Appendix V6-1A

Back River Project: 2011 Hydrology Baseline Report

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BACK RIVER PROJECT
2011 Hydrology Baseline Report

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March 2012

BACK RIVER PROJECT
2011 HYDROLOGY BASELINE REPORT

March 2012
Project #0833-002-02

Citation:
Rescan. 2012. *Back River Project: 2011 Hydrology Baseline Report*. Prepared for Sabina Gold & Silver Corp. by Rescan Environmental Services Ltd.

Prepared for:

Sabina Gold & Silver Corp.

Prepared by:

Rescan™ Environmental Services Ltd.
Vancouver, British Columbia

Executive Summary

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Executive Summary

The Back River Project lies in the southwestern portion of the Ellice River Watershed, in the West Kitikmeot region of Nunavut and is situated within the continuous permafrost zone of the continental Canadian Arctic.

The Back River Project consists of several property areas, and baseline work in 2011 focused on the Goose property area. This report presents the results of the 2011 hydrology baseline program conducted within the Goose property area.

A network of nine hydrometric monitoring stations was operated in 2011. The network monitored the runoff from a total watershed area of 209.8 km^2. Two existing stations were remobilized and seven new stations established in early-June of 2011. The monitoring stations were mostly established at locations within the Goose property area within watersheds containing known deposits. One monitoring station situated outside of the Project area and watershed boundary was established as a reference location.

The hydrometric network was operated through the open water season from June 10, 2011 to September 17, 2011. During this period, continuous time series stage data were collected at each station and a total of 41 manual discharge measurements were completed. Based on the stage and discharge data collected, stage-discharge rating equations were determined and annual hydrographs generated.

The annual hydrographs clearly show that the Project lies in an Arctic-nival flow regime with snowmelt driven peak flows and no flow during the winter. Generally, peak flows were observed during freshet in early to mid-June followed by a second rainfall induced peak in early July. The early timing of the rainfall, occurring before the freshet had receded to summer low flows led to hydrographs with bimodal peaks. Peak flows in the region typically occur during the spring freshet and are driven by snowmelt. In 2011, rainfall events that occurred in July, halfway throughout the spring freshet, generated secondary peaks in the hydrographs. After the July storms, discharge decreased through the summer reaching a minimum in mid-August. Late summer rainfall in the region lead to increased flow through the beginning of September for the Project area.

Peak flows varied substantially among gauged streams. Instantaneous peak flows ranged from 0.10 m^3/s at the EL-H1 hydrometric station, which monitors a drainage area of 1.4 km^2, to 8.44 m^3/s at the PL-H1 station, which monitors the entire Propellor Lake drainage area of 204.4 km^2.

Volumetric outflows from each of the monitored drainages were generally found to be a function of drainage area. The minimum volumetric outflows were observed at EL-H1 (Echo Drainage outflow; drainage area = 1.4 km^2) which had a total annual water output of 0.11 million cubic meters. The maximum annual volumetric output was 25.31 million cubic meters at PL-H1 (Propellor Drainage outflow; drainage area = 204.4 km^2).

Average annual runoff from all gauged drainages in the monitored area was 170 mm. Approximately 75% of the annual runoff occurred in June and July and as little as 3% in August. All monitored streams can be classified as either intermittent or ephemeral. The majority are intermittent with zero flow in the winter due to ice conditions. Three of the smaller streams were found to be ephemeral, only carrying water immediately after snowmelt or rainfall events. It was determined that on average the monitored streams flowed for 30% of the year while for the remaining 70% they were either frozen or dried up.

Acknowledgements

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Acknowledgements

This Report was prepared by Rescan Environmental Services Ltd. (Rescan) for Sabina Gold and Silver Corporation. Field data collection was conducted by Coby Hall (B.Sc.), and Xavier Pinto (M.Sc.). The report was prepared and written by Coby Hall, Xavier Pinto, David Luzi (M.Sc.), and technically reviewed by R.W. (Bob) Askin (M.Sc., MCSCE, P.Geo., P.Eng.). The project was managed by Deborah Muggli (Ph.D., M.Sc., R.P.Bio.).

Rescan staff were assisted in the field by Justin Porter, Robbie Eleehetook and Vernon Harper.

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BACK RIVER PROJECT
2011 HYDROLOGY BASELINE REPORT

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Glossary and Abbreviations

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Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

ADCP	Acoustic Doppler current profiler.
Annual runoff	Annual runoff is a measure of the hydrologic response of a watershed. It is often presented as a depth of water, in mm, over an entire watershed allowing direct comparison with precipitation totals.
Arctic nival	Hydrological regime defined by Church (1974). In this regime snow melt is the major hydrological event producing runoff and continuous permafrost impedes deep infiltration reducing base flow and winter flow.
Baseflow	The groundwater component of flow discharge that is attributed to soil moisture and groundwater drainage into a channel.
Break-up	The melting and dissipation of this ice cover on a water body.
Canadian Shield	A vast geologic area of exposed Precambrian crystalline igneous and high-grade metamorphic rocks that form tectonically stable areas covered by a thin layer of soil. It has a deep, common, joined bedrock region in eastern and central Canada and stretches North from the Great Lakes to the Arctic Ocean, covering over half of Canada.
Drainage Basin	The zone or portion of land that contributes water to the surface water runoff that flows past a given point along a stream channel.
Ephemeral	A stream which flows only during or after rain or snow-melt and has no baseflow component.
Freeze-up	The formation of an ice cover on a water body.
Freshet	In channels, the relatively high annual peak water discharge period resulting from spring/summer meltwater runoff of the snowpack accumulated over the winter.
Hydrograph	A graphical plot of water discharge versus time.
Intermittent	A stream which flows only part of the year.
ISO	International Organization for Standardization
MAD	The mean annual discharge (MAD), computed as an average discharge over the year.
NAD 83	North American Datum 1983. A datum is a reference system for computing or correlating the results of a survey. The NAD83 datum is based on the spheroid (GRS80).
Permafrost	Bedrock, organic or earth material that has temperatures below 0°C persisting over at least two consecutive years.
Stage	The depth of water in a water course or channel.

Stage-Discharge Curve	A curve derived from concurrently measured stage and discharge data that is used to estimate the discharge for any given observed stage. Often referred to as a rating curve for a hydrometric station.
Talik	An unfrozen section of ground within a layer of discontinuous permafrost. Taliks can also be found underneath water bodies in a layer of continuous permafrost.
Unit Yield	It is a ratio of water discharges normalized to the drainage area for a basin. This parameter allows for direct comparison of the hydrological response of basins with different size drainage areas.
WSC	Water Survey of Canada.
UTM	Universal Transverse Mercator. A mathematical transformation (map projection) of the earth's surface to create a flat map sheet.

1. Introduction

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1. Introduction

The Back River Project (the Project) is an exploration gold project owned by Sabina Gold & Silver Corporation (Sabina) located in the West Kitikmeot region on Nunavut. The Project consists of several properties, one of which is the Goose property (Figure 1-1). An exploration camp is located beside Goose Lake (Goose Camp), and Sabina conducted a drilling program out of this camp during 2011.

Several exploration targets exist in the Goose property area, including the Llama, Umwelt, Echo and Goose deposits. For 2011, select baseline studies were conducted in the areas that could be influenced by the future development of these deposits. Rescan Environmental Services (Rescan) was contracted by Sabina, to conduct the following baseline studies in 2011:

- Dustfall and Air Quality;
- Surface Hydrology;
- ML/ARD;
- Lake and Pond Bathymetry;
- Freshwater Water Quality, Sediment Quality and Aquatic Biology;
- Freshwater Fish and Fish Habitat;
- Wildlife; and
- Archaeology.

In addition, Sabina continued the on-site meteorology and hydrogeology monitoring programs. Data from these programs will also be included in 2011 baseline reports to be prepared by Rescan.

This report presents the results from the Hydrology Baseline Program that was carried out in 2011. The Hydrology Baseline Program included the collection of site-specific data from streams and rivers in the Goose property area. Monitoring was focussed on drainages that contain known deposits, the farthest downstream river associated with the property and all the main inflows and outflows of Goose Lake which is central to the property. Additionally, a monitoring site was established in a reference drainage located approximately 14 km away from existing deposits.

The objectives of the 2011 study were:

- the continued operation of the two hydrometric monitoring stations established in 2010;
- the expansion of the existing 2010 hydrometric monitoring network with the installation and operation of six additional hydrometric monitoring stations in the Project area and a reference station adjacent to the Project area;
- the development of stage-discharge relationships for each of the monitored drainage basins;
- the calculation of water discharges and production of annual hydrographs for each of the monitored drainage basins; and
- the calculation of hydrologic indices including: annual runoff, seasonal runoff distribution, peak flows, and low flows.

A description of the hydrological setting, overall sampling design, and the methods used for data collection is provided in Chapter 2 of this report. Results of the 2011 monitoring program are provided in Chapter 3. All raw data collected in 2011 are provided as appendices to this report.

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Back River Project Location

Figure 1-1

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2. Hydrological Setting

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2. Hydrological Setting

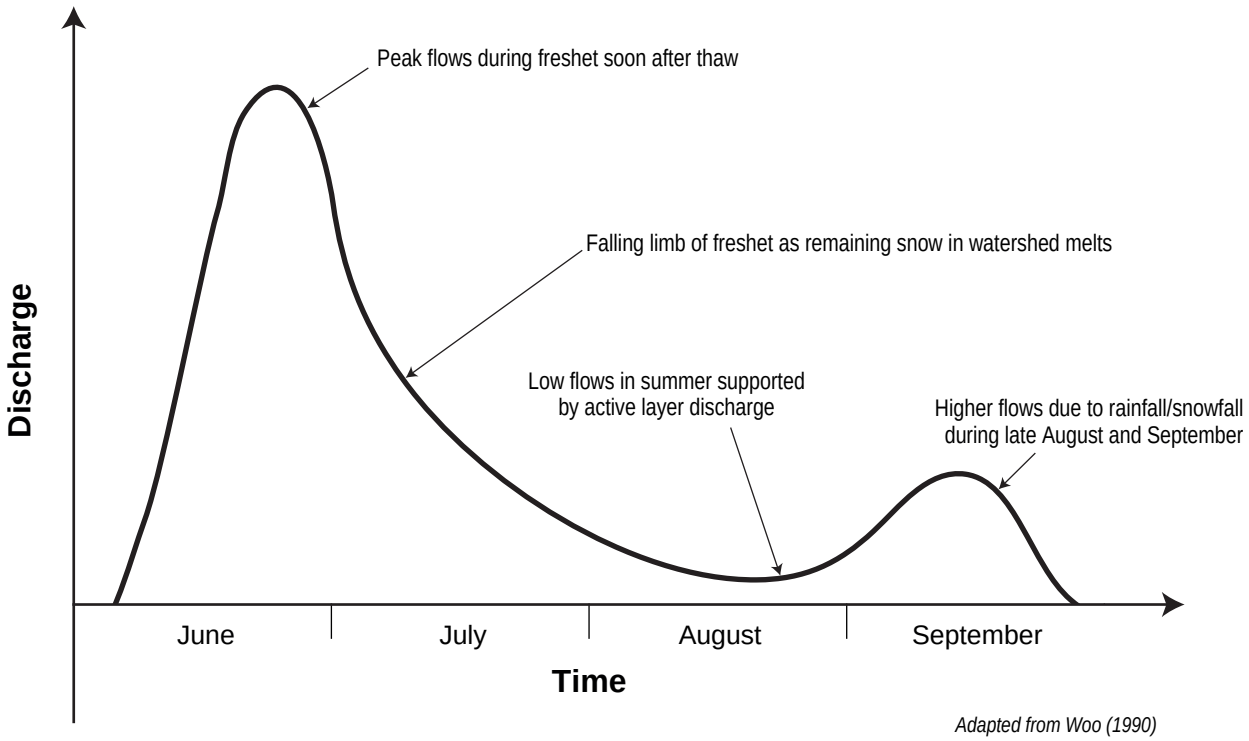
2.1 ARCTIC HYDROLOGY

The Project area lies within the continuous permafrost zone of the continental Canadian Arctic. The presence of permafrost is hydrologically significant as it has a very low hydraulic conductivity and thus acts as a barrier to deep groundwater recharge. This process increases surface runoff and decreases sub-surface flow. Compared to nonpermafrost regions, permafrost watersheds tend to have higher peak flow and lower base flow (Kane 1997). Hydrologic processes in permafrost watersheds are generally dominated by snow accumulation and melt, surface runoff, and runoff routed through lakes. The annual flow hydrograph is defined by the long cold winters and the short summers. Most of the annual runoff occurs during spring freshet and is derived from the melting snow pack. Additionally, summer frontal systems may generate precipitation events that produce moderate runoff late in the season. Following freshet, a low flow period typically develops through July and August. Due to the presence of permafrost, there is limited groundwater support for smaller streams; however, there may be interaction between groundwater systems and larger rivers and/or lakes through taliks or openings in the permafrost. As a result of the permafrost, baseflow in streams is supported only by flow through the shallow upper active layer of the soil and release from storage features including lakes and wetlands. Overall, surface runoff in Arctic basins is largely controlled by snowmelt and the presence of permafrost, which accentuates runoff peaks while reducing base flow conditions (Woo 1990).

The hydrologic year for the region is defined by break-up and freeze-up. According to regional data from the Water Survey of Canada (WSC), break-up typically occurs in early-June and freeze-up in early-October. Water is stored in the snowpack during winter and is released as temperatures increase during the spring freshet. Small to medium sized streams typically freeze dry during the winter, due to the limited storage capacity of the surrounding landscape. Even some large rivers in the continuous permafrost region cease to flow after freeze-up (Woo 1990).

A conceptual hydrograph showing typical annual discharge patterns for small watersheds is shown in Figure 2.1-1. The hydrograph is characterized by a steep rising limb leading to a peak during the freshet period and a second rainfall-generated peak that can be observed in certain years in late August or early to mid-September. Generally, within the continuous permafrost region discharge is dominated by snowmelt floods, referred to as a nival regime. Church (1974) distinguished between a Subarctic and an Arctic Nival regime. The Subarctic regime experiences limited winter low flow sustained by the discharge of intrapermafrost and subpermafrost groundwater, and a spring freshet associated with ice jams. During summer low flow conditions predominate, but large flood peaks can be generated by frontal precipitation systems in zones of discontinuous permafrost. The Arctic Nival regime has one major flood period in the spring, followed by a rapid recession to base flow, with the occasional peak related to rainstorm events. Winter flow is absent because the suprapermafrost groundwater reservoir is too limited to maintain flow.

In very small basins the freshet can be as short as a few days and will often occur immediately after ice break-up in the lakes, if lakes are present in the basin. Stream flow in these basins may cease after freshet and streams remain dry until the late summer rains begin. In contrast to smaller basins, in rivers draining larger watersheds the freshet peak may be delayed after ice break-up. The delay occurs as snowmelt from upper portions of the larger watershed is routed through the system. Smaller basins can also have more dramatic responses to precipitation than larger watersheds. In larger watersheds the presence of lakes creates significant flow attenuation, which may diminish the magnitude of peak flows.



Adapted from Woo (1990)

Note: Approximate scale only

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Theoretical Typical Annual Flow Hydrograph for a Small Arctic Watershed

Figure 2.1-1

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The amount of runoff during summer and fall is controlled by rainfall and evaporation. Open-water evaporation rates in summer often exceed total rainfall such that soil moisture deficits build up in the shallow active layer of the soil. Studies of hillslope processes in northern watersheds (e.g., Quinton and Marsh 1998) have shown that summer rainfall may produce little or no runoff from hillslopes in the permafrost zone. In this case, stream flow increases only due to rain falling directly onto lake surfaces or when there is high intensity or lower intensity/higher duration rainfall.

A number of factors influence the volume of freshet runoff in Arctic watersheds, these factors include:

- *Amount of snowpack available to be melted in spring.* Snowpack depth is dependent on the amount of snowfall during the previous winter and the amount of snow remaining in each watershed in May or June. Snow can be lost or redistributed due to sublimation, melting, or wind;
- *Rate of temperature rise in spring.* This can greatly affect peak flow rates as a rapid increase in temperature after the snowpack is already saturated can produce high melt rates. Differential melt rates on north and south facing slopes can also occur which may affect the size of the area contributing to the melt;
- *Timing of opening of stream channels linking lakes.* Snowmelt from hillslopes surrounding lakes can occur before the stream channels draining the lakes become ice free. In this case, meltwater can be stored in the lake and then released once the channels are open to flow; and
- *Soil moisture conditions and lake levels at the end of the previous summer*. If there was a dry summer during the previous year, lake levels could have been lowered and a soil moisture deficit could have developed within the hillslopes surrounding the lakes. As a result, a portion of the annual runoff will recharge the lakes and soil moisture and not be transmitted from the watershed as stream flow.

