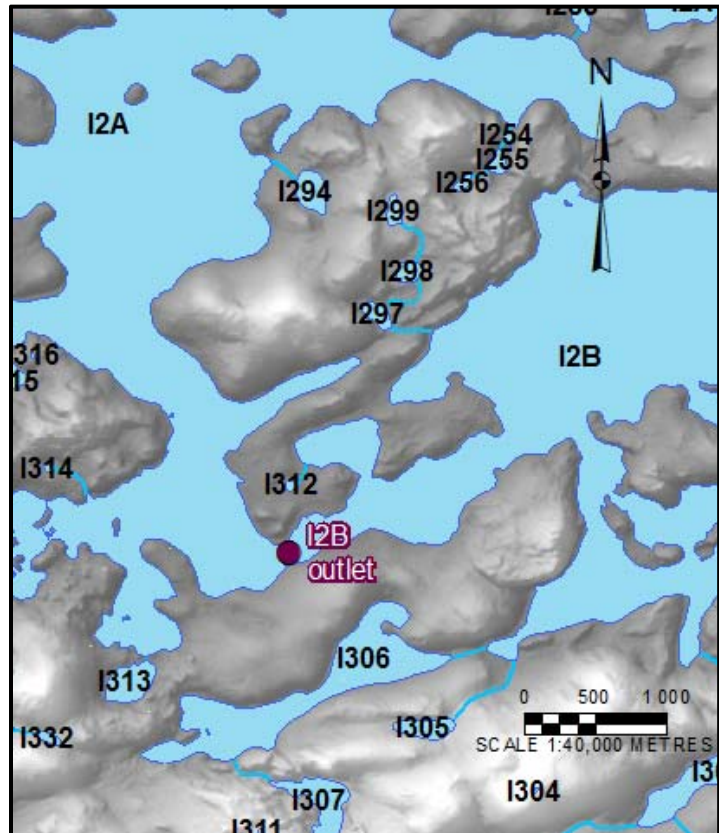
Upstream view of Lake I2B outlet looking northeast (outlet control at photo centre)



Lake I2B outlet, downstream view



Lake I2B inlet, upstream view



**Table E3-111 Summary of Coordinates at Lake I2B and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Non-geodetic)	560167.46	7174342.10
Outlet	560123	7174517

**Table E3-112 2013 Hydrometric Data at Lake I2B and Outlet Station**

Date	Time (24-hour)	Non-geodetic Benchmark Elevation <sup>(a)</sup> (m)	Non-geodetic Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
14-Sep-13	10:00	438.71	437.03	0.6	1.17

a) Elevation of the Benchmark set to 438.71 m to approximately match lake elevations with LiDAR Water Surface Elevation of Lake I2B.

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-113 Geomorphic Parameters at Lake I2B and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	647.6	ha	
Drainage Area (DEM) <sup>(a)</sup>	14940.7	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	437.10	m	
Surveyed Local Stream Slope	0.0058	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.0058	m/m	
Average Bankfull Width	161.5	m	
Channel Material	80% boulder, 20% silt		
Bank Material	60% boulder, 20% silt, 10% cobble, 10% coarse gravel		
Vegetation	Low shrub tundra		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.



**Table E3-114 Stream I2B Discharge Data**

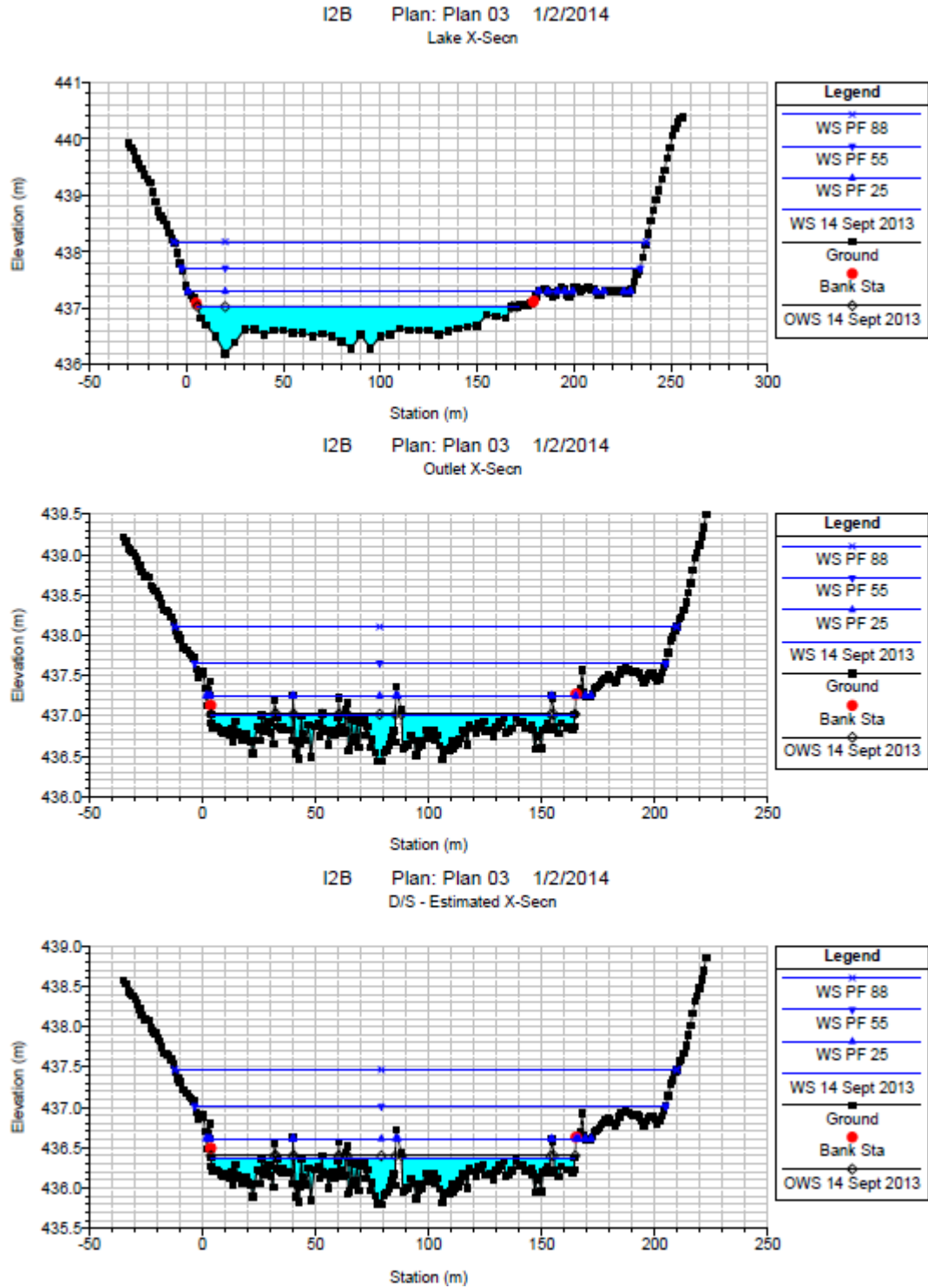
Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	10:00			<b>Location</b>		Lake outlet	
<b>Lake Name</b>	Lake I2B		<b>Method</b>	Velocity – Area (Mid-section)			<b>Instrument Model</b>		SonTek FlowTracker	
<b>Date Monitored</b>	14-Sep-13		<b>Flow Meter Type</b>	Handheld ADV flowmeter			<b>Instrument Serial #</b>		P4017	
<b>Personnel</b>	DC, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	560123	7174517	5.0	0.00	0.25	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.6		7.0	0.20	0.65	0.020	-	-	0.000	0.00
<b>Discharge (m<sup>3</sup>/s)</b>	1.17		10.0	0.32	2.10	0.026	-	-	0.024	1.93
<b>Notes</b>			15.0	0.52	3.40	0.032	-	-	0.068	5.44
			20.0	0.84	3.70	0.022	-	-	0.134	10.81
			25.0	0.64	2.60	0.003	-	-	0.070	5.66
			30.0	0.40	2.00	0.006	-	-	0.006	0.48
			35.0	0.40	2.25	0.018	-	-	0.012	0.97
			40.0	0.50	2.30	0.016	-	-	0.045	3.62
			45.0	0.42	2.10	0.007	-	-	0.034	2.70
			50.0	0.42	2.20	0.014	-	-	0.015	1.18
			55.0	0.46	2.30	0.015	-	-	0.032	2.59
			60.0	0.46	2.45	0.008	-	-	0.035	2.77
			65.0	0.52	2.50	0.020	-	-	0.021	1.67
			70.0	0.48	2.50	0.018	-	-	0.048	3.86
			75.0	0.52	2.85	0.021	-	-	0.047	3.76
			80.0	0.62	3.40	0.013	-	-	0.065	5.24
			85.0	0.74	3.10	0.020	-	-	0.048	3.87
			90.0	0.50	3.10	0.017	-	-	0.050	4.02

**Table E3-114 Stream I2B Discharge Data**

Site Information	Discharge Measurement								
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)			Qi	% of Total Q	
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%	
	95.0	0.74	3.15	0.007	-	-	0.063	5.06	
	100.0	0.52	2.55	0.015	-	-	0.018	1.46	
	105.0	0.50	2.20	0.017	-	-	0.038	3.02	
	110.0	0.38	2.00	0.017	-	-	0.032	2.60	
	115.0	0.42	2.10	0.017	-	-	0.036	2.87	
	120.0	0.42	2.10	0.020	-	-	0.036	2.87	
	125.0	0.42	2.30	0.023	-	-	0.042	3.38	
	130.0	0.50	2.35	0.015	-	-	0.058	4.62	
	135.0	0.44	2.05	0.015	-	-	0.033	2.65	
	140.0	0.38	1.85	0.020	-	-	0.029	2.29	
	145.0	0.36	1.75	0.035	-	-	0.036	2.90	
	150.0	0.34	1.20	0.001	-	-	0.060	4.79	
	155.0	0.14	0.80	0.010	-	-	0.001	0.06	
	160.0	0.18	0.95	0.002	-	-	0.009	0.72	
	165.0	0.20	0.30	0.006	-	-	0.002	0.13	
	168.0	0.00	0.00	Edge of Water (RDB)					
	<b>Total</b>		<b>73.40</b>				<b>1.17</b>	<b>100</b>	

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-43 Stream I2B Transects Used for Hydraulic Modelling



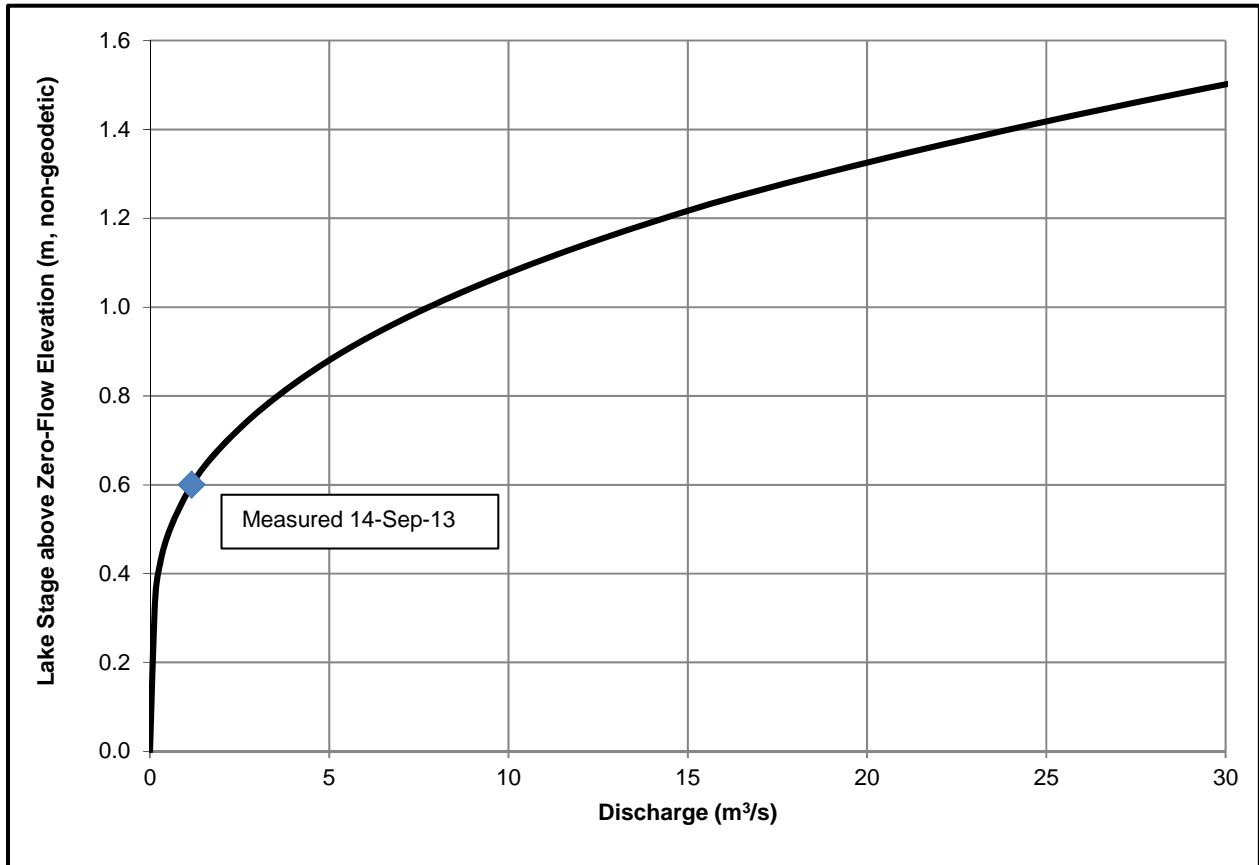
**Table E3-115 Stream I1B Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)		(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	
I2B	3	14-Sep-13	1.17	436.19	437.038	437.030	25	0.800	-	437.04	0.00046	0.02	74.7	165.5	Surveyed
I2B	3	PF 25	3.70	436.19	437.299	-	25	0.742	-	437.30	0.00098	0.03	121.3	197.9	
I2B	3	PF 55	11.80	436.19	437.715	-	25	0.633	-	437.72	0.00133	0.05	217.2	236.7	
I2B	3	PF 88	30.00	436.19	438.180	-	25	0.572	-	438.18	0.00183	0.09	328.8	243.7	
I2B	2	14-Sep-13	1.17	436.44	437.010	437.020	110 (To Stn 1)	0.900	-	437.01	0.00583	0.03	36.4	153.1	Surveyed
I2B	2	PF 25	3.70	436.44	437.250	-	110 (To Stn 1)	0.887	-	437.25	0.00586	0.05	74.1	163.9	
I2B	2	PF 55	11.80	436.44	437.654	-	110 (To Stn 1)	0.760	-	437.65	0.00586	0.08	148.7	208.4	
I2B	2	PF 88	30.00	436.44	438.104	-	110 (To Stn 1)	0.661	-	438.11	0.00585	0.12	245.6	222.1	
I2B	1	14-Sep-13	1.17	435.80	436.370	436.400	-	0.900	435.98	436.37	0.00581	0.03	36.5	153.0	Surveyed
I2B	1	PF 25	3.70	435.80	436.611	-	-	0.887	436.06	436.61	0.00580	0.05	74.3	164.1	
I2B	1	PF 55	11.80	435.80	437.015	-	-	0.759	436.18	437.02	0.00581	0.08	149.1	208.5	
I2B	1	PF 88	30.00	435.80	437.466	-	-	0.660	436.29	437.47	0.00581	0.12	246.1	222.2	

Notes:

Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.  
 All other profiles are used to represent a possible range of discharges to estimate a lake outlet rating curve (100 flow profiles computed in total, only select profiles shown).  
 Other station values decrease in the downstream direction.  
 Manning's n varies vertically for this reach according to the large-scale roughness resistance equation developed by Bathurst (1978 and 2002).  
 Additional interpolated cross-sections were used for hydraulic modelling, but are not included in the summary tables.  
 Elevations are set by the arbitrary setting of the benchmark elevation.  
 m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre; - = no data available.

Figure E3-44 Lake I2B Outlet Rating Curve



m = metre; m<sup>3</sup>/s = cubic metres per second.

### E3.25 Lake I3 (Sterlet Lake) Outlet

Survey Date: 12-Sep-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 566154 m E, 7176614 m N

Outlet Coordinates (Geographic) : 64°42'28" N, 109°36'43"



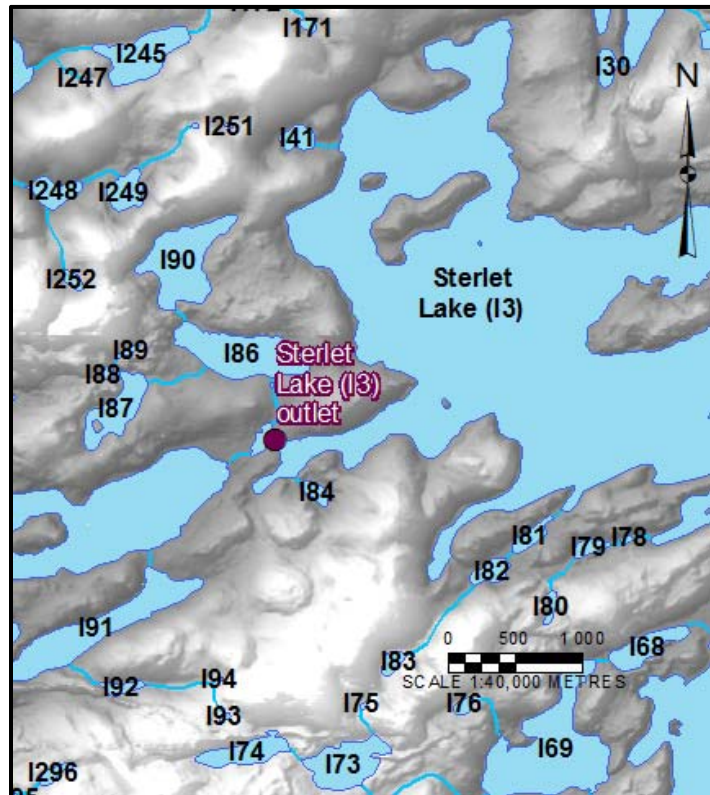
Downstream view of Lake I3 (Sterlet Lake) outlet looking northwest



Upstream view of Lake I3 (Sterlet Lake) outlet



Downstream view of Lake I3 (Sterlet Lake) outlet



NTS Mapping of Area

**Table E3-116 Summary of Coordinates at Lake I3 (Sterlet Lake) and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Non-geodetic)	7210651.41	532110.06
Outlet	566154	7176614

**Table E3-117 2013 Hydrometric Data at Lake I3 (Sterlet Lake) and Outlet Station**

Date	Time (24-hour)	Non-geodetic Benchmark Elevation <sup>(a)</sup> (m)	Non-geodetic Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
12-Sep-13	9:00	414.55	440.10	0.60	0.62

a) Elevation of the Benchmark set to 414.55 m to match lake elevations with LiDAR Water Surface Elevation of Lake I3.

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-118 Geomorphic Parameters at Lake I3 (Sterlet Lake) and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	4434.7	ha	
Drainage Area (DEM) <sup>(a)</sup>	12059.6	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	440.10	m	
Surveyed Local Stream Slope	0.0034	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.0064	m/m	
Average Bankfull Width	117.2	m	
Channel Material	60% boulder, 20% cobble, 10% coarse gravel, 10% silt		
Bank Material	50% boulder, 20% cobble, 10% coarse gravel, 10% medium gravel, 5% fine gravel, 5% silt		
Vegetation	Low shrub tundra		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E3-119 Stream I3 (Sterlet Lake Outlet) Discharge Data**

Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		Time (24 hr)	9:00		<b>Location</b>		Centre cross-section approximately 125 m downstream of lake outlet		
<b>Lake Name</b>	Lake I3 (Sterlet Lake)		Method	Velocity – Area (Mid-section)		<b>Instrument Model</b>		SonTek FlowTracker		
<b>Date Monitored</b>	12-Sep-13		Flow Meter Type	Handheld ADV flowmeter		<b>Instrument Serial #</b>		P4017		
<b>Personnel</b>	DC, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	566116	7176734	2.8	0.00	0.000	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.60		8.0	-	-	-	-	-	-	-
<b>Discharge (m<sup>3</sup>/s)</b>	0.62		9.5	-	-	-	-	-	-	-
<b>Notes</b>			11.0	-	-	-	-	-	-	-
Station 2.8 to 15.5 was an ineffective flow area with very negligible depths			12.5	-	-	-	-	-	-	-
			14.0	-	-	-	-	-	-	-
			15.5	-	-	-	-	-	-	-
			17.0	0.00	0.11	-	-	-	-	-
			18.5	0.14	0.30	0.02	-	-	0.005	0.75
			20.0	0.26	0.35	0.01	-	-	0.003	0.44
			21.5	0.20	0.30	0.04	-	-	0.011	1.80
			23.0	0.20	0.35	0.03	-	-	0.009	1.51
			24.5	0.26	0.41	0.03	-	-	0.012	1.97
			26.0	0.28	0.42	0.03	-	-	0.012	1.98
			27.5	0.28	0.56	0.02	-	-	0.008	1.23
			29.0	0.46	0.62	0.07	-	-	0.045	7.29
			30.5	0.36	0.48	0.06	-	-	0.032	5.18
			32.0	0.28	0.45	0.07	-	-	0.028	4.57
			33.5	0.32	0.51	0.09	-	-	0.041	6.71

**Table E3-119 Stream I3 (Sterlet Lake Outlet) Discharge Data**

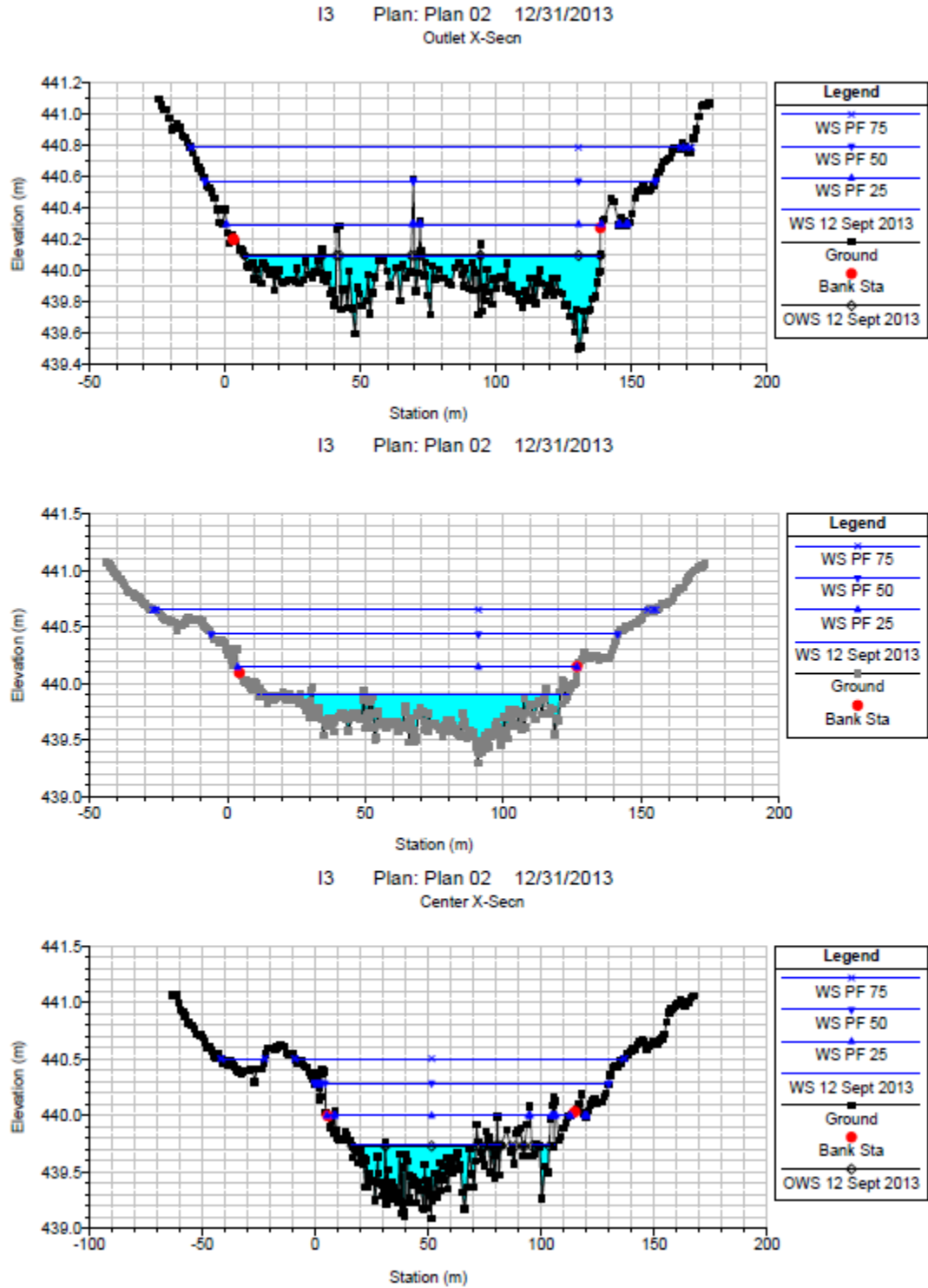
Site Information	Discharge Measurement							
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)			Qi	% of Total Q
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%
	35.0	0.36	0.54	0.05	-	-	0.028	4.48
	36.5	0.36	0.27	0.08	-	-	0.045	7.37
	38.0	0.00	0.20	0.01	-	-	0.000	0.00
	39.5	0.26	0.44	0.09	-	-	0.036	5.90
	41.0	0.32	0.56	0.09	-	-	0.045	7.26
	42.5	0.42	0.60	0.05	-	-	0.033	5.43
	44.0	0.38	0.57	0.08	-	-	0.043	7.04
	45.5	0.38	0.68	0.01	-	-	0.007	1.20
	47.0	0.52	0.77	0.03	-	-	0.023	3.68
	48.5	0.50	0.72	0.03	-	-	0.023	3.66
	50.0	0.46	0.60	0.02	-	-	0.015	2.47
	51.5	0.34	0.38	0.03	-	-	0.015	2.49
	53.0	0.16	0.29	0.09	-	-	0.023	3.67
	54.5	0.22	0.17	0.05	-	-	0.015	2.41
	56.0	0.00	0.15	0.00	-	-	0.000	0.00
	57.5	0.20	0.29	0.04	-	-	0.012	1.90
	59.0	0.18	0.24	0.04	-	-	0.011	1.84
	60.5	0.14	0.11	0.00	-	-	0.000	0.00
	62.0	0.00	0.11	0.00	-	-	0.000	0.00
	63.5	0.14	0.11	0.02	-	-	0.004	0.65
	65.0	boulder	0.00	-	-	-	-	-
	66.5	boulder	0.00	-	-	-	-	-
	68.0	boulder	0.11	-	-	-	-	-

**Table E3-119 Stream I3 (Sterlet Lake Outlet) Discharge Data**

Site Information	Discharge Measurement							
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)			Qi	% of Total Q
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%
	69.5	0.14	0.11	0.15	-	-	0.032	5.12
Ineffective flow area	71.0	0.00	-	-	-	-	-	-
	89.0	0.00	0.00	Edge of Water (RDB)				
	<b>Total</b>		<b>12.78</b>				<b>0.62</b>	<b>100</b>

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-45 Stream I3 (Sterlet Lake Outlet) Transects Used for Hydraulic Modelling



**Table E3-120 Stream I3 (Sterlet Lake Outlet) Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)		(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	
I3	3	12-Sep-13	0.62	439.50	440.097	440.097	49	0.850	-	440.10	0.00454	0.03	23.9	127.1	Surveyed
I3	3	PF 25	2.40	439.50	440.295	-	49	0.641	-	440.30	0.00370	0.05	50.2	137.9	
I3	3	PF 50	7.30	439.50	440.573	-	49	0.470	-	440.57	0.00304	0.08	92.7	166.2	
I3	3	PF 75	13.50	439.50	440.786	-	49	0.399	-	440.79	0.00281	0.10	129.4	182.9	
I3	2.5 <sup>(a)</sup>	12-Sep-13	0.62	439.29	439.910	-	49	0.799	-	439.91	0.00326	0.03	23.8	107.5	Interpolated
I3	2.5 <sup>(a)</sup>	PF 25	2.40	439.29	440.147	-	49	0.605	-	440.15	0.00256	0.05	51.8	123.0	
I3	2.5 <sup>(a)</sup>	PF 50	7.30	439.29	440.438	-	49	0.452	-	440.44	0.00251	0.08	91.5	147.3	
I3	2.5 <sup>(a)</sup>	PF 75	13.50	439.29	440.654	-	49	0.371	-	440.66	0.00254	0.11	126.8	180.2	
I3	2	12-Sep-13	0.62	439.09	439.735	439.728	-	0.744	439.32	439.74	0.00382	0.03	18.8	72.1	Surveyed
I3	2	PF 25	2.40	439.09	439.996	-	-	0.579	439.40	440.00	0.00382	0.06	42.5	105.4	
I3	2	PF 50	7.30	439.09	440.286	-	-	0.455	439.51	440.29	0.00382	0.10	77.1	127.3	
I3	2	PF 75	13.50	439.09	440.503	-	-	0.364	439.59	440.50	0.00382	0.13	108.0	165.3	

Notes:

Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.

All other profiles are used to represent a possible range of discharges to estimate a lake outlet rating curve (100 flow profiles computed in total, only select profiles shown).

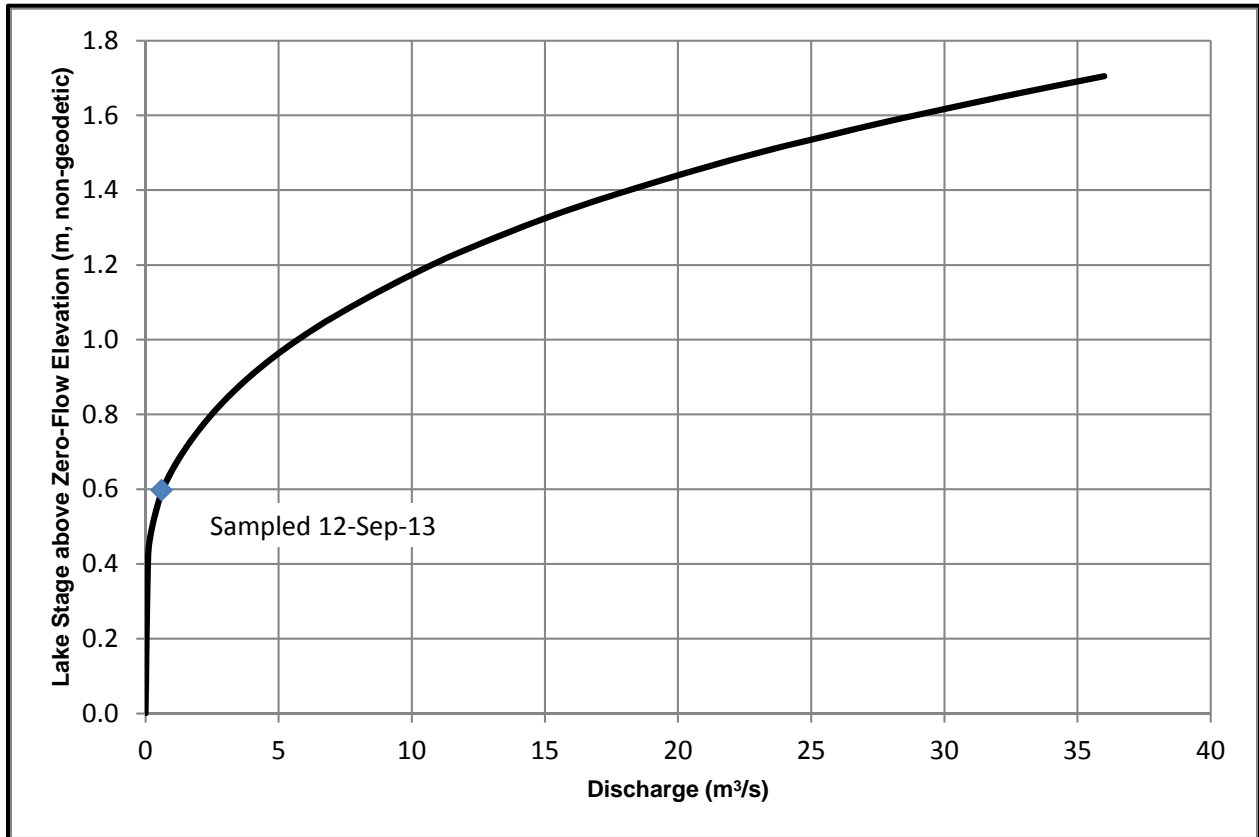
River station values decrease in the downstream direction.

Manning's n varies vertically for this reach according to the large-scale roughness resistance equation developed by Bathurst (1978 and 2002).

a) Interpolated Cross-Section

m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre; - = no data available.

Figure E3-46 Lake I3 (Sterlet Lake) Outlet Rating Curve



m = metre; m³/s = cubic metres per second.

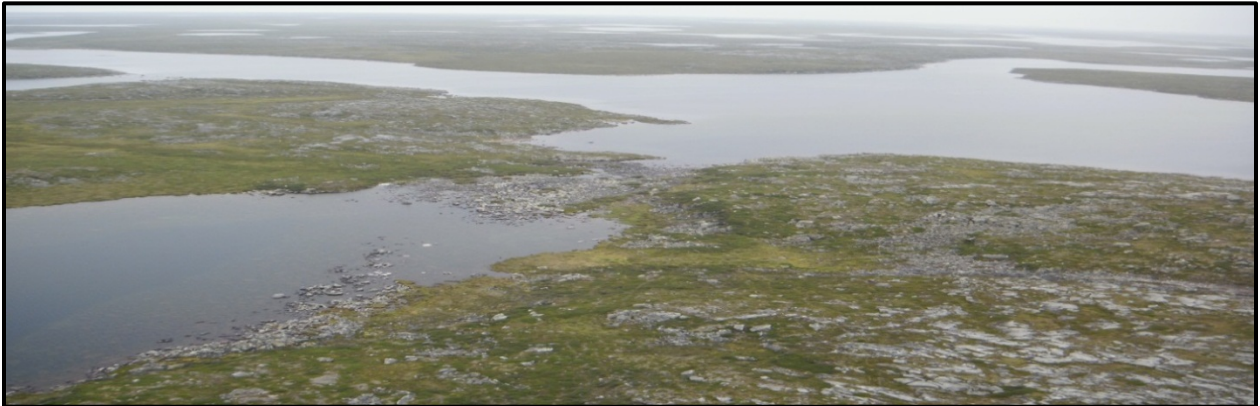
### E3.26 Lake I100 Outlet

Survey Date: 11-Sep-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 563952 m E, 7183674 m N

Outlet Coordinates (Geographic) : 64°46'17" N, 109°39'18" W



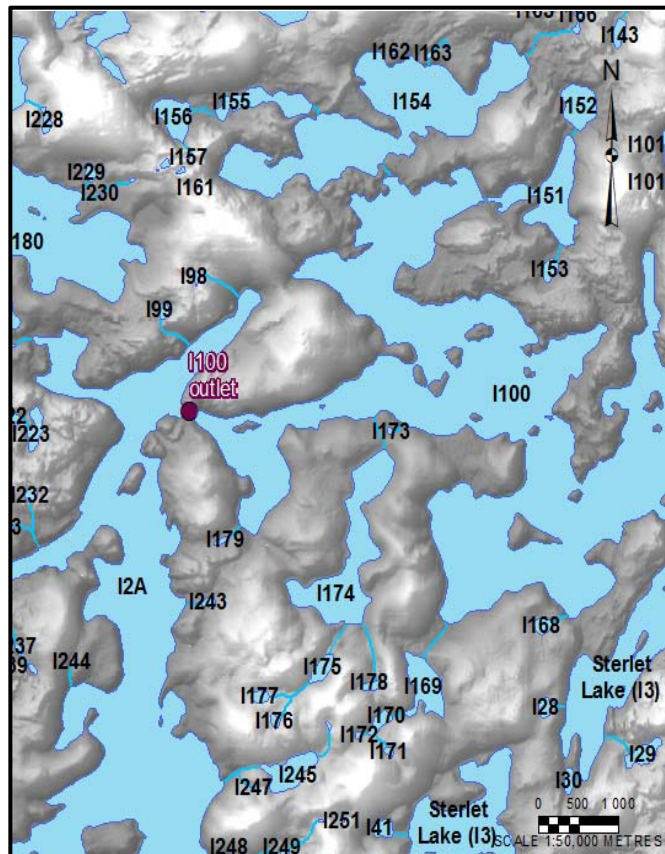
Downstream view of Lake I100 outlet looking west



Upstream view at Lake I100 downstream cross-section



Downstream view at Lake I100 outlet



NTS Mapping of Area

**Table E3-121 Summary of Coordinates at Lake I100 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Non-geodetic)	7208404.99	539027.13
Outlet	563952	7183674

**Table E3-122 2013 Hydrometric Data at Lake I100 and Outlet Station**

Date	Time (24-hour)	Non-geodetic Benchmark Elevation <sup>(a)</sup> (m)	Non-geodetic Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
11-Sep-13	11:00	414.94	437.26	1.05	0.23

a) Elevation of the Benchmark set to 414.94 m to approximately match lake elevations with LiDAR Water Surface Elevation of Lake I100.