2.2 AVAILABLE REGIONAL HYDROLOGIC DATA

Regional data are available from hydrometric stations operated by WSC (Table 2.2-1 and Figure 2.2-1). Data from the five stations with the closest proximity to the Project area were analyzed to provide background information on the regional surface water hydrology.

Table 2.2-1. Regional Water Survey of Canada (WSC) Stations Relevant to the Study Area

Station Name	Station Number	Geographic Location		Drainage Area (km^2)	Period of Record
Back River below Beechy Lake	10RA001	65°11’14”N	106°5’9”W	19,600	1978 - present
Baily River near the mouth	10RA002	65°0’38”N	104°29’26”W	14,500	1978 - present
Burnside River near the mouth	10QC001	66°43’34”N	108°48’47”W	16,800	1976 - present
Gordon River near the mouth	10QC002	66°48’36”N	107°6’4”W	1,530	1977 - 1994
Ellice River near the mouth	10QD001	67°42’30”N	104°8’21”W	16,900	1971 - present

Analysis of historical data revealed the break-up in these rivers has typically occurred in early-June and freeze-up in early-October. Peak flows generally were observed in early to mid-June during freshet and some stations recorded a second substantial peak in late summer or early autumn. The Gordon River and Ellice River hydrometric stations frequently report zero flow throughout the winter.

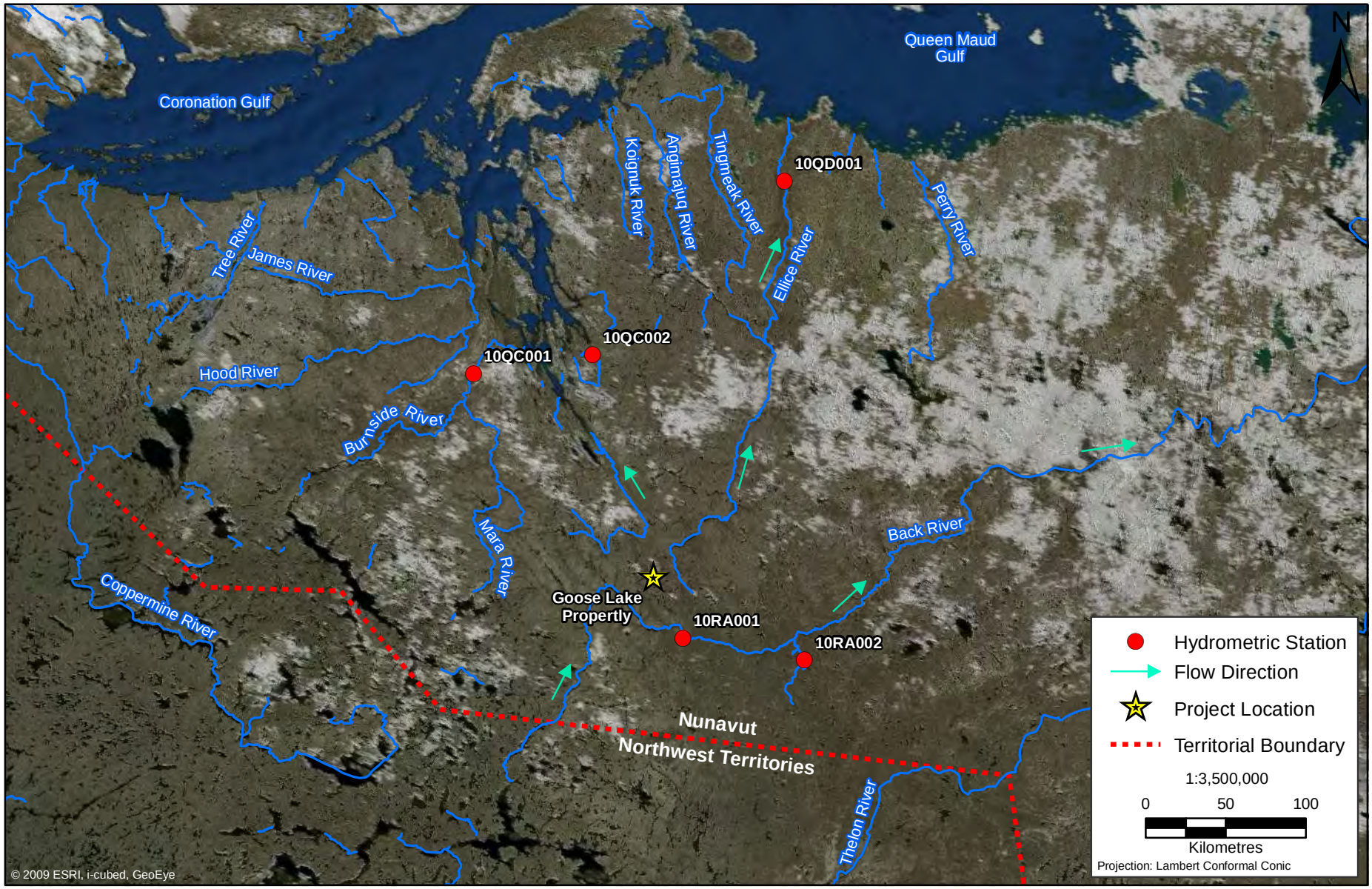

Figure 2.2-1

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Water Survey of Canada (WSC) Hydrometric Stations Relevant to the Study Area

Figure 2.2-1

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2.3 STUDY AREA

The study area is located in the southwestern portion of the Ellice River Watershed (16,900 km^2) near the watershed boundaries of the Back River Watershed and the Western River Watershed (Figure 2.3-1). The Ellice River discharges north to the Arctic Ocean in the Queen Maud Gulf approximately 300 km from the project area.

The 2011 study area comprised a total drainage area of 209.8 km^2. The study was designed monitor a 203.3 km^2 area encompassing the proposed Project development within the Ellice River watershed. An additional reference station was located in a 5.3 km^2 drainage basin within the Back River watershed approximately 14 km to the south of the proposed development (Figure 2.3-2). The basins within the Project area are characterized by extensive networks of lakes, low relief hummocky topography, and exposed bedrock uplands (Plates 2.3-1 and 2.3-2).

Plate 2.3-1. High angle oblique view showing the extensive lake coverage and low relief hummocky topography typical of the Goose property area. This photograph was taken from the Reference drainage basin looking north towards the watershed boundary of the Ellice River and Back River regional watersheds. Photograph taken on August 15, 2011.

The study area has approximately 17% lake coverage, an average slope of 2.4%, and a total relief of 83 m. The gauged streams within the study area range from small ephemeral channels, less than 1 m in width, to larger streams with widths exceeding 50 m. Larger streams are located at the outlets of the larger lakes. Although some large rivers in the region may still have flow during the winter, it is likely that most stream channels around the Project area freeze to their bed and have zero flow during the winter months. Based on available data from WSC, the Ellice River near its mouth typically stops flowing over the winter period.

Plate 2.3-2. Looking north along one of the inflows into Goose Lake which is central to the Goose property. Note the relatively low relief topography, bedrock outcrops and low tundra vegetation typical of the region.

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Figure 2.3-1

Regional Watersheds of the Back River Project

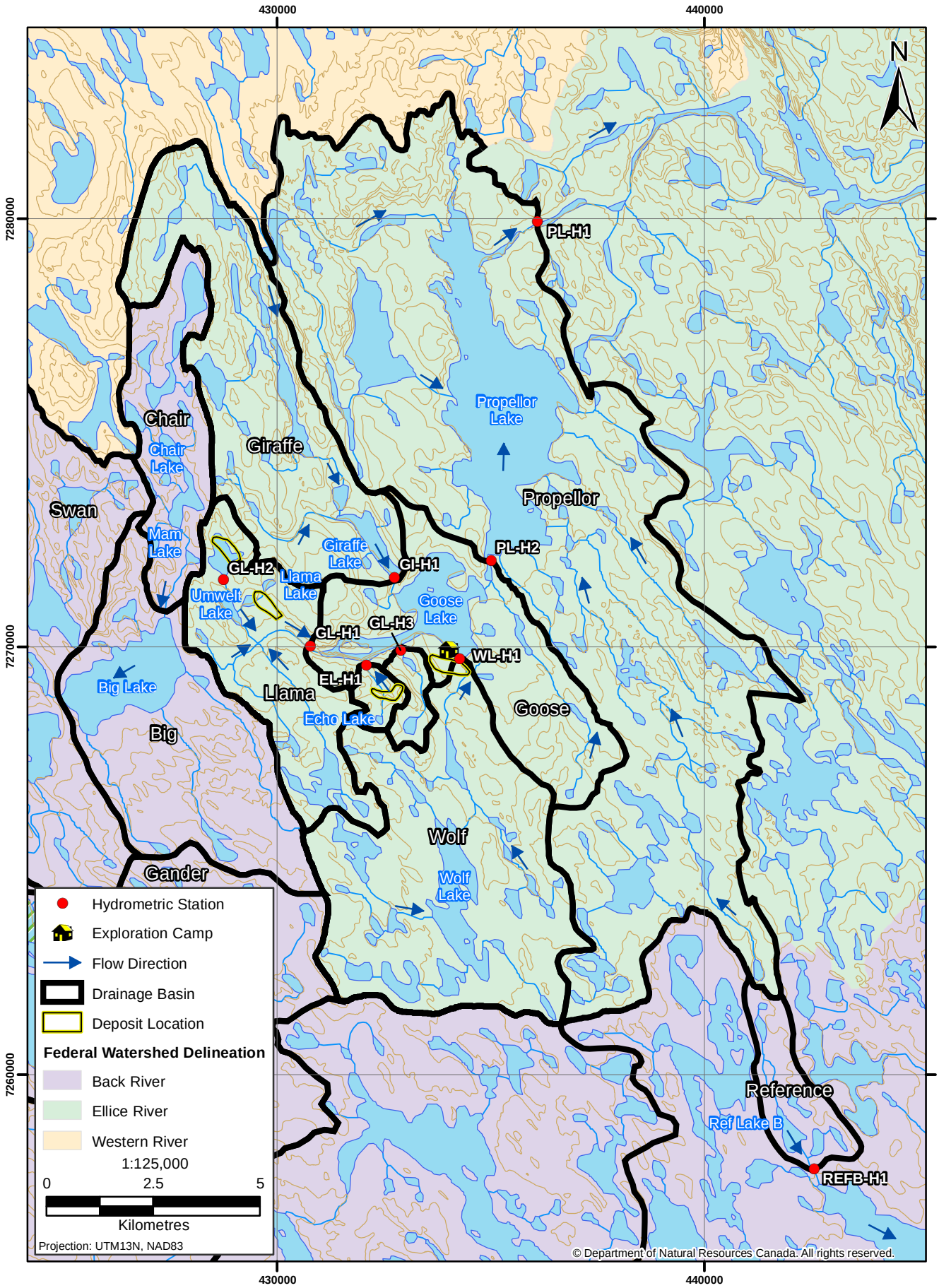

Figure 2.3-2

2011 Study Area Drainage Basins within the Back River Project

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3. Methodology

3. Methodology

3.1 HYDROMETRIC MONITORING NETWORK

A network of hydrometric monitoring stations was established to collect continuous water level data at selected locations within the Project area. The automated stations recorded stream water level data at ten minute intervals during the open water season.

3.1.1 2010 Network

In 2010 a small network of two hydrometric monitoring stations was operated from July 3 to September 13, 2010 (Table 3.1-1).

Table 3.1-1. 2010 Hydrometric Monitoring Stations

Hydro-metric Station	Location	Geographic Coordinates*		Drainage Area (km^2)	Period of Operation	Monitoring Type
		Easting	Northing			
GL-H1	Goose Lake inflow	430,772	7,270,016	14.0	July 3 to September 13	stream water level
GL-H2	Llama Lake outflow	428,746	7,271,567	1.7	July 3 to September 13	stream water level

** UTM, Datum NAD 83, Zone 13 W*

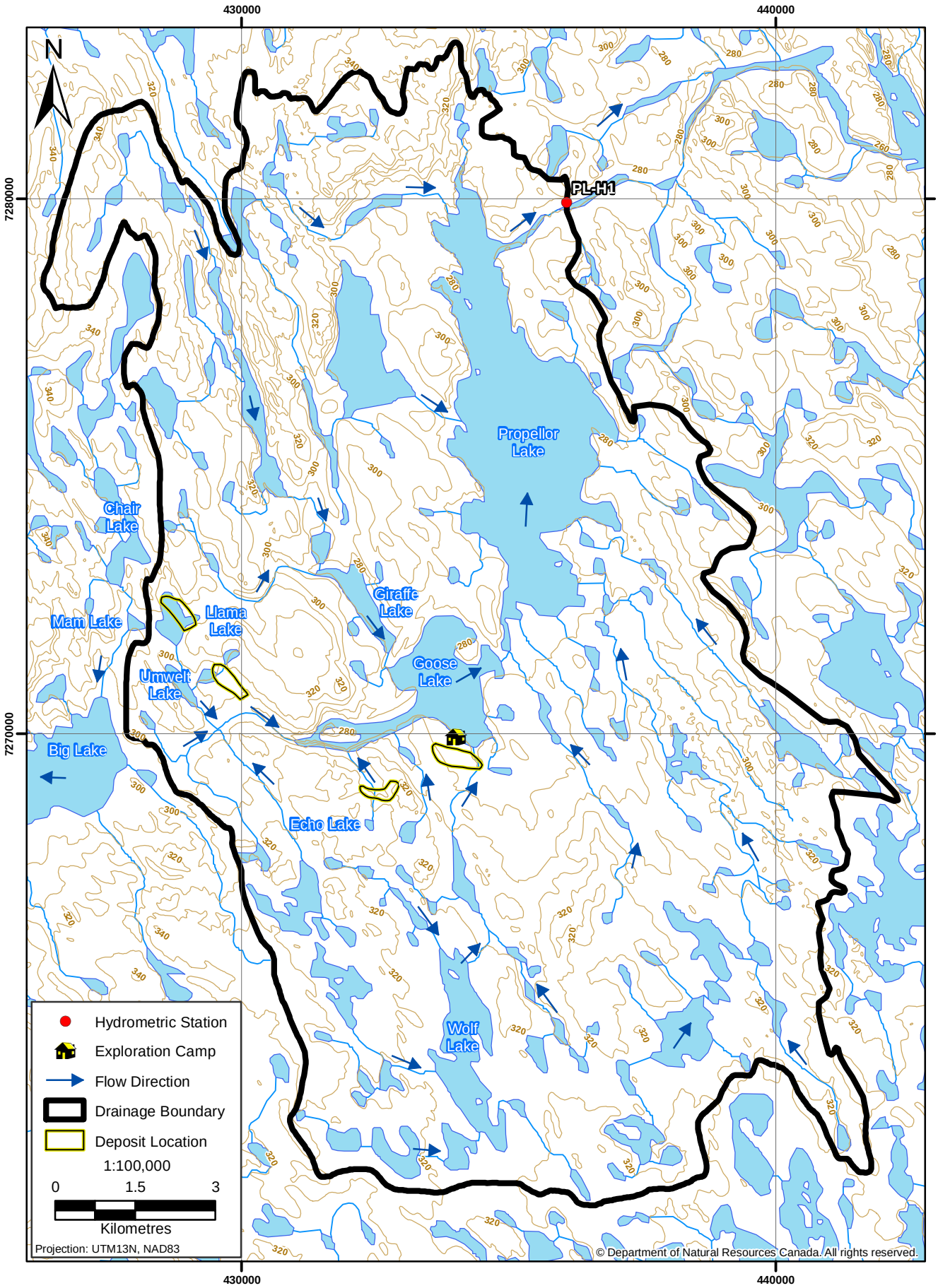
3.1.2 2011 Network

In 2011 a network of nine hydrometric monitoring stations was operated from June 10 to September 17. The 2011 network included the remobilization of the two stations established in 2010, plus the installation of six new stations within the Project area and one reference station south of the Project drainage boundary. The 2011 network focused on monitoring basins and sub-basins around the known deposits in the Project area, and the furthest downstream river associated with the property at Propellor Lake outflow. Location, drainage area and period of operation for each station in the 2011 network are provided in Table 3.1-2 and Figures 3.1-1 through 3.1-6. Station information sheets are provided in Appendix 1.