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-123 Geomorphic Parameters at Lake I100 and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	1107.3	ha	
Drainage Area (DEM) <sup>(a)</sup>	6915.6	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	437.20	m	
Surveyed Local Stream Slope	0.0063	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.0095	m/m	
Average Bankfull Width	58.0	m	
Channel Material	80% boulder, 10% cobble, 5% fine sand, 5% silt		
Bank Material	70% boulder, 15% silt, 10% cobble, 5% fine sand		
Vegetation	Low shrub tundra		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E3-124 Stream I100 Discharge Data**

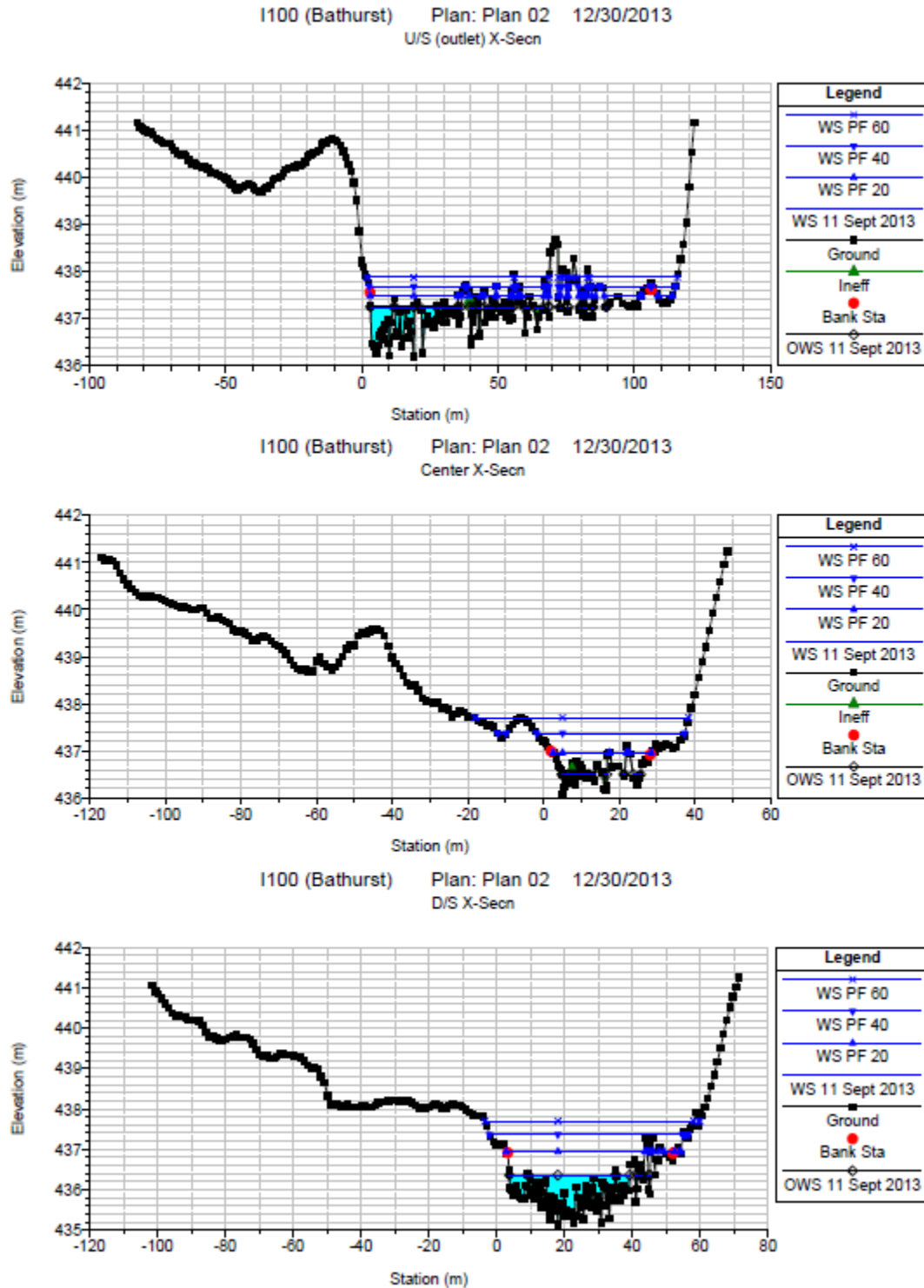
Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	11:00		<b>Location</b>		Centre cross section, approximately 100 m downstream of Lake outlet		
<b>Lake Name</b>	Lake I100		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>		SonTek FlowTracker		
<b>Date Monitored</b>	11-Sep-13		<b>Flow Meter Type</b>	Handheld ADV flowmeter		<b>Instrument Serial #</b>		P4017		
<b>Personnel</b>	DC, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	563855	7183639	0.6	0.00	0.21	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	1.05		1.5	0.46	0.47	0.009	-	-	0.000	0.00
<b>Discharge (m<sup>3</sup>/s)</b>	0.23		2.5	0.48	0.40	0.009	-	-	0.004	1.76
<b>Notes</b>			3.5	0.32	0.44	0.019	-	-	0.003	1.17
			4.5	0.55	0.55	0.025	-	-	0.010	4.25
			5.5	0.55	0.44	0.008	-	-	0.014	5.59
			6.5	0.32	0.30	0.020	-	-	0.003	1.04
			7.5	0.28	0.39	-0.003	-	-	0.006	2.28
			8.5	0.50	0.50	0.029	-	-	-0.002	-0.61
			9.5	0.50	0.43	-0.004	-	-	0.015	5.89
			10.5	0.36	0.26	0.010	-	-	-0.001	-0.59
			11.5	0.16	0.30	0.017	-	-	0.002	0.65
			12.5	0.44	0.53	0.014	-	-	0.007	3.04
			13.5	0.62	0.63	0.014	-	-	0.009	3.53
			14.5	0.64	0.87	0.010	-	-	0.009	3.64
			15.5	1.10	1.00	0.010	-	-	0.011	4.47
			16.5	0.90	0.84	0.019	-	-	0.009	3.66
			17.5	0.78	0.72	0.024	-	-	0.015	6.02
			18.5	0.66	0.84	0.005	-	-	0.016	6.44
			19.5	1.02	0.86	0.016	-	-	0.005	2.07
			20.5	0.70	0.74	0.022	-	-	0.011	4.55
			21.5	0.78	0.61	0.012	-	-	0.017	6.97
			22.5	0.44	0.44	0.023	-	-	0.005	2.15

**Table E3-124 Stream I100 Discharge Data**

Site Information	Discharge Measurement								
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)			Qi	% of Total Q	
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%	
	23.5	0.44	0.56	0.005	-	-	0.010	4.11	
	24.5	0.68	0.58	0.001	-	-	0.003	1.38	
	25.5	0.48	0.53	0.011	-	-	0.000	0.20	
	26.5	0.58	0.49	0.005	-	-	0.006	2.59	
	27.5	0.40	0.32	0.020	-	-	0.002	0.81	
	28.5	0.24	0.52	0.027	-	-	0.005	1.95	
	29.5	0.80	0.66	0.002	-	-	0.022	8.78	
	30.5	0.52	0.41	0.001	-	-	0.001	0.42	
	31.5	0.30	0.15	0.002	-	-	0.000	0.16	
	32.5	0.00	0.18	0.024	-	-	0.000	0.00	
	33.5	0.36	0.33	0.002	-	-	0.009	3.51	
	34.5	0.30	0.32	0.000	-	-	0.001	0.24	
	35.5	0.34	0.42	0.025	-	-	0.000	0.00	
	36.5	0.50	0.44	0.018	-	-	0.013	5.08	
	37.5	0.38	0.19	0.009	-	-	0.007	2.78	
Ineffective flow area (below boulders)	38.5	-	-	-	-	-	-	-	
Ineffective flow area (below boulders)	39.5	-	-	-	-	-	-	-	
Ineffective flow area (below boulders)	40.5	-	-	-	-	-	-	-	
Ineffective flow area (below boulders)	41.5	-	-	-	-	-	-	-	
	42.5		0.00	Edge of Water (RDB)					
	<b>Total</b>		<b>18.86</b>				<b>0.23</b>	<b>100</b>	

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-47 Stream I100 Transects Used for Hydraulic Modelling



**Table E3-125 Stream I100 Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)		(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	
I100	3	11-Sep-13	0.23	436.21	437.250	437.255	88 (To Stn 2)	1.300	436.43	437.25	0.00283	0.02	11.7	46.6	Surveyed
I100	3	PF 20	0.75	436.21	437.488	-	88 (To Stn 2)	1.021	436.53	437.49	0.00286	0.02	30.7	82.0	
I100	3	PF 40	1.75	436.21	437.688	-	88 (To Stn 2)	0.866	436.63	437.69	0.00310	0.04	48.7	100.0	
I100	3	PF 60	3.00	436.21	437.879	-	88 (To Stn 2)	0.768	436.73	437.88	0.00249	0.04	68.6	106.4	
I100	2	11-Sep-13	0.23	436.08	436.511	436.501	53 (To Stn 1)	0.687	436.39	436.53	2.70490	0.59	0.4	10.2	Surveyed
I100	2	PF 20	0.75	436.08	436.960	-	53 (To Stn 1)	0.404	436.57	436.96	0.00430	0.08	9.5	25.0	
I100	2	PF 40	1.75	436.08	437.377	-	53 (To Stn 1)	0.284	436.60	437.38	0.00104	0.07	23.7	41.4	
I100	2	PF 60	3.00	436.08	437.706	-	53 (To Stn 1)	0.240	436.61	437.71	0.00059	0.08	39.4	56.4	
I100	1	11-Sep-13	0.23	435.14	436.354	436.360	-	0.800	435.42	436.35	0.00029	0.01	20.1	37.0	Surveyed
I100	1	PF 20	0.75	435.14	436.943	-	-	0.779	435.52	436.94	0.00029	0.02	44.1	46.9	
I100	1	PF 40	1.75	435.14	437.365	-	-	0.592	435.61	437.37	0.00029	0.03	66.6	58.0	
I100	1	PF 60	3.00	435.14	437.696	-	-	0.514	435.69	437.70	0.00029	0.04	86.4	62.0	

Notes:

Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.

All other profiles are used to represent a possible range of discharges to estimate a lake outlet rating curve (100 flow profiles computed in total, only select profiles shown).

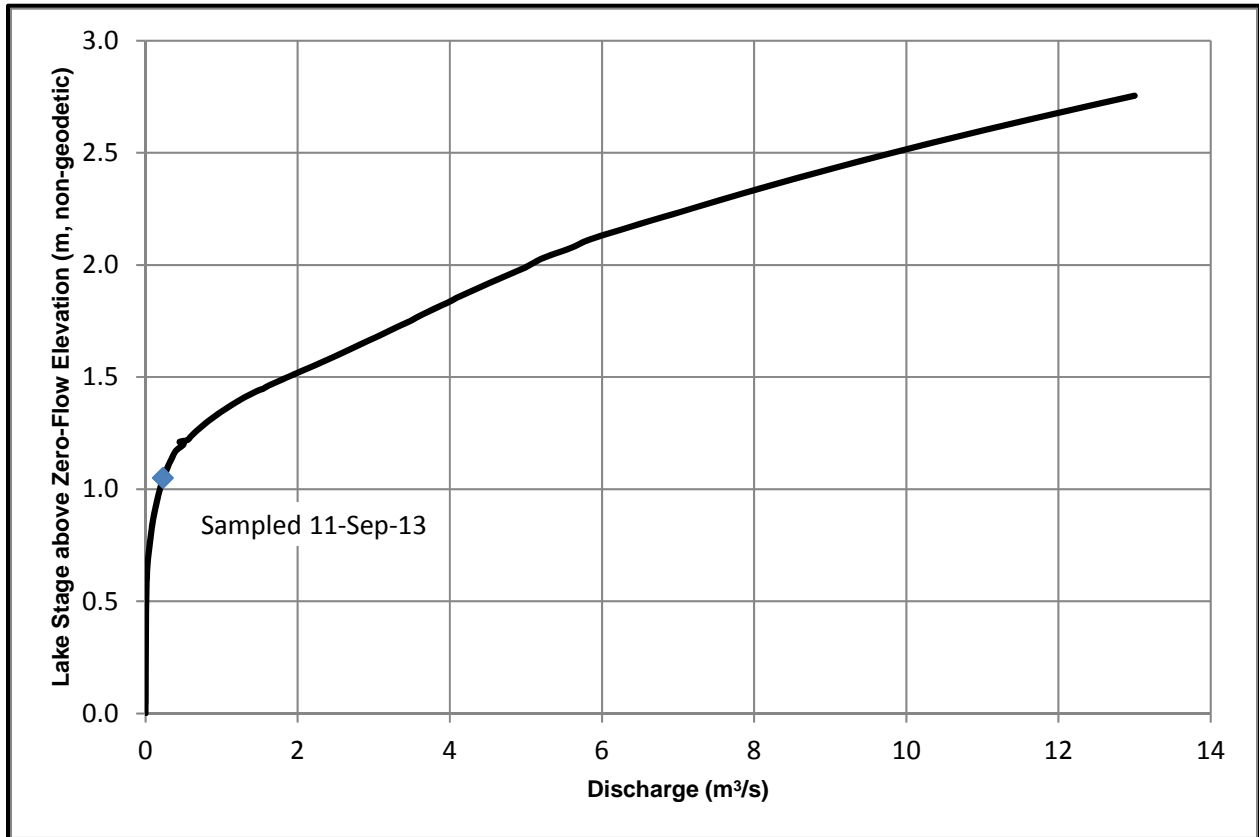
River station values decrease in the downstream direction.

Manning's n varies vertically for this reach according to the large-scale roughness resistance equation developed by Bathurst (1978 and 2002).

Additional interpolated cross-sections were used for hydraulic modelling, but are not included in the summary tables.

m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre; - = no data available.

Figure E3-48 Lake I100 Outlet Rating Curve



m = metre; m³/s = cubic metres per second.

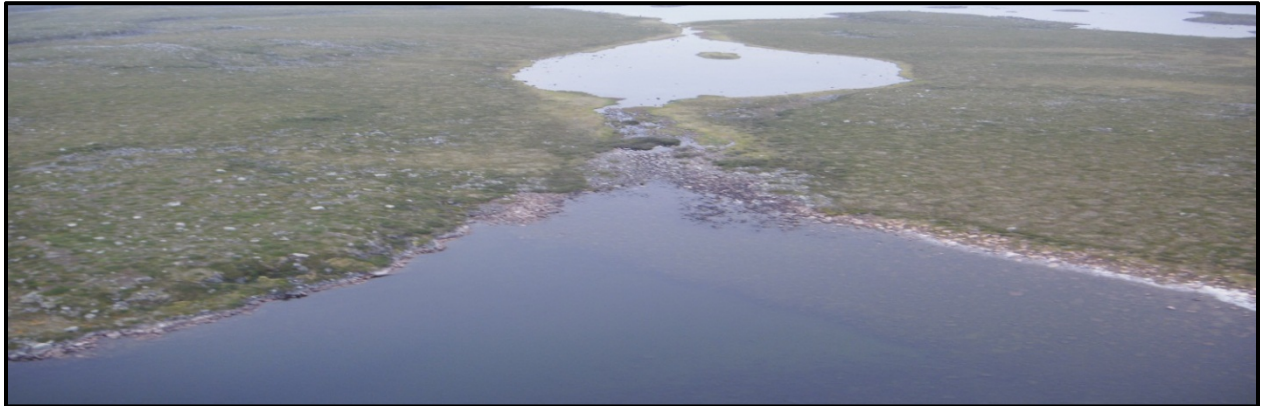
## E3.27 Lake I103 Outlet

Survey Date: 13-Sep-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 571057 m E, 7186954 m N

Outlet Coordinates (Geographic) : 64°47'58" N, 109°30'15" W



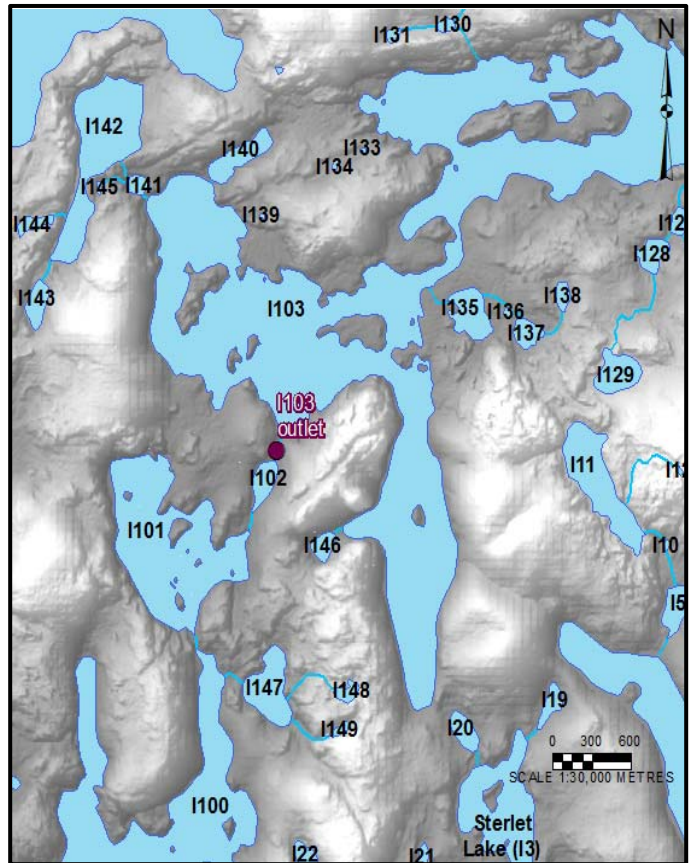
Downstream view of Lake I103 outlet looking southwest (Lake I103 at bottom)



Lake I103 downstream view of outlet



Lake I103 downstream view of downstream cross-section



NTS Mapping of Area

**Table E3-126 Summary of Coordinates at Lake I103 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Non-geodetic)	7215573.99	542264.29
Outlet	571057	7186954

**Table E3-127 2013 Hydrometric Data at Lake I103 and Outlet Station**

Date	Time (24-hour)	Non-geodetic Benchmark Elevation <sup>(a)</sup> (m)	Non-geodetic Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
13-Sep-13	12:30	412.57	439.19	0.60	0.16

a) Elevation of the Benchmark set to 412.57 m match the estimated lake elevations with LiDAR Water Surface Elevation of Lake I103.

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-128 Geomorphic Parameters at Lake I103 and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	444.2	ha	
Drainage Area (DEM) <sup>(a)</sup>	1927.8	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	439.30	m	
Surveyed Local Stream Slope	0.0060	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.0059	m/m	
Average Bankfull Width	25.3	m	
Channel Material	60% boulder, 10% cobble, 10% coarse gravel, 10% medium gravel, 10% silt		
Bank Material	40% boulder, 20% cobble, 10% coarse gravel, 10% medium gravel, 10% fine sand, 10% silt		
Vegetation	Low shrub tundra		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E3-129 Stream I103 Discharge Data**

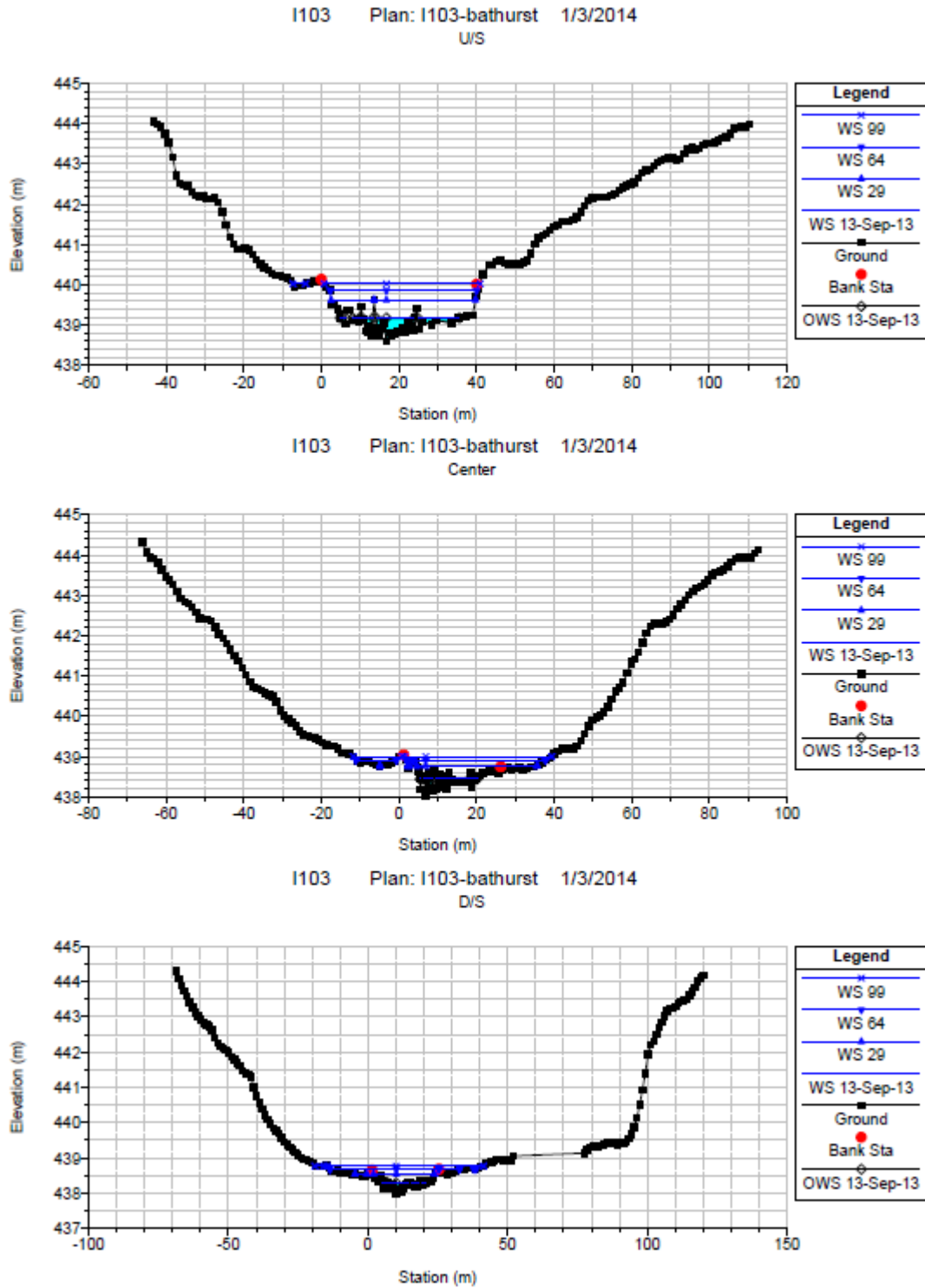
Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	12:30		<b>Location</b>		Downstream cross-section approximately 150 m downstream of lake outlet		
<b>Lake Name</b>	Lake I103		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>		SonTek FlowTracker		
<b>Date Monitored</b>	13-Sep-13		<b>Flow Meter Type</b>	Handheld ADV flowmeter		<b>Instrument Serial #</b>		P4017		
<b>Personnel</b>	DC, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	571037	7186802	1.2	0.00	0.077	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.60		1.9	0.22	0.133	0.000	-	-	0.000	0.00
<b>Discharge (m<sup>3</sup>/s)</b>	0.16		2.6	0.16	0.105	0.060	-	-	0.007	4.27
<b>Notes</b>			3.3	0.14	0.154	0.590	-	-	0.058	36.72
			4.0	0.30	0.238	0.014	-	-	0.003	1.87
			4.7	0.38	0.224	0.011	-	-	0.003	1.86
			5.4	0.26	0.154	0.021	-	-	0.004	2.43
			6.1	0.18	0.210	0.290	-	-	0.037	23.20
			6.8	0.42	0.273	0.016	-	-	0.005	2.99
			7.5	0.36	0.252	0.027	-	-	0.007	4.32
			8.2	0.36	0.231	0.025	-	-	0.006	4.00
			8.9	0.30	0.182	0.003	-	-	0.001	0.40
			9.6	0.22	0.175	0.012	-	-	0.002	1.17
			10.3	0.28	0.189	0.022	-	-	0.004	2.74
			11.0	0.26	0.182	0.036	-	-	0.007	4.16
			11.7	0.26	0.203	0.024	-	-	0.004	2.77
			12.4	0.32	0.224	0.024	-	-	0.005	3.41
			13.1	0.32	0.279	0.016	-	-	0.004	2.60

**Table E3-129 Stream I103 Discharge Data**

Site Information	Discharge Measurement							
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)			Qi	% of Total Q
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%
	14.0	0.30	0.300	0.005	-	-	0.001	0.90
	15.0	0.30	0.310	0.001	-	-	0.000	0.19
	16.0	0.32	0.310	0.000	-	-	0.000	0.00
	17.0	0.30	0.300	0.000	-	-	0.000	0.00
	18.0	0.30	0.225	0.000	-	-	0.000	0.00
	19.5	0.00	0.000	Edge of Water (RDB)				
	<b>Total</b>		<b>4.93</b>				<b>0.16</b>	<b>100</b>

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-49 Stream I103 Transects Used for Hydraulic Modelling



**Table E3-130 Stream I103 Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)		(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	
I103	149.511	13-Sep-13	0.16	438.59	439.163	439.18	113	0.800	-	439.16	0.00760	0.03	4.7	25.8	Surveyed
I103	149.511	30	2.32	438.59	439.632	-	113	0.531	-	439.63	0.00897	0.11	20.3	37.2	
I103	149.511	65	5.12	438.59	439.864	-	113	0.475	-	439.87	0.01087	0.18	29.1	37.7	
I103	149.511	100	7.92	438.59	440.030	-	113	0.421	-	440.03	0.01234	0.22	35.7	43.6	
I103	36.993	13-Sep-13	0.16	438.03	438.471	438.44	37	0.142	-	438.47	0.00508	0.11	1.4	11.3	Surveyed
I103	36.993	30	2.32	438.03	438.770	-	37	0.087	-	438.78	0.00648	0.32	7.2	31.9	
I103	36.993	65	5.12	438.03	438.912	-	37	0.081	-	438.92	0.00664	0.41	12.7	46.2	
I103	36.993	100	7.92	438.03	439.005	-	37	0.084	-	439.02	0.00686	0.46	17.1	50.5	
I103	0	13-Sep-13	0.16	437.97	438.267	438.29	-	0.150	438.12	438.27	0.00596	0.12	1.4	12.8	Surveyed
I103	0	30	2.32	437.97	438.540	-	-	0.087	438.31	438.55	0.00596	0.35	6.6	26.4	
I103	0	65	5.12	437.97	438.680	-	-	0.073	438.41	438.69	0.00596	0.42	12.1	47.3	
I103	0	100	7.92	437.97	438.768	-	-	0.070	438.48	438.79	0.00595	0.47	16.8	59.4	

Notes:

Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.

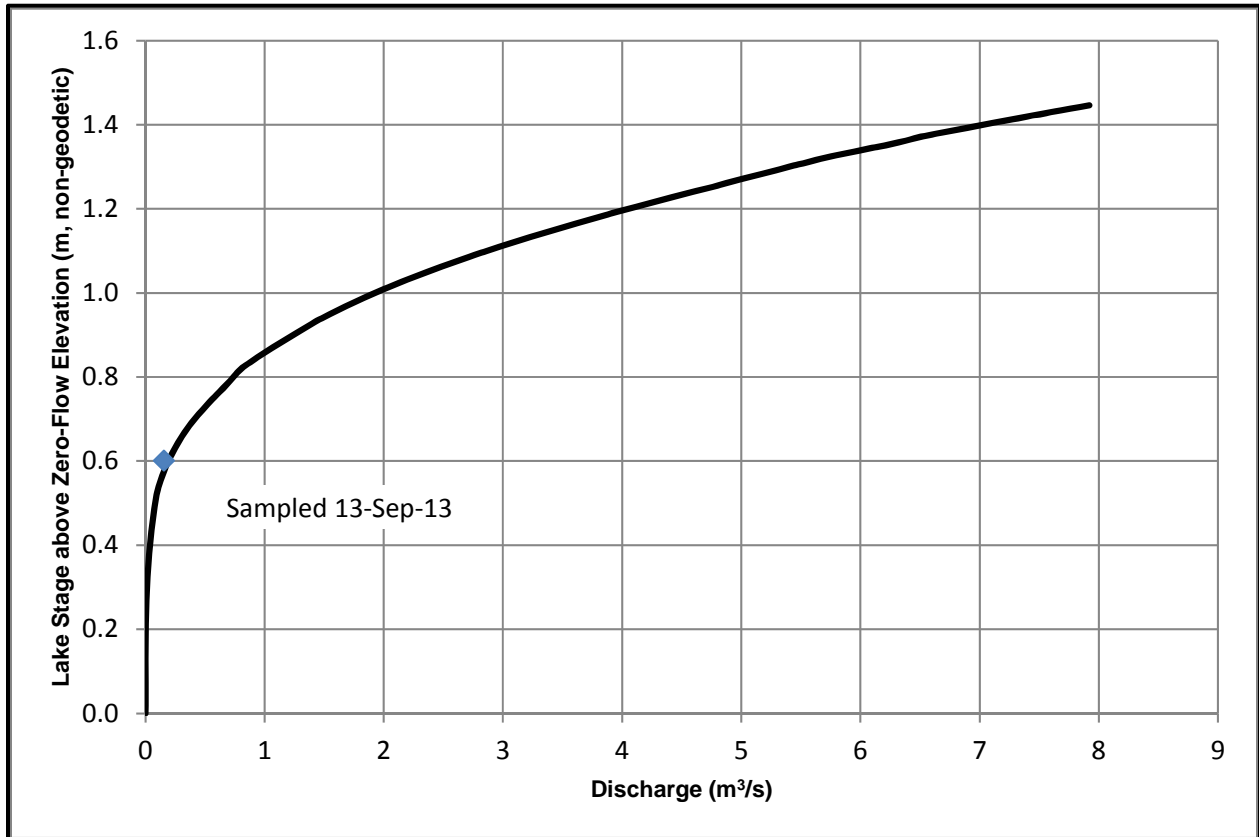
All other profiles are used to represent a possible range of discharges to estimate a lake outlet rating curve (100 flow profiles computed in total, only select profiles shown).

River station values decrease in the downstream direction.

Manning's n varies vertically for this reach according to the large-scale roughness resistance equation developed by Bathurst (1978 and 2002).

m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre; - = no data available.

Figure E3-50 Lake I103 Outlet Rating Curve



m = metre; m³/s = cubic metres per second.

## E3.28 Lake J1 Outlet

Survey Date: 16-Sep-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 556078 m E, 7166584 m N

Outlet Coordinates (Geographic) : 64°37'10" N, 109°49'38"



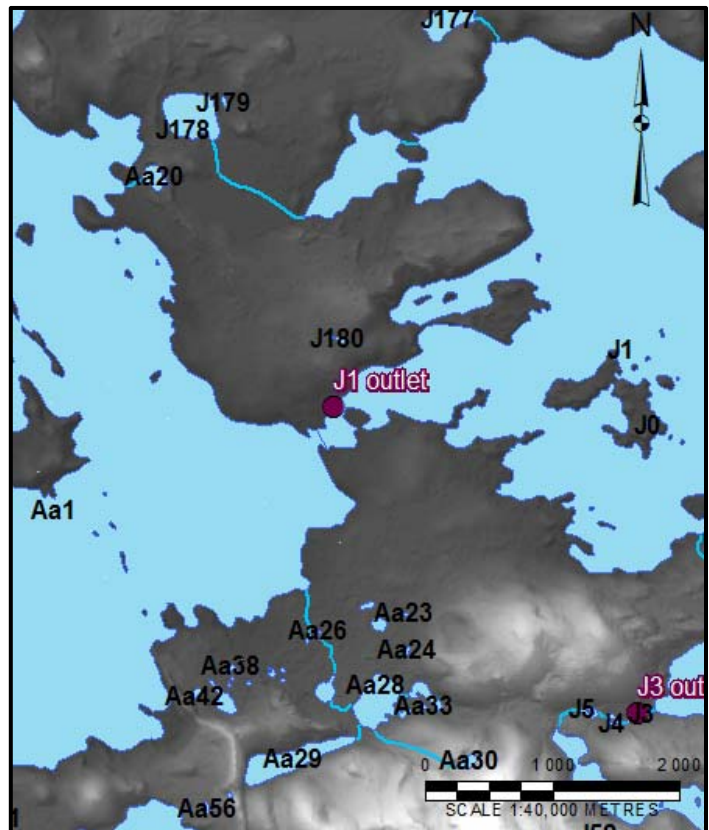
Downstream view of Lake J1 outlet looking west (Lake J1 at bottom)



Lake J1 outlet, downstream view



Lake J1 downstream view of downstream cross-section



NTS Mapping of Area

**Table E3-131 Summary of Coordinates at Lake J1 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Geodetic)	555989.45	7166457.09
Outlet	556078	7166584

**Table E3-132 2013 Hydrometric Data at Lake J1 and Outlet Station**

Date	Time (24-hour)	Benchmark Elevation (m)	Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
18-Aug-13	14:00	416.96	417.23	Not Surveyed	Not Measured
16-Sep-13	16:00	416.96	417.21	0.21	0.32

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-133 Geomorphic Parameters at Lake J1 and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	2045.9	ha	
Drainage Area (DEM) <sup>(a)</sup>	17036.4	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	417.30	m	
Surveyed Local Stream Slope	0.0022	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.0048	m/m	
Average Bankfull Width	83.4	m	
Channel Material	80% boulder, 10% cobble, 10% silt		
Bank Material	70% boulder, 20% cobble, 10% silt		
Vegetation	Grasses and shrubs		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E3-134 Stream J1 Discharge Data**

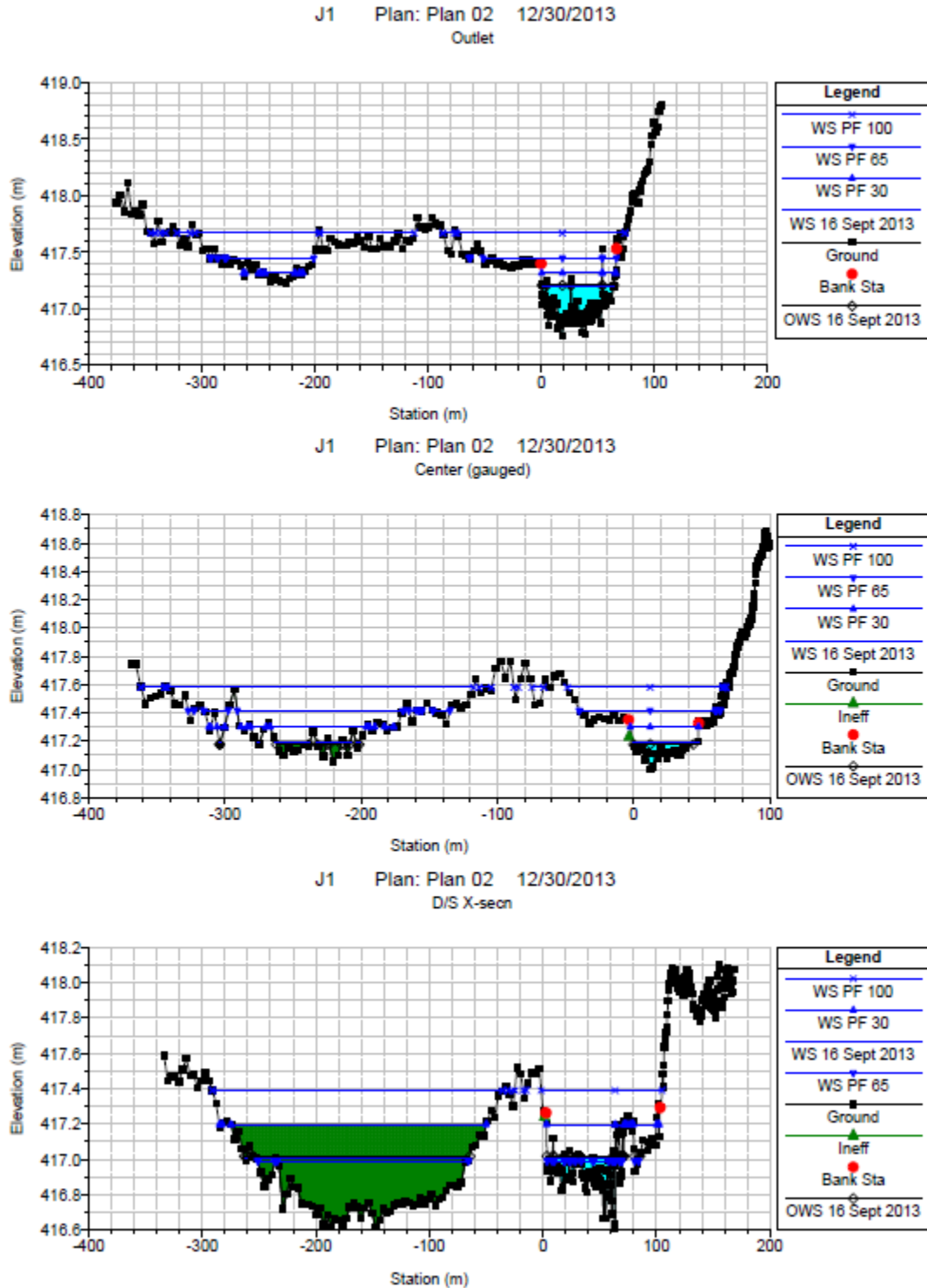
Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	16:00			<b>Location</b>	Lake outlet		
<b>Lake Name</b>	Lake J1		<b>Method</b>	Velocity – Area (Mid-section)			<b>Instrument Model</b>	Marsh-McBirney FLO-MATE Model 2000		
<b>Date Monitored</b>	16-Sep-13		<b>Flow Meter Type</b>	Handheld electromagnetic sensor flowmeter			<b>Instrument Serial #</b>	2005872		
<b>Personnel</b>	DC, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	556078	7166584	0.0	0.00	0.160	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.21		2.0	0.16	0.320	0.03	-	-	0.010	2.92
<b>Discharge (m<sup>3</sup>/s)</b>	0.32		4.0	0.16	0.340	0.02	-	-	0.006	1.94
<b>Notes</b>			6.0	0.18	0.300	0.02	-	-	0.007	2.19
			8.0	0.12	0.220	0.09	-	-	0.022	6.56
			10.0	0.10	0.200	0.04	-	-	0.008	2.43
			12.0	0.10	0.220	0.16	-	-	0.032	9.72
			14.0	0.12	0.240	0.14	-	-	0.034	10.21
			16.0	0.12	0.240	0.05	-	-	0.012	3.65
			18.0	0.12	0.300	0.08	-	-	0.019	5.83
			20.0	0.18	0.360	0.02	-	-	0.007	2.19
			22.0	0.18	0.400	0.05	-	-	0.018	5.47
			24.0	0.22	0.380	0.08	-	-	0.035	10.69
			26.0	0.16	0.360	0.04	-	-	0.013	3.89
			28.0	0.20	0.400	0.04	-	-	0.016	4.86
			30.0	0.20	0.440	0.03	-	-	0.012	3.65
			32.0	0.24	0.540	0.06	-	-	0.029	8.75
			34.0	0.30	0.560	0.06	-	-	0.036	10.94

**Table E3-134 Stream J1 Discharge Data**

Site Information	Discharge Measurement							
	36.0	0.26	0.420	0.02			0.010	3.16
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)			Qi	% of Total Q
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%
	38.0	0.16	0.160	0.01	-	-	0.003	0.97
	40.0	0.00	0.000	Edge of Water (RDB)				
	<b>Total</b>		<b>6.56</b>				<b>0.32</b>	<b>100</b>

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-51 Stream J1 Transects Used for Hydraulic Modelling



**Table E3-135 Stream J1 Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)		(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	
J1	3	16-Sep-13	0.33	416.76	417.204	417.207	20	0.200	-	417.20	0.00016	0.02	14.0	62.3	Surveyed
J1	3	PF 30	1.40	416.76	417.316	-	20	0.146	-	417.32	0.00059	0.06	22.6	98.1	
J1	3	PF 65	4.90	416.76	417.450	-	20	0.119	-	417.45	0.00160	0.12	41.8	202.6	
J1	3	PF 100	21.00	416.76	417.669	-	20	0.134	-	417.68	0.00413	0.20	103.3	373.7	
J1	2	16-Sep-13	0.33	417.00	417.195	417.177	66	0.114	417.11	417.20	0.00330	0.09	3.7	101.7	Surveyed
J1	2	PF 30	1.40	417.00	417.300	-	66	0.117	417.16	417.30	0.00110	0.07	19.5	154.6	
J1	2	PF 65	4.90	417.00	417.417	-	66	0.108	417.22	417.42	0.00155	0.11	44.6	267.8	
J1	2	PF 100	21.00	417.00	417.58	-	66	0.118	417.33	417.59	0.00395	0.22	97.9	379.9	
J1	1	16-Sep-13	0.33	416.61	417.009	417.018	-	0.200	416.81	417.01	0.00241	0.05	6.2	248.7	Surveyed
J1	1	PF 30	1.40	416.61	417.197	-	-	0.271	416.92	417.20	0.00241	0.07	21.0	320.2	
J1	1	PF 65	4.90	416.61	416.990	-	-	0.200	416.99	417.04	0.91978	0.96	5.1	239.5	
J1	1	PF 100	21.00	416.61	417.390	-	-	0.241	417.14	417.39	0.00241	0.12	172.3	371.0	

**Notes:**

Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.