Table 3.1-2. 2011 Hydrometric Monitoring Stations

Hydro-metric Station	Location	Geographic Coordinates*		Drainage Area (km^2)	Period of Operation	Monitoring Type
		Easting	Northing			
GL-H1	Goose Lake inflow	430,772	7,270,016	14.0	June 10 to September 16	stream water level
GL-H2	Llama Lake outflow	428,746	7,271,567	1.7	June 10 to September 16	stream water level
GL-H3	Goose Lake inflow	432,891	7,269,919	1.8	June 14 to September 16	stream water level
PL-H1	Propellor Lake outflow	436,094	7,279,939	204.4	June 14 to September 17	stream water level
PL-H2	Propellor Lake inflow	435,007	7,272,014	101.5	June 11 to September 17	stream water level
GI-H1	Giraffe Lake outflow	432,744	7,271,610	27.4	June 11 to September 16	stream water level
EL-H1	Echo Drainage outflow	432,091	7,269,573	1.4	June 13 to September 16	stream water level
WL-H1	Wolf Drainage outflow	434,269	7,269,719	35.1	June 10 to September 17	stream water level
REFB-H1	Reference B Lake outflow	442,573	7,257,794	5.3	June 13 to September 17	stream water level

** UTM, Datum NAD 83, Zone 13 W.*



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Drainage Boundary for Propellor Lake Hydrometric Monitoring Station PL-H1

Figure 3.1-1

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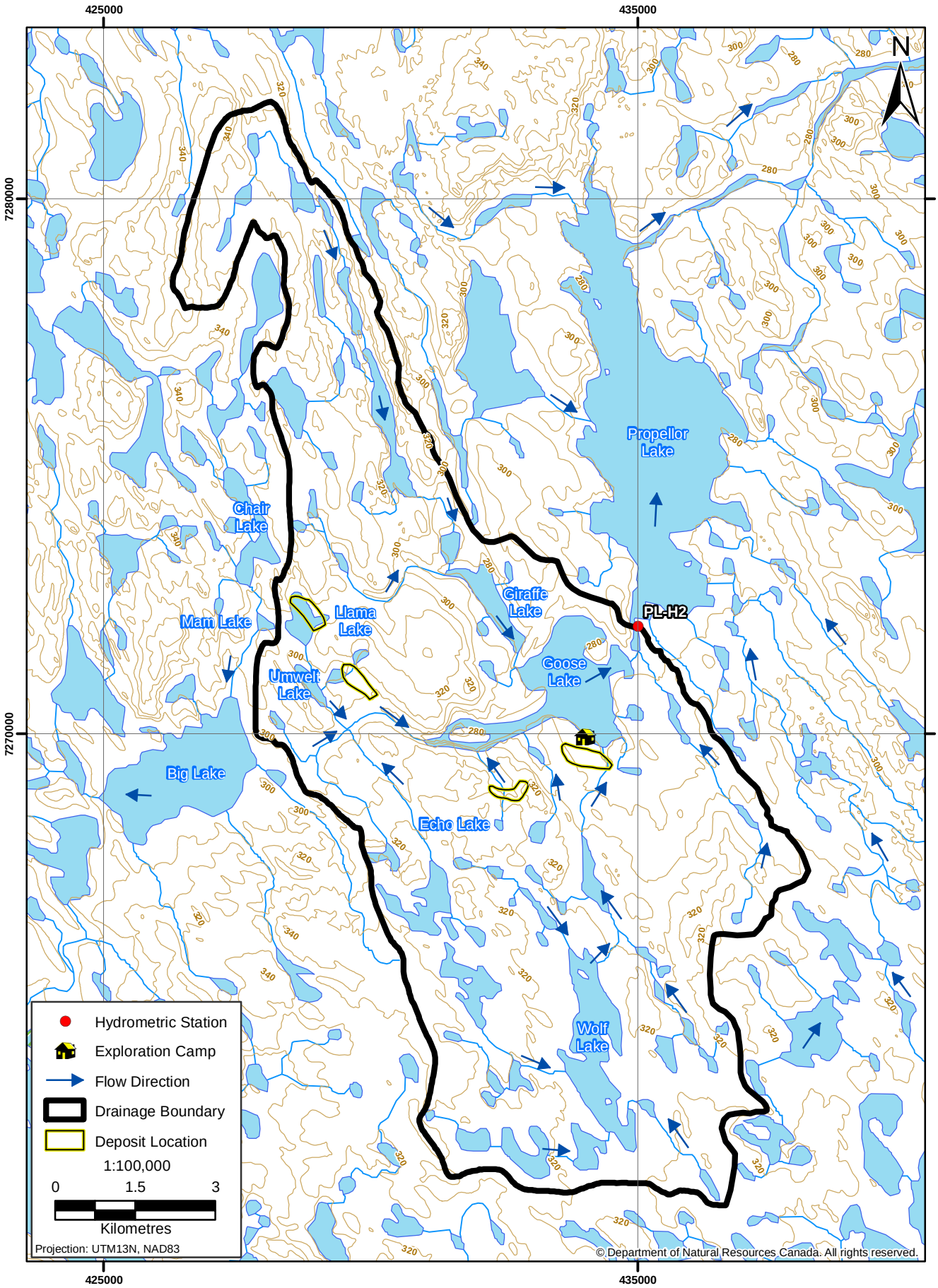

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Drainage Boundary for Propellor Lake Hydrometric Monitoring Station PL-H2

Figure 3.1-2

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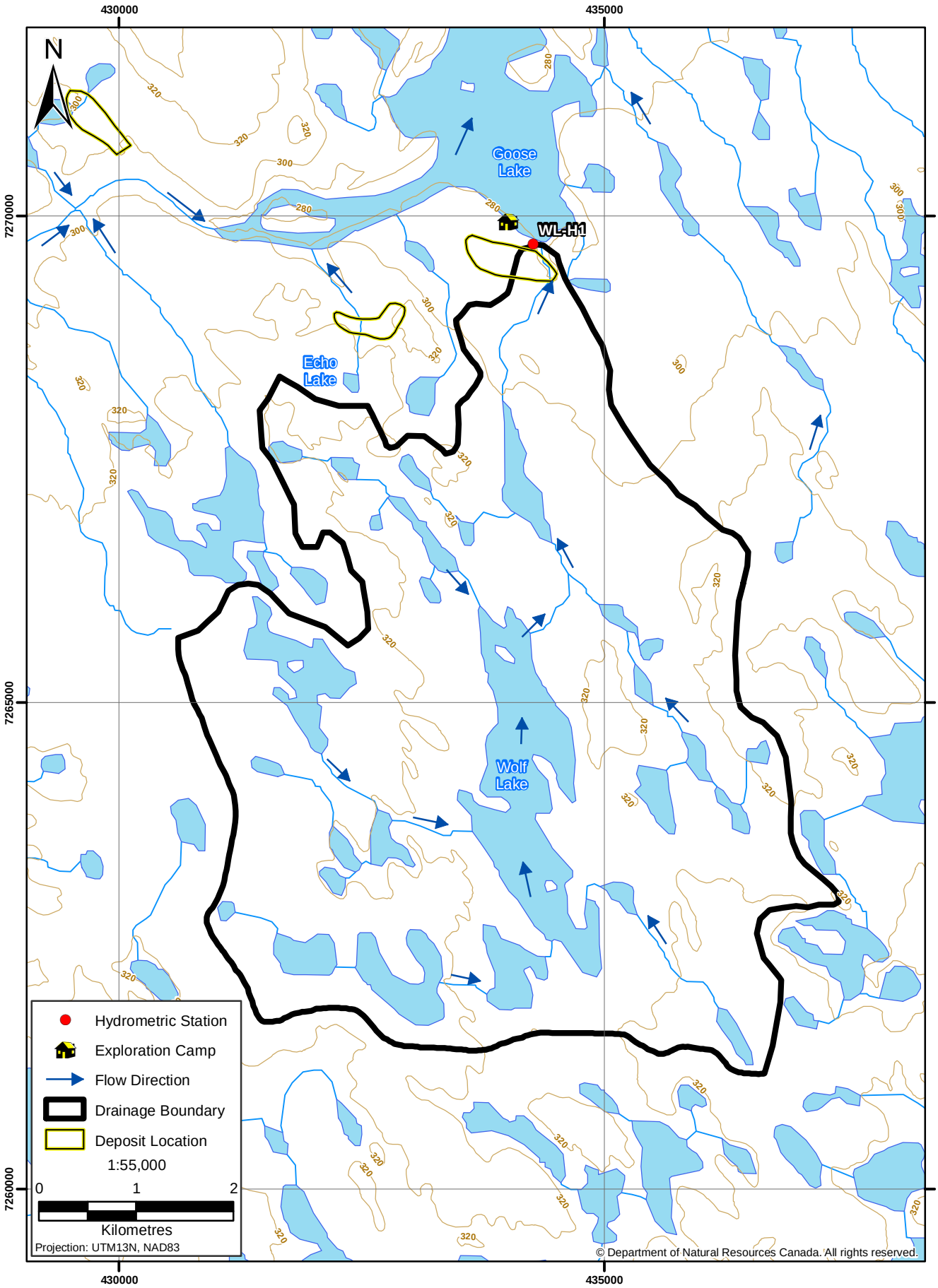

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Drainage Boundary for Goose Lake Hydrometric Monitoring Station WL-H1

Figure 3.1-3

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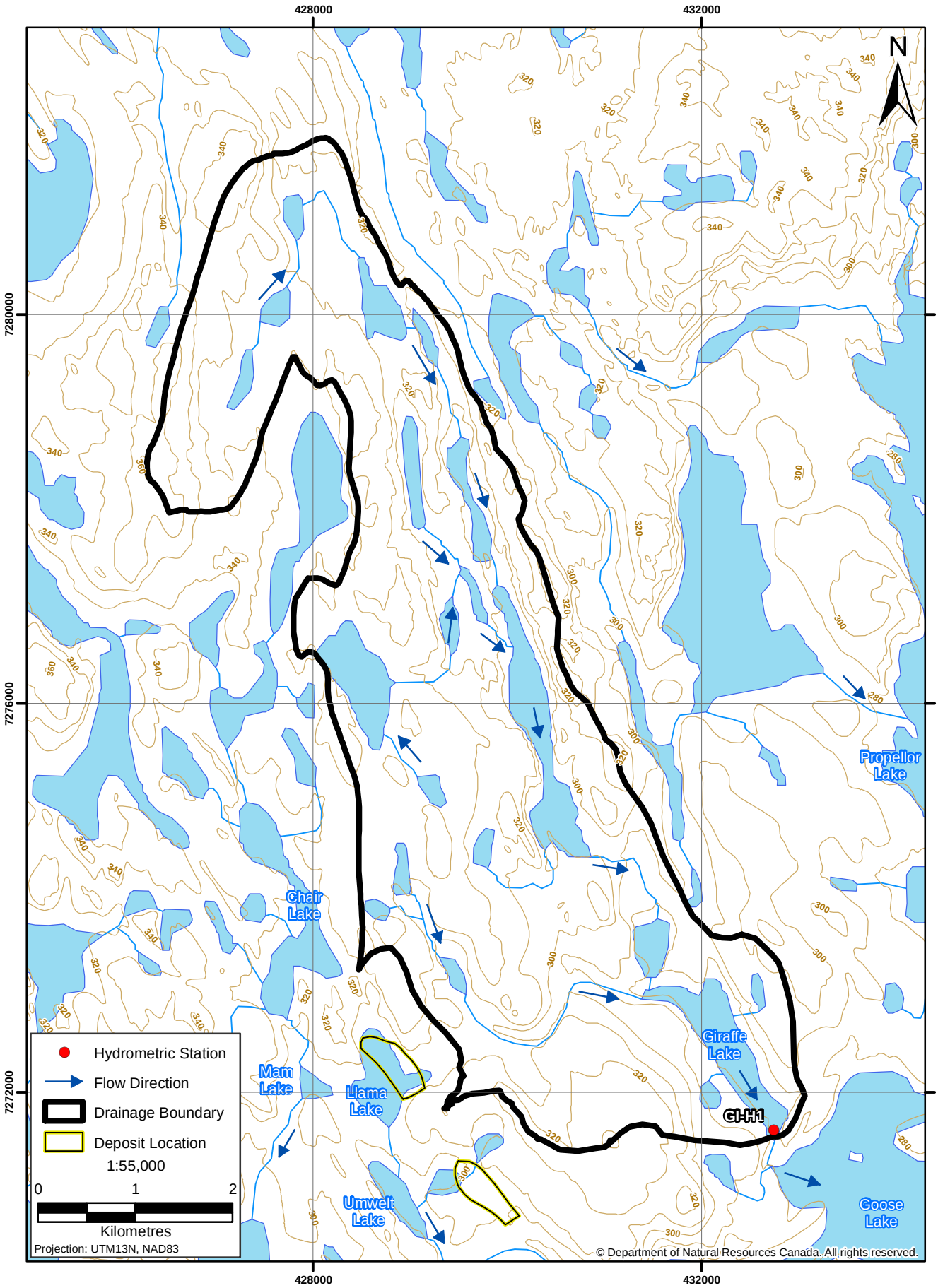

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Drainage Boundary for Giraffe Lake Hydrometric Monitoring Station GI-H1

Figure 3.1-4

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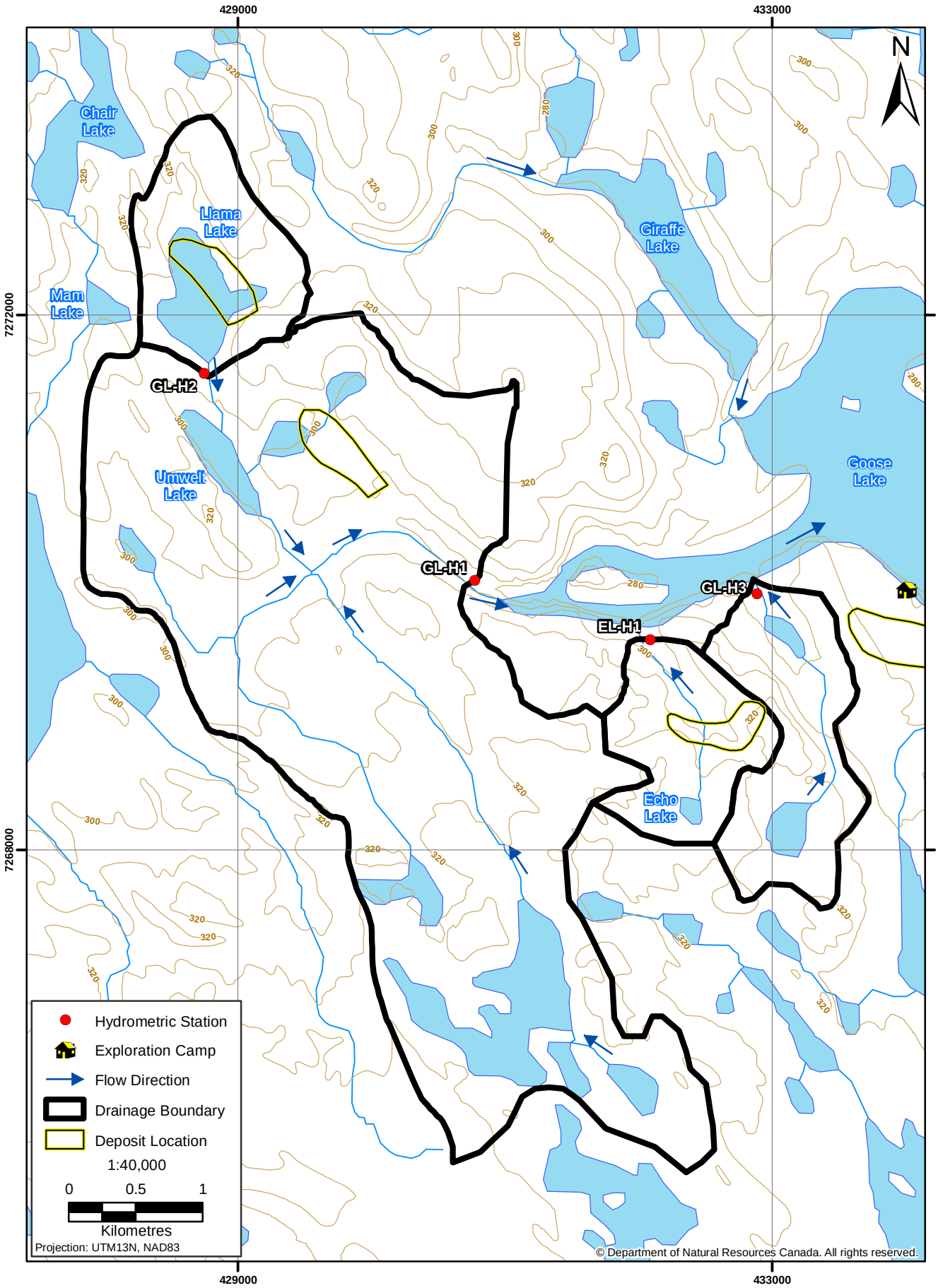

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Drainage Boundaries for GL-H1, GL-H2, GL-H3 and EL-H1 Hydrometric Monitoring Stations

Figure 3.1-5

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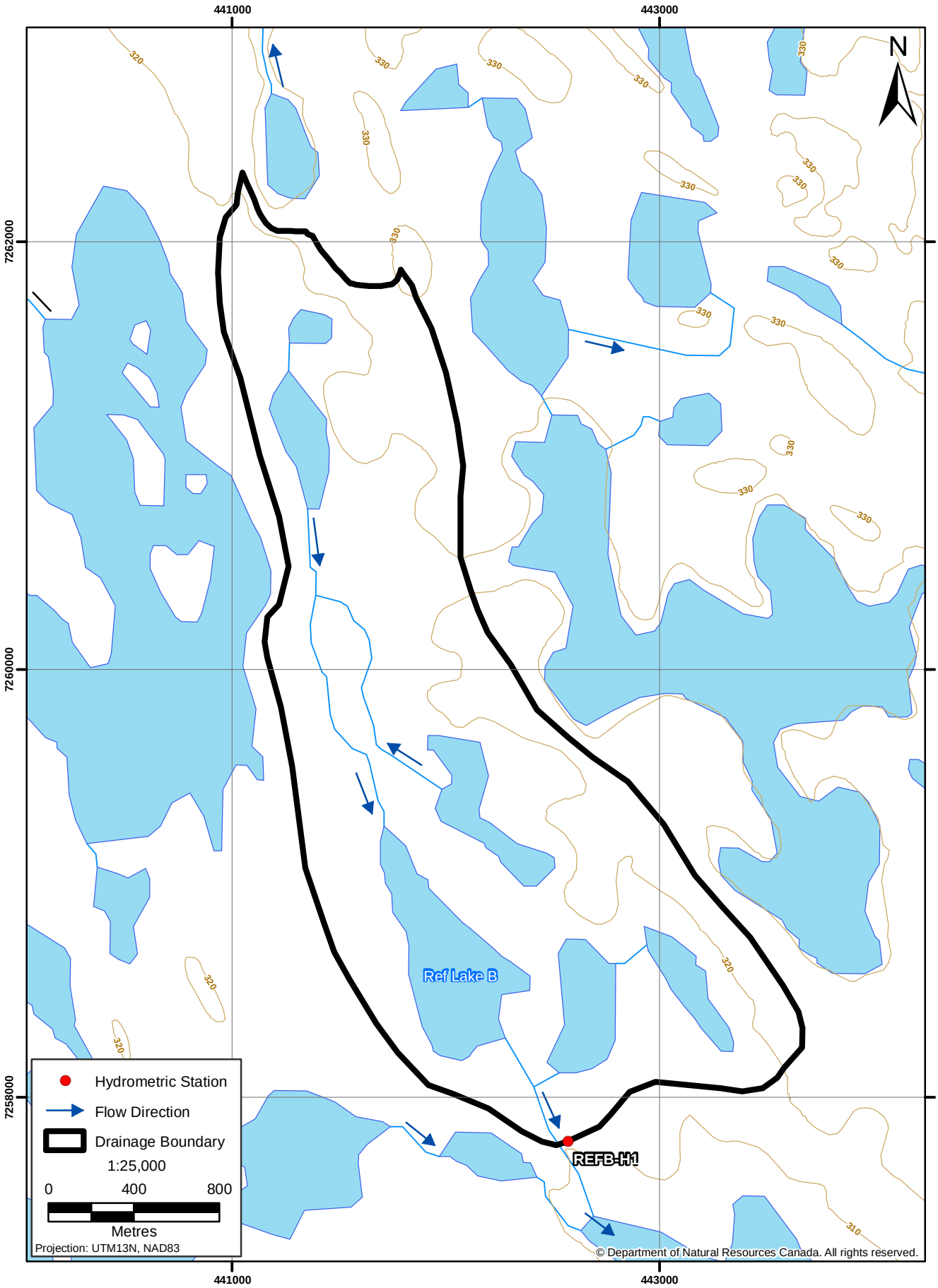

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Drainage Boundary for Reference Lake Hydrometric Monitoring Station REFB-H1

Figure 3.1-6

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3.2 HYDROMETRIC MONITORING STATION SETUPS

Hydrometric monitoring stations were setup within the Project area to obtain water level data at selected stream and lake sites. Automated stations were programmed to record continuous data at 10 minute intervals.

Several factors influenced the selection of the location for the monitoring sites in 2011: the monitored watershed contained known mineral deposits; the location was either a main inflow or outflow of Goose Lake (located at the centre of the deposit area); and the location was at the drainage outlet of the watershed associated with the property. Specific station locations were determined during the initial field reconnaissance conducted in June of 2011. Further, sites were selected to best meet the basic criteria required for desirable gauging locations. Such criteria include: the ability to obtain accurate water level data and to measure discharge at all stages; a stable natural control of water elevation at the site; and accessibility during the entire operational period.

Each hydrometric monitoring station, including the two established in 2010, consisted of a PS-98i® 0-5 PSI vented pressure transducer (Instrumentation Northwest Inc.) paired with an ELF-2 data logger (Terrascience Ltd.). The instrumentation measured and recorded water levels at 10 minute intervals. Pressure transducers were encased within an aluminum flex conduit which was secured to angle iron (1.5 m lengths by 50 mm width and 6 mm thickness) and laid flat on the stream/lake bed in order to keep the transducer weighted in place. The flex conduit housing the transducer cable was routed to a steel weather proof enclosure containing the data logger. The box was securely installed above the high water mark. An example of a typical station set-up is shown in Plate 3.2-1.

3.3 DISCHARGE MEASUREMENTS

At each hydrometric station, current velocity measurements were performed so that discharges could be determined. Measurements were taken throughout the open water season in order to obtain a wide range of discharges under different flow conditions. Four site visits were conducted during mid-June, mid-July, mid-August, and mid-September time periods.

Manual flow measurements were carried out at each site using two different methods depending on the flow conditions and morphology of the stream. At eight of the sites, where the stream channels could be safely waded, a handheld current velocity meter was used. At one site where the channel was too deep to wade, an acoustic Doppler current profiler (ADCP) was used to determine discharge.

3.3.1 Current Velocity Measurements

The location of the metered section at each site was determined based on channel geometry and flow conditions at time of measurement. Generally, the stream was measured along a straight reach near the station where the bed was as uniform as possible. Areas with submerged vegetation and/or immovable rocks were avoided where possible.

Current velocities were measured using either a mechanical current meter (Swoffer 2100™) fitted with a 75 mm diameter propeller or an electromagnetic current meter (Marsh-McBirney Flo-mate™). A fixed sampling interval of 40 seconds was selected for each velocity measurement, during which an average velocity was determined.

Plate 3.2-1. Photographs illustrating the hydrometric monitoring station design.

During each hydrometric station visit, measurements of water current velocity, depth of flow and distance across the channel were obtained. Typically, a minimum of 20 current velocity measurements are taken across the width of a channel, with the aim of having each vertical or observation interval accounting for less than 10% of the total discharge (Plate 3.3-1). This method assumes that the velocity measured at each vertical represents the mean velocity in a segment. At each observation point across the channel, if the observed water depth was less than 0.75 m, current water velocities were measured at 60% of the flow depth of water. The measurement at 60% of the flow depth is generally accepted as representing the mean velocity of the vertical water section (Herschy 2009). When water depths were greater than 0.75 m, current velocities were measured at 20% and 80% of the water depth, with the average of the two readings taken to represent the mean velocity for the vertical. In all cases, the adopted methods followed standard WSC operating procedures (Terzi 1981).

3.3.2 ADCP Measurements

At one hydrometric station, water depth was too high during the open water season to allow field personnel to safely wade and measure discharge with a handheld current velocity meter. Therefore, discharge was measured at this site by means of a StreamPro® (Teledyne RD Instruments) acoustic Doppler current profiler (ADCP). All measurements were conducted according to standard operating procedures (Rehmel et al. 2003, WSC 2004).

Plate 3.3-1. Velocity-area discharge measurements at hydrometric station GL-H1 using a handheld current velocity meter. Photograph taken on June 10, 2011.

The location of the ADCP measurements was selected following the same general principles as with the handheld current velocity meter. In addition, the section was chosen where the channel was relatively narrow to allow for better instrument control during the ADCP measurements.

At the selected location a boat was used to ferry personnel and a rope system across the channel. A cableway was used to manoeuvre the ADCP in controlled transects perpendicular to the direction of flow (Plate 3.3-2). Multiple transects were conducted until a minimum of four transects recorded discharges that were all within 5% of the measured mean discharge. The total discharge measurement was computed by taking the average of the four valid transects.

3.4 HYDROMETRIC STATION SURVEYS

3.4.1 Levelling Surveys

At stations where water surface elevation or stage is measured it is common practice to determine the stage above a specified reference surface or gauge datum. In order to check for the accuracy and consistency of the recorded data, it is necessary to periodically verify the elevation of the gauge in relation to the established station datum. To check and ensure that the gauge is properly set to the station datum, differential levelling techniques are used.

To establish and maintain vertical elevation control at the Project hydrometric monitoring locations, three local benchmarks were installed at each station. Benchmarks consisted of 76 mm concrete expansion bolts secured in bedrock or large stable boulders found in the vicinity of the stations. One benchmark at each station was assigned to be the primary reference point, and assigned an arbitrary local elevation of 100.000 m. All recorded water levels were then referenced to this primary benchmark.

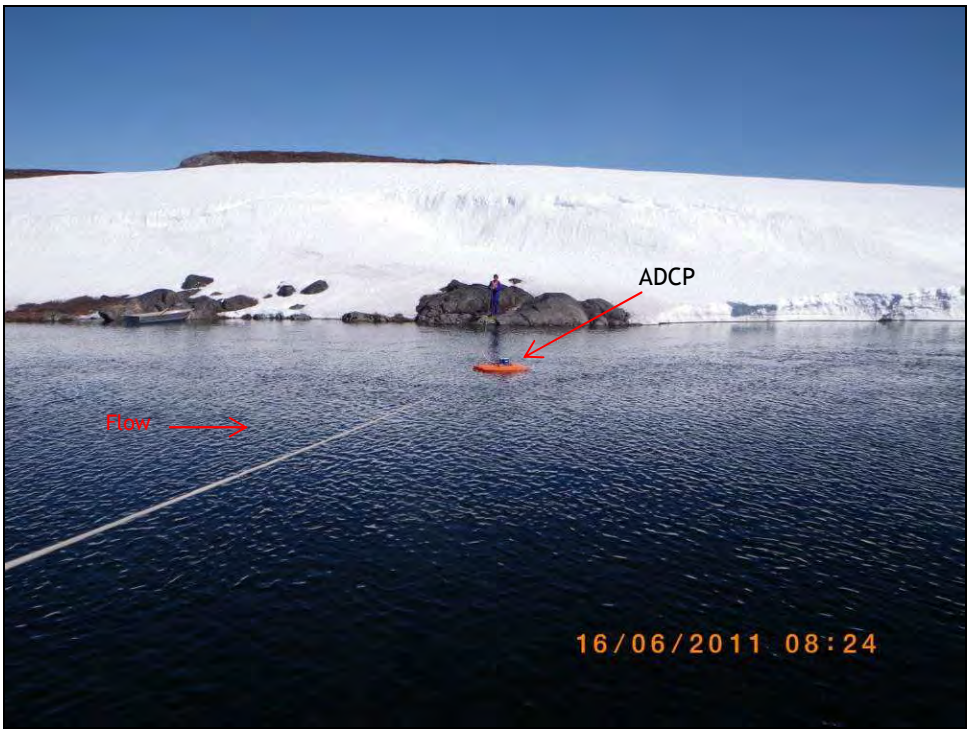

Plate 3.3-2. Discharge measurements at hydrometric station PL-H1 using an acoustic Doppler current profiler (ADCP). Photograph taken on June 16, 2011.

Throughout the 2011 monitoring period, hydrometric levelling surveys were conducted during site visits in early June, mid-July, etc. Each survey was completed using an engineer's level and a calibrated levelling rod.

3.4.2 Channel Geometry Surveys

Surveys were completed at each monitored hydrometric station in order to define channel-geometry of the gauged stream section. At the majority of hydrometric stations, a suitable channel reach with a total length of approximately three to six channel widths was selected, using the hydrometric station as the midpoint of the surveyed section. Three evenly spaced cross-sections, perpendicular to the channel reach, were surveyed using a compass and chain technique.

For the station located at the outflow of Giraffe Lake (GI-H1) a near-shore longitudinal profile was measured at the station. Two additional channel cross-sections were measured downstream from this station. At the outflow of Propellor Lake (PL-H1) only one cross-section was measured. Information of the channel bed topography, obtained from the ADCP measurement, was merged with topographic information of the adjacent banks surveyed using compass and chain. At each station, all surveyed cross-sections were referenced to the established arbitrary local datum. Upon completion of field surveying, data were input into RoadEng® software (Softree Technical Systems Inc.), to produce the representative channel cross-sections.

3.5 STAGE – DISCHARGE RELATIONS

In 2011, stage-discharge relations were developed for each hydrometric station. For the two stations operated in 2010 and 2011, data for those two years were combined in the development of the stage-discharge relations. Stage-discharge relations were expressed as rating curves. Rating curves are used to convert water level data (stage) recorded by the hydrometric monitoring stations into a continuous

discharge time-series or hydrograph. The quality of a rating curve depends on the number and accuracy of the individual data points used to generate the curve as well as the hydraulic characteristics of the monitoring location. To develop a robust stage-discharge relationship 10 to 15 manual stream flow measurements are recommended. These need to be representative of a wide range of flow conditions (ISO 2010). Typically, these measurements are distributed over a minimum two-year period, with approximately 6 measurements collected each year. Each additional point increases the range and robustness of the rating curve at varying discharge levels. Discharge measurements at the higher end of the discharge range are especially important as they help to define the high end of the rating curve. This is important as high flows often require extrapolation beyond the range of the observed data used to generate the rating curve and the rating relationship can change from low flow periods to high flow periods, depending on channel geometry.

In the absence of a stage–discharge measurement corresponding to high flow conditions, the rating curve is often extrapolated to a high flow value that is beyond the range of the observed data used to generate the curve. Most stage-discharge relationships in this study were extrapolated to values less than or equal to 1.5 times the greatest measured discharge. Any discharge extrapolation beyond that limit is not recommended as the resulting value will have a high uncertainty associated with it (ISO 2010). The stage-discharge relation for the hydrometric station EL-H1 was extended beyond 1.5 times the highest measured discharge to account for the range of measured stages, therefore there is greater uncertainty in the high discharges calculated at this station.

Rating curves were developed using Aquarius™ Time Series Hydrologic Software (Aquatics Informatics Inc.). The software uses standard methods outlined by the United States Geological Survey and the International Organization for Standardization (Kennedy 1984, ISO 2010). Plotted on a logarithmic scale, a least-squares regression procedure was used to produce a line of best fit and logarithmic equation for the concurrently measured water level (stage) and discharge data. Taking the antilogarithmic transformation, discharge was determined by a power function of the form:

$$Q = C\ (\mathrm{h} - a)^{b}$$

where Q is the discharge [m^3/s], C and b are regression coefficients, h is the stage (water level) [m], and a is the stage at zero flow (datum correction) [m].

3.6 DAILY DISCHARGE HYDROGRAPHS

Annual hydrographs, presented as mean daily discharge, were generated for each of the hydrometric monitoring stations operated in 2011. Daily discharge is the average discharge calculated over a 24 hour period.

For the operational period at each station, discharges were calculated by applying the developed rating curves to the recorded stage data. Prior to recorded stage data, rising limbs of the hydrographs were estimated assuming a logarithmic growth function. The onset of the spring freshet was determined using available meteorological data from the Project area along with observed site conditions during the initial site visit in early June 2011. The recession limb of each hydrograph was extended down to a zero flow date based on a linear decay function. This function is an extrapolation of the initial recession of the hydrograph that was captured in the data record.

3.7 MONTHLY VOLUMETRIC OUTFLOW

At each hydrometric station, the monthly and annual volumetric water outflows were determined. Volumetric outflows are expressed in millions of cubic meters per month for each of the monitored basins.

3.8 FLOW DURATION ANALYSIS

Flow duration analysis considers the percent of time that a specific discharge level has been exceeded or equalled during a period of record. A flow duration curve is the relation between the magnitudes of stream flow at a point and the frequency (probability) with which those magnitudes are exceeded over an extended period of time (Dingman 2002).

For each monitored basin within the Project area, a flow duration curve was generated. The curve shows the percent of time that a discharge in a stream channel is likely to be equalled or exceeded, and is used to show the range of discharge levels that occurs along a monitored stream course. The flow duration curve is a useful planning tool in evaluating water discharge, as a function of basin characteristics.