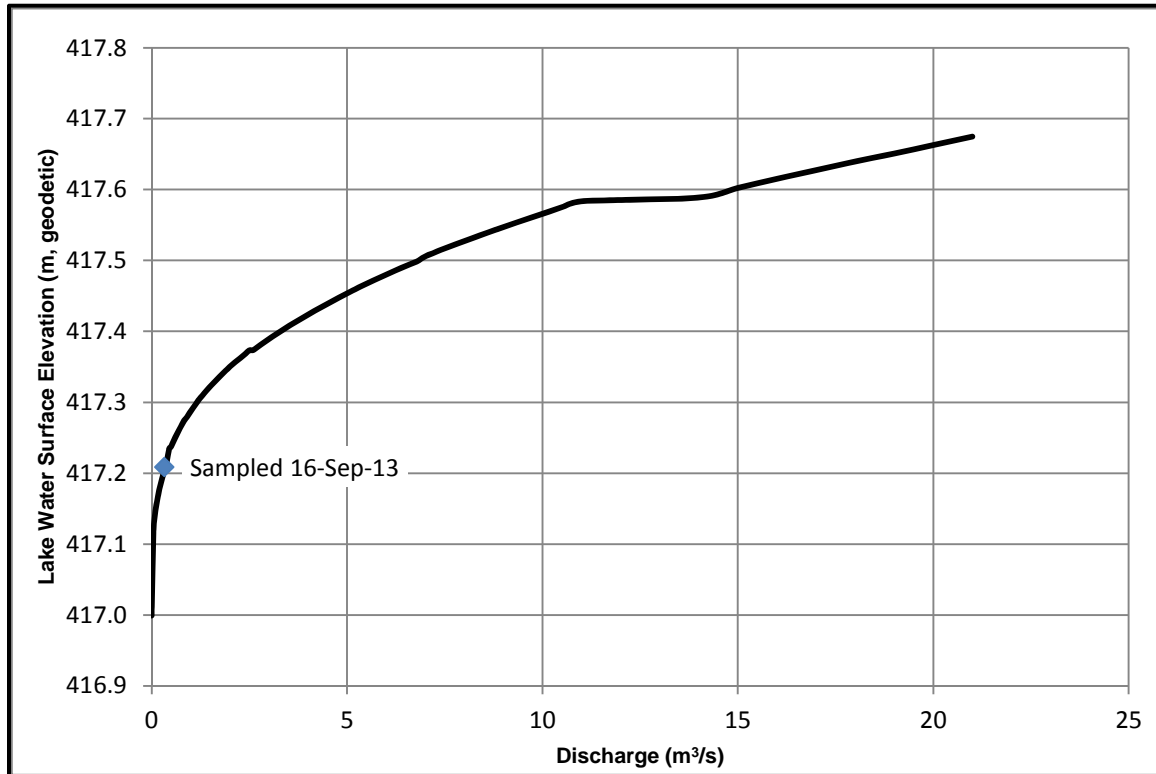
All other profiles are used to represent a possible range of discharges to estimate a lake outlet rating curve (100 flow profiles computed in total, only select profiles shown).

River station values decrease in the downstream direction.

Manning's n varies vertically for this reach according to the large-scale roughness resistance equation developed by Bathurst (1978 and 2002).

m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre; - = no data available.

Figure E3-52 Lake Outlet Rating Curve



m = metre; m³/s = cubic metres per second.

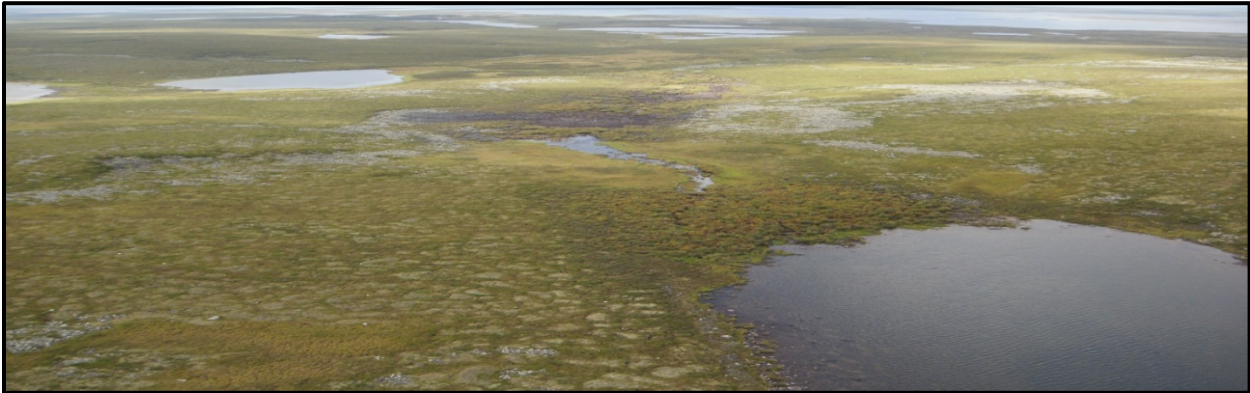
### E3.29 Lake J3 Outlet

Survey Date: 20-Aug-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 557752 m E, 7164010 m N

Outlet Coordinates (Geographic) : 64°35'46" N, 109°47'36"



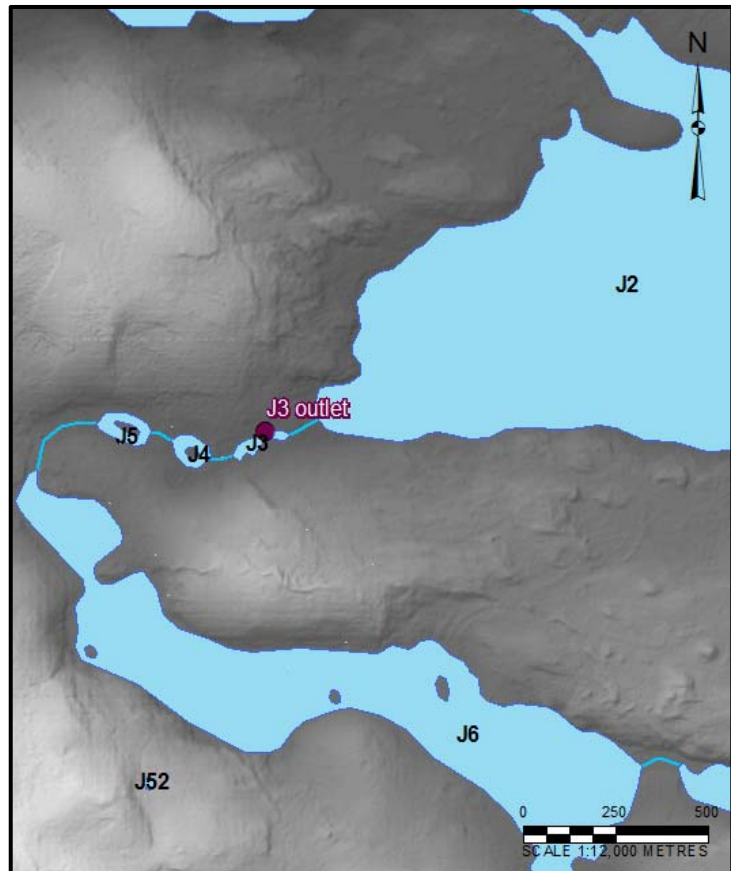
Upstream view of Lake J3 outlet (Lake J2 at bottom, Lake J3 is widening in stream in centre) looking west



Lake J3 upstream view of centre cross-section



Lake J3 downstream view of downstream cross-section



NTS Mapping of Area

**Table E3-136 Summary of Coordinates at Lake J3 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Non-geodetic)	558353.63	7164085.38
Outlet	557752	7164010

**Table E3-137 2013 Hydrometric Data at Lake J3 and Outlet Station**

Date	Time (24-hour)	Non-geodetic Benchmark Elevation <sup>(a)</sup> (m)	Non-geodetic Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
20-Aug-13	13:00	426.97	426.42	Not surveyed	0.04

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-138 Geomorphic Parameters at Lake J3 and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	0.5	ha	
Drainage Area (DEM) <sup>(a)</sup>	2457.0	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	426.50	m	
Surveyed Local Stream Slope	Not Surveyed	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.0091	m/m	
Average Bankfull Width	11.8	m	
Channel Material	30% boulder, 25% cobble, 15% coarse gravel, 10% medium gravel, 10% fine gravel, 10% coarse sand		
Bank Material	35% boulder, 30% cobble, 30% silt, 5% coarse gravel		
Vegetation	Grass and low shrub tundra		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E3-139 Stream J3 Discharge Data**

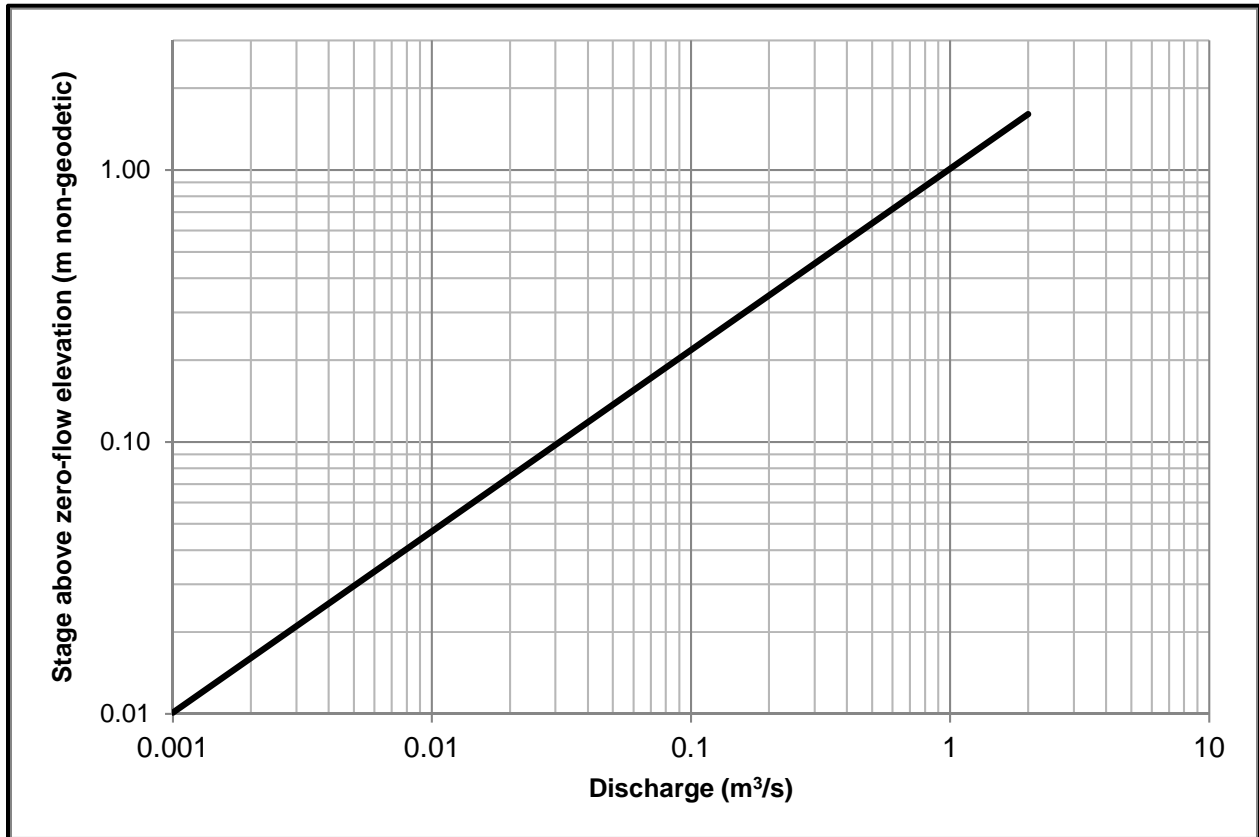
Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	13:00		<b>Location</b>		Centre cross-section approximately 400 m downstream of lake outlet		
<b>Lake Name</b>	Lake J3		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>		Marsh-McBirney FLO-MATE Model 2000		
<b>Date Monitored</b>	20-Aug-13		<b>Flow Meter Type</b>	Handheld electromagnetic sensor flowmeter		<b>Instrument Serial #</b>		2005872		
<b>Personnel</b>	MA, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	558383	7164115	8.5	0.00	0.032	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	Not surveyed		9.2	0.09	0.026	0.05	-	-	0.002	5.12
<b>Discharge (m<sup>3</sup>/s)</b>	0.04		9.5	0.08	0.026	0.15	-	-	0.004	8.37
<b>Notes</b>			9.8	0.09	0.025	0.06	-	-	0.002	3.84
			10.1	0.08	0.027	0.16	-	-	0.004	8.88
			10.4	0.10	0.024	0.06	-	-	0.002	4.27
			10.7	0.06	0.023	0.09	-	-	0.002	3.84
			11.0	0.09	0.027	0.12	-	-	0.003	7.68
			11.3	0.09	0.040	0.12	-	-	0.003	7.68
			11.6	0.18	0.048	0.05	-	-	0.003	6.15
			11.9	0.14	0.034	0.03	-	-	0.001	2.69
			12.2	0.09	0.029	0.10	-	-	0.003	6.15
			12.5	0.10	0.030	0.20	-	-	0.006	13.66
			12.8	0.10	0.030	0.11	-	-	0.003	7.68
			13.1	0.10	0.029	0.08	-	-	0.002	5.55
			13.4	0.09	0.036	0.03	-	-	0.001	2.11
			13.7	0.15	0.038	0.03	-	-	0.001	2.88
			14.0	0.10	0.023	0.02	-	-	0.001	1.28

**Table E3-139 Stream J3 Discharge Data**

Site Information	Discharge Measurement							
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)			Qi	% of Total Q
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%
	14.3	0.05	0.014	0.05	-	-	0.001	1.60
	14.6	0.04	0.009	0.02	-	-	0.000	0.55
	14.9	0.02	-	0.00	-	-	0.000	0.00
Ineffective flow area	16.2	IFA	-	-	-	-	-	-
Ineffective flow area	18.3	IFA	-	-	-	-	-	-
Ineffective flow area	19.7	IFA	-	Edge of Water (RDB)				
	<b>Total</b>		<b>0.57</b>				<b>0.04</b>	<b>100</b>

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-53 Lake J3 Outlet Rating Curve



Note: Cross-sections were measured downstream of the lake outlet and lake J3 is very poorly defined. Therefore, the lake outlet rating curve was not developed based on survey data, but rather the regional lake outlet relationship.

m = metre; m<sup>3</sup>/s = cubic metres per second.

### E3.30 Lake J76 Outlet

Survey Date: 13-Sep-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 566083 m E, 7168272 m N

Outlet Coordinates (Geographic) : 64°37'58" N, 109°37'02" W



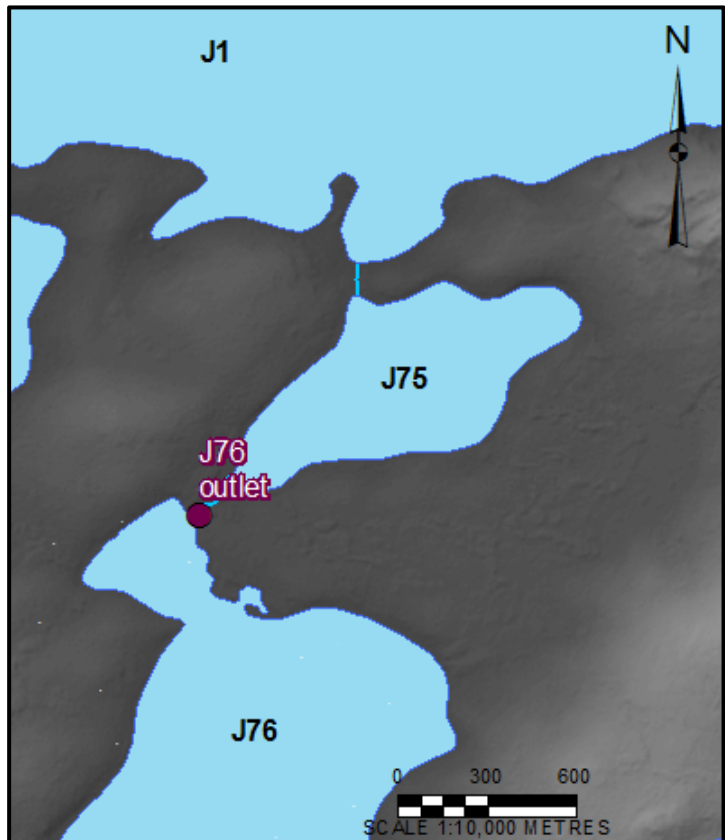
Downstream view of Lake J76 outlet looking northeast (Lake J75 at top)



Lake J76 outlet, downstream view



Lake J76 upstream view of centre cross-section



NTS Mapping of Area

**Table E3-140 Summary of Coordinates at Lake J76 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Non-geodetic)	566161.96	7168279.38
Outlet	566083	7168272

**Table E3-141 2013 Hydrometric Data at Lake J76 and Outlet Station**

Date	Time (24-hour)	Non-geodetic Benchmark Elevation <sup>(a)</sup> (m)	Non-geodetic Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
13-Sep-13	15:20	385.87	418.10	0.24	0.07

a) Elevation of the Benchmark set to 385.87 m to match lake elevations with LiDAR Water Surface Elevation of Lake J76.

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-142 Geomorphic Parameters at Lake J76 and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	100.0	ha	
Drainage Area (DEM) <sup>(a)</sup>	3765.9	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	418.10	m	
Surveyed Local Stream Slope	0.016	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.00030	m/m	
Average Bankfull Width	17.4	m	
Channel Material	40% boulder, 20% cobble, 10% coarse gravel, 10% medium gravel, 10% fine sand, 10% silt		
Bank Material	40% boulder, 40% silt, 10% cobble, 10% coarse gravel		
Vegetation	Grass		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre.

**Table E3-143 Stream J76 Discharge Data**

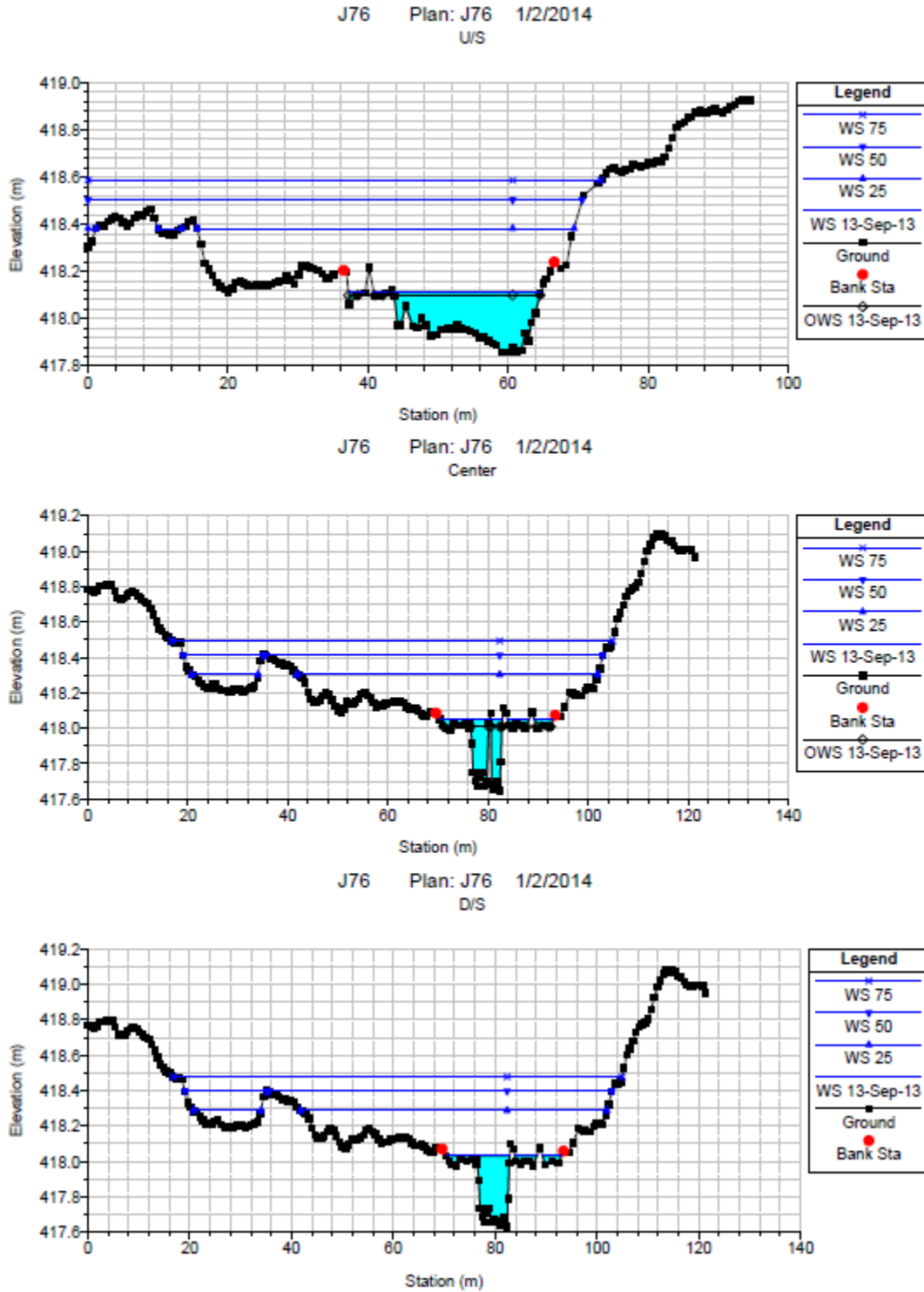
Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	15:20		<b>Location</b>		Centre cross-section approximately 50 m downstream of Lake outlet		
<b>Lake Name</b>	Lake J76		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>		SonTek FlowTracker		
<b>Date Monitored</b>	13-Sep-13		<b>Flow Meter Type</b>	Handheld ADV flowmeter		<b>Instrument Serial #</b>		P4017		
<b>Personnel</b>	DC, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>Qi</b>	<b>%</b>
	566134	7168305	3.6	0.00	0.052	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.24		4.0	0.26	0.038	0.04	-	-	0.003	3.69
<b>Discharge (m<sup>3</sup>/s)</b>	0.07		4.2	0.12	0.028	0.07	-	-	0.002	2.17
<b>Notes</b>			4.4	0.16	0.030	0.06	-	-	0.002	2.55
			4.6	0.14	0.028	0.08	-	-	0.002	3.10
			4.8	0.14	0.028	0.09	-	-	0.002	3.29
			5.0	0.14	0.026	0.12	-	-	0.003	4.57
			5.2	0.12	0.032	0.09	-	-	0.002	2.79
			5.4	0.20	0.046	0.10	-	-	0.004	5.24
			5.6	0.26	0.050	0.12	-	-	0.006	8.64
			5.8	0.24	0.048	0.12	-	-	0.006	7.52
			6.0	0.24	0.048	0.08	-	-	0.004	5.25
			6.2	0.24	0.052	0.04	-	-	0.002	2.46
			6.4	0.28	0.056	0.01	-	-	0.001	0.68
			6.6	0.28	0.062	0.02	-	-	0.001	1.21
			6.8	0.34	0.068	0.06	-	-	0.004	5.88
			7.2	0.30	0.062	0.13	-	-	0.008	10.45

**Table E3-143 Stream J76 Discharge Data**

Site Information	Discharge Measurement							
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)			Qi	% of Total Q
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%
	7.4	0.32	0.062	0.10	-	-	0.007	8.81
	7.6	0.30	0.060	0.11	-	-	0.007	8.91
	7.0	0.34	0.064	0.08	-	-	0.006	7.62
	7.8	0.30	0.030	0.06	-	-	0.004	5.18
	8.0	0.00	0.000	Edge of Water (RDB)				
	<b>Total</b>		<b>0.970</b>				<b>0.07</b>	<b>100</b>

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-54 Stream J76 Transects Used for Hydraulic Modelling



**Table E3-144 Stream J76 Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)		(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	
J76	67.853	13-Sep-13	0.074	417.86	418.111	418.10	58	0.330	-	418.11	0.00066	0.02	3.55	25.6	Surveyed
J76	67.853	25	0.960	417.86	418.383	-	58	0.239	-	418.38	0.00110	0.06	16.26	58.4	
J76	67.853	50	1.960	417.86	418.503	-	58	0.230	-	418.50	0.00144	0.08	24.32	70.6	
J76	67.853	75	2.960	417.86	418.587	-	58	0.223	-	418.59	0.00156	0.10	30.29	73.2	
J76	10	13-Sep-13	0.074	417.65	418.050	418.01	10	0.330	-	418.05	0.00213	0.03	2.32	20.5	Surveyed
J76	10	25	0.960	417.65	418.303	-	10	0.212	-	418.30	0.00170	0.07	14.58	73.4	
J76	10	50	1.960	417.65	418.413	-	10	0.204	-	418.41	0.00167	0.09	23.17	83.5	
J76	10	75	2.960	417.65	418.493	-	10	0.200	-	418.49	0.00165	0.10	30.02	88.2	
J76	0	13-Sep-13	0.074	417.63	418.031	-	-	0.330	417.70	418.03	0.00160	0.03	2.51	20.6	Surveyed
J76	0	25	0.960	417.63	418.287	-	-	0.212	417.83	418.29	0.00160	0.07	14.81	73.4	
J76	0	50	1.960	417.63	418.397	-	-	0.204	417.91	418.40	0.00160	0.08	23.42	83.5	
J76	0	75	2.960	417.63	418.477	-	-	0.200	418.04	418.48	0.00160	0.10	30.27	88.2	

Notes:

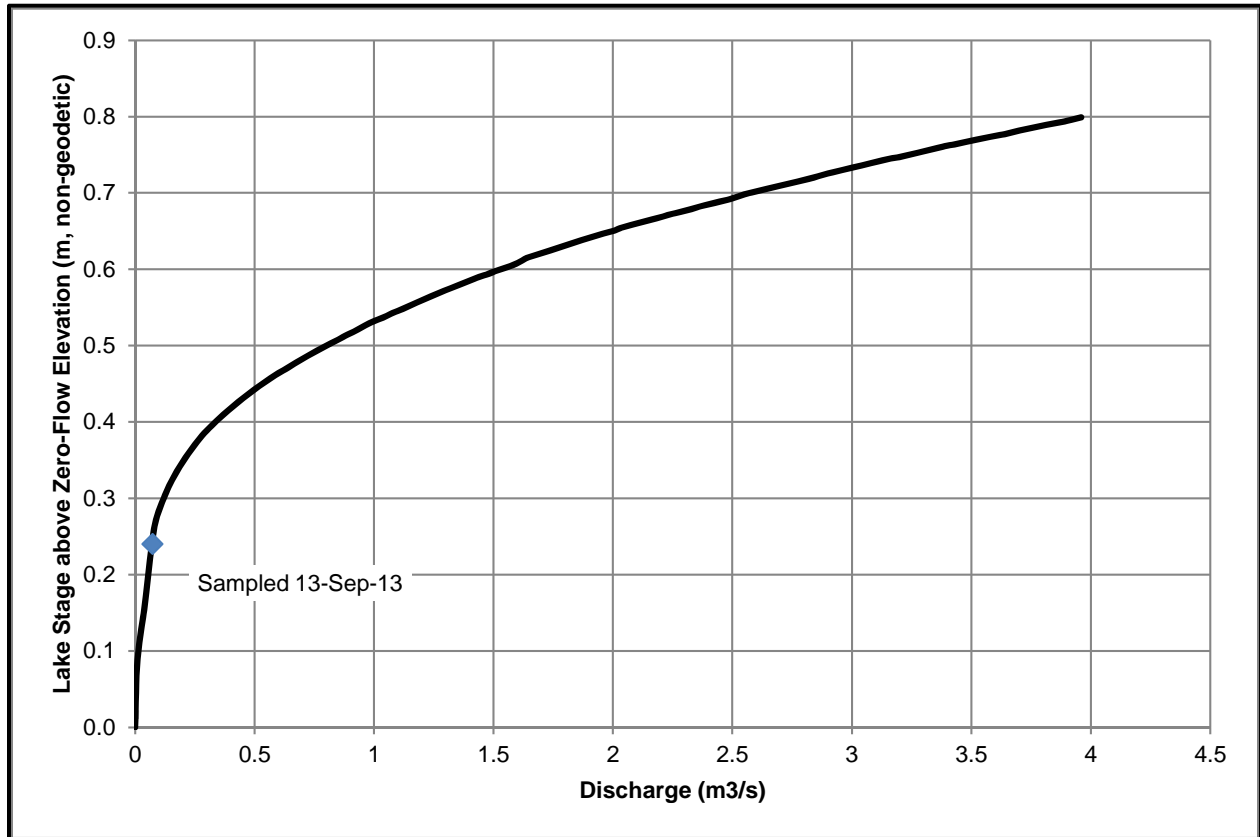
Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.

All other profiles are used to represent a possible range of discharges to estimate a lake outlet rating curve (100 flow profiles computed in total, only select profiles shown).

River station values decrease in the downstream direction.

m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre; - = no data available.

Figure E3-55 Lake J76 Outlet Rating Curve



m = metre; m<sup>3</sup>/s = cubic metres per second.