A flow duration curve is constructed by ranking discharge values over a period of record, and then calculating their associated probabilities of exceedance using the following equation:

$$P = 100 \times [M/(n+1)] \qquad (2)$$

Where P is the probability that a given flow will be equalled or exceed, M is the ranked position on the listing, and n is the number of events for the period of record (OSU 2005).

3.9 HYDROLOGIC INDICES

Calculated annual runoff, seasonal runoff distribution, mean annual discharge (MAD), peak flow, and low flow are important hydrologic indices that provide useful information when undertaking a hydrologic assessment for design of mine Project infrastructure as well as when managing the water resources once a mine has entered operations.

3.9.1 Annual Runoff

Calculated annual runoff (expressed as a depth) represents the difference between annual precipitation, snowmelt, and evaporation. It is a valuable metric for obtaining gross estimates of the water available from a basin. Because it is standardized by watershed area it is also a useful index for comparing the hydrologic response of basins of different sizes. Annual runoff was expressed as observed annual runoff and as estimated annual runoff. Observed annual runoff only included runoff values for the period of record at each hydrometric station. Estimated annual runoff was the total runoff for the entire open water season, which includes both estimated and observed values.

3.9.2 Seasonal Runoff Distribution

Seasonal runoff distribution was determined by summing the daily runoff by month for each basin. Monthly runoff as a depth and as a percent of the total annual runoff was calculated and presented to illustrate the spatial and temporal distribution of runoff in the Project area.

3.9.3 Mean Annual Discharge

The mean annual discharge (MAD), computed as an average discharge over the year, is an additional variable that gives an indication of the potential amount of water a basin can provide as a function of drainage area, geology, and climate.

3.9.4 Annual Peak and Low Flow

Peak flows represent the maximum flow rate of a catchment during a year in response to precipitation events or snowmelt. Peak flows are used in combination with flood frequency analysis techniques in order to estimate design flows used in the sizing of ditches, diversion channels, or stream crossings. Conversely, low flows provide an estimate of the normal baseflow conditions during the open water season, which is important to the sustained health of a stream's aquatic community.

4. Results

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4. Results

Results from the 2011 Hydrology Monitoring Program are presented as follows: (1) completed discharge measurements, (2) hydrometric surveys, (3) determined stage-discharge relationships, (4) daily discharge hydrographs, (5) volumetric outflows, (6) flow duration analysis, and (7) hydrologic indices for the area.

4.1 DISCHARGE MEASUREMENT SUMMARY

Discharge measurements were taken during the June freshet period at each hydrometric station with additional measurements conducted in July, August, and September 2011, for a total of 41 measurements. The measurements were collected through the open water season in order to obtain a range of discharges at different flow conditions (Table 4.1-1 and Appendix 2).

Two discharge measurements were taken during the freshet period at most of the hydrometric stations to capture the range of flow conditions observed, the exception was the hydrometric station REFB-H1 where stream flows remained constant during the site visit. During the August visit, discharge measurements were not conducted at the hydrometric stations GL-H3, EL-H1, and REFB-H1, as these streams were dry.

Table 4.1-1. Summary of Completed Discharge Measurements in the Goose Property Area in 2011

Hydrometric Station	Date Measured	Pressure Transducer Stage (m)*	Measured Discharge (m^3/s)	Method (Equipment Used)
GL-H1	June 10	99.638	0.439	Velocity-Area (Swoffer current meter)
	June 15	99.699	0.615	Velocity-Area (Swoffer current meter)
	July 8	99.522	0.247	Velocity-Area (FlowMate current meter)
	August 14	98.837	0.007	Velocity-Area (FlowMate current meter)
	September 16	99.566	0.270	Velocity-Area (FlowMate current meter)
GL-H2	June 10	99.833	0.075	Velocity-Area (Swoffer current meter)
	June 15	99.879	0.121	Velocity-Area (Swoffer current meter)
	July 8	99.821	0.063	Velocity-Area (FlowMate current meter)
	August 12	99.713	<0.001	Velocity-Area (FlowMate current meter)
	September 16	99.813	0.046	Velocity-Area (FlowMate current meter)
GL-H3	June 14	99.934	0.648	Velocity-Area (Swoffer current meter)
	June 15	99.916	0.478	Velocity-Area (Swoffer current meter)
	July 9	99.806	0.075	Velocity-Area (FlowMate current meter)
	September 16	99.816	0.172	Velocity-Area (FlowMate current meter)
PL-H1	June 14	99.190	7.338	Velocity-Area (ADCP)†
	June 16	99.202	8.079	Velocity-Area (ADCP)
	July 10	99.063	4.575	Velocity-Area (ADCP)
	August 12	98.644	0.116	Velocity-Area (ADCP)
	September 17	99.021	3.925	Velocity-Area (ADCP)

(continued)

Table 4.1-1. Summary of Completed Discharge Measurements in the Goose Property Area in 2011 (completed)

Hydrometric Station	Date Measured	Pressure Transducer Stage (m)*	Measured Discharge (m^3/s)	Method (Equipment Used)
PL-H2	June 11	99.730	1.813	Velocity-Area (Swoffer current meter)
	June 16	99.810	3.332	Velocity-Area (Swoffer current meter)
	July 8	99.691	1.780	Velocity-Area (FlowMate current meter)
	August 14	99.482	0.055	Velocity-Area (FlowMate current meter)
	September 17	99.720	1.646	Velocity-Area (FlowMate current meter)
GI-H1	June 11	99.660	0.587	Velocity-Area (Swoffer current meter)
	June 15	99.722	0.965	Velocity-Area (Swoffer current meter)
	July 8	99.733	0.523	Velocity-Area (FlowMate current meter)
	August 13	99.541	0.041	Velocity-Area (FlowMate current meter)
	September 16	99.735	0.403	Velocity-Area (FlowMate current meter)
EL-H1	June 13	99.375	0.037	Velocity-Area (Swoffer current meter)
	June 15	99.361	0.023	Velocity-Area (Swoffer current meter)
	July 9	99.259	0.002	Velocity-Area (FlowMate current meter)
	September 16	99.304	0.013	Velocity-Area (FlowMate current meter)
WL-H1	June 13	98.704	1.973	Velocity-Area (Swoffer current meter)
	June 17	98.648	0.840	Velocity-Area (Swoffer current meter)
	July 9	98.522	0.370	Velocity-Area (FlowMate current meter)
	August 15	98.229	0.003	Velocity-Area (FlowMate current meter)
	September 17	98.525	0.371	Velocity-Area (FlowMate current meter)
REFB-H1	June 12	99.633	0.206	Velocity-Area (Swoffer current meter)
	July 9	99.540	0.031	Velocity-Area (FlowMate current meter)
	September 17	99.513	0.023	Velocity-Area (FlowMate current meter)

† - Discharge measured by means of an acoustic Doppler current profiler
** - Pressure transducer stage referenced to site-specific arbitrary datum*

4.2 HYDROMETRIC STATION SURVEYS

4.2.1 Levelling Surveys

Levelling surveys were completed during each flow measurement during the 2011 field season. A summary of the survey control points at each station are provided in the station information sheets (Appendix 1). Survey data from the re-established GL-H1 and GL-H2 stations were used to reference the 2011 stage data to existing benchmarks installed in 2010.

At the majority of new stations the surveys confirmed that the pressure transducers measuring water level remained stationary and properly calibrated during the monitoring period. At the station GL-H3 the transducer was shifted vertically during field work and the survey data were used to confirm the change in elevation of the pressure transducer and to correct for this error in the stage time series. At the reference station, REFB-H1 survey data were used to correct for a drift in the stage time series. The drift was caused by a gradual sinking of the transducer as the stream bed thawed over the period of record (Plate 4.2-1).

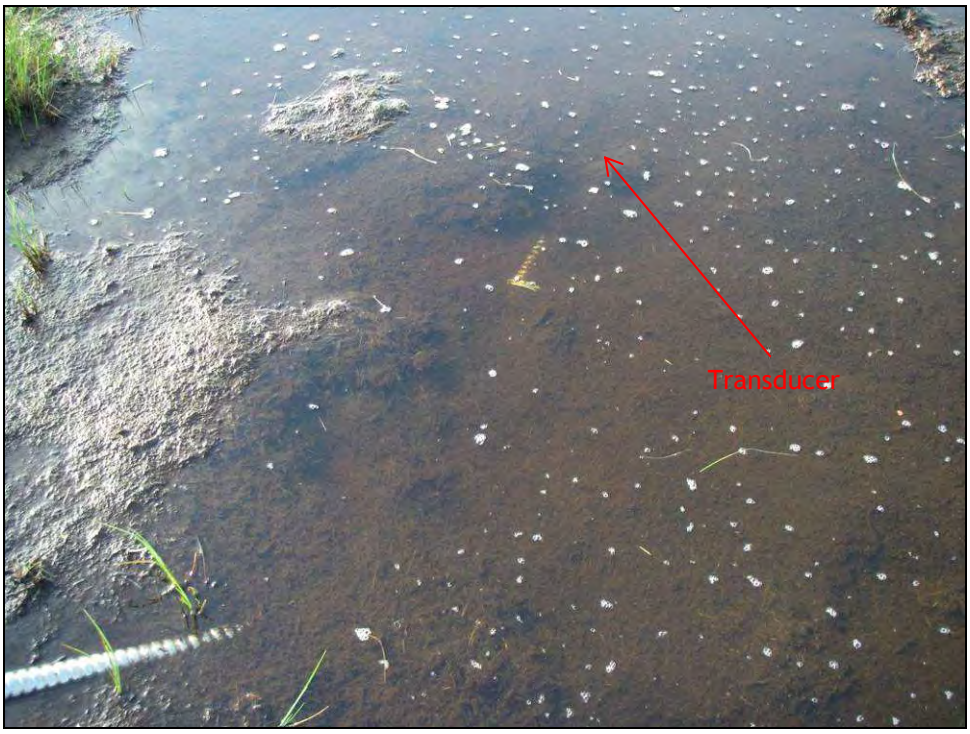


Plate 4.2-1. Close up view showing the transducer submerged in the thawed stream bed late in the summer at the hydrometric monitoring station REFB-H1. Data recorded in the levelling surveys conducted over the field season were used to correct for the change in elevation of the transducer. Photograph taken on August 15, 2011.

4.2.2 Channel Geometry Surveys

Channel geometry surveys conducted at each hydrometric monitoring location are provided in Appendix 6. Surveys of the monitored reaches provide a physical representation of the channel geometry. These data will be used to determine channel stability and shifts on an annual basis. Cross-sections of the channels at the installed pressure transducers also show the 2011 minimum, mean, and maximum observed water level elevations.

4.3 STAGE-DISCHARGE RATING CURVES

At the two hydrometric stations established in 2010, the data collected in 2011 were combined with the data collected in 2010 to increase the range and the robustness of the rating curves. A wider range of flows were measured in 2011. This helped to better define the upper and lower ends of the preliminary rating curves that were developed in 2010. At the seven new stations installed in 2011, between three and five discharge measurements were conducted during the open water season. These measurements were used in the development of preliminary rating equations. Additional discharge measurements are required in order to increase the range and robustness of the stage-discharge relationships.

At most stations a single rating curve was fit to the full range of flows measured, as no substantial break points were observed. The exception was at hydrometric station WL-H1 where a two stage (Low/High) rating curve was developed. At this site, the monitored reach was confined to a fairly deep channel with steep banks during low to medium flow conditions; however, during high flow conditions the banks were overtopped and the stream was able to flood the flat tundra adjacent to the channel. Rating equations are summarized in Table 4.3-1 and rating curves are provided in Appendix 3.

Table 4.3-1. Summary of 2011 Rating Equations for the Hydrometric Monitoring Stations in the Goose Property Area

Hydrometric Station		Rating Equation $Q = C (h-a)^b$	Root Mean Square
GL-H1		$Q = 0.26 (h-98.32)^{4.82}$	18.6
GL-H2		$Q = 5.55 (h-99.52)^{2.21}$	18.0
GL-H3		$Q = 12.30 (h-99.71)^{2.01}$	21.8
PL-H1		$Q = 21.25 (h-98.52)^{2.50}$	3.3
PL-H2		$Q = 26.42 (h-99.30)^{3.09}$	12.8
GI-H1		$Q = 9.55 (h-99.48)^{1.91}$	41.0
EL-H1		$Q = 5.63 (h-99.20)^{2.88}$	30.0
WL-H1	Low Stage	$Q = 4.35 (h-98.19)^{2.30}$	15.7
	High Stage	$Q = 22.97 (h-98.28)^{2.96}$	15.7
REFB-H1		$Q = 29.21 (h-99.35)^{3.98}$	13.5

Q= discharge [m^3/s]; C= y intercept; h= recorded stage [m]; a= stage at zero flow (datum correction) [m]; b= slope

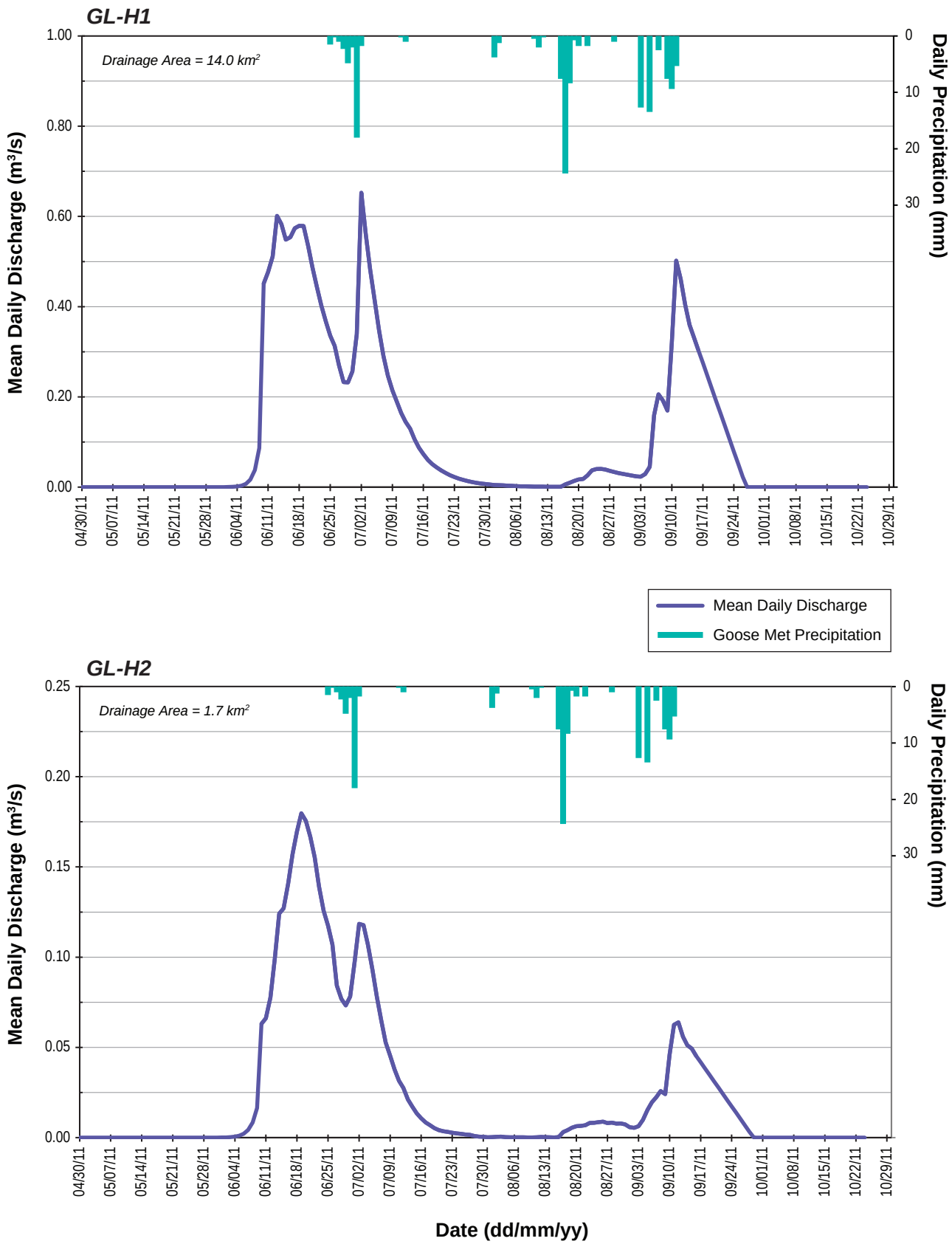
Also included in the table is the Root Mean Square (RMS) which is used by the Aquarius® software as an overall measure of error of the stage-discharge relation. The RMS is a statistical parameter that describes how well the values predicted by the stage-discharge relation fit or represent the observed data. The departure from true values computed by this statistic combines both bias and lack of precision. The lower the RMS, the better the estimated values provided by the rating relationship.