### E3.31 Lake J77 Outlet

Survey Date: 11-Sep-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 566857 m E, 7166602 m N

Outlet Coordinates (Geographic) : 64°37'04" N, 109°36'07" W



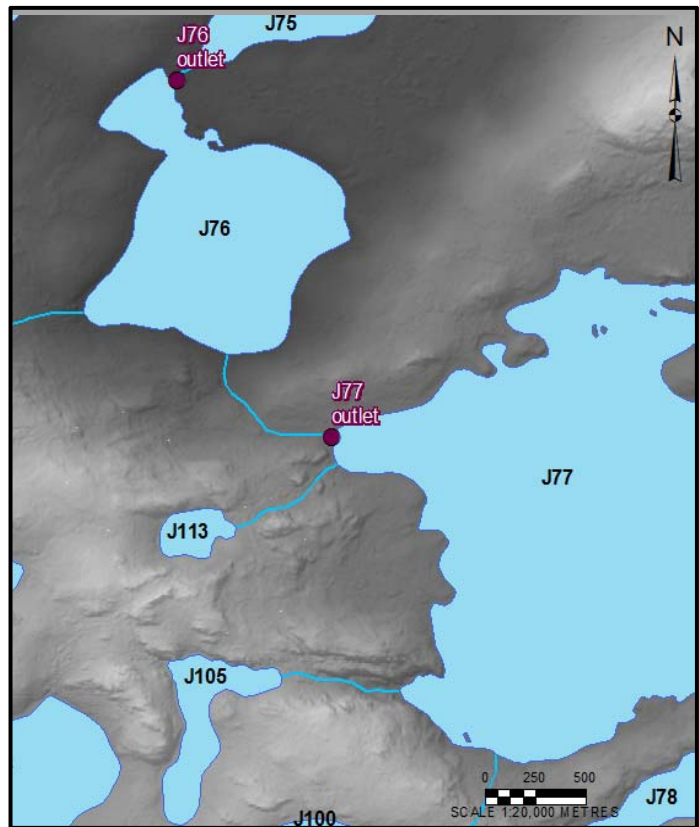
Upstream view of Lake J77 outlet looking east



Lake J77 upstream view of centre cross-section



Lake J77 downstream view of downstream cross-section



NTS Mapping of Area

**Table E3-145 Summary of Coordinates at Lake J77 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Non-geodetic)	7211330.95	521938.47
Outlet	566857	7166602

**Table E3-146 2013 Hydrometric Data at Lake J77 and Outlet Station**

Date	Time (24-hour)	Non-geodetic Benchmark Elevation <sup>(a)</sup> (m)	Non-geodetic Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
11-Sep-13	15:00	409.77	430.50	0.43	0.07

a) Elevation of the Benchmark set to 409.77 m to match lake elevations with LiDAR Water Surface Elevation of Lake J77.  
m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-147 Geomorphic Parameters at Lake J77 and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	427.6	ha	
Drainage Area (DEM) <sup>(a)</sup>	3218.6	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	430.50	m	
Surveyed Local Stream Slope	0.0011	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.016	m/m	
Average Bankfull Width	29.3	m	
Channel Material	60% boulder, 20% cobble, 20% silt		
Bank Material	50% boulder, 30% silt, 20% cobble		
Vegetation	Low shrub tundra		

a) DEM from LiDAR data flown 23 July – 1 August 2013.  
b) Overall stream slope between upstream and downstream lakes.  
m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E3-148 Lake J77 Discharge Data**

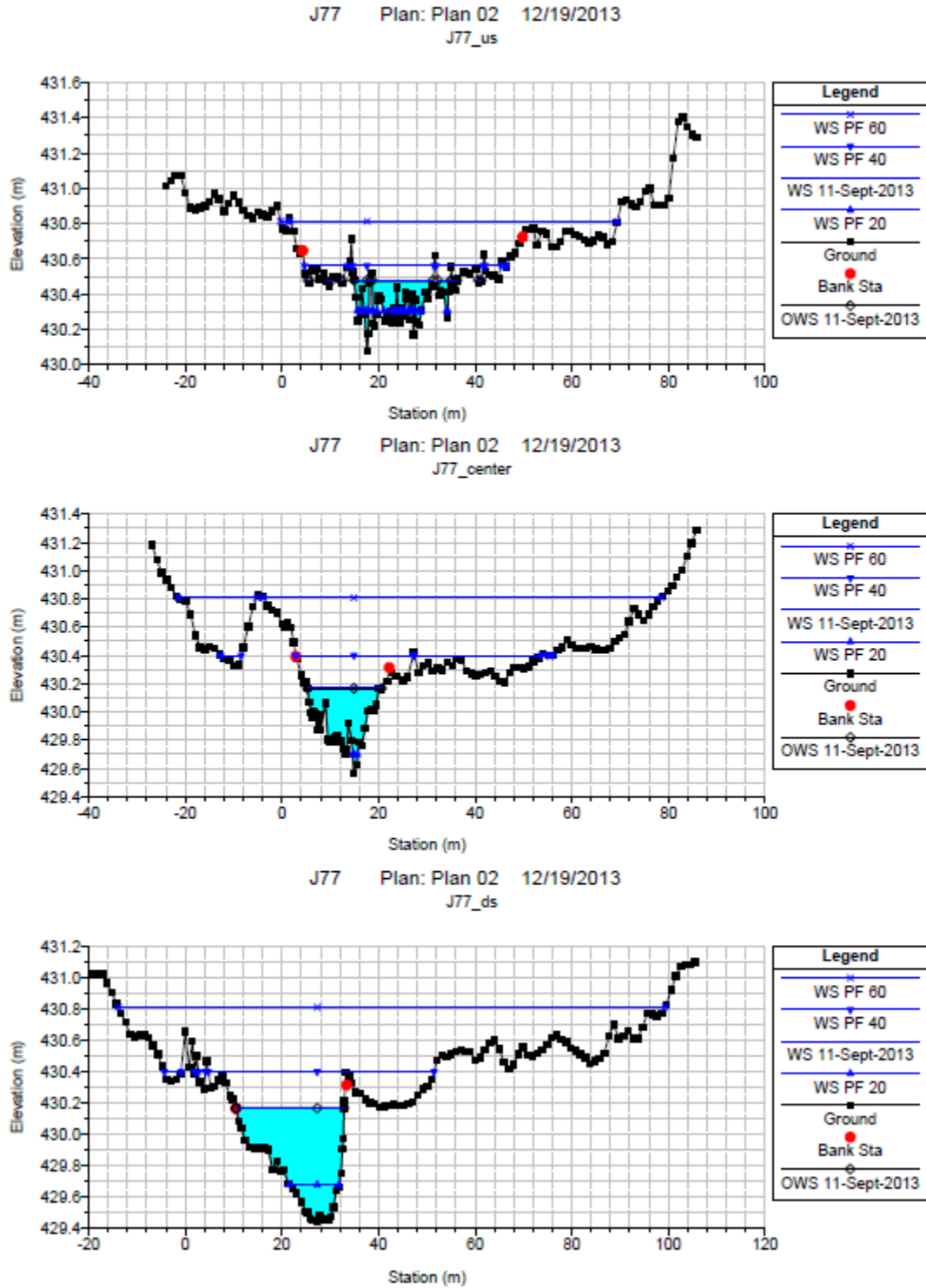
Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	15:00		<b>Location</b>	Centre cross-section approximately 250 m downstream of Lake outlet			
<b>Lake Name</b>	Lake J77		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	SonTek FlowTracker			
<b>Date Monitored</b>	11-Sep-13		<b>Flow Meter Type</b>	Handheld ADV flowmeter		<b>Instrument Serial #</b>	P4017			
<b>Personnel</b>	MA, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	566623	7166585	2.5	0.00	0.045	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.43		3.0	0.18	0.090	0.006	-	-	0.001	0.78
<b>Discharge (m<sup>3</sup>/s)</b>	0.07		3.5	0.18	0.090	-0.003	-	-	0.000	-0.39
<b>Notes</b>			4.0	0.18	0.100	0.002	-	-	0.000	0.26
			4.5	0.22	0.105	0.010	-	-	0.001	1.58
			5.0	0.20	0.105	0.011	-	-	0.001	1.58
			5.5	0.22	0.080	0.000	-	-	0.000	0.00
			6.0	0.10	0.115	0.015	-	-	0.001	1.08
			6.5	0.36	0.180	0.140	-	-	0.025	36.20
			7.0	0.36	0.160	0.013	-	-	0.002	3.36
			7.5	0.28	0.160	0.008	-	-	0.001	1.61
			8.0	0.36	0.165	0.016	-	-	0.003	4.14
			8.5	0.30	0.165	0.013	-	-	0.002	2.80
			9.0	0.36	0.200	0.022	-	-	0.004	5.69
			9.5	0.44	0.220	0.021	-	-	0.005	6.64
			10.0	0.44	0.250	0.005	-	-	0.001	1.58
			10.5	0.56	0.215	0.011	-	-	0.003	4.42
			11.0	0.30	0.175	0.019	-	-	0.003	4.09

**Table E3-148 Lake J77 Discharge Data**

Site Information	Discharge Measurement								
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)			Qi	% of Total Q	
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%	
	11.5	0.40	0.245	0.026	-	-	0.005	7.47	
	12.0	0.58	0.280	0.003	-	-	0.001	1.29	
	12.5	0.54	0.240	0.007	-	-	0.002	2.72	
	13.0	0.42	0.210	0.024	-	-	0.005	7.24	
	13.5	0.42	0.195	0.016	-	-	0.003	4.83	
	14.0	0.36	0.150	0.004	-	-	0.001	1.03	
	14.5	0.24	0.060	0.000	-	-	0.000	0.00	
	15.0	0.00	0.000	Edge of Water (RDB)					
	<b>Total</b>		<b>4.00</b>				<b>0.07</b>	<b>100</b>	

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-56 Stream J77 Transects Used for Hydraulic Modelling



**Table E3-149 Stream J77 Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)		(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	
J77	3	11-Sep-13	0.07	430.07	430.473	430.479	224 (To Stn 2)	0.450	-	430.47	0.00209	0.03	2.8	21.5	Surveyed
J77	3	PF 20	0.01	430.07	430.306	-	224 (To Stn 2)	0.450	-	430.31	0.00197	0.01	0.4	8.1	
J77	3	PF 40	0.17	430.07	430.561	-	224 (To Stn 2)	0.375	-	430.56	0.00184	0.03	5.5	38.9	
J77	3	PF 60	0.77	430.07	430.813	-	224 (To Stn 2)	0.053	-	430.81	0.00003	0.04	18.7	69.3	
J77	2	11-Sep-13	0.07	429.57	430.171	430.166	52 (To Stn 1)	0.185	-	430.17	0.00005	0.02	4.4	15.5	Surveyed
J77	2	PF 20	0.01	429.57	429.698	-	52 (To Stn 1)	0.185	-	429.70	0.00388	0.06	0.1	1.0	
J77	2	PF 40	0.17	429.57	430.400	-	52 (To Stn 1)	0.115	-	430.40	0.00002	0.01	11.8	55.9	
J77	2	PF 60	0.77	429.57	430.810	-	52 (To Stn 1)	0.091	-	430.81	0.00001	0.02	45.1	98.6	
J77	1	11-Sep-13	0.07	429.44	430.170	430.166	-	0.185	429.49	430.17	0.00001	0.01	10.1	22.5	Surveyed
J77	1	PF 20	0.01	429.44	429.677	-	-	0.185	429.46	429.68	0.00001	0.00	1.5	10.4	
J77	1	PF 40	0.17	429.44	430.399	-	-	0.126	429.51	430.40	0.00001	0.01	19.1	51.8	
J77	1	PF 60	0.77	429.44	430.810	-	-	0.097	429.59	430.81	0.00001	0.01	55.3	113.2	

**Notes:**

Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.

All other profiles are used to represent a possible range of discharges to estimate a lake outlet rating curve (100 flow profiles computed in total, only select profiles shown).

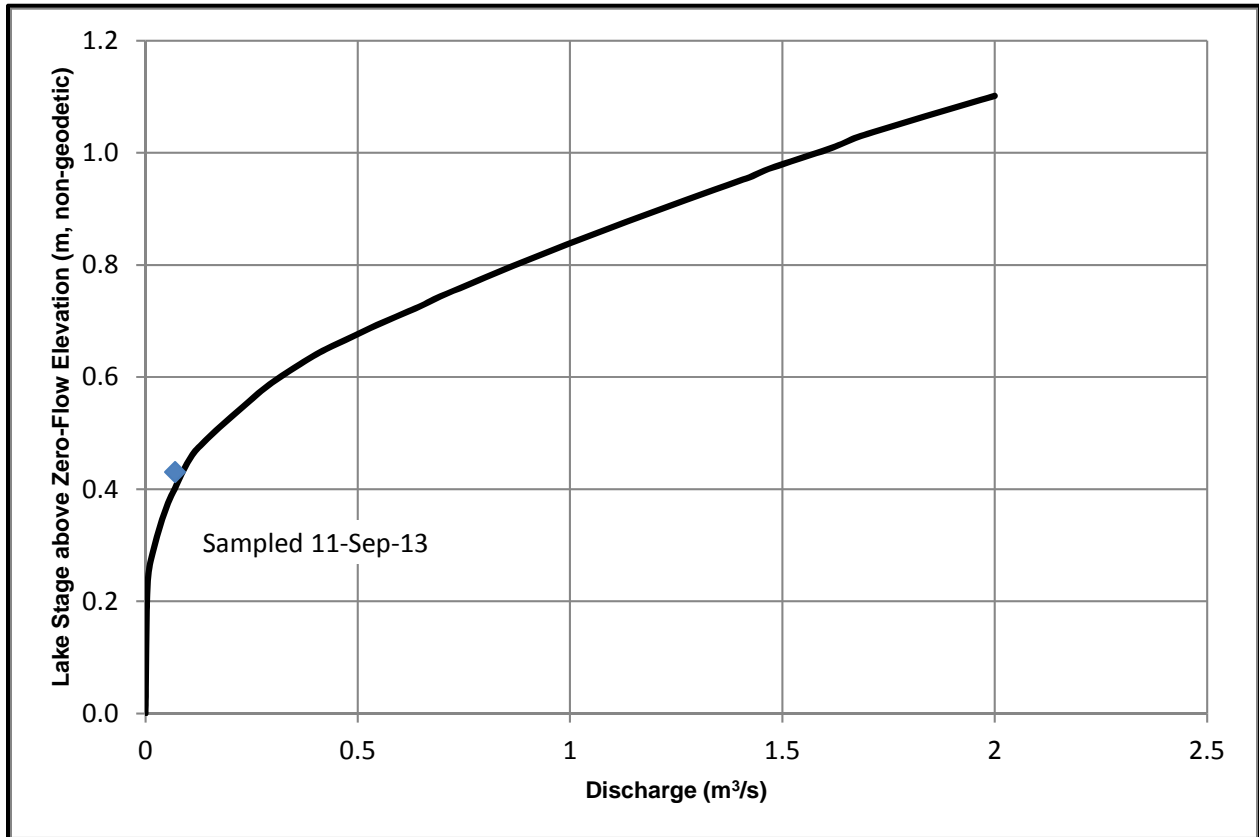
River station values decrease in the downstream direction.

Manning's n varies vertically for this reach according to the large-scale roughness resistance equation developed by Bathurst (1978 and 2002).

Additional interpolated cross-sections were used for hydraulic modelling, but are not included in the summary tables.

m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre; - = no data available.

Figure E3-57 Lake J77 Outlet Rating Curve



m = metre; m³/s = cubic metres per second.

### E3.32 Paul Lake Outlet

Survey Date: 9-Sep-13

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 525146 m E, 7169666 m N

Outlet Coordinates (Geographic) : 64°39'03" N, 110°28'24" W



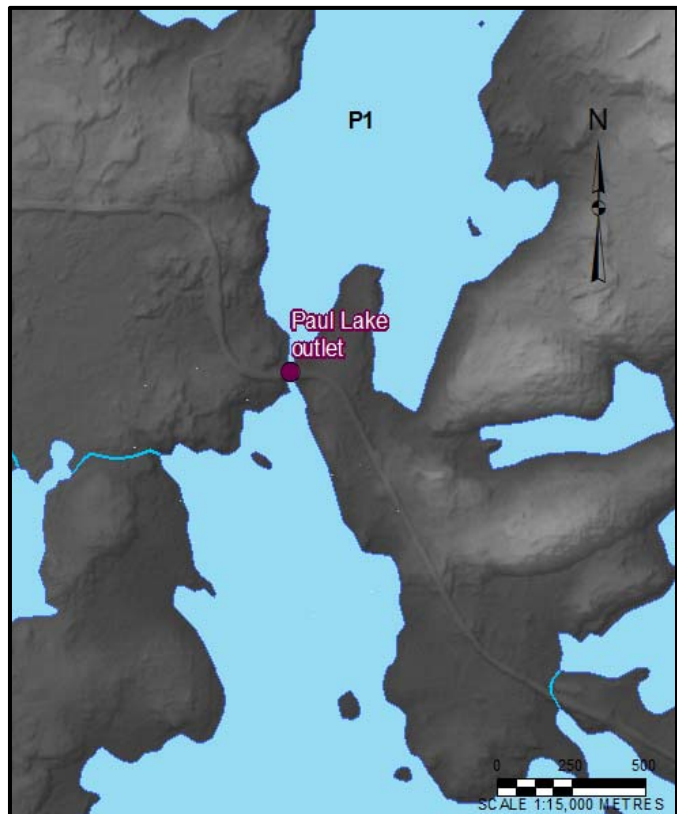
Upstream view of Paul Lake Outlet



Upstream view at Lac de Gras inlet



Downstream view at downstream cross-section (looking at Lac de Gras)



NTS Mapping of Area

**Table E3-150 Summary of Coordinates at Paul Lake Outlet and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Geodetic)	525450.77	7170014.80
Outlet	525146	7169666

**Table E3-151 2013 Hydrometric Data at Paul Lake Outlet and Outlet Station**

Date	Time (24-hour)	Benchmark Elevation (m)	Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
9-Sep-13	9:30	422.09	416.96	Not measured	0.94

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-152 Geomorphic Parameters at Paul Lake Outlet and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	930.8	ha	
Drainage Area (DEM) <sup>(a)</sup>	12506.1	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	417.00	m	
Surveyed Local Stream Slope	0.0051	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.0051	m/m	
Average Bankfull Width	30.5	m	
Channel Material	70% boulder, 10% cobble, 10% coarse sand, 10% fine sand		
Bank Material	60% boulder, 30% cobble, 10% fine sand		
Vegetation	Low shrub tundra		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E3-153 Paul Lake Outlet Discharge Data**

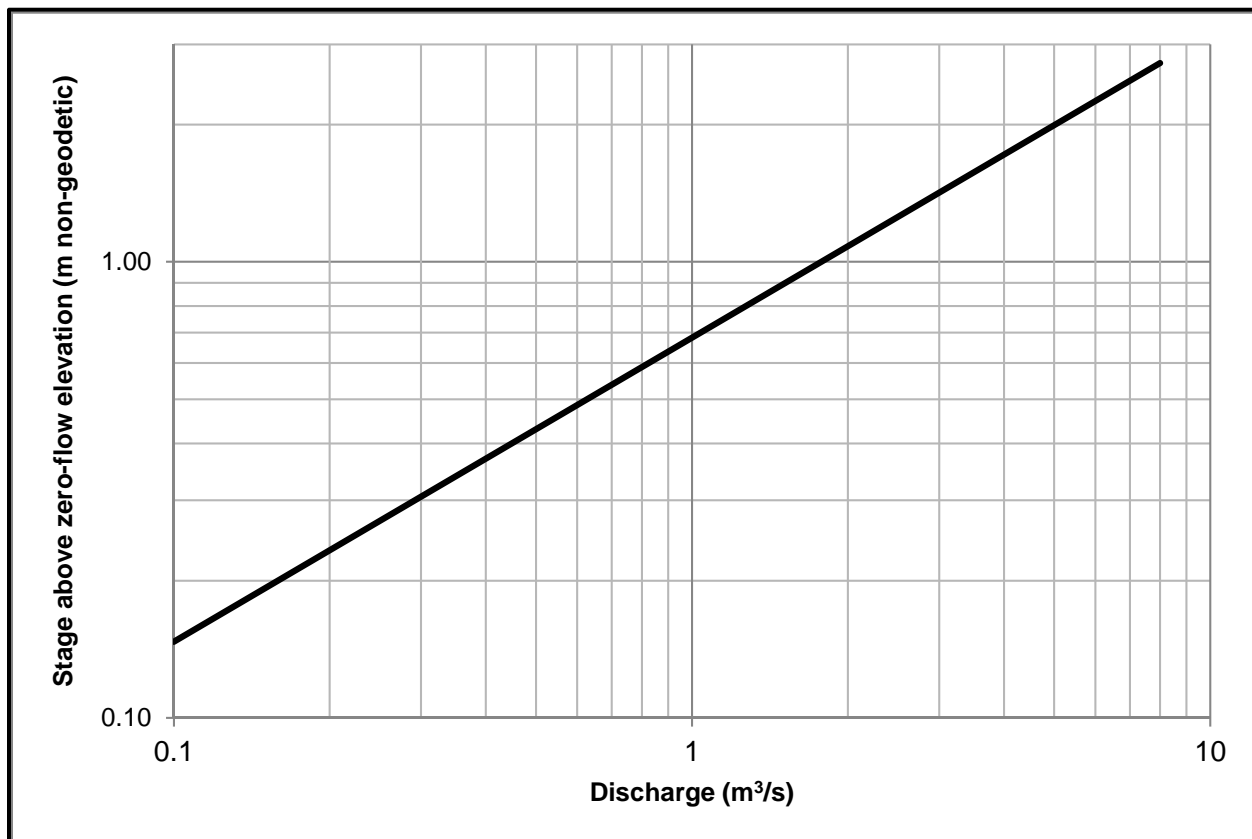
Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	9:30		<b>Location</b>		Approximately 100 m downstream of Lake outlet		
<b>Lake Name</b>	Paul Lake Outlet		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>		Marsh-McBirney FLO-MATE Model 2000		
<b>Date Monitored</b>	9-Sep-13		<b>Flow Meter Type</b>	Handheld electromagnetic sensor flowmeter		<b>Instrument Serial #</b>		2005872		
<b>Personnel</b>	DC, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	525365	7169755	1.1		0.140	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	Not measured		2.1	0.28	0.180	0.03	-	-	0.008	0.89
<b>Discharge (m<sup>3</sup>/s)</b>	0.94		3.1	0.08	0.190	0.00	-	-	0.000	0.00
<b>Notes</b>			4.1	0.30	0.280	0.04	-	-	0.012	1.28
			5.1	0.26	0.310	0.01	-	-	0.003	0.28
			6.1	0.36	0.360	0.02	-	-	0.007	0.77
			7.1	0.36	0.420	0.09	-	-	0.032	3.45
			8.1	0.48	0.440	0.01	-	-	0.005	0.51
			9.1	0.40	0.380	0.04	-	-	0.016	1.70
			10.1	0.36	0.360	0.14	-	-	0.050	5.36
			11.1	0.36	0.350	0.18	-	-	0.065	6.89
			12.1	0.34	0.295	0.22	-	-	0.075	7.95
			13.1	0.25	0.305	0.15	-	-	0.038	3.99
			14.1	0.36	0.320	0.26	-	-	0.094	9.95
			15.1	0.28	0.290	0.23	-	-	0.064	6.85
			16.1	0.30	0.390	0.10	-	-	0.030	3.19
			17.1	0.48	0.590	0.18	-	-	0.086	9.19

**Table E3-153 Paul Lake Outlet Discharge Data**

Site Information	Discharge Measurement								
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)			Qi	% of Total Q	
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%	
	18.1	0.70	0.570	0.28	-	-	0.196	20.84	
	19.1	0.44	0.460	0.24	-	-	0.106	11.23	
	20.1	0.48	0.530	0.05	-	-	0.024	2.55	
	21.1	0.58	0.540	0.03		-	0.017	1.85	
	22.1	0.50	0.150	0.03	-	-	0.012	1.28	
	22.7		0.000	Edge of Water (RDB)					
	<b>Total</b>		<b>7.85</b>				<b>0.94</b>	<b>100</b>	

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-58 Paul Lake Outlet Rating Curve



Note: Cross-sections were measured downstream of the lake outlet, as the lake outlet was a boulder garden with considerable interstitial boulder flow with a poorly defined streambed. Therefore, the lake outlet rating curve was not developed based on survey data, but rather the regional lake outlet relationship.

m = metre; m³/s = cubic metres per second.

### E3.33 Lake Ab13 Outlet

Survey Date: 19-Aug-13

Benchmark: Drilled hole in rock

Outlet Coordinates (UTM Zone 12, NAD 83): 552055 m E, 7161674 m N

Outlet Coordinates (Geographic) : 64°34'34" N, 109°54'47" W



Upstream view of Lake Ab13 outlet looking east (Lac du Sauvage at foreground)



Lake Ab13 outlet upstream view of upstream cross section



Lake Ab13 outlet downstream view of downstream cross-section



NTS Mapping of Area

**Table E3-154 Summary of Coordinates at Lake Ab13 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Geodetic)	552082.22	7161654.84
Outlet	552055	7161674

**Table E3-155 2013 Hydrometric Data at Lake Ab13 and Outlet Station**

Date	Time (24-hour)	Benchmark Elevation (m)	Water Surface Elevation (m)	Lake Stage Above Zero-Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
19-Aug-13	14:00	416.67	416.02	0.37	0.06

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E3-156 Geomorphic Parameters at Lake Ab13 and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	39.3	ha	
Drainage Area (DEM) <sup>(a)</sup>	2357.9	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	416.20	m	
Surveyed Local Stream Slope	0.00043	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.038	m/m	
Average Bankfull Width	66.1	m	
Channel Material	60% boulder, 20% cobble, 20% silt		
Bank Material	50% boulder, 20% cobble, 30% silt		
Vegetation	Low shrub tundra		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.



**Table E3-157 Stream Ab13 Discharge Data**

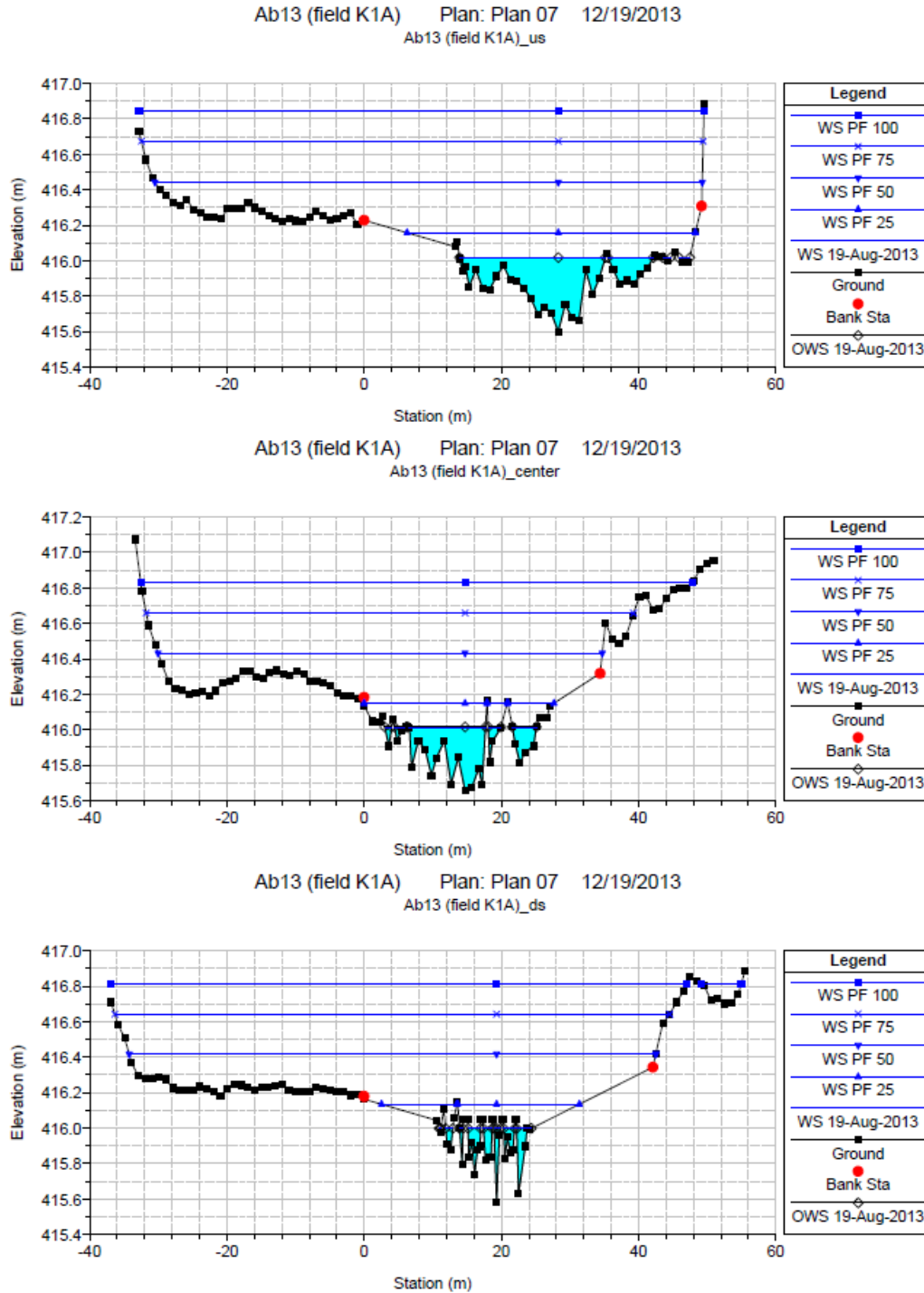
Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	14:00		<b>Location</b>		Downstream cross-section approximately 55 m downstream of lake outlet		
<b>Lake Name</b>	Lake Ab13		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>		Marsh-McBirney FLO-MATE Model 2000		
<b>Date Monitored</b>	19-Aug-13		<b>Flow Meter Type</b>	Handheld electromagnetic sensor flowmeter		<b>Instrument Serial #</b>		2005872		
<b>Personnel</b>	MA, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Approximate Gauging Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	552063	7161654	3.3	0.00	0.040	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.37		3.7	0.20	-	0.024	-	-	0.0013	2.34
<b>Discharge (m<sup>3</sup>/s)</b>	0.06		3.8	Boulder edge	-	-	-	-	-	-
<b>Notes</b>			4.5	Boulder edge	-	-	-	-	-	-
			4.6	0.16	0.054	0.043	-	-	0.0020	3.57
			5.1	0.08	0.068	0.006	-	-	0.0002	0.36
			5.5	0.26	0.076	0.012	-	-	0.0013	2.21
			5.9	0.12	0.044	0.107	-	-	0.0051	8.92
			6.3	0.10	-	0.110	-	-	0.0027	4.78
			6.4	Boulder edge	-	-	-	-	-	-
			6.7	Boulder edge	-	-	-	-	-	-
			7.1	0.18	0.068	0.009	-	-	0.0066	1.15
			7.5	0.16	0.064	0.021	-	-	0.0014	2.38
			7.9	0.16	-	0.027	-	-	0.0013	2.29
			8.1	Boulder edge	-	-	-	-	-	-
			8.3	Boulder edge	-	-	-	-	-	-
			8.7	0.17	0.058	0.128	-	-	0.0087	15.16
			9.1	0.12	-	0.012	-	-	0.0006	1.02
			9.5	Boulder edge	-	-	-	-	-	-

**Table E3-157 Stream Ab13 Discharge Data**

Site Information	Discharge Measurement								
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)			Qi	% of Total Q	
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%	
	9.7	Boulder edge	-	-	-	-	-	-	
	9.9	0.17	0.044	0.076	-	-	0.0039	6.77	
	10.3	0.05	0.038	0.162	-	-	0.0032	5.63	
	10.7	0.14	0.052	0.119	-	-	0.0067	11.59	
	11.1	0.12	-	0.207	-	-	0.0091	15.81	
	11.43	Boulder edge	-	-	-	-	-	0.00	
	11.6	Boulder edge	-	-	-	-	-	0.00	
	11.9	0.37	0.235	0.012	-	-	0.0029	5.11	
	12.9	0.10	0.013	0.101	-	-	0.0063	10.95	
	13.15	0.00	0.000	Edge of Water (RDB)					
	<b>Total</b>		<b>0.85</b>				<b>0.06</b>	<b>100</b>	

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E3-59 Stream Ab13 Transects Used for Hydraulic Modelling

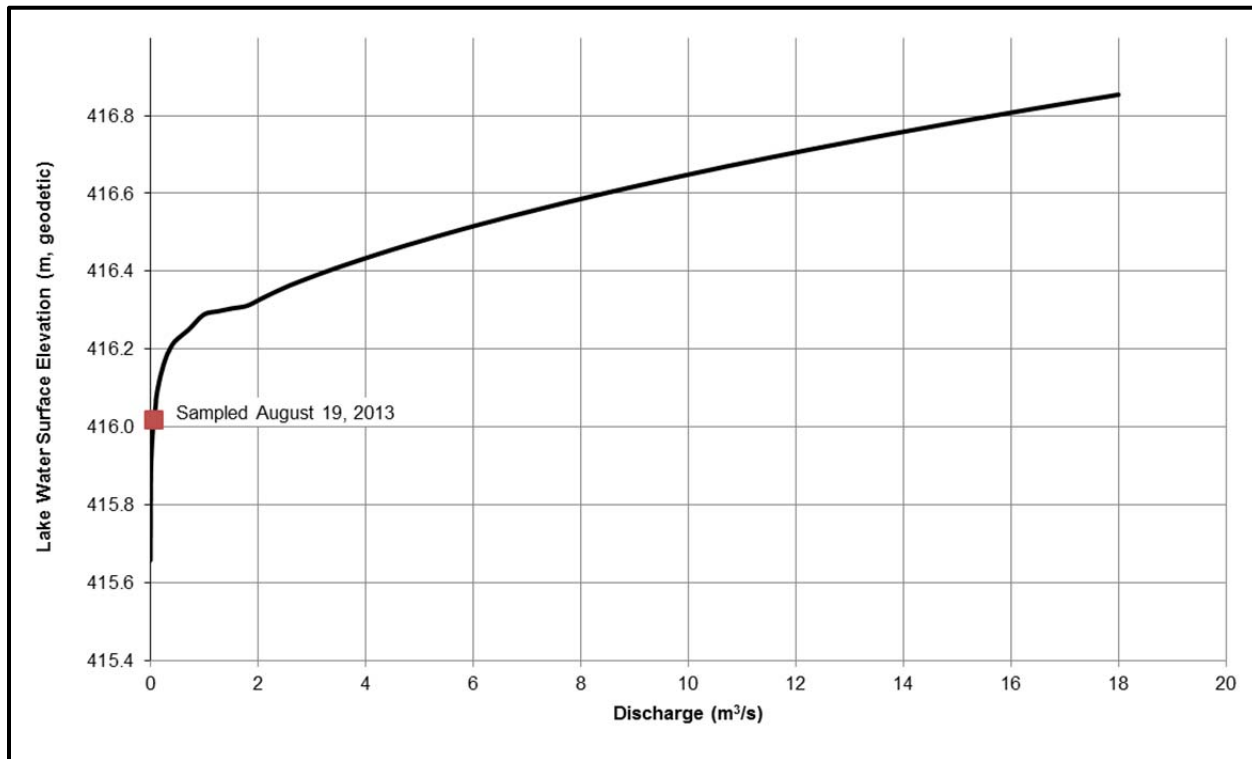


**Table E3-158 Stream Ab13 Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)		(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	
Ab13	3	19-Aug-13	0.06	415.60	416.016	416.017	23	0.290	-	416.02	0.00015	0.01	4.7	30.5	Surveyed
Ab13	3	PF 25	0.24	415.60	416.157	-	23	0.230	-	416.16	0.00022	0.02	9.8	42.0	
Ab13	3	PF 50	4.23	415.60	416.443	-	23	0.055	-	416.44	0.00026	0.15	28.8	79.8	
Ab13	3	PF 75	10.98	415.60	416.674	-	23	0.059	-	416.68	0.00039	0.23	47.5	81.9	
Ab13	3	PF 100	18.00	415.60	416.849	-	23	0.060	-	416.85	0.00046	0.29	61.9	82.3	
Ab13	2	19-Aug-13	0.06	415.66	416.011	416.016	21	0.300	-	416.01	0.00043	0.02	2.9	18.8	Surveyed
Ab13	2	PF 25	0.24	415.66	416.150	-	21	0.240	-	416.15	0.00064	0.04	6.2	27.5	
Ab13	2	PF 50	4.23	415.66	416.433	-	21	0.055	-	416.44	0.00062	0.21	20.5	64.7	
Ab13	2	PF 75	10.98	415.66	416.659	-	21	0.059	-	416.66	0.00081	0.31	35.9	71.0	
Ab13	2	PF 100	18.00	415.66	416.831	-	21	0.058	-	416.84	0.00089	0.37	48.9	80.4	
Ab13	1	19-Aug-13	0.06	415.58	415.998	415.998	-	0.139	415.76	416.00	0.00084	0.05	1.2	9.6	Surveyed
Ab13	1	PF 25	0.24	415.58	416.134	-	-	0.110	415.87	416.14	0.00084	0.07	3.7	28.7	
Ab13	1	PF 50	4.23	415.58	416.418	-	-	0.060	416.13	416.42	0.00084	0.20	20.9	76.8	
Ab13	1	PF 75	10.98	415.58	416.642	-	-	0.061	416.27	416.65	0.00085	0.29	38.5	80.9	
Ab13	1	PF 100	18.00	415.58	416.814	-	-	0.060	416.33	416.82	0.00084	0.34	53.2	89.7	

Notes: Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.  
 All other profiles are used to represent a possible range of discharges to estimate a lake outlet rating curve (100 flow profiles computed in total, only select profiles shown).  
 River station values decrease in the downstream direction.  
 Manning's n varies vertically for this reach according to the large-scale roughness resistance equation developed by Bathurst (1978 and 2002).  
 Additional interpolated cross-sections were used for hydraulic modelling, but are not included in the summary tables.  
 m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre; - = no data available.

Figure E3-60 Lake Ab13 Outlet Rating Curve



m = metre; m³/s = cubic metres per second.

## E4 HYDROMETRIC STATIONS

Continuous measurement hydrometric stations were set up at six outlets in the Lac du Sauvage watershed, as shown in Map 3.3-1. Stations were installed at the Lac du Sauvage outlet, Lake E1 outlet, Lake E10 (Ursula Lake) outlet, Lake G2 outlet, Lake I1A outlet, and Lake L1 outlet to develop stage-discharge relationships and flow series for the open-water season. These stations were equipped with self-contained water level dataloggers that recorded water pressure on a 10-minute interval, which was corrected to derive a water level time series using two installed barometric loggers at the Lac du Sauvage and Lake G2 outlets.

In addition to the installation of water level data loggers and barometric loggers at the six outlets, a complete hydrology survey (as described in Section 3.3.2.2) was completed at the hydrometric station during each site visit. All sites were visited twice during the 2013 field program, at installation and removal, except for Lake E10 (Ursula Lake), which was surveyed three times due to an additional opportunistic site visit. When possible, site benchmarks were referenced to geodetic base stations installed by Aurora Geosciences Ltd..

Actions or data collected at each of these sites included the following:

- Oblique aerial and land-based geo-referenced photographs.
- Installation of a permanent benchmark (an anchor installed into overburden rock or into bedrock where available).
- Detailed channel survey including cross-sections sufficient to characterize the control section of the outlet channel in HEC-RAS (when combined with additional LiDAR elevation data), stream and lake water levels, and local water surface slopes using either a self-levelling level and rod with spatial coordinates measured using a handheld GPS unit (sites in August) or a Real Time Kinematic (RTK) satellite navigation system (sites in September).
- Stream discharge measurements performed according to the Water Survey of Canada standard described by Terzi et al. (1994), using a top-setting wading rod and either a Marsh-McBirney Flo-Mate Model 2000 or a SonTek Flow Tracker current velocity meter.
- Observations of channel geomorphology including bed and bank material types, vegetation, sinuosity, high-water marks, and bankfull locations.
- Installation of a self-contained water level data logger (Solinst Levellogger Edge Model 3001) at each hydrometric station in the lake above the outlet. Each data logger was programmed to record water pressure measurements at 10-minute intervals. Each station was referenced to an elevation benchmark.
- Installation of transducers as early as possible during the August field program and removal as late as possible during the September field program.
- Installation of barometric data loggers (Solinst Barologger at two sites within the Lac du Sauvage watershed to provide for correction of pressure transducer readings to water depths.



- Downloading of the data loggers at each station completed at the same time, and pressure transducer readings coincident with each discharge measurement, installation and removal noted.

Summaries of the relevant field data from the hydrology surveys and hydrometric stations for each site are provided in the following sections.

## E4.1 Lake E1 Outlet

Operational in August and September 2013

Benchmark: Top of Rock Anchor Bolt      Pressure Transducer: 30011 LT Levellogger Edge Solinst (S/N 2012117)

Outlet Coordinates (UTM Zone 12, NAD 83): 537245 m E, 7175203 m N

Outlet Coordinates (Geographic): 64°41'58"N, 110°13'08" W



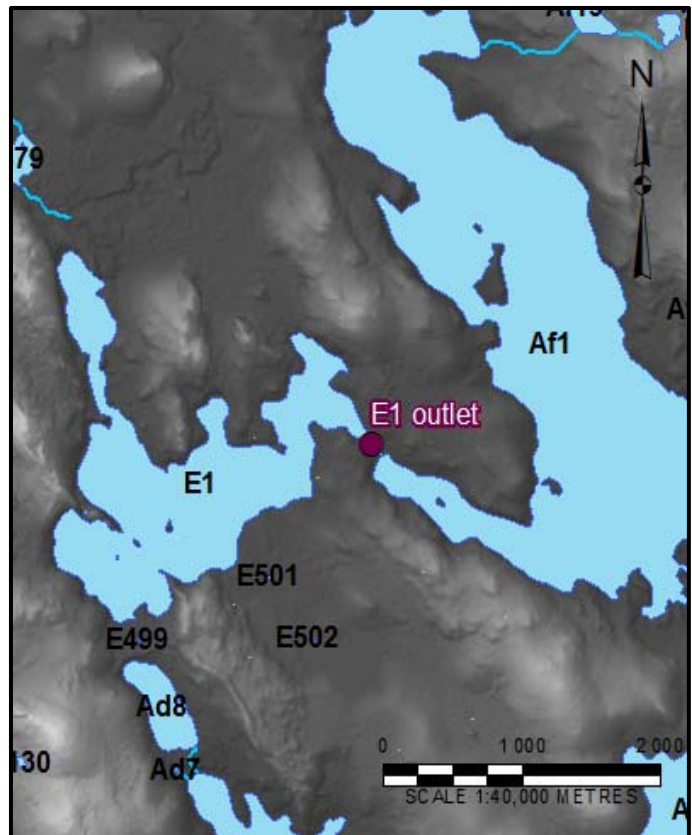
Upstream view of Lake E1 outlet looking north (Lake Af1 at foreground)



Lake E1 upstream view of upstream cross-section



Lake E1 downstream view of downstream cross-section



NTS Mapping of Area

**Table E4-1 Summary of Coordinates at Lake E1 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Geodetic)	537224.24	7175271.69
Outlet	537245	7175203
Transducer	537217.73	7175269.99

**Table E4-2 2013 Hydrometric Data at Lake E1 and Outlet Station**

Date	Time (24-hour)	Benchmark Elevation (m)	Water Surface Elevation (m)	Transducer Elevation (m)	Stage Above Zero Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
12-Aug-13	12:30	418.34	417.81	417.27	0.62	1.00
18-Sep-13	13:00	418.34	417.75	417.27	0.61	1.16

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E4-3 Geomorphic Parameters at Lake E1 and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	196.7	ha	
Drainage Area (DEM) <sup>(a)</sup>	20889.9	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	417.90	m	
Surveyed Local Stream Slope	0.0078	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.0016	m/m	
Average Bankfull Width	44.3	m	
Channel Material	40% boulder, 35% cobble, 20% coarse gravel, 5% medium gravel		
Bank Material	40% boulder, 30% cobble, 15% coarse gravel, 5% medium gravel		
Vegetation	High shrub tundra and grass		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E4-4 Stream E1 Discharge Sheet 12-Aug-13**

Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	12:30		<b>Location</b>	Centre cross-section approximately 50 m downstream of Lake outlet			
<b>Lake Name</b>	Lake E1		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	Marsh-McBirney FLO-MATE Model 2000			
<b>Date Monitored</b>	12-Aug-13		<b>Flow Meter Type</b>	Handheld electromagnetic sensor flowmeter		<b>Instrument Serial #</b>	2005872			
<b>Personnel</b>	MA, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Station Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	537257	7175177	8.2		0.01	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.62		8.7	0.05	0.03	0.03	-	-	0.001	0.07
<b>Discharge (m<sup>3</sup>/s)</b>	1.00		9.2	0.06	0.01	0.04	-	-	0.001	0.11
<b>Pressure Transducer Reading (m)</b>	0.49		9.6		-	0.01	-	-	0.000	0.00
<b>Lake Water Surface Elevation from Transducer (m)</b>	417.76		9.7	Rock edge	-	-	-	-	-	-
<b>Notes</b>			10.2	Rock edge, thick vegetation edge	-	-	-	-	-	-
			10.7	0.06	-	-	-	-	-	-
			11.1	Thick vegetation edge	0.17	-	-	-	-	-
			11.2	0.31	0.19	0.09	-	-	0.008	0.83
			11.7	0.38	0.20	0.10	-	-	0.019	1.89
			12.2	0.38	0.21	0.12	-	-	0.023	2.27
			12.7	0.42	0.22	0.10	-	-	0.021	2.09
		13.2	0.40	0.20	0.13	-	-	0.026	2.59	
		13.7	0.46	0.17	0.17	-	-	0.039	3.90	

**Table E4-4 Stream E1 Discharge Sheet 12-Aug-13**

Site Information	Discharge Measurement								
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)			Qi	% of Total Q	
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%	
	14.2	0.33	0.25	0.14	-	-	0.023	2.30	
	14.7	0.34	0.37	0.09	-	-	0.015	1.53	
	15.2	0.66	0.41	0.13	-	-	0.043	4.28	
	15.7	0.80	0.36	0.09	0.17	-	0.052	5.18	
	16.2	0.84	0.36	0.14	0.25	-	0.082	8.17	
	16.7	0.60	0.44	0.250	-	-	0.075	7.48	
	17.2	0.84	0.44	0.21	0.26	-	0.099	9.84	
	17.7	0.90	0.42	0.21	0.25	-	0.104	10.32	
	18.2	0.87	0.40	0.15	0.25	-	0.087	8.67	
	18.7	0.79	0.41	0.14	0.20	-	0.067	6.70	
	19.2	0.81	0.36	0.12	0.14	-	0.053	5.25	
	19.7	0.81	0.33	0.05	0.10	-	0.030	3.03	
	20.2	0.61	0.33	0.08	-	-	0.024	2.43	
	20.7	0.71	0.29	0.07	-	-	0.025	2.48	
	21.2	0.60	0.26	0.06	-	-	0.018	1.79	
	21.7	0.54	0.24	0.07	-	-	0.019	1.88	
	22.2	0.49	1.013	0.05	-	-	0.012	1.22	
	22.7	0.46	0.330	0.03	-	-	0.021	2.06	
	25.2	0.35	0.149	0.02	-	-	0.014	1.40	
	23.7	0.09	0.000	0.01	-	-	0.002	0.22	
	27.0	-	-	Edge of Water (RDB)					
	<b>Total</b>		<b>8.53</b>				<b>1.0</b>	<b>100</b>	

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

**Table E4-5 Stream E1 Discharge Sheet 18-Sep-13**

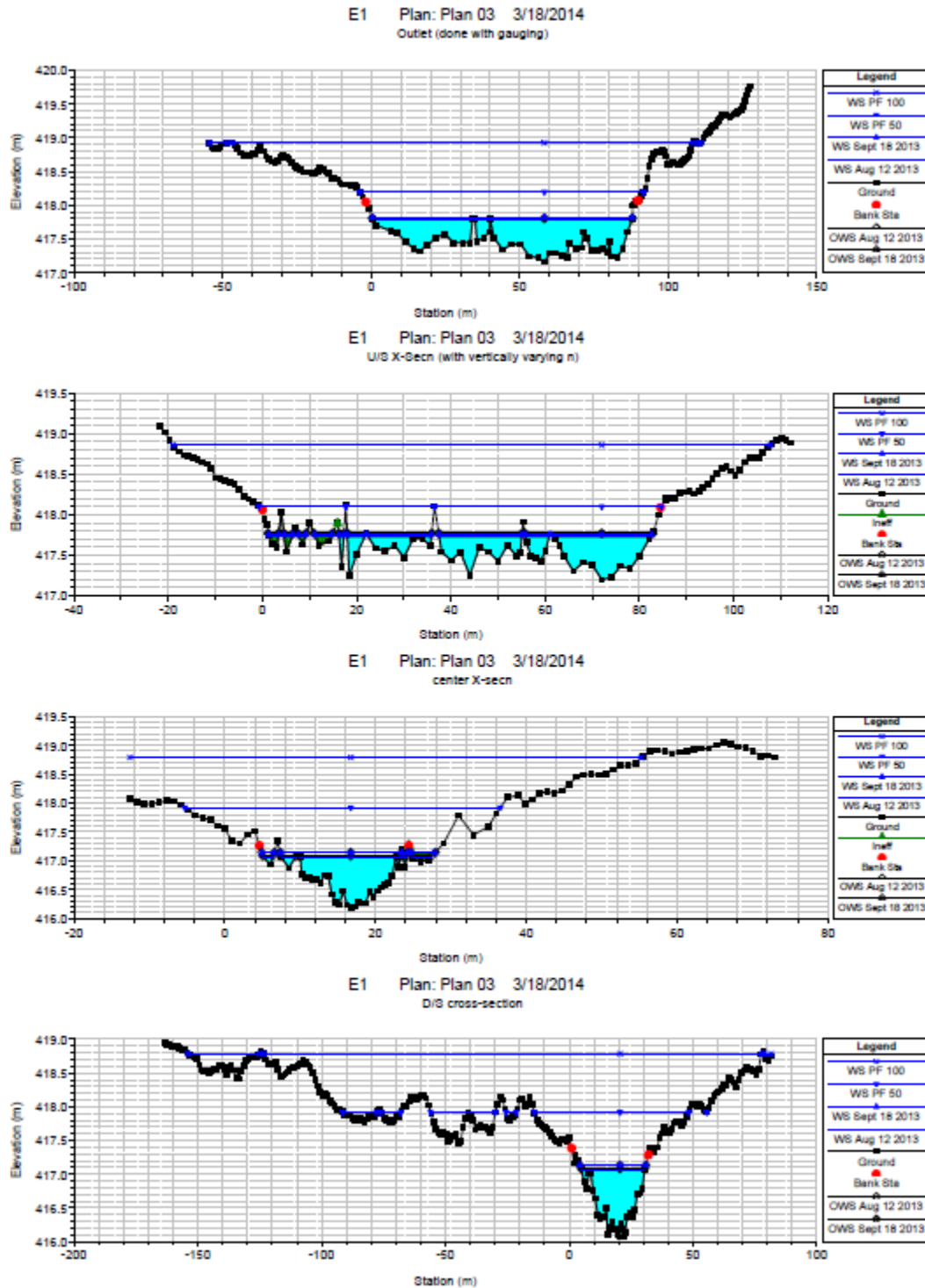
Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24-hr)</b>	13:00		<b>Location</b>		Outlet cross-section		
<b>Lake Name</b>	Lake E1		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>		SonTek FlowTracker		
<b>Date Monitored</b>	18-Sep-13		<b>Flow Meter Type</b>	Handheld ADV flowmeter		<b>Instrument Serial #</b>		P4017		
<b>Personnel</b>	NS, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Station Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	537245	7175203	0.5	0.00	0.06	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.61		1.6	0.10	0.70	0.006	-	-	0.002	0.17
<b>Discharge (m<sup>3</sup>/s)</b>	1.16		6.6	0.18	0.39	0.020	-	-	0.012	1.06
<b>Pressure Transducer Reading (m)</b>	0.49		8.6	0.21	0.83	0.030	-	-	0.016	1.36
<b>Lake Water Surface Elevation from Transducer (m)</b>	417.76		11.6	0.34	1.11	0.017	-	-	0.017	1.42
<b>Notes</b>			14.4	0.45	0.84	0.014	-	-	0.014	1.25
			16.2	0.48	1.23	0.032	-	-	0.035	3.00
			19.0	0.40	0.95	0.041	-	-	0.045	3.90
			21.8	0.28	0.77	0.019	-	-	0.016	1.35
			24.8	0.23	0.89	0.021	-	-	0.014	1.22
			27.8	0.36	1.08	0.022	-	-	0.024	2.03
			30.8	0.36	0.90	0.017	-	-	0.016	1.40
			33.3	0.36	0.16	0.029	-	-	0.018	1.52
			34.2	0.00	0.00	0.025	-	-	0.000	0.00
			35.0	0.00	0.10	0.010	-	-	0.000	0.00
			35.6	0.34	0.74	0.039	-	-	0.020	1.71
			38.0	0.28	0.43	0.044	-	-	0.026	2.20
			39.8	0.20	0.02	0.033	-	-	0.007	0.57
			40.0	0.00	0.18	0.024	-	-	0.000	0.00
			41.3	0.28	1.11	0.016	-	-	0.010	0.83

**Table E4-5 Stream E1 Discharge Sheet 18-Sep-13**

Site Information	Discharge Measurement							
	44.3	0.46	1.26	0.028			0.038	3.30
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)			Qi	% of Total Q
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%
	47.3	0.38	1.14	0.015	-	-	0.017	1.50
	50.3	0.38	1.41	0.015	-	-	0.017	1.43
	53.3	0.56	1.71	0.064	-	-	0.107	9.17
	56.3	0.58	1.22	0.050	-	-	0.072	6.20
	58.3	0.64	1.15	0.039	-	-	0.050	4.28
	60.3	0.51	1.02	0.047	-	-	0.048	4.16
	62.3	0.51	1.05	0.058	-	-	0.059	5.10
	64.3	0.54	0.89	0.030	-	-	0.029	2.47
	65.9	0.57	0.33	0.062	-	-	0.041	3.48
	66.6	0.36	0.97	0.049	-	-	0.027	2.34
	69.0	0.45	0.79	0.018	-	-	0.017	1.45
	70.8	0.43	0.22	0.028	-	-	0.015	1.30
	71.5	0.20	0.25	0.048	-	-	0.008	0.71
	72.5	0.29	0.65	0.044	-	-	0.017	1.47
	74.2	0.47	0.85	0.015	-	-	0.012	1.07
	76.0	0.47	0.82	0.051	-	-	0.043	3.69
	77.8	0.44	0.85	0.048	-	-	0.038	3.26
	79.6	0.50	0.26	0.056	-	-	0.034	2.90
	80.2	0.35	0.27	0.075	-	-	0.016	1.36
	80.8	0.56	1.24	0.067	-	-	0.052	4.48
	83.0	0.57	0.86	0.076	-	-	0.085	7.29
	84.7	0.44	0.51	0.038	-	-	0.028	2.38
	86.3	0.20	0.16	0.007	-	-	0.002	0.20
	87.9			Edge of Water (RDB)				
	<b>Total</b>		<b>32.34</b>				<b>1.16</b>	<b>100</b>

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E4-1 Stream E1 Transects Used for Hydraulic Modelling

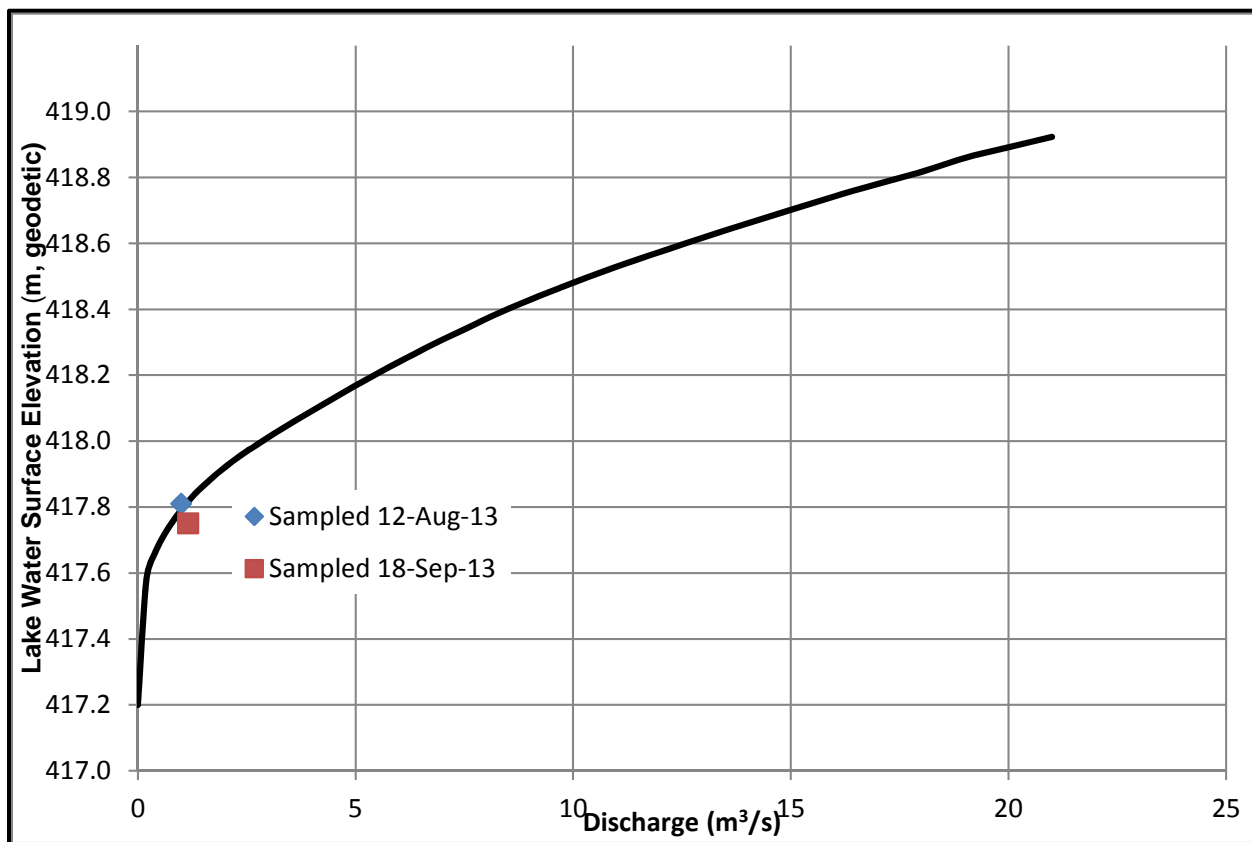


**Table E4-6 Stream E1 Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)		(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	
E1	4	Aug 12 2013	1.00	417.16	417.792	417.811	49 (To Stn 3)	0.150	-	417.79	0.00009	0.03	31.7	86.4	Surveyed
E1	4	Sept 18 2013	1.16	417.16	417.818	417.800	49 (To Stn 3)	0.150	-	417.82	0.00009	0.03	33.9	87.6	
E1	4	PF 50	5.35	417.16	418.194	-	49 (To Stn 3)	0.147	-	418.19	0.00021	0.08	68.0	95.6	
E1	4	PF 100	21.00	417.16	418.922	-	49 (To Stn 3)	0.117	-	418.92	0.00026	0.13	157.0	162.3	
E1	3	Aug 12 2013	1.00	417.20	417.728	417.771	64 (To Stn 2)	0.600	417.39	417.73	0.01230	0.07	14.4	69.3	Surveyed
E1	3	Sept 18 2013	1.16	417.20	417.750	417.767	64 (To Stn 2)	0.600	417.40	417.75	0.01254	0.07	15.8	71.9	
E1	3	PF 50	5.35	417.20	418.100	-	64 (To Stn 2)	0.596	417.54	418.10	0.01243	0.12	44.7	85.3	
E1	3	PF 100	21.00	417.20	418.859	-	64 (To Stn 2)	0.382	417.72	418.86	0.00426	0.17	125.3	126.8	
E1	2	Aug 12 2013	1.00	416.18	417.072	417.081	25.5 (To Stn 1)	0.100	416.45	417.07	0.00055	0.13	7.6	19.4	Surveyed
E1	2	Sept 18 2013	1.16	416.18	417.135	417.147	25.5 (To Stn 1)	0.100	416.47	417.14	0.00052	0.13	8.7	21.4	
E1	2	PF 50	5.35	416.18	417.923	-	25.5 (To Stn 1)	0.083	416.76	417.92	0.00024	0.16	33.8	41.9	
E1	2	PF 100	21.00	416.18	418.788	-	25.5 (To Stn 1)	0.079	417.18	418.79	0.00030	0.25	84.1	67.8	
E1	1	Aug 12 2013	1.00	416.07	417.069	417.079	-	0.060	416.29	417.07	0.00004	0.07	14.8	25.6	Surveyed
E1	1	Sept 18 2013	1.16	416.07	417.132	417.138	-	0.060	416.31	417.13	0.00004	0.07	16.5	26.7	
E1	1	PF 50	5.35	416.07	417.921	-	-	0.042	416.51	417.92	0.00004	0.09	58.8	114.4	
E1	1	PF 100	21.00	416.07	418.787	-	-	0.054	416.86	418.79	0.00004	0.10	208.3	232.9	

Notes: Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.  
 All other profiles are used to represent a possible range of discharges to estimate a lake outlet rating curve (100 flow profiles computed in total, only select profiles shown).  
 River station values decrease in the downstream direction.  
 Manning's n varies vertically for this reach according to the large-scale roughness resistance equation developed by Bathurst (1978 and 2002).  
 Additional interpolated cross-sections were used for hydraulic modelling, but are not included in the summary tables.  
 m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre; - = no data available.

Figure E4-2 Lake E1 Outlet Rating Curve



m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E4-7 Lake E1, 2013 Mean Daily Water Surface Elevation (m, geodetic)**

Date	Jun	Jul	Aug	Sep	Oct
1	-	-	-	417.80	-
2	-	-	-	417.80	-
3	-	-	-	417.79	-
4	-	-	-	417.80	-
5	-	-	-	417.79	-
6	-	-	-	417.79	-
7	-	-	-	417.79	-
8	-	-	-	417.78	-
9	-	-	-	417.79	-
10	-	-	-	417.81	-
11	-	-	-	417.83	-
12	-	-	417.79	417.83	-
13	-	-	417.79	417.84	-
14	-	-	417.79	417.84	-
15	-	-	417.79	417.84	-
16	-	-	417.80	417.85	-
17	-	-	417.79	417.85	-
18	-	-	417.80	417.86	-
19	-	-	417.80	-	-
20	-	-	417.80	-	-
21	-	-	417.82	-	-
22	-	-	417.82	-	-
23	-	-	417.81	-	-
24	-	-	417.81	-	-
25	-	-	417.81	-	-
26	-	-	417.81	-	-
27	-	-	417.81	-	-
28	-	-	417.81	-	-
29	-	-	417.81	-	-
30	-	-	417.80	-	-
31	-	-	417.80	-	-
<b>Min</b>	-	-	<b>417.79</b>	<b>417.78</b>	-
<b>Max</b>	-	-	<b>417.82</b>	<b>417.86</b>	-
<b>Mean</b>	-	-	<b>417.80</b>	<b>417.82</b>	-

**Table E4-8 Lake E1 Outlet, 2013 Mean Daily Discharge (m<sup>3</sup>/s)**

Date	Jun	Jul	Aug	Sep	Oct
1	-	-	-	1.07	-
2	-	-	-	1.09	-
3	-	-	-	1.01	-
4	-	-	-	1.07	-
5	-	-	-	1.01	-
6	-	-	-	1.02	-
7	-	-	-	1.02	-
8	-	-	-	0.98	-
9	-	-	-	1.00	-
10	-	-	-	1.17	-
11	-	-	-	1.25	-
12	-	-	0.99	1.30	-
13	-	-	1.00	1.31	-
14	-	-	1.01	1.35	-
15	-	-	1.02	1.35	-
16	-	-	1.06	1.42	-
17	-	-	1.01	1.40	-
18	-	-	1.07	1.47	-
19	-	-	1.06	-	-
20	-	-	1.07	-	-
21	-	-	1.17	-	-
22	-	-	1.18	-	-
23	-	-	1.16	-	-
24	-	-	1.14	-	-
25	-	-	1.15	-	-
26	-	-	1.15	-	-
27	-	-	1.16	-	-
28	-	-	1.16	-	-
29	-	-	1.12	-	-
30	-	-	1.09	-	-
31	-	-	1.05	-	-
<b>Min</b>	-	-	<b>0.99</b>	<b>0.98</b>	-
<b>Max</b>	-	-	<b>1.18</b>	<b>1.47</b>	-
<b>Mean</b>	-	-	<b>1.09</b>	<b>1.18</b>	-

m = metre; m<sup>3</sup>/s = cubic metres per second; - = no data available.

## E4.2 Lake E10 (Ursula Lake) Outlet

Operational in August and September 2013

Benchmark: Top of Rock Anchor Bolt      Pressure Transducer: 3001 LT Levelogger Edge Solinst (S/N 2012129)

Outlet Coordinates (UTM Zone 12, NAD 83): 530677 m E, 7185194 m N

Outlet Coordinates (Geographic): 64°47'23" N, 110°21'16" W



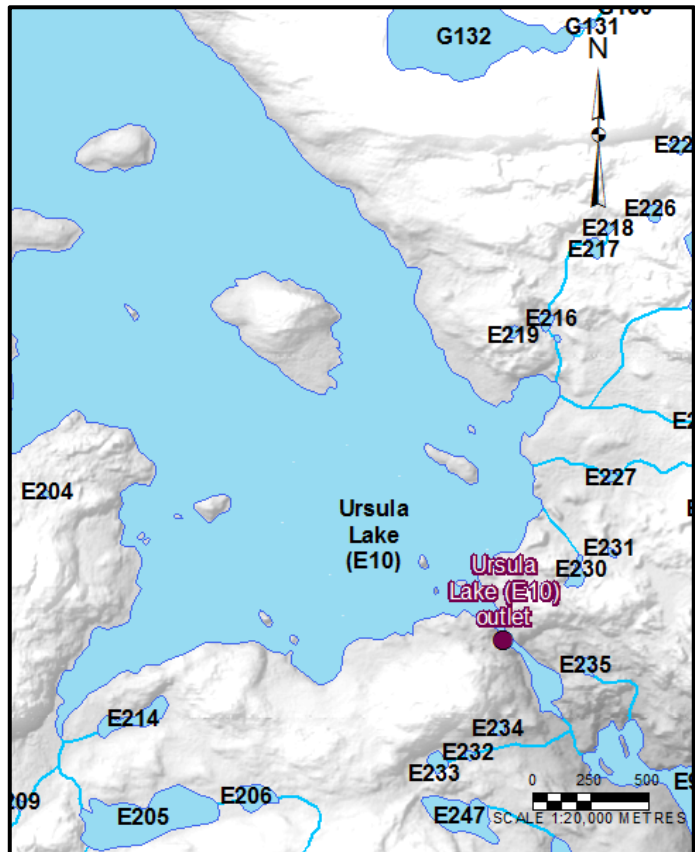
Left downstream bank view of Lake E10 (Ursula Lake) outlet looking northeast (Lake E10 at top right)



Lake E10 upstream view of upstream cross-section



Lake E10 downstream view of downstream cross-section



NTS Mapping of Area

**Table E4-9 Summary of Coordinates at Lake E10 (Ursula Lake) and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (non-geodetic)	530693.17	7185143.47
Outlet	530677	7185194
Transducer	530681.61	7185232.30

**Table E4-10 2013 Hydrometric Data at Lake E10 (Ursula Lake) and Outlet Station**

Date	Time (24-hour)	Assumed Benchmark Elevation <sup>(a)</sup> (m)	Assumed Water Surface Elevation (m)	Assumed Transducer Elevation (m)	Stage Above Zero Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
14-Aug-13	14:15	462.47	463.34	465.34	0.41	0.62
19-Aug-13	11:00	462.47	463.32	465.34	0.39	0.39
18-Sep-13	12:30	462.47	463.30	465.34	0.37	0.47

a) Elevation of the Benchmark set to 432.47 m to match lake elevations with LiDAR Water Surface Elevation of Lake E10 (Ursula Lake) and to match previous rating curves developed at the outlet.

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E4-11 Geomorphic Parameters at Lake E10 (Ursula Lake) and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	2246.9	ha	
Drainage Area (DEM) <sup>(a)</sup>	9424.5	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	462.90	m	
Surveyed Local Stream Slope	0.015	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.054	m/m	
Average Bankfull Width	7.0	m	
Channel Material	65% boulder, 30% cobble, 5% coarse gravel		
Bank Material	70% boulder, 20% cobble, 10% silt		
Vegetation	Low shrub tundra		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E4-12 Stream E10 Discharge Sheet 14-Aug-13**

Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	15:00		<b>Location</b>	Centre cross-section approximately 50 m downstream of Lake outlet			
<b>Lake Name</b>	Lake E10		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	Marsh-McBirney FLO-MATE Model 2000			
<b>Date Monitored</b>	14-Aug-13		<b>Flow Meter Type</b>	Handheld electromagnetic sensor flowmeter		<b>Instrument Serial #</b>	2005872			
<b>Personnel</b>	MA, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Station Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	530700	7185131	4.0		0.02	Edge of Water (RDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.41		4.4	0.10	0.04	0.33	-	-	0.013	2.12
<b>Discharge (m<sup>3</sup>/s)</b>	0.62		4.8	0.10	0.07	0.55	-	-	0.022	3.54
<b>Pressure Transducer Reading (m)</b>	(Pressure Transducer installed 19-Aug-13)		5.2	0.26	0.10	0.47	-	-	0.049	7.87
<b>Lake Water Surface Elevation from Transducer (m)</b>	(Pressure Transducer installed 19-Aug-13)		5.6	0.24	0.10	0.27	-	-	0.026	4.17
<b>Notes</b>			6.0	0.25	0.11	0.56	-	-	0.056	9.01
			6.4	0.30	0.11	0.52	-	-	0.062	10.04
			6.8	0.25	0.10	0.50	-	-	0.050	8.05
			7.2	0.25	0.09	0.42	-	-	0.042	6.76
			7.6	0.20	0.09	0.28	-	-	0.022	3.61
			8.0	0.25	0.11	0.08	-	-	0.008	1.29
			8.4	0.28	0.12	0.04	-	-	0.004	0.72
			8.8	0.32	0.12	0.18	-	-	0.023	3.71
			9.2	0.26	0.13	0.32	-	-	0.033	5.36
			9.6	0.40	0.14	0.18	-	-	0.029	4.64
			10.0	0.30	0.11	0.34	-	-	0.041	6.57

**Table E4-12 Stream E10 Discharge Sheet 14-Aug-13**

Site Information	Discharge Measurement								
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)			Qi	% of Total Q	
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%	
	10.4	0.26	0.08	0.40	-	-	0.042	6.70	
	10.8	0.16	0.08	0.19	-	-	0.012	1.96	
	11.2	0.22	0.08	0.05	-	-	0.004	0.71	
	11.6	0.20	0.08	0.48	-	-	0.038	6.18	
	12.0	0.20	0.07	0.42	-	-	0.034	5.41	
	12.4	0.15	0.01	0.22	-	-	0.010	1.59	
	12.6			Edge of Water (LDB)					
	<b>Total</b>		<b>1.97</b>				<b>0.62</b>	<b>100</b>	

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

**Table E4-13 Stream E10 Discharge Sheet 19-Aug-13**

Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	10:00		<b>Location</b>	Centre cross-section approximately 50 m downstream of Lake outlet			
<b>Lake Name</b>	Lake E10		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	Marsh-McBirney FLO-MATE Model 2000			
<b>Date Monitored</b>	19-Aug-13		<b>Flow Meter Type</b>	Handheld electromagnetic sensor flowmeter		<b>Instrument Serial #</b>	2005872			
<b>Personnel</b>	MA, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Station Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	530700	7185131	0.90		0.02	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.39		1.30	0.12	0.05	0.05	-	-	0.002	0.61
<b>Discharge (m<sup>3</sup>/s)</b>	0.39		1.70	0.14	0.08	0.21	-	-	0.012	2.99
<b>Pressure Transducer Reading (m)</b>	0.29		2.10	0.28	0.10	0.25	-	-	0.028	7.12
<b>Lake Water Surface Elevation from Transducer (m)</b>	463.30		2.50	0.20	0.10	0.25	-	-	0.020	5.09
<b>Notes</b>			2.90	0.30	0.12	0.28	-	-	0.034	8.55
			3.30	0.31	0.11	0.31	-	-	0.038	9.78
			3.70	0.22	0.09	0.42	-	-	0.037	9.40
			4.10	0.24	0.08	0.38	-	-	0.036	9.28
			4.50	0.18	0.11	0.22	-	-	0.016	4.03
			4.90	0.37	0.13	0.04	-	-	0.006	1.51
			5.30	0.28	0.11	0.06	-	-	0.007	1.71
			5.70	0.29	0.11	0.18	-	-	0.021	5.31
			6.10	0.28	0.13	0.23	-	-	0.025	6.41
			6.50	0.37	0.11	0.09	-	-	0.013	3.20
			6.90	0.20	0.08	0.42	-	-	0.034	8.55

**Table E4-13 Stream E10 Discharge Sheet 19-Aug-13**

Site Information	Discharge Measurement							
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)			Qi	% of Total Q
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%
	7.30	0.18	0.06	0.27	-	-	0.019	4.95
	7.70	0.14	0.04	0.09	-	-	0.005	1.28
	8.10	0.06	0.06	0.29	-	-	0.007	1.77
	8.50	0.22	0.06	0.25	-	-	0.022	5.60
	8.90	0.08	0.04	0.28	-	-	0.009	2.28
	9.30	0.14	0.01	0.06	-	-	0.002	0.59
	9.45		0.00	Edge of Water (RDB)				
	<b>Total</b>		<b>1.82</b>				<b>0.39</b>	<b>100</b>

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available..

**Table E4-14 Stream E10 Discharge Sheet 16-Sep-13**

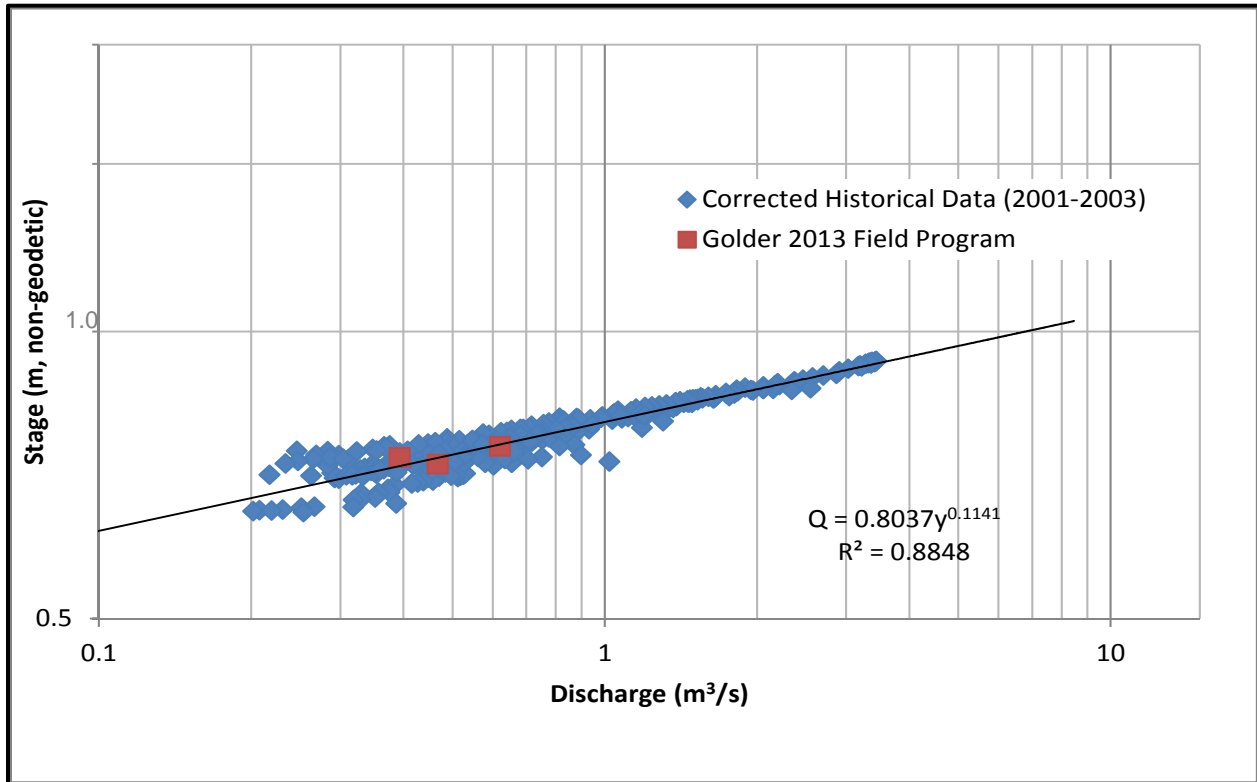
Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24-hr)</b>	12:30		<b>Location</b>	Centre cross-section approximately 50 m downstream of Lake outlet			
<b>Lake Name</b>	Lake E10		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	SonTek FlowTracker			
<b>Date Monitored</b>	16-Sep-13		<b>Flow Meter Type</b>	Handheld ADV flowmeter		<b>Instrument Serial #</b>	P4017			
<b>Personnel</b>	DC, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Station Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	530700	7185131	0.0		0.01	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.37		0.2	0.12	0.02	0.08	-	-	0.002	0.43
<b>Discharge (m<sup>3</sup>/s)</b>	0.47		0.4	0.10	0.05	0.39	-	-	0.012	2.50
<b>Pressure Transducer Reading (m)</b>	0.35		0.8	0.16	0.06	0.20	-	-	0.013	2.72
<b>Lake Water Surface Elevation from Transducer (m)</b>	463.37		1.2	0.16	0.07	0.47	-	-	0.030	6.38
<b>Notes</b>			1.6	0.20	0.09	0.54	-	-	0.043	9.19
			2.0	0.26	0.10	0.54	-	-	0.056	12.03
			2.4	0.26	0.10	0.40	-	-	0.041	8.83
			2.8	0.26	0.09	0.26	-	-	0.027	5.81
			3.2	0.20	0.10	0.39	-	-	0.031	6.72
			3.6	0.30	0.11	0.09	-	-	0.011	2.41
			4.0	0.26	0.11	0.04	-	-	0.004	0.82
			4.4	0.28	0.11	0.09	-	-	0.010	2.18
			4.8	0.28	0.12	0.29	-	-	0.032	6.88
			5.2	0.30	0.12	0.19	-	-	0.023	4.88
			5.6	0.30	0.10	0.17	-	-	0.020	4.26

**Table E4-14 Stream E10 Discharge Sheet 16-Sep-13**

Site Information	Discharge Measurement								
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)			Qi	% of Total Q	
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%	
	6.0	0.22	0.08	0.29	-	-	0.026	5.51	
	6.4	0.16	0.06	0.21	-	-	0.014	2.93	
	6.8	0.14	0.06	0.42	-	-	0.023	5.01	
	7.2	0.18	0.06	0.18	-	-	0.013	2.73	
	7.6	0.12	0.05	0.35	-	-	0.017	3.57	
	8.0	0.12	0.02	0.35	-	-	0.013	2.73	
	8.2	0.10	0.01	0.35	-	-	0.007	1.48	
	8.4			Edge of Water (RDB)					
	<b>Total</b>		<b>1.73</b>				<b>0.47</b>	<b>100</b>	

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E4-3 Lake E10 (Ursula Lake) Outlet Rating Curve



Notes:

Modelling of this site was not required because of the presence of a historical hydrometric data.