4.4 ANNUAL HYDROGRAPHS

The 2011 annual mean daily discharge hydrographs presented in Figures 4.4-1 through 4.4-5 show similar trends over the year at each monitored location in the Back River Project area. Mean daily discharge tables are provided in Appendix 4 and individual hydrographs in Appendix 5.

Break-up was estimated to occur in early-June when mean daily air temperatures were consistently above freezing in the Project area (Figure 4.4-6). Three prominent peaks were observed in each of the hydrographs. The largest peak flows were driven by snowmelt and occurred during the freshet period in early to mid-June in most basins. A second peak was observed in all basins approximately 19 days after the freshet peak and was the result of precipitation events that occurred in late June and early July. This was the maximum event for stations GL-H2 and GI-H1. After the July elevated flows, discharge steadily decreased throughout the Project area until mid-August. After this date daily discharges were augmented by rainfall events occurring throughout the second half of August and carrying on through September leading to a third peak evident in most of the hydrographs. After the September precipitation event, flows continued to recede until end of the monitoring period, which coincided with mean daily air temperatures dropping below the freezing level.

It is important to note there is a degree of uncertainty in the estimated freshet peak flows for hydrometric stations GL-H3, WL-H1, REFB-H1 and EL-H1. Based on the continuous time series recorded at these sites, it is unclear whether the maximum freshet peak was recorded or it occurred prior to station installation. To estimate the spring freshet peak a correlation analysis between the observed discharge time series at these sites and the time series recorded at GL-H1 (where the peak was observed) was performed. Results from the analysis were used to estimate discharges prior to June 10 when data collection began at the station GL-H1. A strong correlation was observed between discharge values at GL-H1 and GL-H3, WL-H1, and REFB-H1 (Table 4.4-1). The correlation analysis between discharge values at GL-H1 and EL-H1 did not yield good results and therefore was not used in further analysis.



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Annual Hydrograph at GL-*H1* and GL-*H2* Hydrometric Monitoring Stations, 2011

Figure 4.4-1

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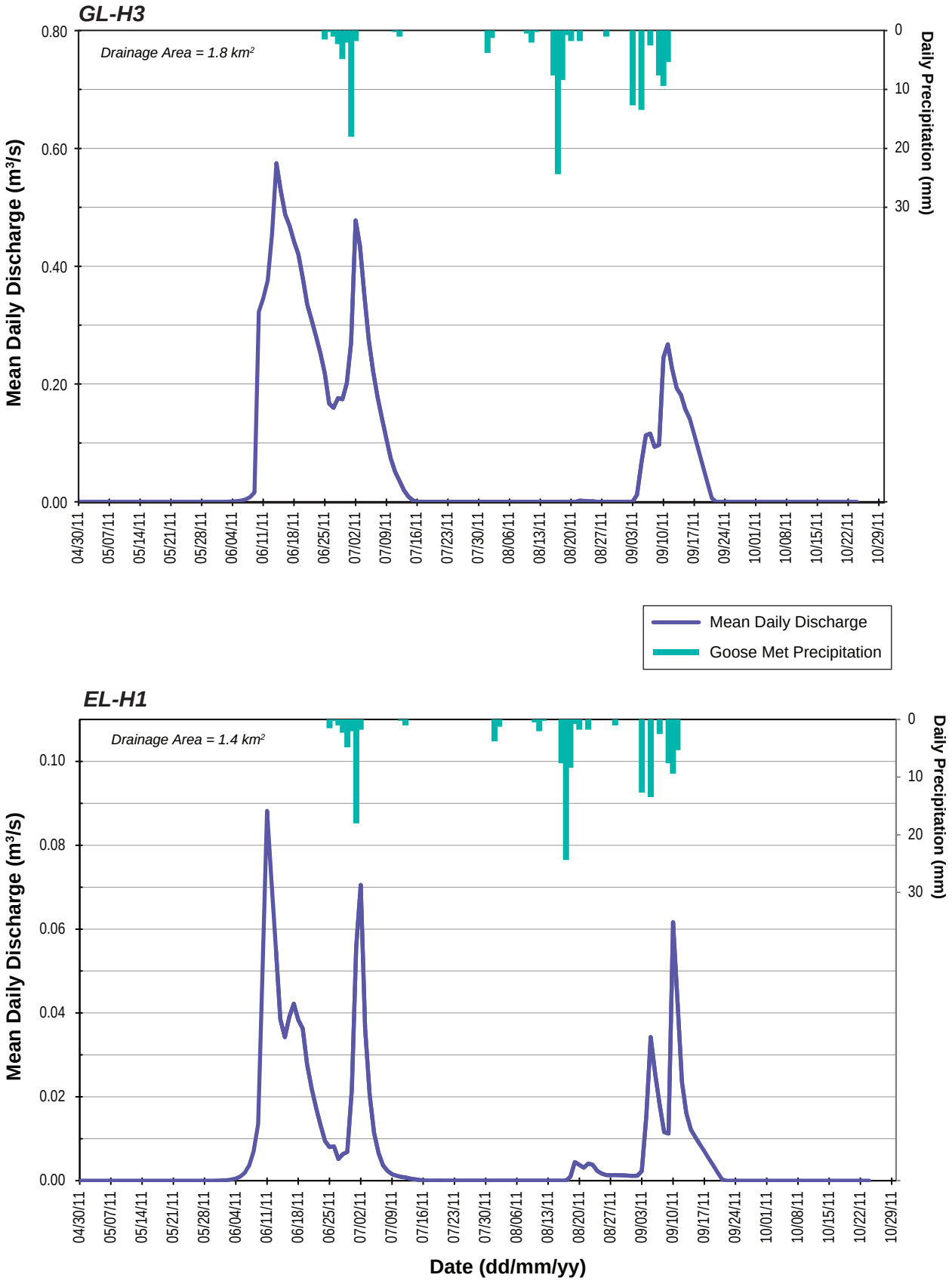

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Annual Hydrograph at GL-*H3* and EL-*H1* Hydrometric Monitoring Stations, 2011

Figure 4.4-2

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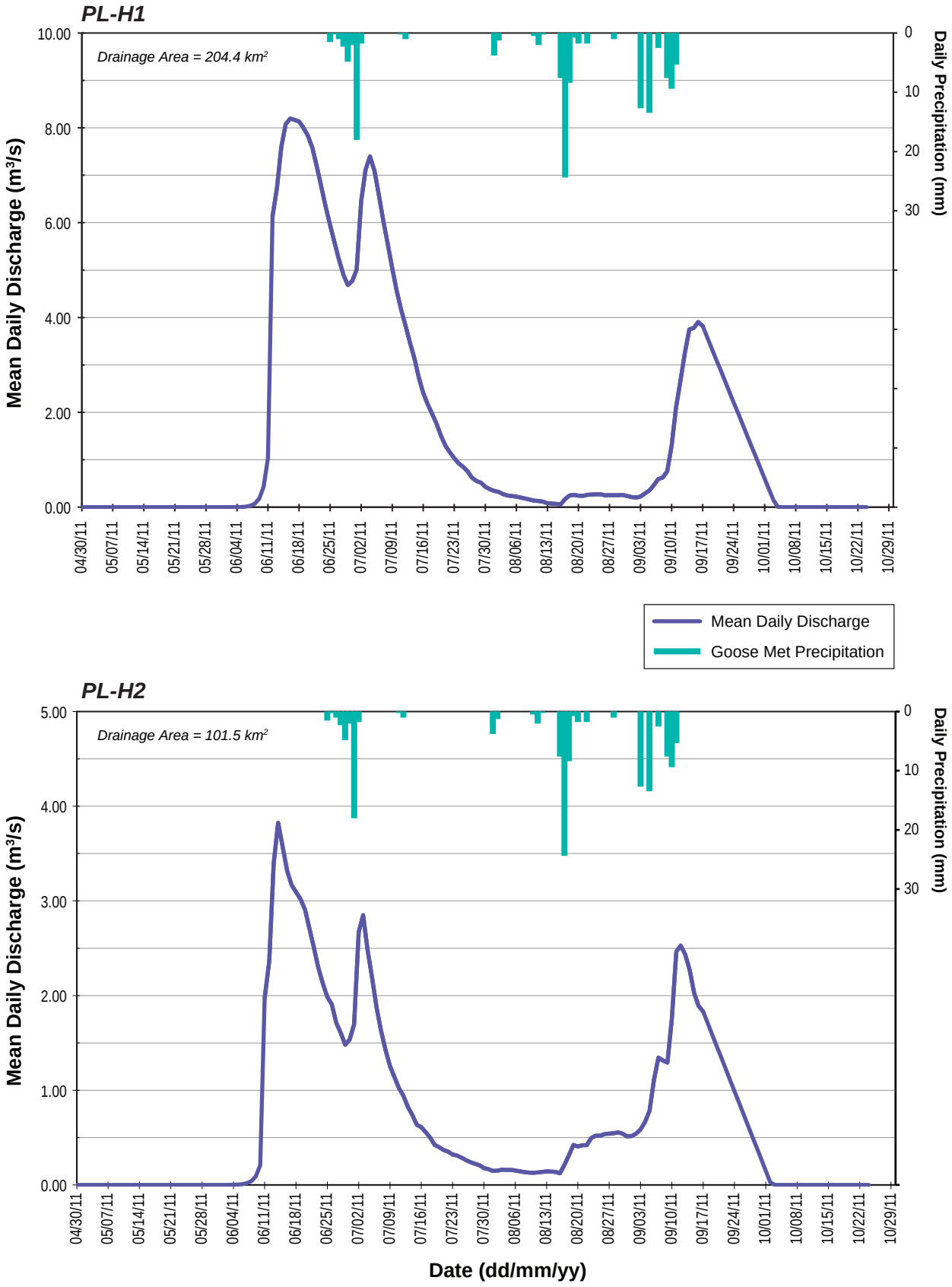

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Annual Hydrograph at PL-*H1* and PL-*H2* Hydrometric Monitoring Stations, 2011

Figure 4.4-3

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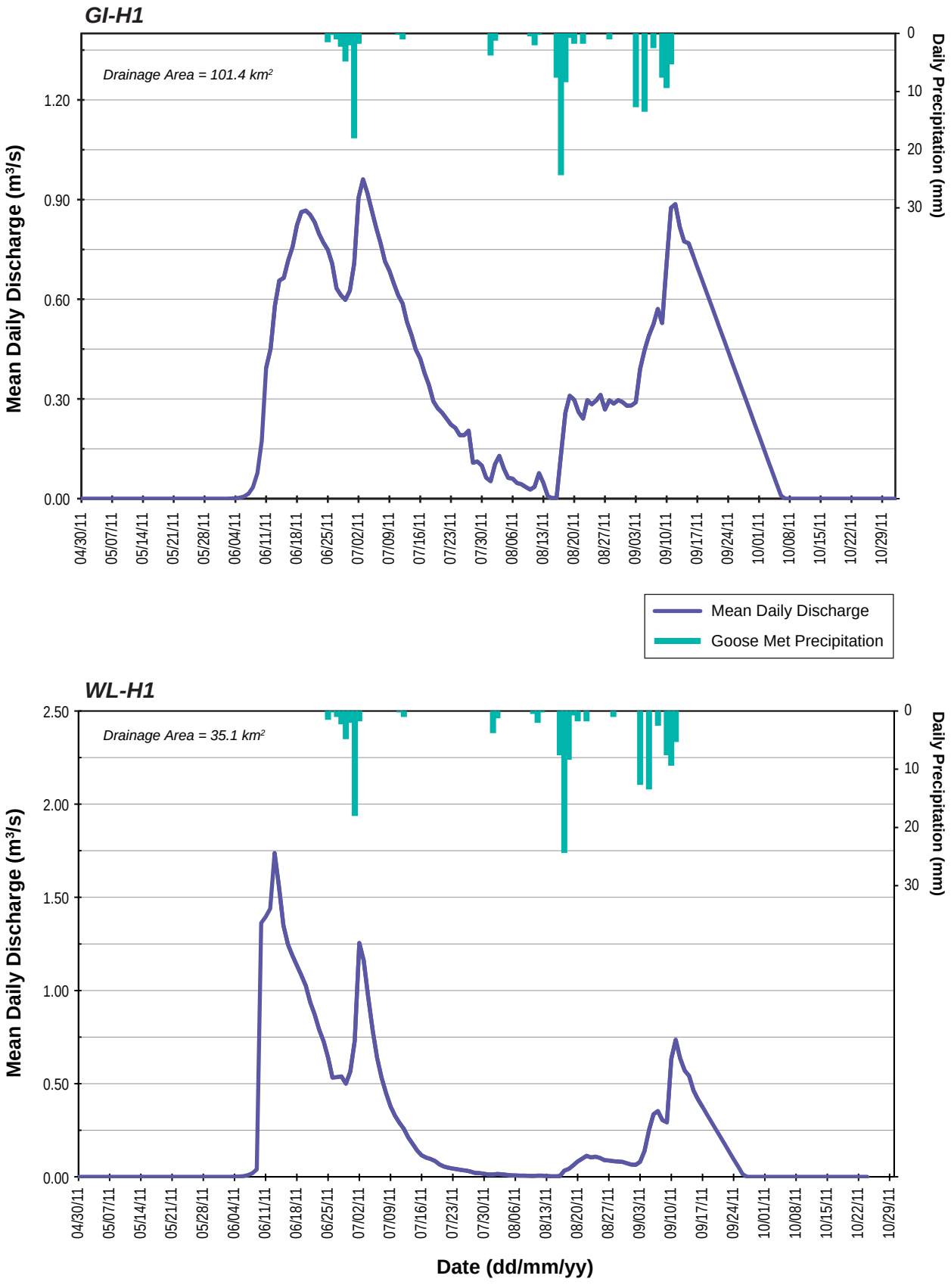
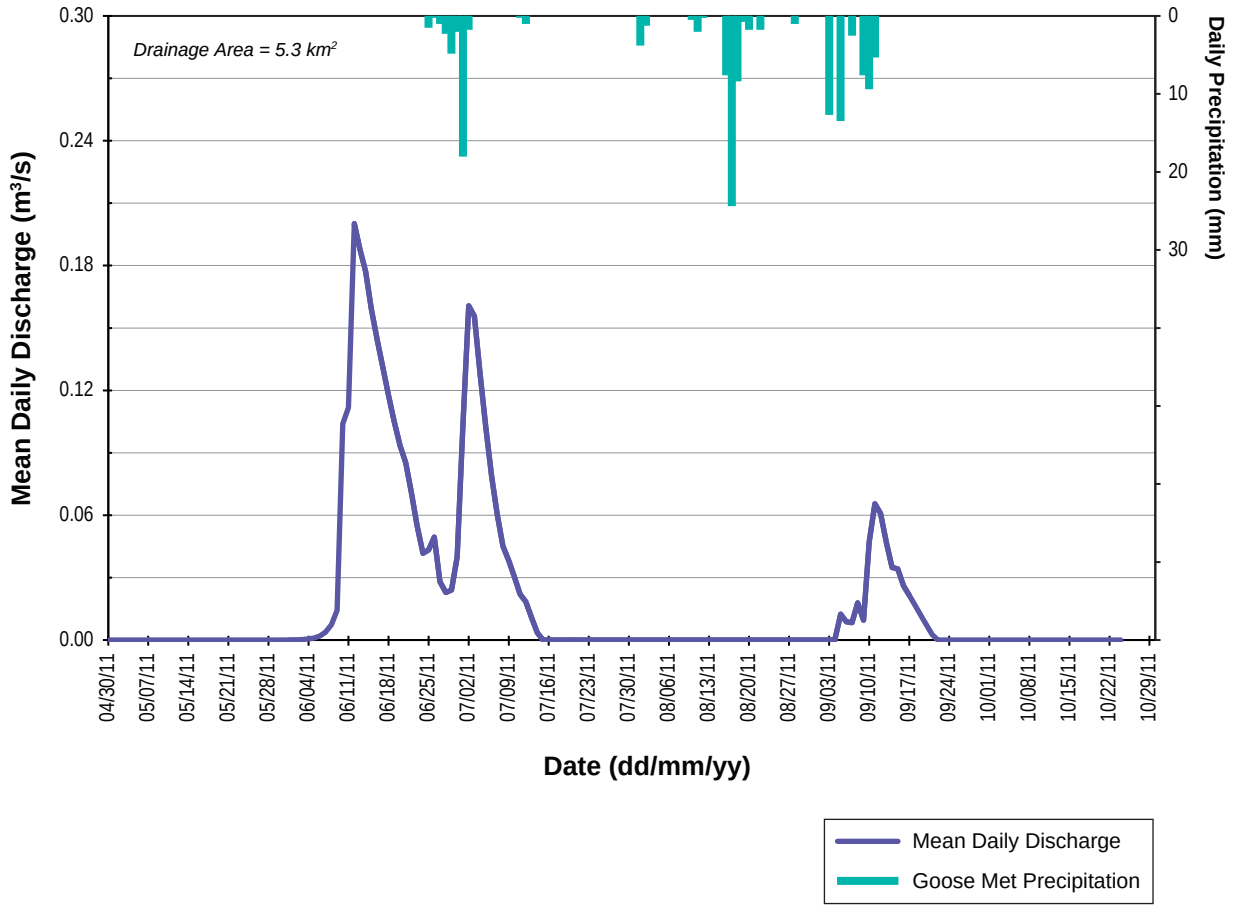


Annual Hydrograph at GI-*H1* and WL-*H1* Hydrometric Monitoring Stations, 2011

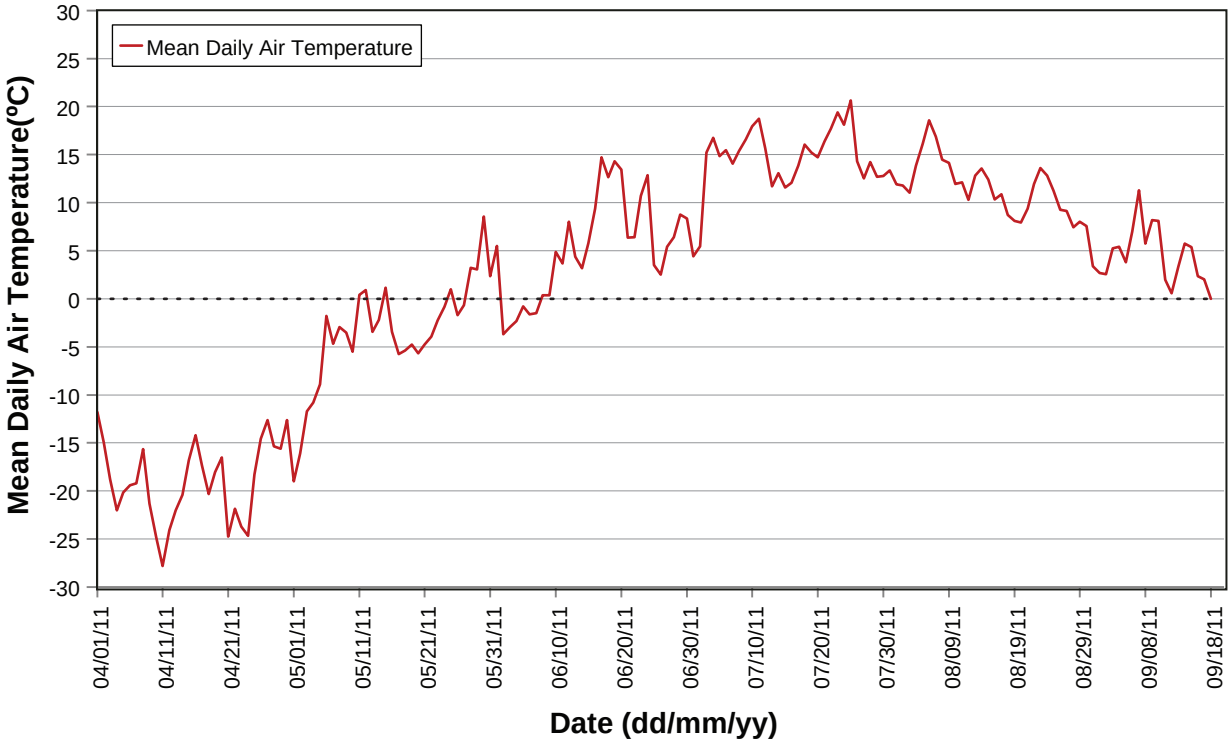
Figure 4.4-4



Annual Hydrograph at REFB-*H1* Hydrometric Monitoring Station, 2011

Figure 4.4-5

High angle oblique view of Propellor Lake outflow during spring freshet. Note the lakes remain ice covered for a period after break-up occurs in the streams thus delaying or extending the freshet period in the region.



Mean Daily Air Temperature Recorded During the Break-up Period and Through The Open Water Season at Goose Lake Meteorological Station in 2011

Figure 4.4-6

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Table 4.4-1. Correlation Analysis between the Observed Discharge Time Series at Station GL-H1 and Stations GL-H3, WL-H1, and REFB-H1

Station	Sample Size (Days)	R2
GL-H3	33	0.97
WL-H1	33	0.97
REFB-H1	34	0.91

The freshet peak at EL-H1 was estimated using a different approach. The annual hydrograph for this station shows a flashier response in the drainage compared to the larger drainages. Runoff response to precipitation inputs was observed to occur one to two days earlier than at other drainages. Therefore, it was assumed that the freshet peak also occurred slightly earlier than the peaks at the surrounding stations. Linear extrapolation was used to extend the recession limb of the recorded freshet data back two days prior to the start of the monitoring period for this station.

4.4.1 Volumetric Outflow

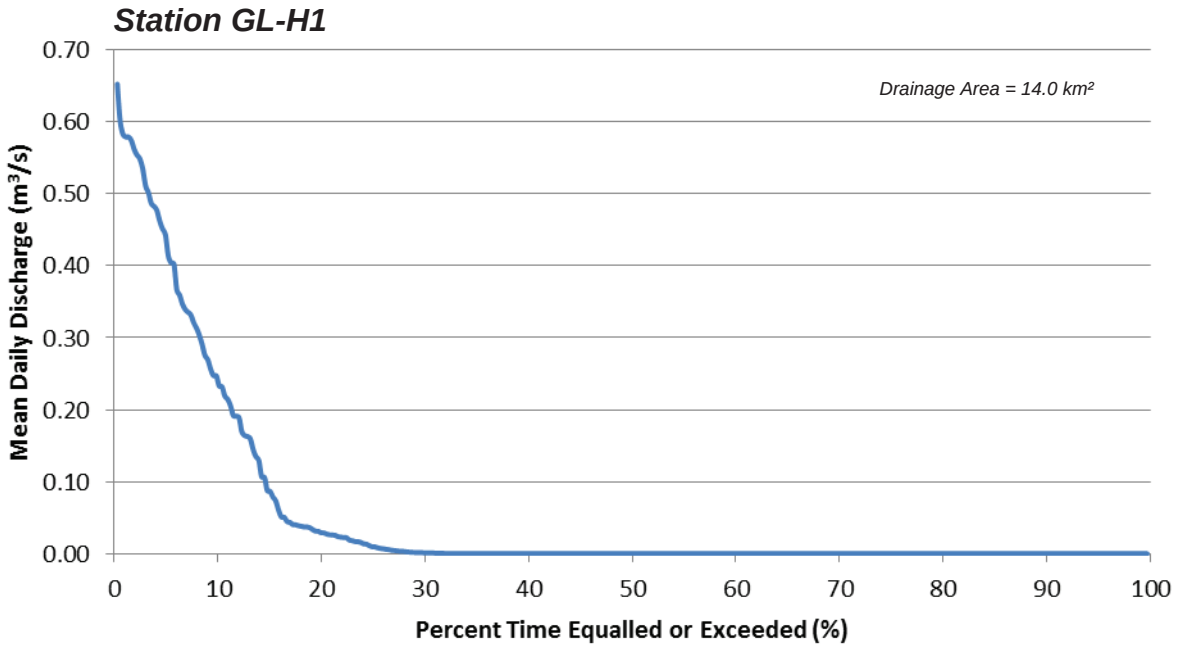
The total monthly and annual volumetric water outflows for each of the drainages are presented in Table 4.4-2. Outflows from each of the monitored drainages were generally found to be a function of drainage area. The minimum volumetric outflows were observed at EL-H1 (drainage area = 1.4 km^2) which had a total annual water output of 0.11 million cubic meters. The maximum annual volumetric output was 25.13 million cubic meters at PL-H1 (drainage area = 204.4 km^2).

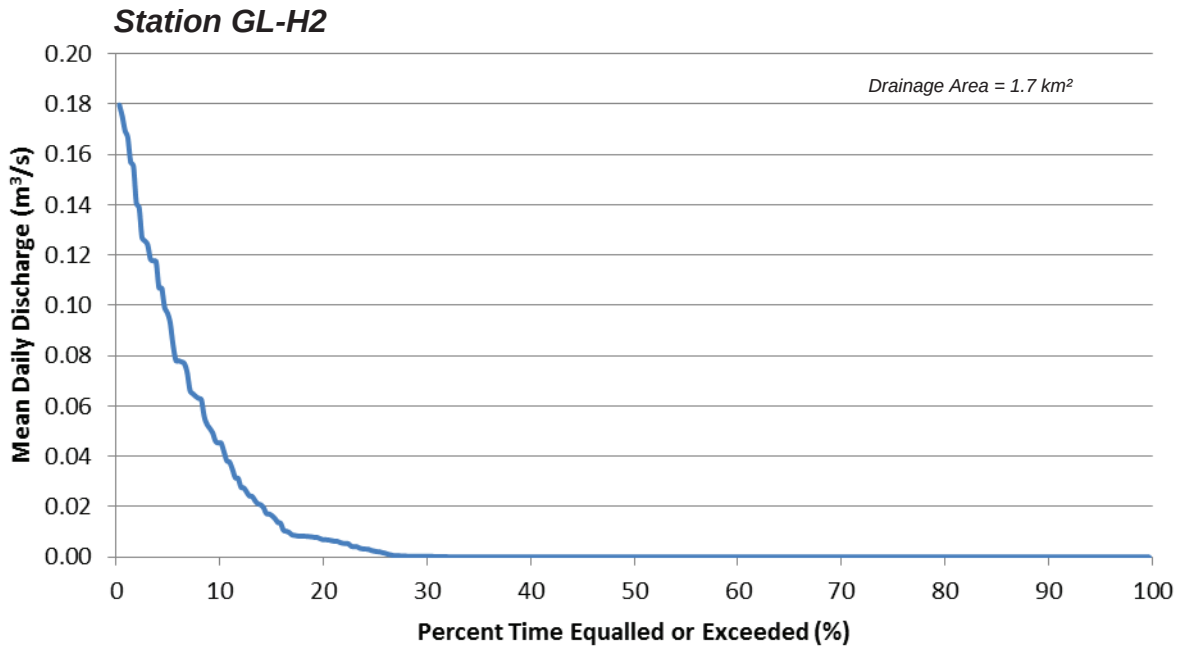
Table 4.4-2. 2011 Volumetric Water Yield in Millions of Cubic Meters (million m^3) for Hydrometric Stations in the Goose Property Area

Hydrometric Station	Jan-May	June	July	August	September	October	Nov-Dec	Total Annual
GL-H1	0.00	0.82	0.42	0.04	0.44	0.00	0.00	1.71
GL-H2	0.00	0.22	0.08	0.01	0.07	0.00	0.00	0.38
GL-H3	0.00	0.61	0.23	<0.01	0.19	0.00	0.00	1.03
PL-H1	0.00	11.20	8.34	0.57	4.93	0.10	0.00	25.13
PL-H2	0.00	4.40	2.49	0.80	3.30	0.02	0.00	11.00
GI-H1	0.00	1.23	1.23	0.43	1.37	0.05	0.00	4.31
EL-H1	0.00	0.06	0.02	<0.01	0.03	0.00	0.00	0.11
WL-H1	0.00	1.83	0.79	0.12	0.68	0.00	0.00	3.42
REFB-H1	0.00	0.17	0.08	0.00	0.04	0.00	0.00	0.29

4.5 FLOW DURATION ANALYSIS

Annual flow duration curves (FDC) were produced for each of the monitored streams in 2011 (Figures 4.5-1 through 4.5-5). The trends in the FDC clearly demonstrate the seasonality of these small Arctic streams. A range of exceedance values and a percentage of time in the open water season during which streams were flowing are presented in Table 4.5-1. The flow duration analysis of all drainages in the Project area reveals that on average there was stream flow during 30% of the year with a maximum of 36% observed at GL-H1 and a minimum of 17% at REFB-H1. The shape of the FDC describes the runoff response of each drainage to precipitation or snow melt events. The smaller (e.g., EL-H1) basins typically produced a steeper FDC as they responded quicker to hydrological inputs.





Sabina GOLD & SILVER CORP.

2011 Flow Duration Curves for Hydrometric Monitoring Stations GL-H1 and GL-H2

Figure 4.5-1

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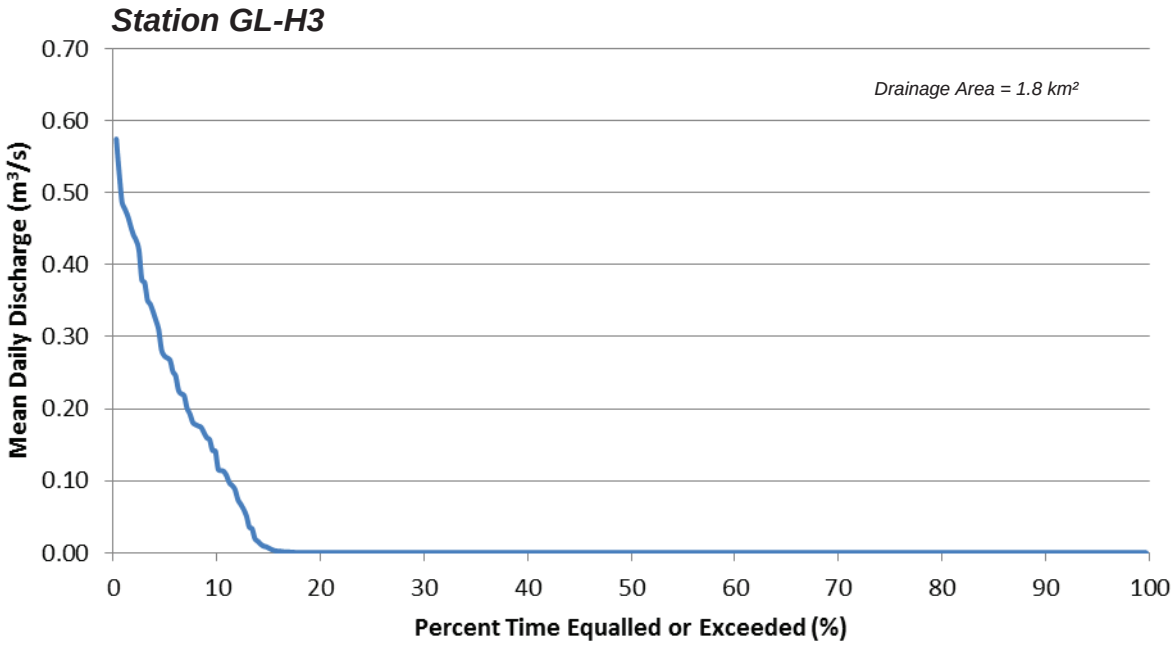
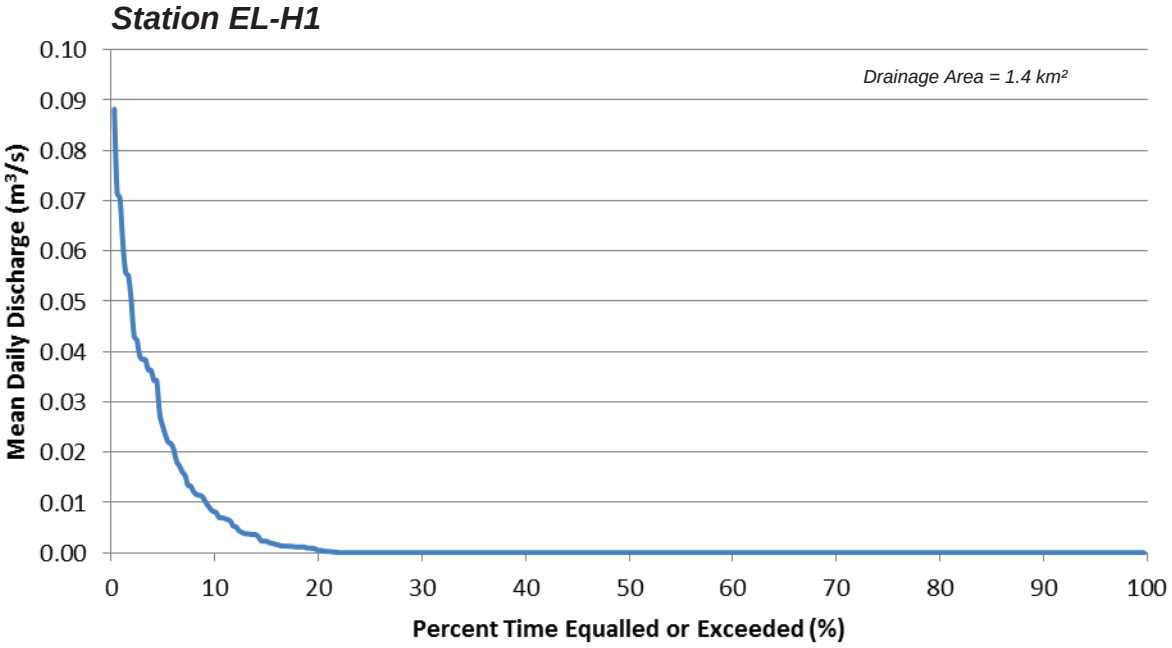