Historical daily stage and discharge from 2001 to 2003 were available and are described in Historical Hydrometric Data (Appendix C).

Development of rating curve was completed using the historical data which was in agreement with three separate surveys completed during the 2013 field program.

Historical data records did not have a specified datum; therefore, the stage discharge curve was fit using the three surveys completed in the 2013 field program to estimate the height above the lake sill and therefore the lake elevations with the benchmark set to an elevation of 462.47 m.

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E4-15 Lake E10 (Ursula Lake), 2013  
Mean Daily Stage (m, assumed  
geodetic)**

Date	Jun	Jul	Aug	Sep	Oct
1	-	-	-	463.33	-
2	-	-	-	463.34	-
3	-	-	-	463.31	-
4	-	-	-	463.32	-
5	-	-	-	463.32	-
6	-	-	-	463.33	-
7	-	-	-	463.33	-
8	-	-	-	463.32	-
9	-	-	-	463.32	-
10	-	-	-	463.34	-
11	-	-	-	463.34	-
12	-	-	-	463.35	-
13	-	-	-	463.37	-
14	-	-	-	463.35	-
15	-	-	-	463.35	-
16	-	-	-	463.36	-
17	-	-	-	-	-
18	-	-	-	-	-
19	-	-	463.34	-	-
20	-	-	463.35	-	-
21	-	-	463.34	-	-
22	-	-	463.36	-	-
23	-	-	463.36	-	-
24	-	-	463.35	-	-
25	-	-	463.34	-	-
26	-	-	463.34	-	-
27	-	-	463.34	-	-
28	-	-	463.34	-	-
29	-	-	463.32	-	-
30	-	-	463.32	-	-
31	-	-	463.32	-	-
<b>Min</b>	-	-	<b>463.32</b>	<b>463.31</b>	-
<b>Max</b>	-	-	<b>463.36</b>	<b>463.37</b>	-
<b>Mean</b>	-	-	<b>463.34</b>	<b>463.34</b>	-

**Table E4-16 Lake E10 (Ursula Lake) Outlet,  
2013 Mean Daily Discharge  
(m<sup>3</sup>/s)**

Date	Jun	Jul	Aug	Sep	Oct
1	-	-	-	0.35	-
2	-	-	-	0.35	-
3	-	-	-	0.28	-
4	-	-	-	0.28	-
5	-	-	-	0.30	-
6	-	-	-	0.34	-
7	-	-	-	0.34	-
8	-	-	-	0.29	-
9	-	-	-	0.30	-
10	-	-	-	0.38	-
11	-	-	-	0.39	-
12	-	-	-	0.41	-
13	-	-	-	0.50	-
14	-	-	-	0.40	-
15	-	-	-	0.43	-
16	-	-	-	0.47	-
17	-	-	-	-	-
18	-	-	-	-	-
19	-	-	0.38	-	-
20	-	-	0.41	-	-
21	-	-	0.38	-	-
22	-	-	0.45	-	-
23	-	-	0.46	-	-
24	-	-	0.40	-	-
25	-	-	0.39	-	-
26	-	-	0.35	-	-
27	-	-	0.38	-	-
28	-	-	0.37	-	-
29	-	-	0.30	-	-
30	-	-	0.31	-	-
31	-	-	0.29	-	-
<b>Min</b>	-	-	<b>0.29</b>	<b>0.28</b>	-
<b>Max</b>	-	-	<b>0.46</b>	<b>0.50</b>	-
<b>Mean</b>	-	-	<b>0.39</b>	<b>0.36</b>	-

m = metre; m<sup>3</sup>/s = cubic metres per second; - = no data available.

### E4.3 Lake G2 Outlet

Operational in August and September

Pressure Transducer: 3001 LT Levelogger Edge Solinst (S/N 2012125)

Benchmark: Top of Rock Anchor Bolt

Barometric Data Logger: 3001 Barologger Edge Solinst (S/N 2019498)

Outlet Coordinates (UTM Zone 12, NAD 83): 545655 m E, 7173904 m N

Outlet Coordinates (Geographic): 64°41'12" N, 110°02'34" W



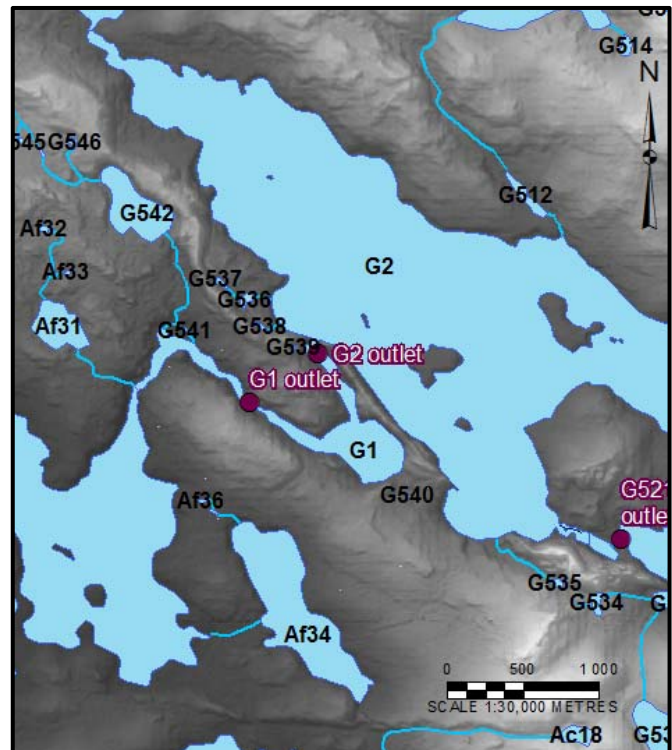
Upstream view of Lake G2 outlet



Lake G2 upstream view of upstream cross-section



Lake G2 downstream view of downstream cross-section



NTS Mapping of Area

**Table E4-17 Summary of Coordinates at Lake G2 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Geodetic)	545870.93	7174472.48
Outlet	545655	7173904
Transducer	545873.14	7174479.72

**Table E4-18 2013 Hydrometric Data at Lake G2 and Outlet Station**

Date	Time (24-hour)	Benchmark Elevation (m)	Water Surface Elevation (m)	Transducer Elevation (m)	Stage Above Zero Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
9-Aug-13	13:30	422.85	422.67	422.10	0.37	2.36
15-Sep-13	14:00	422.85	422.49	422.10	0.19	1.39

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E4-19 Geomorphic Parameters at Lake G2 and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	460.2	ha	
Drainage Area (DEM) <sup>(a)</sup>	33389.2	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	422.70	m	
Surveyed Local Stream Slope	0.00029	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.00021	m/m	
Average Bankfull Width	86.8	m	
Channel Material	50% cobble, 20% coarse gravel, 10% medium gravel, 5% boulder, 5% fine gravel, 5% coarse sand, 5% fine sand		
Bank Material	20% coarse gravel, 20% cobble, 20% medium gravel, 15% fine gravel, 15% coarse sand, 5% boulder, 5% sand		
Vegetation	Low shrub tundra		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E4-20 Stream G2 Discharge Sheet 9-Aug-13**

Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24-hr)</b>	13:30		<b>Location</b>	Centre cross-section approximately 200 m downstream of Lake outlet			
<b>Lake Name</b>	Lake G2		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	Marsh-McBirney FLO-MATE Model 2000			
<b>Date Monitored</b>	9-Aug-13		<b>Flow Meter Type</b>	Handheld electromagnetic sensor flowmeter		<b>Instrument Serial #</b>	2005872			
<b>Personnel</b>	MA, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Station Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	545473	7174022	20.2		0.016	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.37		21.0	0.04	0.060	0.105	-	-	0.004	0.16
<b>Discharge (m<sup>3</sup>/s)</b>	2.37		22.0	0.08	0.115	0.151	-	-	0.012	0.51
<b>Pressure Transducer Reading (m)</b>	0.52		23.0	0.15	0.180	0.254	-	-	0.038	1.61
<b>Lake Water Surface Elevation from Transducer (m)</b>	422.62		24.0	0.21	0.255	0.264	-	-	0.055	2.34
<b>Notes</b>			25.0	0.30	0.325	0.305	-	-	0.092	3.87
			26.0	0.35	0.375	0.312	-	-	0.109	4.62
			27.0	0.40	0.400	0.330	-	-	0.132	5.58
			28.0	0.40	0.420	0.399	-	-	0.160	6.75
			29.0	0.44	0.445	0.439	-	-	0.193	8.17
			30.0	0.45	0.465	0.473	-	-	0.213	9.00
			31.0	0.48	0.465	0.451	-	-	0.216	9.15
			32.0	0.45	0.470	0.397	-	-	0.179	7.55
			33.0	0.49	0.495	0.419	-	-	0.205	8.68
			34.0	0.50	0.475	0.323	-	-	0.162	6.83
			35.0	0.45	0.445	0.300	-	-	0.135	5.71

**Table E4-20 Stream G2 Discharge Sheet 9-Aug-13**

Site Information	Discharge Measurement								
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)			Qi	% of Total Q	
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%	
	36.0	0.44	0.420	0.245	-	-	0.108	4.56	
	37.0	0.40	0.280	0.213	-	-	0.085	3.60	
	38.0	0.16	0.255	0.312	-	-	0.050	2.11	
	39.0	0.35	0.335	0.238	-	-	0.083	3.52	
	40.0	0.32	0.285	0.219	-	-	0.070	2.96	
	41.0	0.25	0.175	0.191	-	-	0.048	2.02	
	42.0	0.10	0.060	0.162	-	-	0.016	0.68	
	43.0	0.02	0.007	0.005	-	-	0.000	0.00	
	43.7			Edge of Water (RDB)					
	<b>Total</b>		<b>7.22</b>				<b>2.37</b>	<b>100</b>	

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

**Table E4-21 Stream G2 Discharge Sheet 15-Sep-13**

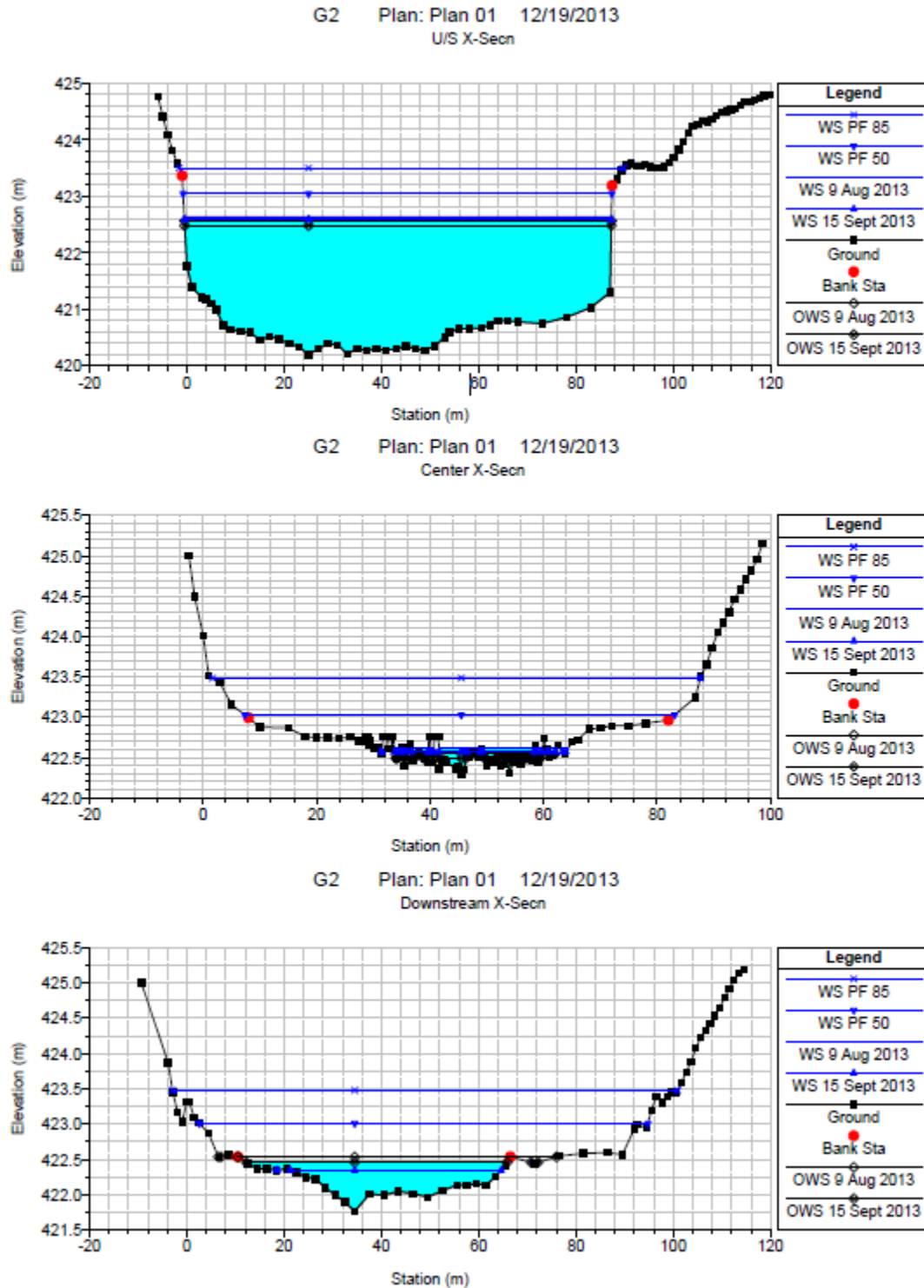
Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24-hr)</b>	14:00		<b>Location</b>	Centre cross-section approximately 200 m downstream of Lake outlet			
<b>Lake Name</b>	Lake G2		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	SonTek FlowTracker			
<b>Date Monitored</b>	15-Sep-13		<b>Flow Meter Type</b>	Handheld ADV flowmeter		<b>Instrument Serial #</b>	P4017			
<b>Personnel</b>	DC, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Station Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	545473	7174022	1.30		0.045	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.19		2.30	0.09	0.036	0.25	-	-	0.015	1.11
<b>Discharge (m<sup>3</sup>/s)</b>	1.34		2.70	0.09	0.069	0.20	-	-	0.009	0.64
<b>Pressure Transducer Reading (m)</b>	0.39		3.30	0.14	0.090	0.19	-	-	0.016	1.14
<b>Lake Water Surface Elevation from Transducer (m)</b>	422.50		3.90	0.16	0.102	0.23	-	-	0.022	1.58
<b>Notes</b>			4.50	0.18	0.114	0.23	-	-	0.025	1.80
			5.10	0.20	0.132	0.20	-	-	0.024	1.72
			5.70	0.24	0.141	0.28	-	-	0.041	2.93
			6.30	0.23	0.156	0.33	-	-	0.045	3.26
			6.90	0.29	0.183	0.28	-	-	0.049	3.54
			7.50	0.32	0.180	0.27	-	-	0.051	3.68
			8.10	0.28	0.186	0.35	-	-	0.059	4.28
			8.70	0.34	0.192	0.31	-	-	0.063	4.52
			9.30	0.30	0.192	0.39	-	-	0.070	5.03
			9.90	0.34	0.228	0.38	-	-	0.078	5.58
			10.50	0.42	0.234	0.37	-	-	0.094	6.75

**Table E4-21 Stream G2 Discharge Sheet 15-Sep-13**

Site Information	Discharge Measurement							
Notes	Station	Depth	Area	Velocity at Specified Depth			Qi	% of Total Q
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%
	11.10	0.36	0.234	0.34	-	-	0.074	5.32
	11.70	0.42	0.252	0.27	-	-	0.067	4.83
	12.30	0.42	0.258	0.32	-	-	0.080	5.77
	12.90	0.44	0.264	0.29	-	-	0.076	5.45
	13.50	0.44	0.255	0.30	-	-	0.078	5.64
	14.10	0.41	0.218	0.24	-	-	0.055	3.94
	14.60	0.46	0.135	0.23	-	-	0.052	3.78
	15.10	0.08	0.110	0.27	-	-	0.011	0.76
	15.60	0.36	0.201	0.25	-	-	0.049	3.52
	16.20	0.31	0.183	0.23	-	-	0.043	3.12
	16.80	0.30	0.174	0.20	-	-	0.035	2.53
	17.40	0.28	0.168	0.08	-	-	0.013	0.94
	18.00	0.28	0.159	0.12	-	-	0.020	1.44
	18.60	0.25	0.144	0.14	-	-	0.021	1.53
	19.20	0.23	0.129	0.13	-	-	0.018	1.27
	19.80	0.20	0.114	0.15	-	-	0.018	1.31
	20.40	0.18	0.072	0.14	-	-	0.015	1.09
	21.00	0.06	0.016	0.08	-	-	0.002	0.15
	21.25	0.07	0.021	0.01	-	-	0.000	0.03
	21.85			Edge of Water (RDB)				
	<b>Total</b>		<b>5.39</b>				<b>1.34</b>	<b>100</b>

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E4-4 Stream G2 Transects Used for Hydraulic Modelling



**Table E4-22 Stream G2 Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)		(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	
G2	3	9-Aug-13	2.37	420.2	422.64	422.567	25 (To Stn 2)	0.025	-	422.64	0.00000	0.01	176.1	87.8	Surveyed
G2	3	15-Sep-13	1.39	420.2	422.591	422.483	25 (To Stn 2)	0.025	-	422.59	0.00000	0.01	171.8	87.8	
G2	3	PF 50	14.00	420.2	423.047	-	25 (To Stn 2)	0.025	-	423.05	0.00000	0.07	211.9	88.2	
G2	3	PF 85	31.50	420.2	423.501	-	25 (To Stn 2)	0.025	-	423.50	0.00000	0.13	252.4	91.3	
G2	2	9-Aug-13	2.37	422.29	422.614	422.545	65 (To Stn 2)	0.030	-	422.64	0.00679	0.68	3.5	27.3	Surveyed
G2	2	15-Sep-13	1.39	422.29	422.572	422.49	65 (To Stn 2)	0.030	-	422.59	0.00700	0.58	2.4	24.4	
G2	2	PF 50	14.00	422.29	423.029	-	65 (To Stn 2)	0.030	-	423.05	0.00121	0.56	25.2	75.7	
G2	2	PF 85	31.50	422.29	423.486	-	65 (To Stn 2)	0.029	-	423.50	0.00035	0.50	62.5	86.0	
G2	1	9-Aug-13	2.37	421.77	422.462	422.535	-	0.044	422.07	422.46	0.00015	0.13	17.9	55.6	Surveyed
G2	1	15-Sep-13	1.39	421.77	422.346	422.459	-	0.045	422.04	422.35	0.00015	0.12	12.0	43.6	
G2	1	PF 50	14.00	421.77	423.009	-	-	0.043	422.28	423.01	0.00015	0.22	62.6	92.2	
G2	1	PF 85	31.50	421.77	423.476	-	-	0.044	422.45	423.48	0.00015	0.29	108.1	103.8	

Notes:

Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.

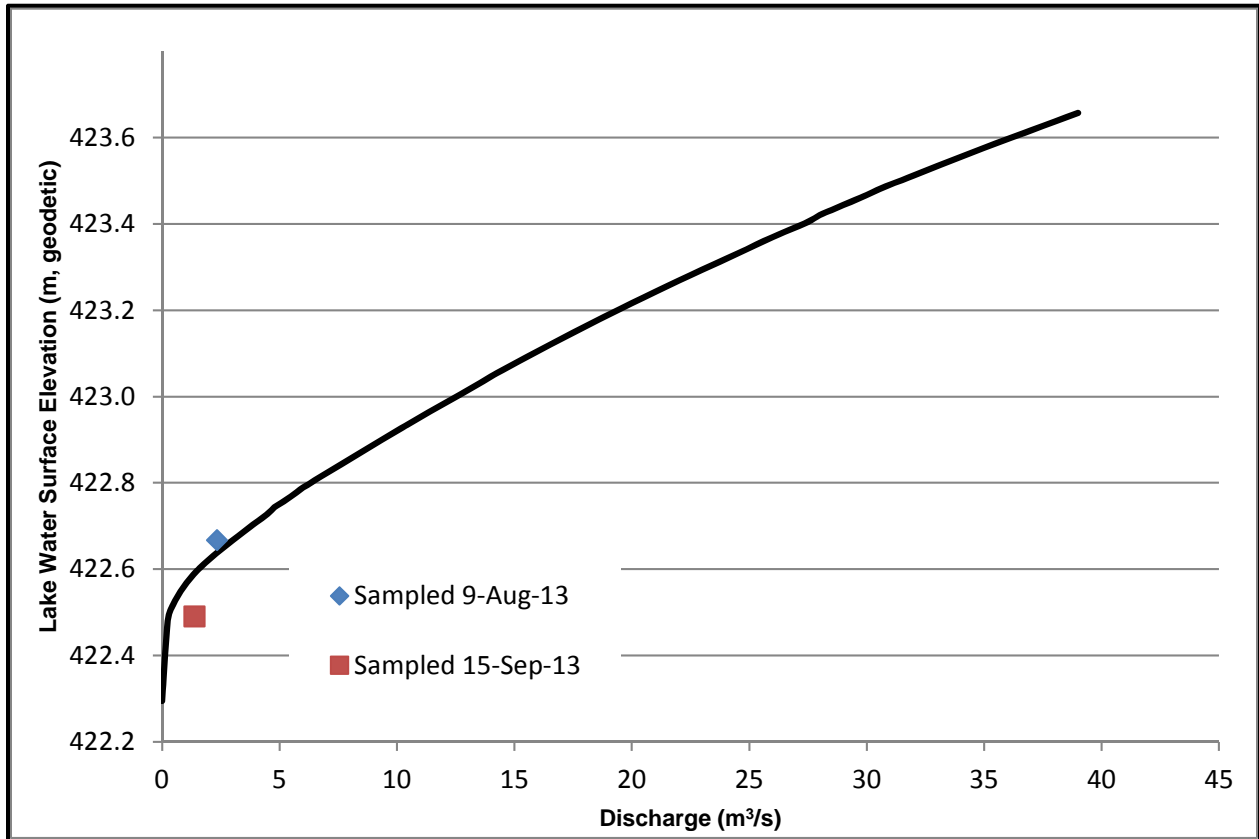
All other profiles are used to represent a possible range of discharges to estimate a lake outlet rating curve (100 flow profiles computed in total, only select profiles shown).

River station values decrease in the downstream direction.

Additional interpolated cross-sections were used for hydraulic modelling, but are not included in the summary tables.

m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre; - = no data available.

Figure E4-5 Lake G2 Outlet Rating Curve



m = metre; m³/s = cubic metres per second.

**Table E4-23 Lake G2, 2013 Mean Daily Water Surface Elevation (m, geodetic)**

Date	Jun	Jul	Aug	Sep	Oct
1	-	-	-	422.51	-
2	-	-	-	422.52	-
3	-	-	-	422.50	-
4	-	-	-	422.50	-
5	-	-	-	422.49	-
6	-	-	-	422.50	-
7	-	-	-	422.50	-
8	-	-	-	422.51	-
9	-	-	422.63	422.53	-
10	-	-	422.63	422.54	-
11	-	-	422.61	422.52	-
12	-	-	422.57	422.51	-
13	-	-	422.55	422.53	-
14	-	-	422.55	422.51	-
15	-	-	422.55	422.51	-
16	-	-	422.55	-	-
17	-	-	422.54	-	-
18	-	-	422.55	-	-
19	-	-	422.54	-	-
20	-	-	422.55	-	-
21	-	-	422.54	-	-
22	-	-	422.54	-	-
23	-	-	422.54	-	-
24	-	-	422.55	-	-
25	-	-	422.54	-	-
26	-	-	422.53	-	-
27	-	-	422.52	-	-
28	-	-	422.53	-	-
29	-	-	422.51	-	-
30	-	-	422.51	-	-
31	-	-	422.50	-	-
<b>Min</b>	-	-	<b>422.50</b>	<b>422.49</b>	-
<b>Max</b>	-	-	<b>422.63</b>	<b>422.54</b>	-
<b>Mean</b>	-	-	<b>422.55</b>	<b>422.51</b>	-

**Table E4-24 Lake G2 Outlet, 2013 Mean Daily Discharge (m<sup>3</sup>/s)**

Date	Jun	Jul	Aug	Sep	Oct
1	-	-	-	0.41	-
2	-	-	-	0.47	-
3	-	-	-	0.35	-
4	-	-	-	0.35	-
5	-	-	-	0.29	-
6	-	-	-	0.34	-
7	-	-	-	0.34	-
8	-	-	-	0.43	-
9	-	-	2.25	0.55	-
10	-	-	2.20	0.66	-
11	-	-	1.80	0.48	-
12	-	-	1.00	0.43	-
13	-	-	0.76	0.58	-
14	-	-	0.78	0.45	-
15	-	-	0.86	0.43	-
16	-	-	0.87	-	-
17	-	-	0.70	-	-
18	-	-	0.76	-	-
19	-	-	0.70	-	-
20	-	-	0.86	-	-
21	-	-	0.69	-	-
22	-	-	0.75	-	-
23	-	-	0.74	-	-
24	-	-	0.83	-	-
25	-	-	0.73	-	-
26	-	-	0.57	-	-
27	-	-	0.54	-	-
28	-	-	0.59	-	-
29	-	-	0.46	-	-
30	-	-	0.43	-	-
31	-	-	0.36	-	-
<b>Min</b>	-	-	<b>0.36</b>	<b>0.29</b>	-
<b>Max</b>	-	-	<b>2.25</b>	<b>0.66</b>	-
<b>Mean</b>	-	-	<b>0.88</b>	<b>0.44</b>	-

m = metre; m<sup>3</sup>/s = cubic metres per second; - = no data available.

## E4.4 Lake I1A Outlet

Operational in August and September 2013

Benchmark: Top of Rock Anchor Bolt      Pressure Transducer: 3001 LT Levellogger Edge Solinst (S/N 2012131)

Outlet Coordinates (UTM Zone 12, NAD 83): 553047 m E, 7171059 m N

Outlet Coordinates (Geographic): 64°39'37" N, 109°53'20" W



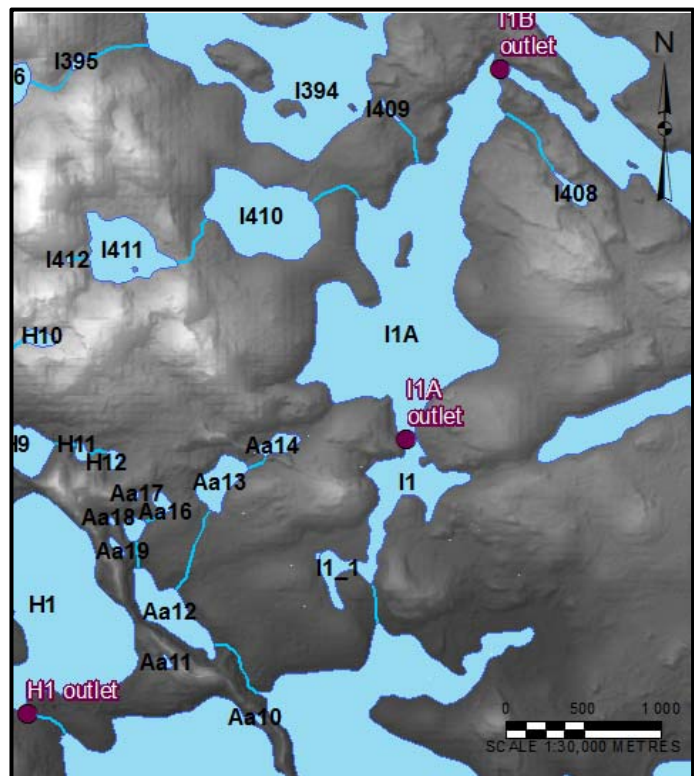
Downstream view of Lake I1A outlet looking southwest (Lake I1 in centre, Lac du Sauvage at top)



Lake I1A LDB view of upstream cross-section



Lake I1A downstream view of downstream cross-section



NTS Mapping of Area

**Table E4-25 Summary of Coordinates at Lake I1A and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Geodetic)	552994.66	7170975.58
Outlet	553047	7171059
Transducer	552972.67	7171104.74

**Table E4-26 2013 Hydrometric Data at Lake I1A and Outlet Station**

Date	Time (24-hour)	Benchmark Elevation (m)	Water Surface Elevation (m)	Transducer Elevation (m)	Stage Above Zero Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
10-Aug-13	14:00	425.41	424.74	424.37	0.55	3.24
18-Sep-13	11:00	425.41	424.66	424.37	0.47	1.68

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E4-27 Geomorphic Parameters at Lake I1A and Outlet Station**

Description	Value	Note
Local Lake Area (DEM) <sup>(a)</sup>	139.9	ha
Drainage Area (DEM) <sup>(a)</sup>	42443.2	ha
Upstream Lake Elevation (DEM) <sup>(a)</sup>	424.80	m
Surveyed Local Stream Slope	0.0029	m/m
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.00091	m/m
Average Bankfull Width	110.9	m
Channel Material	40% boulder, 30% cobble, 10% coarse gravel, 10% medium gravel, 5% fine gravel, 5% coarse sand	
Bank Material	30% boulder, 15% cobble, 10% coarse gravel, 10% medium gravel, 10% fine gravel, 10% coarse sand, 10% fine sand, 5% silt	
Vegetation	Grass and low shrub tundra	

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E4-28 Stream I1A Discharge Sheet 10-Aug-13**

Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	14:00		<b>Location</b>	Upper cross-section approximately 60 m downstream of Lake outlet			
<b>Lake Name</b>	Lake I1A		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	Marsh-McBirney FLO-MATE Model 2000			
<b>Date Monitored</b>	10-Aug-13		<b>Flow Meter Type</b>	Handheld electromagnetic sensor flowmeter		<b>Instrument Serial #</b>	2005872			
<b>Personnel</b>	MA, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Station Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	553038	7171001	1.0	0.09	0.21	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.55		2.0	0.33	-	0.040	-	-	0.003	0.10
<b>Discharge (m<sup>3</sup>/s)</b>	3.24		3.0	Boulder edge	-	0.010	-	-	-	-
<b>Pressure Transducer Reading (m)</b>	0.39		4.0	Boulder edge	-	0.000	-	-	-	-
<b>Lake Water Surface Elevation from Transducer (m)</b>	424.76		5.0	0.04	-	0.000	-	-	0.001	0.04
<b>Notes</b>			6.0	Boulder	-	0.030	-	-	-	0.00
			7.0	0.18	0.26	0.000	-	-	0.011	0.32
			8.0	0.34	0.26	0.060	-	-	0.000	0.00
			9.0	0.18	0.15	0.000	-	-	0.049	1.43
			10.0	0.12	0.10	0.270	-	-	0.000	0.00
			11.0	0.08	0.12	0.000	-	-	0.009	0.26
			12.0	0.16	0.17	0.110	-	-	0.002	0.05
			13.0	0.18	0.19	0.010	-	-	0.036	1.06
			14.0	0.20	0.18	0.200	-	-	0.052	1.53
			15.0	0.15	0.13	0.260	-	-	0.068	1.99

**Table E4-28 Stream I1A Discharge Sheet 10-Aug-13**

Site Information	Discharge Measurement							
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)			Qi	% of Total Q
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%
	16.0	0.10	0.21	0.450	-	-	0.037	1.09
	17.0	0.32	0.30	0.370	-	-	0.045	1.32
	18.0	0.27	0.30	0.140	-	-	0.049	1.43
	19.0	0.32	0.30	0.180	-	-	0.003	0.09
	20.0	0.27	0.27	0.010	-	-	0.032	0.96
	21.0	0.27	0.28	0.120	-	-	0.086	2.55
	22.0	0.28	0.25	0.320	-	-	0.048	1.40
	23.0	0.22	-	0.170	-	-	0.066	1.95
	24.0	Boulder edge	-	0.300	-	-	-	-
	25.0	Boulder edge	-	0.000	-	-	-	-
	26.0	0.12	0.11	0.000	-	-	0.000	0.00
	27.0	0.09	-	0.000	-	-	0.009	0.27
	28.0	Boulder	-	0.100	-	-	-	-
	29.0	0.07	0.07	0.000	-	-	0.008	0.23
	30.0	0.06	0.12	0.110	-	-	0.011	0.34
	31.0	0.18	-	0.190	-	-	0.054	1.59
	32.0	Boulder	-	0.300	-	-	-	-
	33.0	0.44	0.35	0.000	-	-	0.172	5.06
	34.0	0.26	-	0.390	-	-	0.112	3.30
	35.0	Boulder edge	-	0.43	-	-	-	-
	35.4	Boulder edge	-	-	-	-	-	-

**Table E4-28 Stream I1A Discharge Sheet 10-Aug-13**

Site Information		Discharge Measurement						
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)			Qi	% of Total Q
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%
	36.0	0.24	-	0.00	-	-	0.062	1.83
	36.8	Boulder edge	-	0.37	-	-	-	-
	37.0	Boulder	-	-	-	-	-	-
	37.5	Boulder edge	-	-	-	-	-	-
	38.0	0.20	0.17	0.00	-	-	0.045	1.33
	39.0	0.14	0.13	0.30	-	-	0.066	1.94
	40.0	0.12	0.11	0.47	-	-	0.036	1.06
	41.0	0.10	0.10	0.30	-	-	0.005	0.15
	42.0	0.10	0.11	0.05	-	-	0.025	0.74
	43.0	0.12	0.19	0.25	-	-	0.022	0.64
	44.0	0.26	0.24	0.18	-	-	0.005	0.15
	45.0	0.22	0.19	0.02	-	-	0.026	0.78
	46.0	0.15	0.13	0.12	-	-	0.009	0.27
	47.0	0.10	-	0.06	-	-	0.002	0.06
	48.0	Boulder	-	0.02	-	-	-	-
	49.0	0.14	0.10	0.00	-	-	0.032	0.95
	50.0	0.06	0.06	0.23	-	-	0.003	0.09
	51.0	0.05	0.09	0.05	-	-	0.020	0.58
	52.0	0.13	0.20	0.39	-	-	0.059	1.73
	53.0	0.26	-	0.45	-	-	0.070	2.07
	54.0	Boulder	-	0.27	-	-	-	-
	55.0	0.25	0.23	0.00	-	-	0.105	3.10

**Table E4-28 Stream I1A Discharge Sheet 10-Aug-13**

Site Information	Discharge Measurement							
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)			Qi	% of Total Q
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%
	56.0	0.20	0.23	0.42	-	-	0.060	1.77
	57.0	0.26	-	0.30	-	-	0.101	2.99
	58.0	Boulder	-	0.39	-	-	-	-
	59.0	0.27	0.23	0.00	-	-	0.173	5.10
	60.0	0.18	0.17	0.64	-	-	0.099	2.92
	61.0	0.16	0.12	0.55	-	-	0.085	2.50
	62.0	0.07	0.13	0.53	-	-	0.024	0.70
	63.0	0.18	0.17	0.34	-	-	0.049	1.43
	64.0	0.16	0.20	0.27	-	-	0.120	3.54
	65.0	0.24	0.15	0.75	-	-	0.094	2.76
	66.0	0.05	0.05	0.39	-	-	0.004	0.10
	67.0	0.05	0.11	0.07	-	-	0.000	0.00
	68.0	0.17	0.19	0.00	-	-	0.053	1.56
	69.0	0.20	0.16	0.31	-	-	0.114	3.36
	70.0	0.11	0.20	0.57	-	-	0.039	1.14
	71.0	0.28	0.30	0.35	-	-	0.059	1.74
	72.0	0.32	0.32	0.21	-	-	0.134	3.97
	73.0	0.32	0.31	0.42	-	-	0.144	4.25
	74.0	0.30	0.29	0.45	-	-	0.090	2.66
	75.0	0.27	-	0.30	-	-	0.089	2.62
	75.4	Boulder edge	-	0.47	-	-	-	-
	76.2	Boulder edge	-	0.00	-	-	-	-

**Table E4-28 Stream I1A Discharge Sheet 10-Aug-13**

Site Information	Discharge Measurement							
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)			Qi	% of Total Q
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%
	77.0	0.20	0.20	0.00	-	-	0.083	2.44
	78.0	0.20	-	0.46	-	-	0.065	1.92
	78.1	Boulder edge	-	0.59	-	-	-	-
	78.7	Boulder edge	-	0.00	-	-	-	-
	79.0	0.11	0.08	0.00	-	-	0.006	0.17
	80.0	0.05	0.12	0.08	-	-	0.006	0.17
	82.3	0.05	2.06	0.07	-	-	0.148	4.37
	<b>Total</b>		<b>12.06</b>				<b>3.24</b>	<b>100</b>

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

**Table E4-29 Stream I1A Discharge Sheet 18-Sep-13**

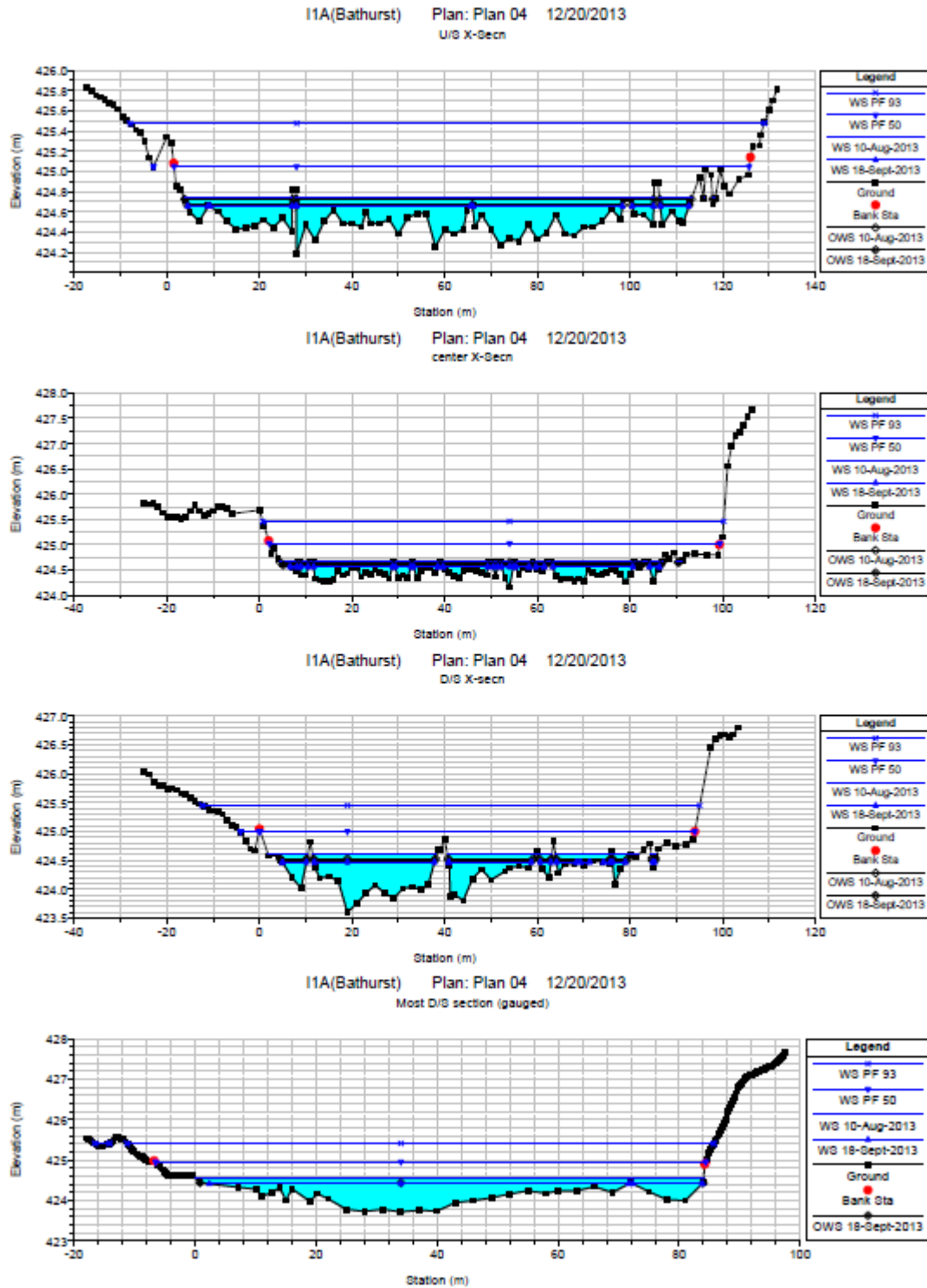
Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	11:00		<b>Location</b>	September 18 cross-section approximately 250 m downstream of Lake outlet			
<b>Lake Name</b>	Lake I1A		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	SonTek FlowTracker			
<b>Date Monitored</b>	18-Sep-13		<b>Flow Meter Type</b>	Handheld ADV flowmeter		<b>Instrument Serial #</b>	P4017			
<b>Personnel</b>	NS, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Station Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	553112	7170930	0.8		0.35	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.47		7.1	0.11	0.41	0.00	-	-	0.002	0.09
<b>Discharge (m<sup>3</sup>/s)</b>	1.68		10.1	0.16	0.23	0.02	-	-	0.007	0.42
<b>Pressure Transducer Reading (m)</b>	424.68		11.0	0.34	0.46	0.03	-	-	0.013	0.75
<b>Lake Water Surface Elevation from Transducer (m)</b>	424.76		12.6	0.24	0.25	0.04	-	-	0.013	0.80
<b>Notes</b>			14.0	0.12	0.28	0.08	-	-	0.012	0.71
			15.0	0.44	0.30	0.04	-	-	0.017	1.00
			16.0	0.15	0.92	0.06	-	-	0.017	0.98
			19.0	0.46	0.44	0.01	-	-	0.011	0.67
			20.2	0.27	0.60	0.04	-	-	0.015	0.90
			22.0	0.40	1.59	0.04	-	-	0.035	2.06
			25.0	0.66	2.06	0.05	-	-	0.101	6.00

**Table E4-29 Stream I1A Discharge Sheet 18-Sep-13**

Site Information	Discharge Measurement							
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)			Qi	% of Total Q
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%
	28.0	0.71	2.06	0.04	-	-	0.093	5.54
	31.0	0.66	2.07	0.09	-	-	0.173	10.25
	34.0	0.72	2.10	0.13	-	-	0.286	16.98
	37.0	0.68	2.07	0.07	-	-	0.141	8.36
	40.0	0.70	1.79	0.09	-	-	0.185	11.00
	43.0	0.49	1.40	0.10	-	-	0.143	8.52
	46.0	0.44	1.22	0.07	-	-	0.093	5.53
	49.0	0.37	0.98	0.08	-	-	0.086	5.11
	52.0	0.28	0.72	0.05	-	-	0.038	2.26
	55.0	0.20	0.69	0.09	-	-	0.052	3.06
	58.0	0.26	0.46	0.02	-	-	0.010	0.62
	60.0	0.20	0.60	0.02	-	-	0.012	0.72
	63.0	0.20	0.45	0.04	-	-	0.026	1.53
	66.0	0.10	0.51	0.06	-	-	0.018	1.07
	69.0	0.24	0.36	0.04	-	-	0.032	1.91
	72.0	0.00	0.33	0.00	-	-	0.000	0.00
	75.0	0.22	0.96	0.00	-	-	0.001	0.06
	78.0	0.42	1.29	0.01	-	-	0.018	1.05
	81.0	0.44	0.66	0.03	-	-	0.035	2.05
	84.0			Edge of Water (RDB)				
	<b>Total</b>		<b>28.56</b>				<b>1.68</b>	<b>100</b>

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E4-6 Stream I1A Transects Used for Hydraulic Modelling



**Table E4-30 Stream I1A Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)		(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	
I1A	4	10-Aug-13	3.24	424.19	424.737	424.725	47 (To Stn 3)	0.059	-	424.74	0.00032	0.12	27.1	108.1	Surveyed
I1A	4	18-Sep-13	1.68	424.19	424.653	424.668	47 (To Stn 3)	0.065	-	424.65	0.00037	0.09	18.2	103.0	
I1A	4	PF 50	12.00	424.19	425.048	-	47 (To Stn 3)	0.043	-	425.05	0.00017	0.19	63.5	124.2	
I1A	4	PF 93	30.00	424.19	425.476	-	47 (To Stn 3)	0.034	-	425.48	0.00009	0.25	119.3	137.0	
I1A	3	10-Aug-13	3.24	424.16	424.681	424.650	21	0.103	-	424.68	0.00282	0.18	17.9	83.6	Surveyed
I1A	3	18-Sep-13	1.68	424.16	424.559	424.593	21	0.120	-	424.56	0.00805	0.19	8.7	65.9	
I1A	3	PF 50	12.00	424.16	425.026	-	21	0.075	-	425.03	0.00081	0.24	49.8	97.3	
I1A	3	PF 93	30.00	424.16	425.464	-	21	0.060	-	425.47	0.00042	0.32	93.0	99.5	
I1A	2	10-Aug-13	3.24	423.60	424.608	424.530	19	0.315	-	424.61	0.00456	0.11	29.2	76.6	Surveyed
I1A	2	18-Sep-13	1.68	423.60	424.462	424.497	19	0.280	-	424.46	0.00303	0.09	19.0	62.1	
I1A	2	PF 50	12.00	423.60	425.000	-	19	0.201	-	425.00	0.00254	0.19	64.3	97.8	
I1A	2	PF 93	30.00	423.60	425.449	-	19	0.156	-	425.45	0.00180	0.27	110.2	107.5	
I1A	1	10-Aug-13	3.24	423.71	424.540	-	-	0.363	423.90	424.54	0.00290	0.09	37.5	84.0	Surveyed
I1A	1	18-Sep-13	1.68	423.71	424.406	424.433	-	0.400	423.85	424.41	0.00291	0.06	26.4	80.8	
I1A	1	PF 50	12.00	423.71	424.948	-	-	0.287	424.11	424.95	0.00290	0.16	73.7	90.9	
I1A	1	PF 93	30.00	423.71	425.406	-	-	0.234	424.30	425.41	0.00290	0.26	117.2	99.4	

**Notes:**

Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.

All other profiles are used to represent a possible range of discharges to estimate a lake outlet rating curve (100 flow profiles computed in total, only select profiles shown).

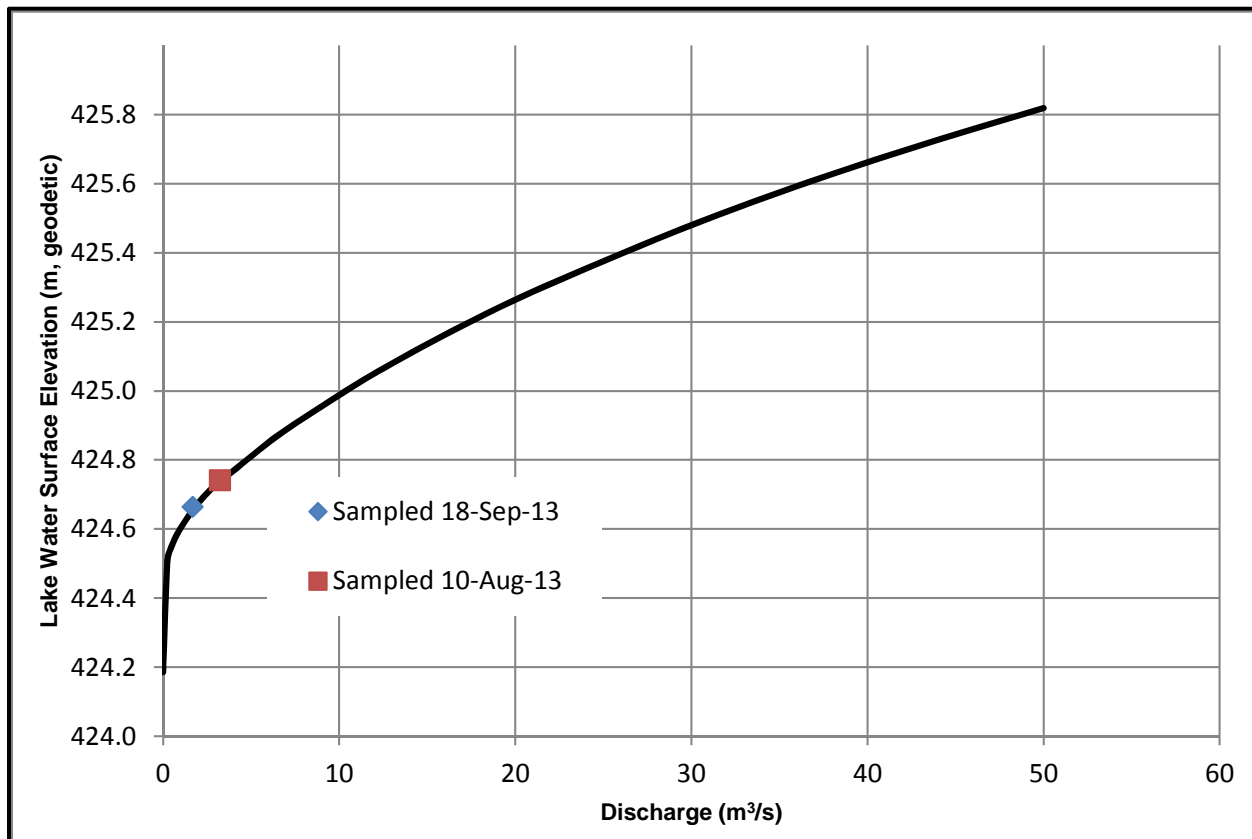
River station values decrease in the downstream direction.

Manning's n varies vertically for this reach according to the large-scale roughness resistance equation developed by Bathurst (1978 and 2002).

Additional interpolated cross-sections were used for hydraulic modelling, but are not included in the summary tables.

m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre; - = no data available.

Figure E4-7 Lake I1A Outlet Rating Curve



m = metre; m³/s = cubic metres per second.

**Table E4-31 Lake I1A, 2013 Mean Daily Water Surface Elevation (m, geodetic)**

Date	Jun	Jul	Aug	Sep	Oct
1	-	-	-	424.73	-
2	-	-	-	424.73	-
3	-	-	-	424.72	-
4	-	-	-	424.73	-
5	-	-	-	424.71	-
6	-	-	-	424.72	-
7	-	-	-	424.72	-
8	-	-	-	424.73	-
9	-	-	-	424.74	-
10	-	-	424.78	424.75	-
11	-	-	424.78	424.73	-
12	-	-	424.74	424.73	-
13	-	-	424.73	424.74	-
14	-	-	424.74	424.73	-
15	-	-	424.74	424.73	-
16	-	-	424.75	424.74	-
17	-	-	424.74	424.75	-
18	-	-	424.75	424.76	-
19	-	-	424.74	-	-
20	-	-	424.75	-	-
21	-	-	424.74	-	-
22	-	-	424.75	-	-
23	-	-	424.74	-	-
24	-	-	424.75	-	-
25	-	-	424.75	-	-
26	-	-	424.74	-	-
27	-	-	424.74	-	-
28	-	-	424.74	-	-
29	-	-	424.73	-	-
30	-	-	424.73	-	-
31	-	-	424.72	-	-
<b>Min</b>	-	-	<b>424.72</b>	<b>424.71</b>	-
<b>Max</b>	-	-	<b>424.78</b>	<b>424.76</b>	-
<b>Mean</b>	-	-	<b>427.74</b>	<b>424.73</b>	-

**Table E4-32 Lake I1A Outlet, 2013 Mean Daily Discharge (m<sup>3</sup>/s)**

Date	Jun	Jul	Aug	Sep	Oct
1	-	-	-	3.08	-
2	-	-	-	3.07	-
3	-	-	-	2.81	-
4	-	-	-	2.94	-
5	-	-	-	2.70	-
6	-	-	-	2.80	-
7	-	-	-	2.91	-
8	-	-	-	2.99	-
9	-	-	-	3.29	-
10	-	-	4.22	3.41	-
11	-	-	4.20	3.15	-
12	-	-	3.19	3.12	-
13	-	-	3.05	3.37	-
14	-	-	3.20	3.11	-
15	-	-	3.30	3.15	-
16	-	-	3.41	3.40	-
17	-	-	3.23	3.49	-
18	-	-	3.50	3.70	-
19	-	-	3.39	-	-
20	-	-	3.47	-	-
21	-	-	3.28	-	-
22	-	-	3.59	-	-
23	-	-	3.31	-	-
24	-	-	3.60	-	-
25	-	-	3.57	-	-
26	-	-	3.38	-	-
27	-	-	3.39	-	-
28	-	-	3.34	-	-
29	-	-	3.09	-	-
30	-	-	3.08	-	-
31	-	-	2.90	-	-
<b>Min</b>	-	-	<b>2.90</b>	<b>2.70</b>	-
<b>Max</b>	-	-	<b>4.22</b>	<b>3.70</b>	-
<b>Mean</b>	-	-	<b>3.40</b>	<b>3.14</b>	-

m = metre; m<sup>3</sup>/s = cubic metres per second; - = no data available.

## E4.5 Lake L1 Outlet

Operational in August and September 2013

Benchmark: Top of Rock Anchor Bolt      Pressure Transducer: 3001 LT Levellogger Edge Solinst (S/N 2020673)

Outlet Coordinates (UTM Zone 12, NAD 83): 550343 m E, 7158955 m N

Outlet Coordinates (Geographic): 64°33'07" N, 109°56'59" W



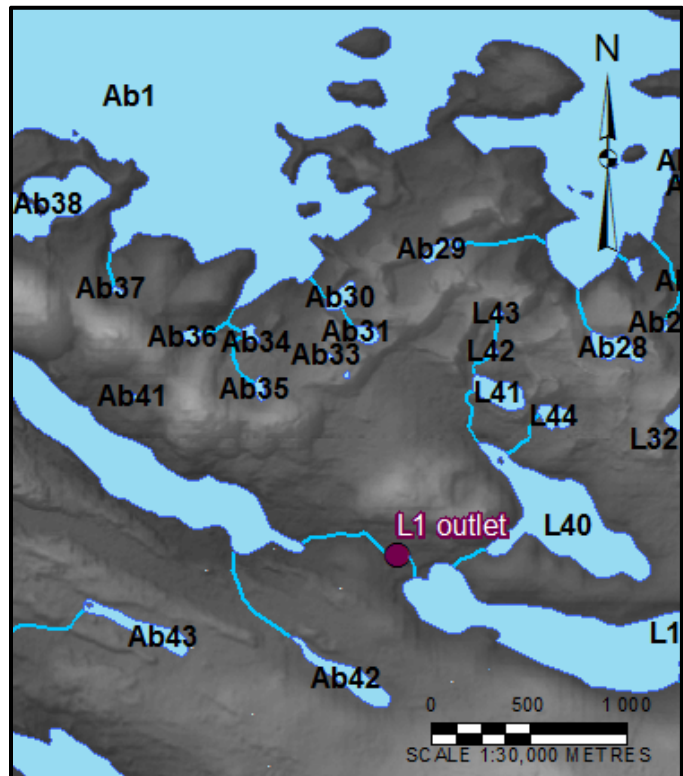
Upstream view of Lake L1 outlet looking southeast



Lake L1 upstream view of upstream cross-section



Lake L1 downstream view of downstream cross-section



NTS Mapping of Area

**Table E4-33 Summary of Coordinates at Lake L1 and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Geodetic)	50488.73	7159043.46
Outlet	550343	7158955
Transducer	550554	7158851

**Table E4-34 2013 Hydrometric Data at Lake L1 and Outlet Station**

Date	Time (24-hour)	Benchmark Elevation (m)	Water Surface Elevation (m)	Transducer Elevation (m)	Stage Above Zero Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
13-Aug-13	8:00	420.62	418.58	418.40	0.80 (Estimated)	0.00092
14-Sep-13	14:00	420.62	418.54	418.40	0.76 (Estimated)	0.0016

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E4-35 Geomorphic Parameters at Lake L1 and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	66.2	ha	
Drainage Area (DEM) <sup>(a)</sup>	1577.4	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	418.70	m	
Surveyed Local Stream Slope	0.0015	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.37	m/m	
Average Bankfull Width	00.37	m	
Channel Material	50% silt, 25% clay, 5% boulder, 5% cobble, 5% coarse gravel, 5% medium gravel, 5% fine gravel		
Bank Material	65% silt, 30% clay, 5% fine sand		
Vegetation	Grass and high shrub tundra		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E4-36 Stream L1 Discharge Sheet 13-Aug-13**

Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	8:00		<b>Location</b>	Centre cross-section approximately 120 m downstream of Lake outlet			
<b>Lake Name</b>	Lake L1		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	Marsh-McBirney FLO-MATE Model 2000			
<b>Date Monitored</b>	13-Aug-13		<b>Flow Meter Type</b>	Handheld electromagnetic sensor flowmeter		<b>Instrument Serial #</b>	2005872			
<b>Personnel</b>	MA, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Station Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	550254	7159044	6.3		0.004	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.8		6.4	0.08	0.009	0.01	-	-	0.00008	8.70
<b>Discharge (m<sup>3</sup>/s)</b>	0.00092		6.5	0.10	0.011	0.01	-	-	0.00010	10.87
<b>Pressure Transducer Reading (m)</b>	0.19		6.6	0.12	0.013	0.01	-	-	0.00012	13.04
<b>Lake Water Surface Elevation from Transducer (m)</b>	418.59		6.7	0.13	0.012	0.02	-	-	0.00026	28.26
<b>Notes</b>			6.8	0.11	0.011	0.01	-	-	0.00011	11.96
			6.9	0.10	0.010	0.01	-	-	0.00010	10.87
			7.0	0.10	0.007	0.01	-	-	0.00010	10.87
			7.1	0.05	0.003	0.01	-	-	0.00005	5.43
			7.2			Edge of Water(RDB)				
			<b>Total</b>		<b>0.08</b>				<b>0.00092</b>	<b>100</b>

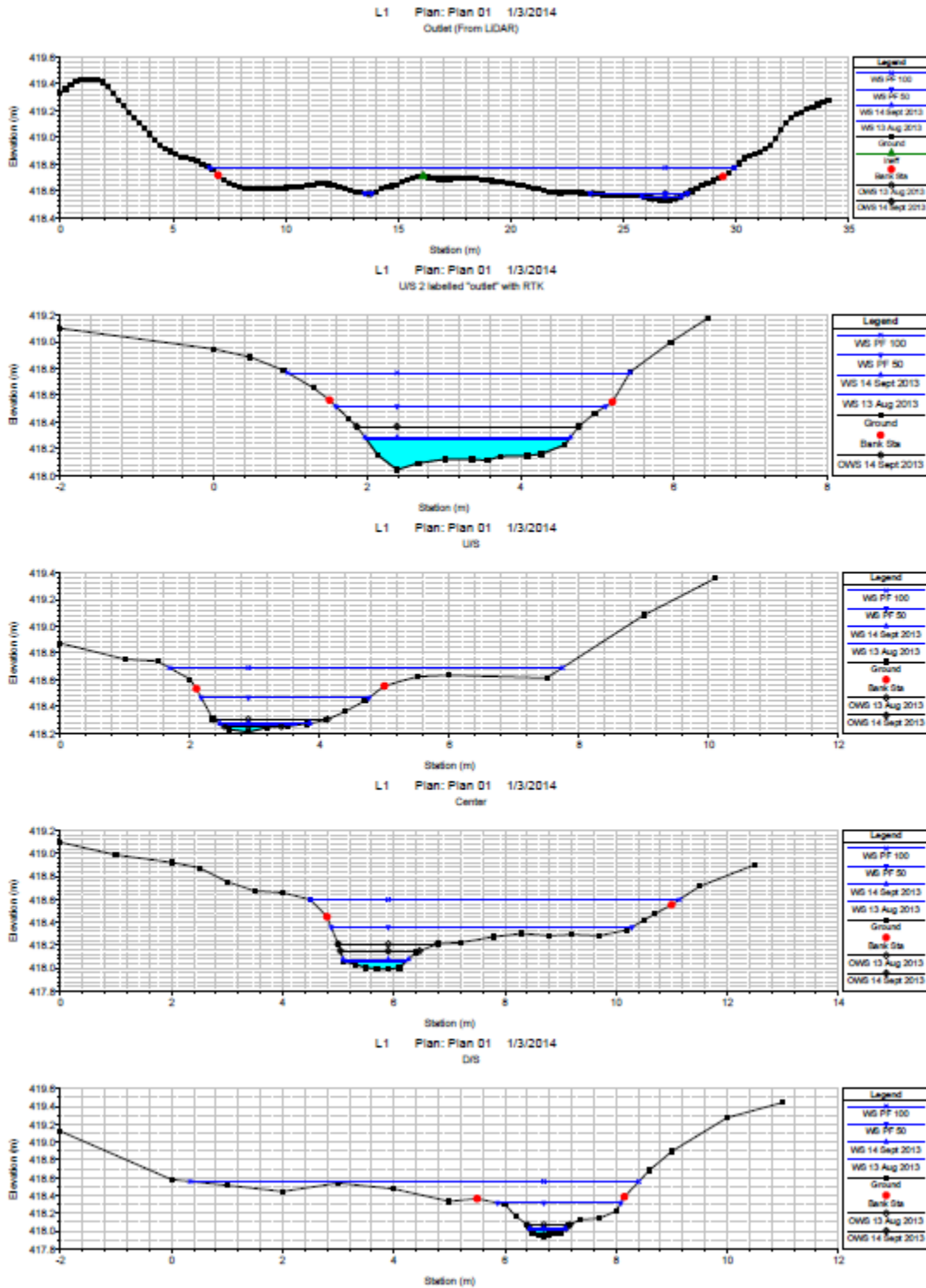
m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

**Table E4-37 Stream L1 Discharge Sheet 14-Sep-13**

Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24-hr)</b>	14:00		<b>Location</b>	Centre cross-section approximately 120 m downstream of Lake outlet			
<b>Lake Name</b>	Lake L1		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	SonTek FlowTracker			
<b>Date Monitored</b>	14-Sep-13		<b>Flow Meter Type</b>	Handheld ADV flowmeter		<b>Instrument Serial #</b>	P4017			
<b>Personnel</b>	MA, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Station Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	550254	7159044	0.41		0.008	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.76		0.50	0.18	0.019	0.02	-	-	0.00034	21.62
<b>Discharge (m<sup>3</sup>/s)</b>	0.0016		0.60	0.20	0.017	0.02	-	-	0.00040	25.28
<b>Pressure Transducer Reading (m)</b>	0.20		0.70	0.14	0.015	0.03	-	-	0.00053	33.19
<b>Lake Water Surface Elevation from Transducer (m)</b>	418.59		0.85	0.06	0.006	0.03	-	-	0.00032	19.91
<b>Notes</b>			1.05			Edge of Water (RDB)				
			<b>Total</b>		<b>0.065</b>				<b>0.0016</b>	<b>100</b>

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E4-8 Stream L1 Transects Used for Hydraulic Modelling



**Table E4-38 Stream L1 Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)		(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	
L1	5	13-Aug-13	0.001	418.52	418.550	418.578	14 (To Stn 4)	0.150	418.53	418.55	0.01117	0.04	0.02	1.5	Estimated
L1	5	14-Sep-13	0.002	418.52	418.557	418.540	14 (To Stn 4)	0.150	418.54	418.56	0.01106	0.05	0.03	1.8	
L1	5	PF 50	0.048	418.52	418.580	-	14 (To Stn 4)	0.150	418.58	418.59	0.71246	0.47	0.10	4.6	
L1	5	PF 100	0.200	418.52	418.772	-	14 (To Stn 4)	0.148	418.61	418.77	0.00103	0.06	3.35	23.3	
L1	4	13-Aug-13	0.001	418.04	418.268	-	66 (To Stn 3)	0.150	-	418.27	0.00000	0.00	0.36	2.6	Surveyed
L1	4	14-Sep-13	0.002	418.04	418.283	418.365	66 (To Stn 3)	0.150	-	418.28	0.00001	0.00	0.40	2.7	
L1	4	PF 50	0.048	418.04	418.516	-	66 (To Stn 3)	0.150	-	418.52	0.00021	0.04	1.11	3.5	
L1	4	PF 100	0.200	418.04	418.766	-	66 (To Stn 3)	0.138	-	418.77	0.00052	0.10	2.11	4.5	
L1	3	13-Aug-13	0.001	418.21	418.261	418.303	88 (To Stn 2)	0.150	-	418.26	0.00294	0.03	0.03	1.2	Surveyed
L1	3	14-Sep-13	0.002	418.21	418.273	418.250	88 (To Stn 2)	0.150	-	418.27	0.00267	0.04	0.05	1.4	
L1	3	PF 50	0.048	418.21	418.465	-	88 (To Stn 2)	0.150	-	418.47	0.00277	0.11	0.45	2.6	
L1	3	PF 100	0.200	418.21	418.688	-	88 (To Stn 2)	0.118	-	418.69	0.00268	0.15	1.30	6.1	
L1	2	13-Aug-13	0.001	417.99	418.056	418.210	83 (To Stn 1)	0.100	-	418.06	0.00022	0.02	0.05	1.1	Surveyed
L1	2	14-Sep-13	0.002	417.99	418.076	418.150	83 (To Stn 1)	0.100	-	418.08	0.00020	0.02	0.07	1.2	
L1	2	PF 50	0.048	417.99	418.357	-	83 (To Stn 1)	0.100	-	418.36	0.00046	0.06	0.81	5.4	
L1	2	PF 100	0.200	417.99	418.598	-	83 (To Stn 1)	0.097	-	418.60	0.00033	0.09	2.26	6.6	

**Table E4-38 Stream L1 Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	Water Surface Elevation	Observed Water Surface	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)		(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	
L1	1	13-Aug-13	0.001	417.94	418.007	418.068	-	0.100	417.97	418.01	0.00100	0.04	0.02	0.6	Surveyed
L1	1	14-Sep-13	0.002	417.94	418.025	418.030	-	0.100	417.97	418.03	0.00100	0.04	0.04	0.6	
L1	1	PF 50	0.048	417.94	418.315	-	-	0.100	418.05	418.32	0.00100	0.11	0.46	2.2	
L1	1	PF 100	0.200	417.94	418.556	-	-	0.082	418.17	418.56	0.00100	0.13	1.57	8.1	

Notes:

Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.

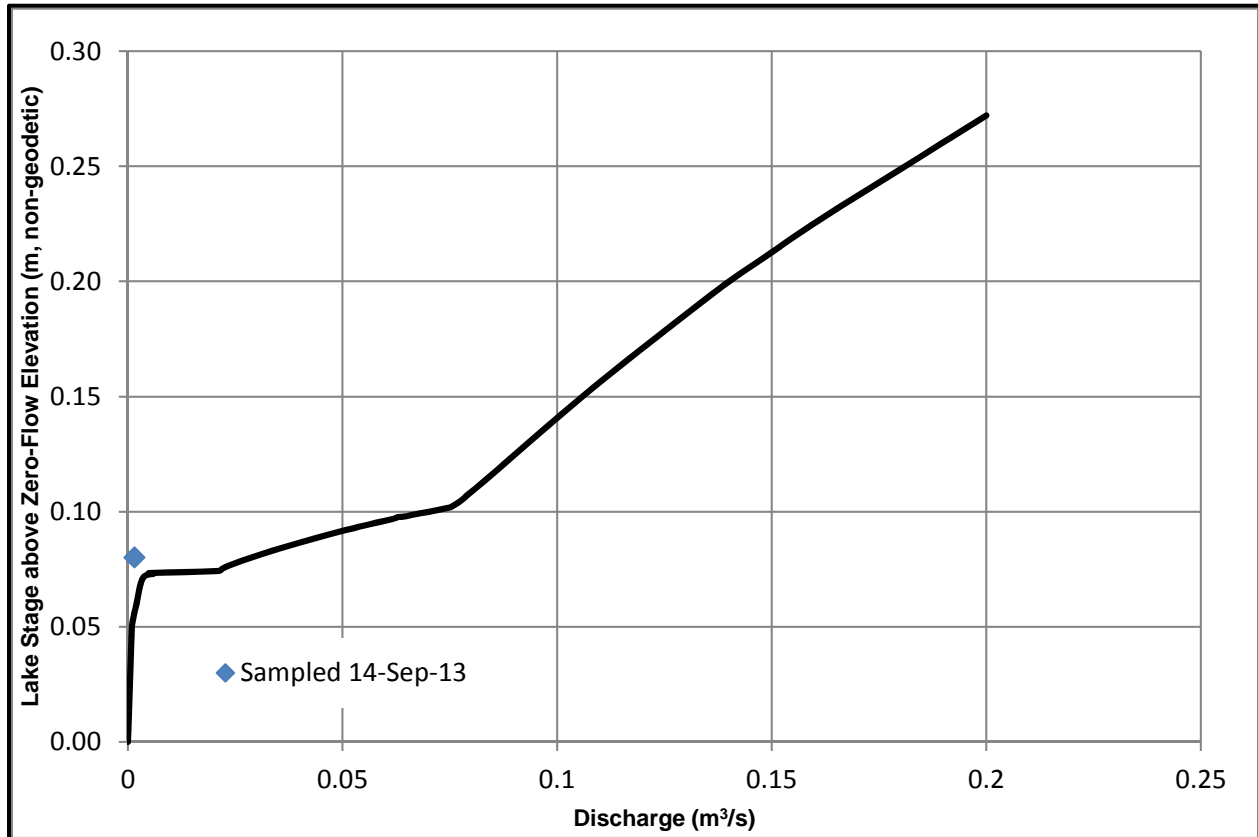
All other profiles are used to represent a possible range of discharges to estimate a lake outlet rating curve (100 flow profiles computed in total, only select profiles shown).

River station values decrease in the downstream direction.

Additional interpolated cross-sections were used for hydraulic modelling, but are not included in the summary tables.

m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre; - = no data available.

Figure E4-9 Lake L1 Outlet Rating Curve



m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E4-39 Lake L1, 2013 Mean Daily Water Surface Elevation (m, geodetic)**

Date	Jun	Jul	Aug	Sep	Oct
1	-	-	-	418.60	-
2	-	-	-	418.61	-
3	-	-	-	418.59	-
4	-	-	-	418.60	-
5	-	-	-	418.59	-
6	-	-	-	418.60	-
7	-	-	-	418.60	-
8	-	-	-	418.62	-
9	-	-	-	418.63	-
10	-	-	-	418.63	-
11	-	-	-	418.61	-
12	-	-	-	418.61	-
13	-	-	418.59	418.61	-
14	-	-	418.60	418.61	-
15	-	-	418.61	-	-
16	-	-	418.61	-	-
17	-	-	418.60	-	-
18	-	-	418.61	-	-
19	-	-	418.62	-	-
20	-	-	418.62	-	-
21	-	-	418.62	-	-
22	-	-	418.62	-	-
23	-	-	418.62	-	-
24	-	-	418.63	-	-
25	-	-	418.62	-	-
26	-	-	418.61	-	-
27	-	-	418.61	-	-
28	-	-	418.62	-	-
29	-	-	418.61	-	-
30	-	-	418.60	-	-
31	-	-	418.60	-	-
<b>Min</b>	-	-	<b>418.59</b>	<b>418.59</b>	-
<b>Max</b>	-	-	<b>418.63</b>	<b>418.63</b>	-
<b>Mean</b>	-	-	<b>418.61</b>	<b>418.61</b>	-

**Table E4-40 Lake L1 Outlet, 2013 Mean Daily Discharge (m<sup>3</sup>/s)**

Date	Jun	Jul	Aug	Sep	Oct
1	-	-	-	0.08	-
2	-	-	-	0.08	-
3	-	-	-	0.05	-
4	-	-	-	0.07	-
5	-	-	-	0.04	-
6	-	-	-	0.06	-
7	-	-	-	0.07	-
8	-	-	-	0.09	-
9	-	-	-	0.10	-
10	-	-	-	0.09	-
11	-	-	-	0.08	-
12	-	-	-	0.08	-
13	-	-	0.05	0.08	-
14	-	-	0.07	0.08	-
15	-	-	0.08	-	-
16	-	-	0.08	-	-
17	-	-	0.07	-	-
18	-	-	0.08	-	-
19	-	-	0.08	-	-
20	-	-	0.09	-	-
21	-	-	0.08	-	-
22	-	-	0.09	-	-
23	-	-	0.09	-	-
24	-	-	0.09	-	-
25	-	-	0.09	-	-
26	-	-	0.08	-	-
27	-	-	0.08	-	-
28	-	-	0.08	-	-
29	-	-	0.08	-	-
30	-	-	0.08	-	-
31	-	-	0.06	-	-
<b>Min</b>	-	-	<b>0.05</b>	<b>0.04</b>	-
<b>Max</b>	-	-	<b>0.09</b>	<b>0.10</b>	-
<b>Mean</b>	-	-	<b>0.08</b>	<b>0.08</b>	-

m = metre; m<sup>3</sup>/s = cubic metres per second; - = no data available.

## E4.6 Lac du Sauvage Outlet

Operational in August and September 2013

Benchmark: Top of Rock Anchor Bolt

Outlet Coordinates (UTM Zone 12, NAD 83): 547067 m E, 7159610 m N

Outlet Coordinates (Geographic): 64°33'30" N, 110°01'04" W

Pressure Transducer: 3001 LT Levelogger Edge Solinst  
(S/N 2020717)

Barometric Data Logger: 3001 Barologger Edge Solinst  
(S/N 2019491)



Upstream view of Lac du Sauvage outlet looking northeast (Lac du Sauvage at top and Lac de Gras at bottom)



Lac du Sauvage upstream view of upstream cross-section



Lac du Sauvage downstream view of downstream cross-section



NTS Mapping of Area

**Table E4-41 Summary of Coordinates at Lac du Sauvage and Outlet Station**

Location	Coordinates	
	Easting	Northing
Benchmark (Geodetic)	546907.39	7159643.88
Outlet	547067	7159610
Level and Barometric Data Loggers	546907.95	7159645.29

**Table E4-42 2013 Hydrometric Data at Lac du Sauvage and Outlet Station**

Date	Time (24-hour)	Benchmark Elevation (m)	Water Surface Elevation (m)	Transducer Elevation (m)	Stage Above Zero Flow Elevation (m)	Measured Discharge (m <sup>3</sup> /s)
11-Aug-13	12:30	416.70	416.04	415.62	1.06	11.91
22-Sep-13	15:30	416.70	415.90	415.62	0.91	5.98

m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E4-43 Geomorphic Parameters at Lac du Sauvage and Outlet Station**

Description	Value		Note
Local Lake Area (DEM) <sup>(a)</sup>	8650.0	ha	
Drainage Area (DEM) <sup>(a)</sup>	146382	ha	
Upstream Lake Elevation (DEM) <sup>(a)</sup>	415.9	m	
Surveyed Local Stream Slope	0.0013	m/m	
Overall Stream Slope (DEM) <sup>(a,b)</sup>	0.0012	m/m	
Average Bankfull Width	60.9	m	
Channel Material	40% cobble, 35% boulder, 10% coarse gravel, 10% medium gravel, 5% fine gravel		
Bank Material	70% boulder, 25% cobble, 5% coarse gravel		
Vegetation	High shrub tundra and grass		

a) DEM from LiDAR data flown 23 July – 1 August 2013.

b) Overall stream slope between upstream and downstream lakes.

m = metre; ha = hectare; m/m = metres per metre; DEM = Digital Elevation Model; % = percent.

**Table E4-44 Lac du Sauvage Discharge Sheet 11-Aug-13**

Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	12:30		<b>Location</b>	Centre cross-section approximately 120 m downstream of Lake outlet			
<b>Lake Name</b>	Lac du Sauvage		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	Marsh-McBirney FLO-MATE Model 2000			
<b>Date Monitored</b>	11-Aug-13		<b>Flow Meter Type</b>	Handheld electromagnetic sensor flowmeter		<b>Instrument Serial #</b>	2005872			
<b>Personnel</b>	MA, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Station Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	546802	7159563	11.3		0.04	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	1.06		12.3	0.07	-	0.07	-	-	0.00	0.04
<b>Discharge (m<sup>3</sup>/s)</b>	11.91		13.3	Boulder	-	0.00	-	-	-	-
<b>Pressure Transducer Reading (m)</b>	0.41		14.3	0.05	0.05	0.17	-	-	0.01	0.07
<b>Lake Water Surface Elevation from Transducer (m)</b>	416.03		15.3	0.05	0.06	0.22	-	-	0.01	0.09
<b>Notes</b>			16.3	0.06	0.07	0.05	-	-	0.00	0.03
			17.3	0.08	0.11	0.18	-	-	0.01	0.12
			18.3	0.14	0.15	0.32	-	-	0.04	0.38
			19.3	0.16	0.17	0.25	-	-	0.04	0.34
			20.3	0.17	0.18	0.30	-	-	0.05	0.43
			21.3	0.18	0.22	0.38	-	-	0.07	0.57
			22.3	0.26	0.21	0.33	-	-	0.09	0.72
			23.3	0.16	0.18	0.93	-	-	0.15	1.25
			24.3	0.20	0.27	0.91	-	-	0.18	1.53
			25.3	0.34	0.36	0.68	-	-	0.23	1.94
			26.3	0.38	0.40	0.67	-	-	0.25	2.14

**Table E4-44 Lac du Sauvage Discharge Sheet 11-Aug-13**

Site Information	Discharge Measurement								
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)			Qi	% of Total Q	
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%	
	27.3	0.41	0.44	0.65	-	-	0.27	2.24	
	28.3	0.46	0.47	0.62	-	-	0.29	2.40	
	29.3	0.48	0.41	0.60	-	-	0.29	2.42	
	30.3	0.34	0.38	0.76	-	-	0.26	2.17	
	31.3	0.42	0.44	0.80	-	-	0.34	2.82	
	32.3	0.46	0.49	0.84	-	-	0.39	3.25	
	33.3	0.52	0.50	0.77	-	-	0.40	3.36	
	34.3	0.48	0.49	0.70	-	-	0.34	2.82	
	35.3	0.50	0.72	0.66	-	-	0.33	2.77	
	36.3	0.94	1.96	0.86	-	-	1.21	10.18	
	38.3	1.02	1.03	0.83	-	-	1.27	10.66	
	39.3	1.04	1.26	0.85	-	-	1.01	8.44	
	40.6	0.94	1.22	0.84	-	-	1.08	9.06	
	42.0	0.74	0.90	1.00	-	-	1.08	9.06	
	43.5	0.50	0.70	0.97	-	-	0.71	5.94	
	44.9	0.46	0.66	1.01	-	-	0.68	5.69	
	46.4	0.45	0.62	0.92	-	-	0.60	5.07	
	47.9	0.40	0.51	0.37	-	-	0.22	1.81	
	49.3	0.30	0.03	0.10	-	-	0.02	0.21	
	49.5			Edge of Water (RDB)					
	<b>Total</b>		<b>15.68</b>				<b>11.91</b>	<b>100</b>	

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

**Table E4-45 Lac du Sauvage Discharge Sheet 22-Sep-13**

Site Information			Discharge Measurement							
<b>Project Name</b>	Dominion Diamond – Hydrology Baseline		<b>Time (24 hr)</b>	15:30		<b>Location</b>	Centre cross-section approximately 120 m downstream of Lake outlet			
<b>Lake Name</b>	Lac du Sauvage		<b>Method</b>	Velocity – Area (Mid-section)		<b>Instrument Model</b>	SonTek FlowTracker			
<b>Date Monitored</b>	22-Sep-13		<b>Flow Meter Type</b>	Handheld ADV flowmeter		<b>Instrument Serial #</b>	P4017			
<b>Personnel</b>	NS, CV		<b>Station</b>	<b>Depth</b>	<b>Area</b>	<b>Velocity at Specified Depth (m/s)</b>			<b>Qi</b>	<b>% of Total Q</b>
<b>Station Coordinates</b>	<b>Easting</b>	<b>Northing</b>	<b>(m)</b>	<b>(m)</b>	<b>(m<sup>2</sup>)</b>	<b>60%</b>	<b>20%</b>	<b>80%</b>	<b>(m<sup>3</sup>/s)</b>	<b>%</b>
	546802	7159563	2.4	0.00	0.06	Edge of Water (LDB)				
<b>Stage Above Zero Flow Elevation (m)</b>	0.91		3.4	0.12	0.24	0.06	-	-	0.01	0.18
<b>Discharge (m<sup>3</sup>/s)</b>	5.98		5.4	0.12	0.32	0.11	-	-	0.03	0.45
<b>Pressure Transducer Reading (m)</b>	0.28		7.4	0.20	0.38	0.14	-	-	0.06	0.96
<b>Lake Water Surface Elevation from Transducer (m)</b>	415.90		9.4	0.18	0.43	0.19	-	-	0.07	1.16
<b>Notes</b>			11.4	0.25	0.48	0.07	-	-	0.04	0.61
			13.4	0.23	0.58	0.28	-	-	0.13	2.12
			15.4	0.35	0.73	0.27	-	-	0.19	3.14
			17.4	0.38	0.75	0.27	-	-	0.21	3.47
			19.4	0.37	0.78	0.33	-	-	0.25	4.14
			21.4	0.41	0.81	0.34	-	-	0.28	4.71
			23.4	0.40	0.45	0.39	-	-	0.23	3.92
			24.4	0.49	0.51	0.37	-	-	0.18	3.04
			25.4	0.52	0.29	0.40	-	-	0.16	2.61
			25.9	0.65	0.33	0.36	-	-	0.12	1.94
			26.4	0.68	0.36	0.37	-	-	0.13	2.10

**Table E4-45 Lac du Sauvage Discharge Sheet 22-Sep-13**

Site Information	Discharge Measurement							
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)			Qi	% of Total Q
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%
	26.9	0.75	0.36	0.37	-	-	0.14	2.31
	27.4	0.67	0.34	0.37	-	-	0.13	2.09
	27.9	0.67	0.34	0.42	-	-	0.14	2.35
	28.4	0.69	0.35	0.42	-	-	0.15	2.44
	28.9	0.70	0.36	0.41	-	-	0.14	2.41
	29.4	0.74	0.38	0.37	-	-	0.14	2.32
	29.9	0.76	0.39	0.39	-	-	0.15	2.51
	30.4	0.78	0.39	0.40	-	-	0.15	2.58
	30.9	0.79	0.41	0.37	-	-	0.15	2.46
	31.4	0.85	0.43	0.39	-	-	0.17	2.80
	31.9	0.86	0.43	0.40	-	-	0.17	2.84
	32.4	0.86	0.42	0.37	-	-	0.16	2.69
	32.9	0.82	0.41	0.38	-	-	0.16	2.59
	33.4	0.83	0.42	0.35	-	-	0.15	2.44
	33.9	0.84	0.43	0.37	-	-	0.15	2.57
	34.4	0.86	0.43	0.35	-	-	0.15	2.49
	34.9	0.84	0.41	0.32	-	-	0.14	2.26
	35.4	0.78	0.32	0.37	-	-	0.14	2.39
	35.9	0.51	0.53	0.33	-	-	0.13	2.11
	36.9	0.54	1.08	0.32	-	-	0.26	4.34
	38.9	0.54	1.06	0.24	-	-	0.26	4.30
	40.9	0.52	0.59	0.19	-	-	0.16	2.71
	42.2	0.38	0.44	0.24	-	-	0.10	1.72

**Table E4-45 Lac du Sauvage Discharge Sheet 22-Sep-13**

Site Information	Discharge Measurement								
Notes	Station	Depth	Area	Velocity at Specified Depth (m/s)			Qi	% of Total Q	
	(m)	(m)	(m <sup>2</sup> )	60%	20%	80%	(m <sup>3</sup> /s)	%	
	26.9	0.75	0.36	0.37	-	-	0.14	2.31	
	43.2	0.50	0.65	0.21	-	-	0.12	2.06	
	44.5	0.50	0.94	0.18	-	-	0.14	2.38	
	46.4	0.49	0.85	-0.01	-	-	-0.01	0.14*	
	48.3	0.4	0.67	0.09	-	-	0.07	1.10	
	50.2	0.3	0.48	0.04	-	-	0.02	0.37	
	52.2	0.18	0.19	-0.01	-	-	-0.002	0.04*	
	54.3	0.00	0	Edge of Water (RDB)					
	<b>Total</b>		<b>21.94</b>				<b>5.98</b>	<b>100</b>	

m<sup>3</sup>/s = cubic metres per second; hr = hour; # = number; % = percent; LDB = left downstream bank; RDB = right downstream bank; m<sup>2</sup> = square metre; Q = discharge; Qi = interval discharge; m/s = metres per second; - = no data available.

Figure E4-10 Lac du Sauvage Outlet Transects Used for Hydraulic Modelling (1 of 2)

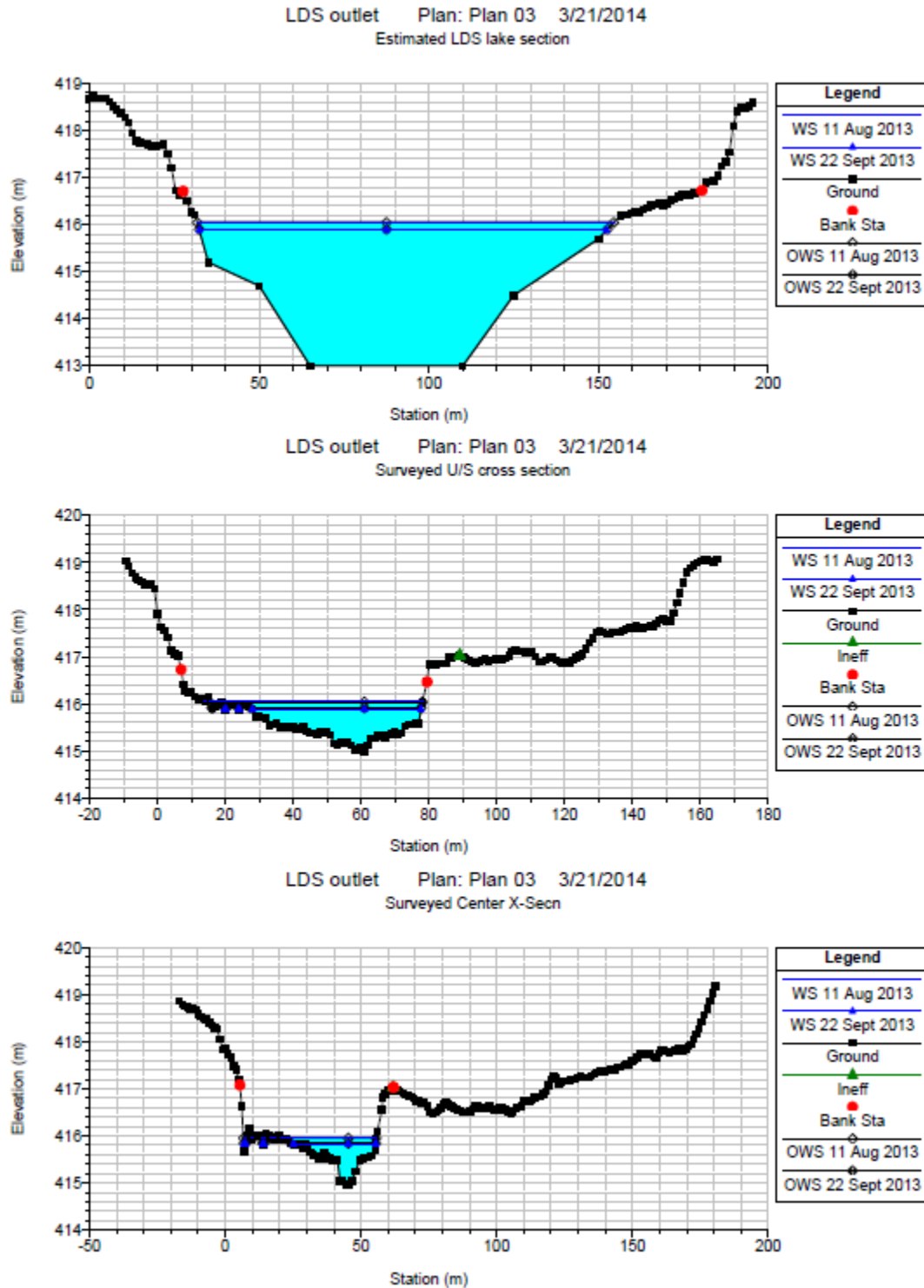
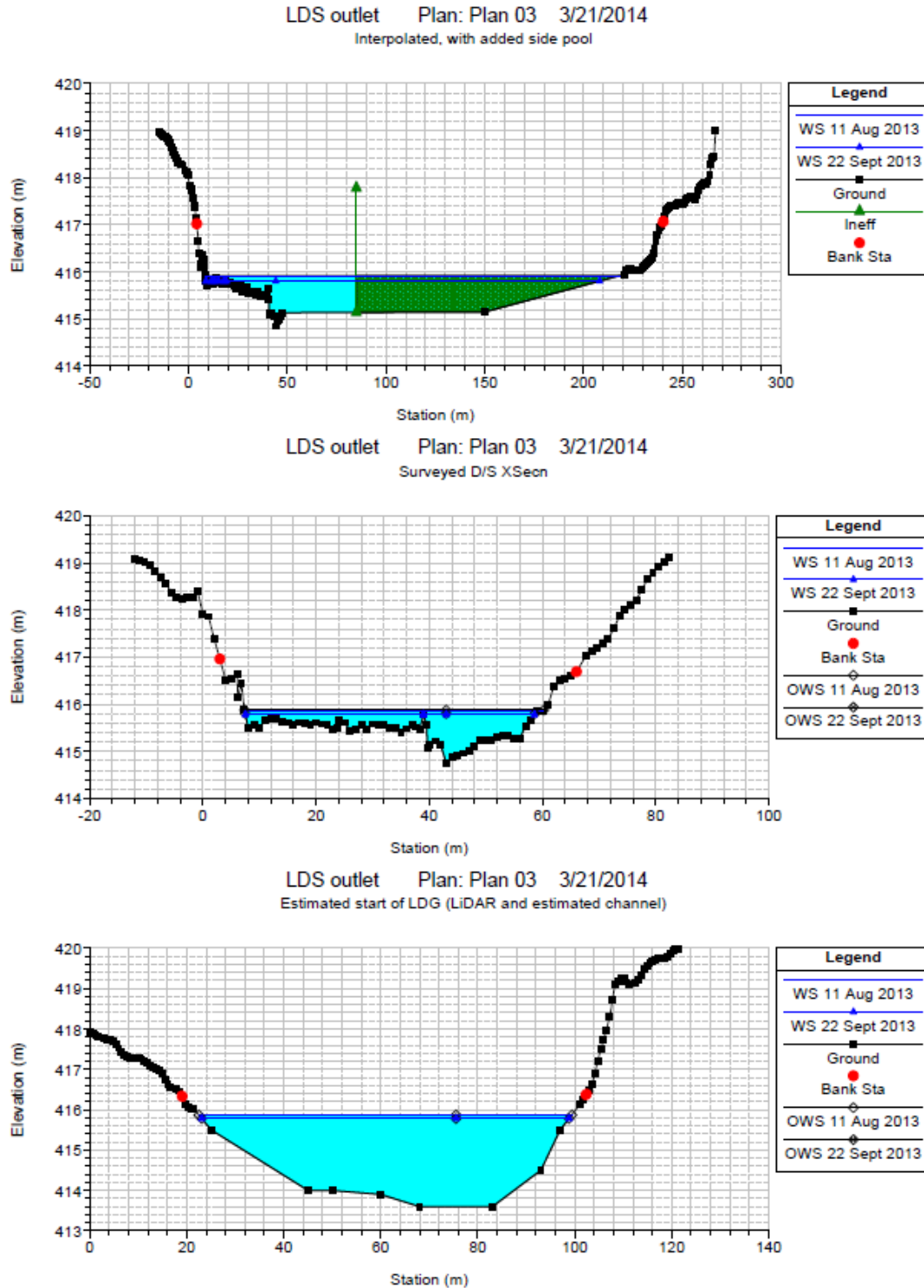


Figure E4-11 Lac du Sauvage Outlet Transects Used for Hydraulic Modelling (2 of 2)



**Table E4-46 Lac du Sauvage Outlet Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	LDS Water Surface Elevation	LDS Observed Water Surface Elevation	LDG (Downstream boundary) Observed Water Surface Elevation	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface Elevation	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)	(m)		(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	
Lac du Sauvage Outlet	6	11-Aug-13	11.91	413	416.062	416.045	415.87	70	0.057	-	416.06	0.00000	0.05	248.7	123.1	Estimated Lac du Sauvage lake bed (LiDAR used for banks)
Lac du Sauvage Outlet	6	22-Sep-13	5.98	413	415.883	415.900	415.78	70	0.057	-	415.88	0.00000	0.03	227.0	120.0	
Lac du Sauvage Outlet	5	11-Aug-13	11.91	414.98	416.055	416.036	415.87	35	0.057	415.53	416.06	0.00090	0.35	34.2	63.0	Surveyed
Lac du Sauvage Outlet	5	22-Sep-13	5.98	414.98	415.880	415.910	415.78	35	0.057	415.42	415.88	0.00053	0.25	24.2	50.0	
Lac du Sauvage Outlet	4	11-Aug-13	11.91	414.94	415.958	415.950	415.87	44	0.057	415.69	415.99	0.00744	0.79	15.2	40.0	Surveyed
Lac du Sauvage Outlet	4	22-Sep-13	5.98	414.94	415.824	415.840	415.78	44	0.057	415.55	415.84	0.00456	0.57	10.5	31.2	
Lac du Sauvage Outlet	3	11-Aug-13	11.91	414.85	415.921	-	415.87	44	0.057	415.31	415.92	0.00052	0.27	43.5	209.9	Interpolated with ineffective flow area (north bay)
Lac du Sauvage Outlet	3	22-Sep-13	5.98	414.85	415.805	-	415.78	44	0.057	415.24	415.81	0.00026	0.17	34.7	196.3	
Lac du Sauvage Outlet	2	11-Aug-13	11.91	414.75	415.865	415.875	415.87	80	0.057	-	415.88	0.00285	0.53	22.6	52.8	Surveyed
Lac du Sauvage Outlet	2	22-Sep-13	5.98	414.75	415.778	415.8	415.78	80	0.057	-	415.78	0.00143	0.33	18.1	51.0	

**Table E4-46 Lac du Sauvage Outlet Hydraulic Modelling Output**

Reach	River Station	Profile	Q Total	Minimum Channel Elevation	LDS Water Surface Elevation	LDS Observed Water Surface Elevation	LDG (Downstream boundary) Observed Water Surface Elevation	Distance to Downstream Cross-Section	Composite Manning's n	Critical Water Surface Elevation	Energy Grade Elevation	Energy Grade Slope	Velocity Total	Flow Area	Top Width	Source of Cross-Section
			(m <sup>3</sup> /s)	(m)	(m)	(m)	(m)	(m)		(m)	(m)	(m)	(m/m)	(m/s)	(m <sup>2</sup> )	
Lac du Sauvage Outlet	1	11-Aug-13	11.91	413.6	415.87	415.87	415.87	-	0.057	413.95	415.87	0.00002	0.10	124.6	76.9	Estimated Lac de Gras lake bed (LiDAR used for banks)
Lac du Sauvage Outlet	1	22-Sep-13	5.98	413.6	415.78	415.78	415.78	-	0.057	413.83	415.78	0.00001	0.05	117.7	75.7	

Notes:

Dated profiles are discharges measured at the time of surveys with associated observed water surface elevations used for calibration.

Interpolated cross-sections and topography above water levels (from LiDAR data) are included in the model.

Minimal change in elevation between LDS and LDG; therefore, backwater effects are expected at the LDS outlet and discharge is a function of the LDG lake water levels and the LDS water levels.

The downstream boundary condition (the lake water surface elevation of LDG) was varied over 415 to 416.9 masl at 0.05 m increments to envelope the range of acceptable LDG water levels

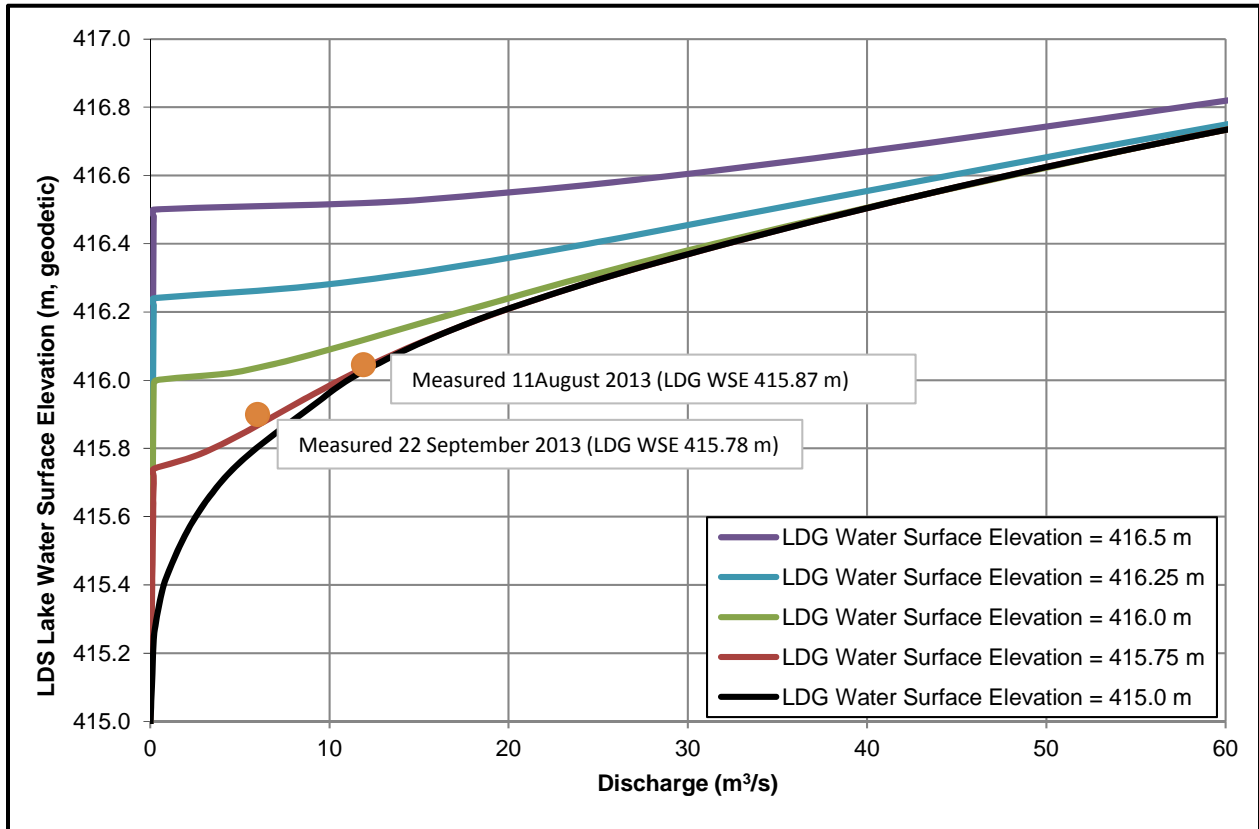
Development of the rating curve for each downstream Lac de Gras water surface elevation was completed by modelling a complete range of flows to over 100 m<sup>3</sup>/s

River station values decrease in the downstream direction.

The model assumes that the northern bay at the center of the outlet is an ineffective flow area not providing conveyance during all discharges.

m = metre; m/m = metres per metre; m<sup>3</sup>/s = cubic metres per second; m/s = metres per second; m<sup>2</sup> = square metre; LiDAR = light detection and ranging; - = no data available.

Figure E4-12 Lac du Sauvage Outlet Rating Curve



m = metre; m<sup>3</sup>/s = cubic metres per second.

**Table E4-47 Lac du Sauvage Outlet,  
2013 Mean Daily Water Surface  
Elevation (m, geodetic)**

Date	Jun	Jul	Aug	Sep	Oct
1	-	-	-	415.98	-
2	-	-	-	415.98	-
3	-	-	-	415.96	-
4	-	-	-	415.95	-
5	-	-	-	415.95	-
6	-	-	-	415.95	-
7	-	-	-	415.95	-
8	-	-	-	415.95	-
9	-	-	-	415.96	-
10	-	-	-	415.97	-
11	-	-	416.04	415.95	-
12	-	-	416.04	415.94	-
13	-	-	416.03	415.97	-
14	-	-	416.03	415.94	-
15	-	-	416.04	415.94	-
16	-	-	416.04	415.96	-
17	-	-	416.02	415.96	-
18	-	-	416.02	415.95	-
19	-	-	416.02	415.94	-
20	-	-	416.04	415.94	-
21	-	-	416.01	415.92	-
22	-	-	416.03	415.93	-
23	-	-	416.03	-	-
24	-	-	416.03	-	-
25	-	-	416.02	-	-
26	-	-	415.99	-	-
27	-	-	415.99	-	-
28	-	-	416.00	-	-
29	-	-	415.98	-	-
30	-	-	415.98	-	-
31	-	-	415.96	-	-
<b>Min</b>	-	-	<b>415.96</b>	<b>415.92</b>	-
<b>Max</b>	-	-	<b>416.04</b>	<b>415.98</b>	-
<b>Mean</b>	-	-	<b>416.02</b>	<b>415.95</b>	-

**Table E4-48 Lac du Sauvage Outlet,  
2013 Mean Daily Discharge  
(m<sup>3</sup>/s)**

Date	Jun	Jul	Aug	Sep	Oct
1	-	-	-	9.49	-
2	-	-	-	9.83	-
3	-	-	-	8.93	-
4	-	-	-	8.74	-
5	-	-	-	8.65	-
6	-	-	-	8.98	-
7	-	-	-	8.70	-
8	-	-	-	8.99	-
9	-	-	-	9.15	-
10	-	-	-	9.70	-
11	-	-	10.83	9.06	-
12	-	-	11.02	8.72	-
13	-	-	10.71	9.66	-
14	-	-	10.72	8.88	-
15	-	-	11.17	8.81	-
16	-	-	11.13	9.37	-
17	-	-	10.32	9.50	-
18	-	-	10.56	9.10	-
19	-	-	10.61	8.62	-
20	-	-	11.28	8.39	-
21	-	-	10.32	7.50	-
22	-	-	10.96	7.54	-
23	-	-	10.99	-	-
24	-	-	11.14	-	-
25	-	-	10.73	-	-
26	-	-	9.93	-	-
27	-	-	9.94	-	-
28	-	-	10.24	-	-
29	-	-	9.54	-	-
30	-	-	9.40	-	-
31	-	-	8.96	-	-
<b>Min</b>	-	-	<b>8.96</b>	<b>7.50</b>	-
<b>Max</b>	-	-	<b>11.28</b>	<b>9.83</b>	-
<b>Mean</b>	-	-	<b>10.50</b>	<b>8.92</b>	-

m = metre; m<sup>3</sup>/s = cubic metres per second; - = no data available.

## E5 SHORELINE SURVEY PHOTOGRAPHS

This section presents photographs acquired during 2013 field program shoreline surveys at the Project.

### E5.1 Lac du Sauvage North Arm – Northeast Shore Area



Photo E5-SL01: Shoreline with large boulders (looking southeast)



Photo E5-SL02: Shoreline with boulders in the shallow area (looking northeast)



Photo E5-SL03: Shoreline with steep shoreline (looking north)



Photo E5-SL04: Shoreline with shallow bay with gravel and cobble, (looking east)

## E5.1 Lac du Sauvage North Arm – Northeast Shore Area



Photo E5-SL05: Shoreline with boulders and fractured bedrock (looking northeast)



Photo E5-SL06: Shoreline boulders intercalated with gravel and sand (looking north)



Photo E5-SL07: Shoreline detail with sand, gravel and some boulders.



Photo E5-SL08: Shoreline with large boulders (looking southeast)

## E5.1 Lac du Sauvage North Arm – Northeast Shore Area



Photo E5-SL09: Shoreline with bedrock (looking northeast)



Photo E5-SL10: Shoreline with large boulders (looking east)



Photo E5-SL11: Shoreline with steep bedrock (looking northeast)



Photo E5-SL12: Shoreline with boulders and vegetation on top (looking east)

## E5.2 Lac du Sauvage North Arm – North Bays Shore Area



Photo E5-SL13: Shoreline with boulders and fine sediments (looking east)



Photo E5-SL14: Shoreline with boulders and fine sediments (looking west)



Photo E5-SL15: Low slope island with shallow shores (looking west)

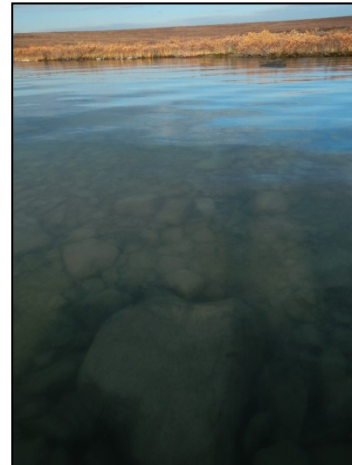


Photo E5-SL16: Shallow shoreline with cobble and some boulders (looking north)

## E5.2 Lac du Sauvage North Arm – North Bays Shore Area



Photo E5-SL17: Shoreline with cobble and vegetation on top (looking north)



Photo E5-SL18: Shallow shoreline with sand and gravel intercalated with cobble and some boulders (looking west)

### E5.3 Lac du Sauvage North Arm – Southwest Shore Area



Photo E5-SL19: Shoreline with sandy beach(looking northwest)



Photo E5-SL20: Esker shoreline (looking southeast)



Photo E5-SL21: Esker shoreline with erosion and bank failures (looking south)



Photo E5-SL22: Shoreline with cobble beach (looking north)

### E5.3 Lac du Sauvage North Arm – Southwest Shore Area



Photo E5-SL23: Shoreline with sand and cobble beaches (looking east)



Photo E5-SL24: Esker shoreline with alternating small beaches and cobble and boulder material (looking north)



Photo E5-SL25: Shallow shoreline with gravel and cobble and small boulders (looking west)



Photo E5-SL26: Shoreline with sandy and cobble beach (looking north)

### E5.3 Lac du Sauvage North Arm – Southwest Shore Area



Photo E5-SL27: Shoreline with cobble beach (looking northwest)



Photo E5-SL28: Shoreline sandy beach and soil erosion signs due to wave action at the base of the esker (looking west)



Photo E5-SL29: Shallow shoreline with sandy bottom and aquatic vegetation



Photo E5-SL30: Shoreline with sandy beach and cobble (looking west)

### E5.3 Lac du Sauvage North Arm – Southwest Shore Area



Photo E5-SL31: Shoreline with soil erosion signs (looking west)



Photo E5-SL32: Shoreline with exposed bedrock (looking west)



Photo E5-SL33: Shoreline with exposed bedrock (looking southwest)

## E5.4 Duchess Lake



Photo E5-SL35: The inlet channel from Lake G1 to Duchess Lake (looking upstream)



Photo E5-SL36: The outlet channel of Lake Af1 into Duchess Lake (approximate dimensions are shown for reference; looking upstream, Lake Af1 at top)



Photo E5-SL37: Shallow shoreline of Duchess Lake with fine sediments (looking west)

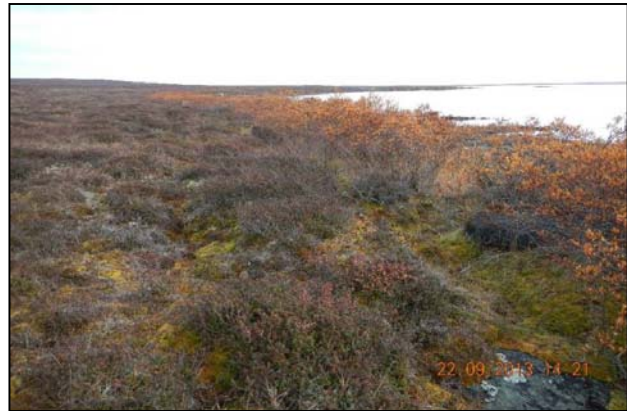


Photo E5-SL38: Low slope shoreline in Duchess Lake with soils and ice-push berms (looking southeast)



Photo E5-SL40: Duchess Lake small shoreline with sandy beach (looking west)



Photo E5-SL42: Duchess Lake shallow shoreline with fine sediments and organics (looking northwest)

## E5.4 Duchess Lake



Photo E5-SL45: Duchess Lake shoreline with exposed bedrock and cobble with some boulders (looking northeast)



Photo E5-SL46: Duchess Lake shoreline with sand and gravel intercalated with cobble and some boulders (looking north)



Photo E5-SL47: Detail of Duchess Lake shoreline with gravel and cobble intercalated with boulders, (looking southeast)



Photo E5-SL48: Detail of Duchess Lake shoreline gravel intercalated with cobble and boulders (looking north)

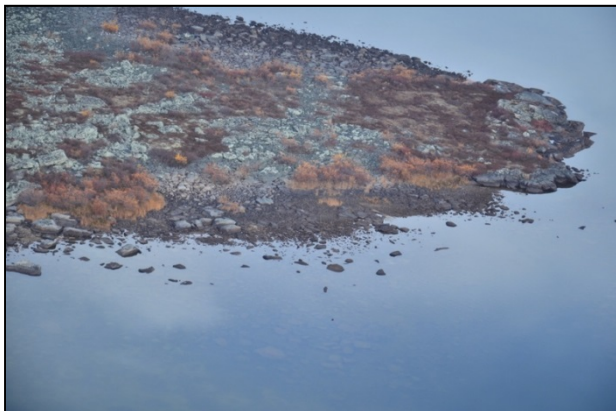


Photo E5-SL49: Duchess Lake shoreline with boulders and exposed bedrock (looking northeast)



Photo E5-SL54: Duchess Lake shoreline with large boulders and exposed bedrock (looking north)

## E5.4 Duchess Lake



Photo E5-SL55: Duchess Lake shoreline with large boulders (looking southwest)

## E5.5 Lake Af1



Photo E5-SL34: The inlet channel from Lake E1 to Lake Af1 (looking upstream, Lake Af1 at bottom)

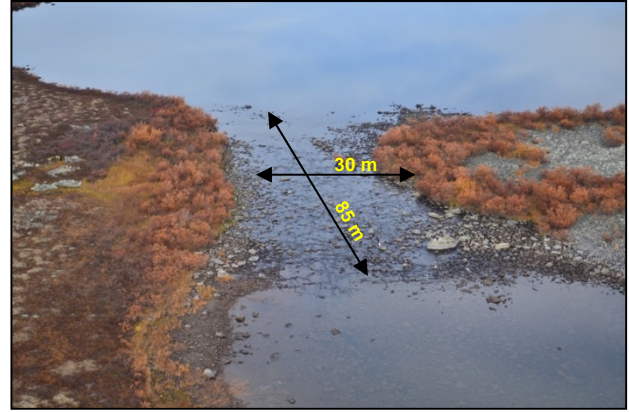


Photo E5-SL36: The outlet channel of Lake Af1 into Duchess Lake (approximate dimensions are shown for reference; looking upstream, Lake Af1 at top)



Photo E5-SL39: Lake Af1 shoreline with organics and soils (looking west)



Photo E5-SL41: Lake Af1 shoreline cobble and steep vegetated bank (looking north)



Photo E5-SL43: Lake Af1 shoreline with low slopes and organics (looking northeast)



Photo E5-SL44: Low slope shoreline for local tributaries to Lake Af1 (looking east)

## E5.5 Lake Af1



Photo E5-SL50: Lake Af1 shoreline with boulder gardens (looking east)



Photo E5-SL51: Lake Af1 shoreline detail with large boulders



Photo E5-SL52: Lake Af1 shoreline with boulders (looking west)



Photo E5-SL53: Lake Af1 shoreline with bedrock and boulders (looking northeast)

## E5.6 Lake E1



Photo E5-SL56: Shoreline with sandy beaches (looking north)



Photo E5-SL57: Sandy shoreline detail with steep banks and some bank failures (looking west)



Photo E5-SL58: Shoreline with gravel beach (looking east)



Photo E5-SL59: Shallow shoreline with fine sediments and some cobble (looking northeast)

## E5.6 Lake E1



Photo E5-SL60: Shoreline with sand and some cobble and boulders (looking east)



Photo E5-SL61: Shoreline with boulders (looking southeast)



Photo E5-SL62: Shoreline with gravel and cobble intercalated with boulders (looking southeast)



Photo E5-SL63: Shoreline with boulders (looking east)

## E5.6 Lake E1



Photo E5-SL64: Esker shoreline with sand intercalated with cobble and boulders (looking south)



Photo E5-SL65: Esker shoreline with sand and gravel and some cobble (looking east)



Photo E5-SL66: Esker traversing Lake E1, with steep shoreline with cobble and boulders (looking north)