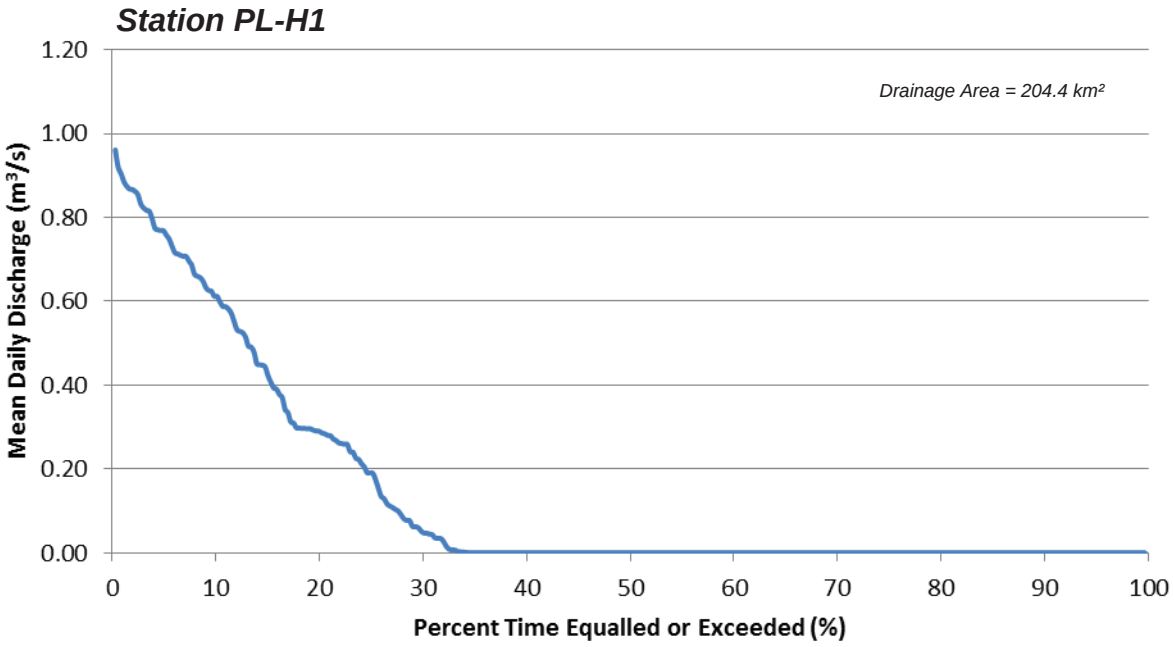


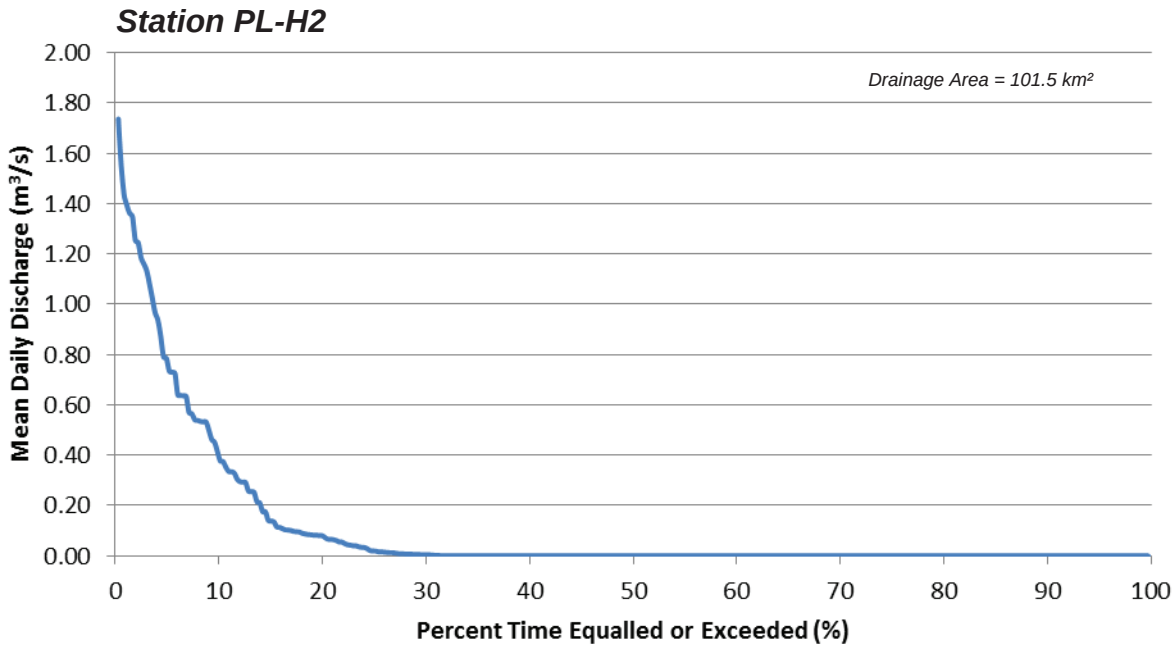
Sabina GOLD & SILVER CORP.

2011 Flow Duration Curves for Hydrometric Monitoring Stations GL-H3 and EL-H1

Figure 4.5-2

Rescan™ Engineers & Scientists





Sabina GOLD & SILVER CORP.

2011 Flow Duration Curves for Hydrometric Monitoring Stations PL-H1 and PL-H2

Figure 4.5-3

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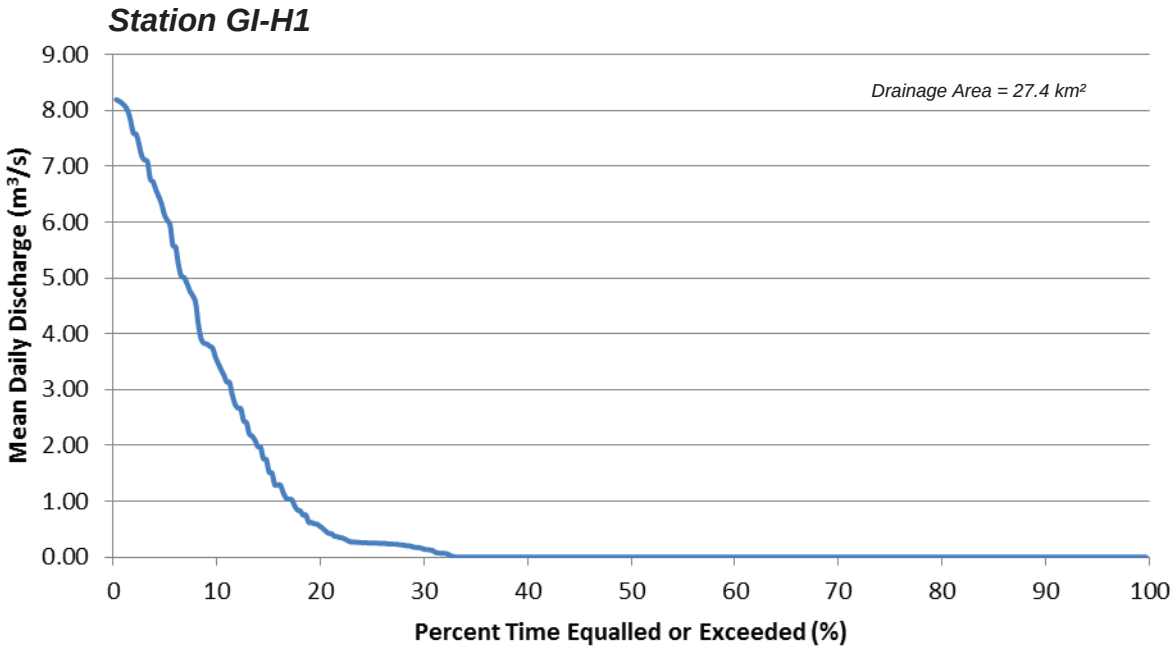
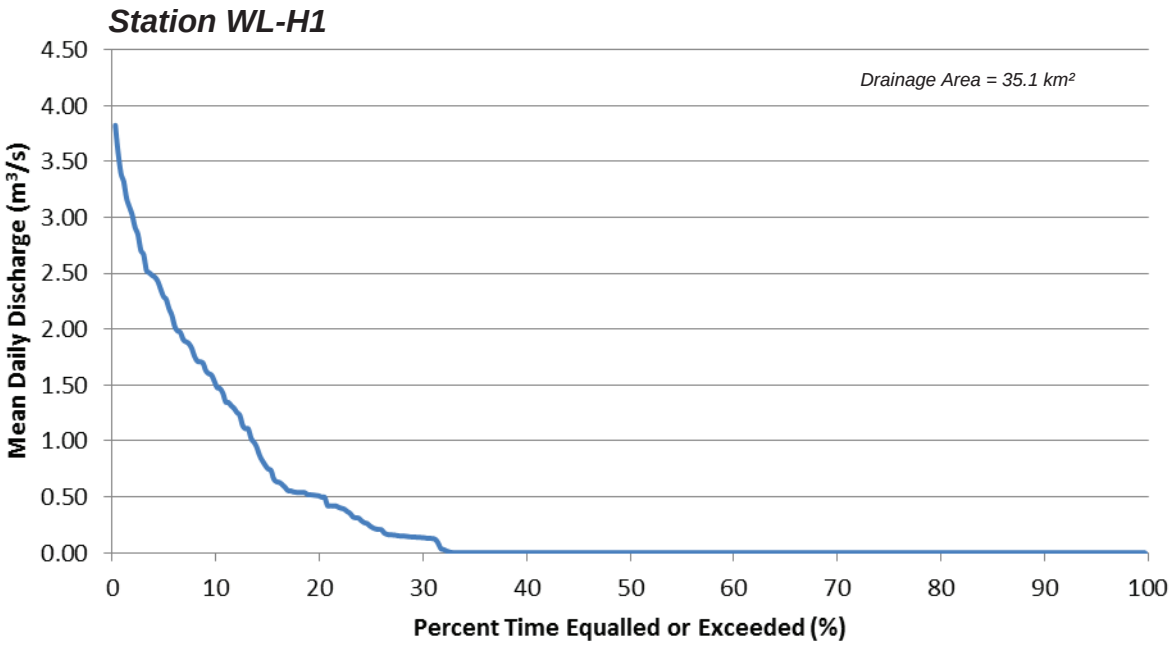


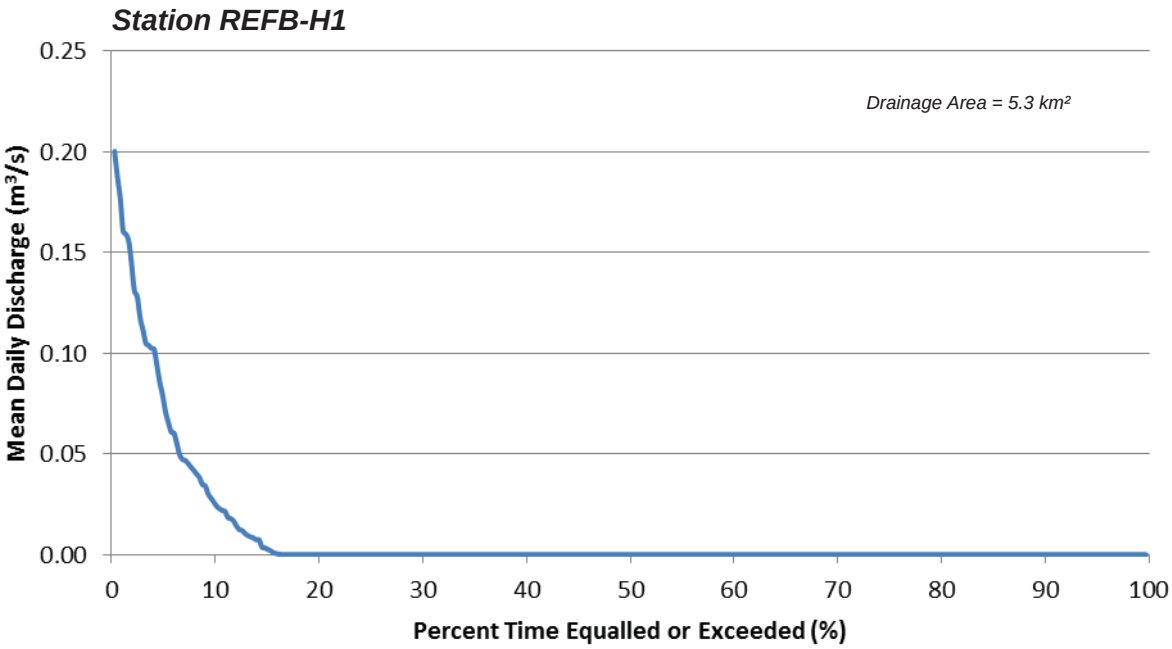


Sabina GOLD & SILVER CORP.

2011 Flow Duration Curves for Hydrometric Monitoring Stations GI-H1 and WL-H1

Figure 4.5-4

Rescan™ Engineers & Scientists



Sabina GOLD & SILVER CORP.

2011 Flow Duration Curve for Hydrometric Monitoring Station REFB-H1

Figure 4.5-5

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Table 4.5-1. Flow Duration Analysis Exceedance Values and Annual Flow Duration for Stations Located in the Project Area

Hydrometric Station	Drainage Area (km^2)	Flow (m^3/s) Equalled or Exceeded 5% of the Time	Flow (m^3/s) Equalled or Exceeded 10% of the Time	Flow (m^3/s) Equalled or Exceeded 20% of the Time	% of Year with Flow
GL-H1	14.0	0.414(m^3/s)	0.230(m^3/s)	0.027(m^3/s)	33%
GL-H2	1.7	0.093(m^3/s)	0.045(m^3/s)	0.007(m^3/s)	34%
GL-H3	1.8	0.271(m^3/s)	0.116(m^3/s)	<0.001(m^3/s)	21%
PL-H1	204.4	6.036(m^3/s)	3.470(m^3/s)	0.515(m^3/s)	35%
PL-H2	101.5	2.267(m^3/s)	1.479(m^3/s)	0.497(m^3/s)	34%
GI-H1	27.4	0.758(m^3/s)	0.612(m^3/s)	0.280(m^3/s)	36%
EL-H1	1.4	0.024(m^3/s)	0.008(m^3/s)	0.001(m^3/s)	24%
WL-H1	35.1	0.735(m3/s)	0.378(m3/s)	0.073(m3/s)	33%
REFB-H1	5.3	0.071(m3/s)	0.024(m3/s)	0.000(m3/s)	17%

Conversely, larger drainage basins showed a flatter FDC. This reflects a more attenuated response as water was routed through the system (e.g., station PL-H1).

4.6 HYDROLOGIC INDICIES

4.6.1 Annual Runoff

In 2011 the estimated average annual runoff from the gauged drainages in the Goose property area and the adjacent reference drainage was 170 mm, ranging from 56 mm at REFB-H1 to 564 mm at GL-H3. The estimated runoff was generally only slightly higher than the observed runoff for the period of record which ranged from 51 to 477 mm with an average of 144 mm (Table 4.6-1). The differences in observed runoff is likely due to the physical characteristics of the individual drainages including, drainage area, topography (slope and aspect), lake and wetland coverage, amount of exposed bedrock and the depth of the active layer.

The low runoff at REFB-H1 is likely related to the percent of lake coverage in the basin (16.6%), which acts as a storage reservoir. The relative large storage in the watershed coupled to the low relief topography limit drainage and promotes local ponding of runoff. The potential for hydrological losses through evaporation from this drainage basin is great due to the inputs (snowmelt or rainfall) slowly moving through the system and collecting in lakes or other depressions of the flat topography.

In contrast, the highest runoff values observed at GL-H3 may be a result of the low percent of lake coverage (7.5%) and uncharacteristically steep terrain for the Project area. The steeper topography may generate greater runoff by increasing overland flow during snowmelt or rain events. Further, with fewer lakes available for storage this surface runoff directly generates stream flow. Finally, the steep topography will affect snow accumulation and melt rates in the drainage. In order to fully understand the runoff production from individual basins, further work would need to be conducted to characterize the physiography of each basin.

4.6.2 Mean Annual Discharge

Mean annual discharge (MAD) was calculated as an average of the mean daily discharges for the open water period from the beginning of June through September and for the total year (January to December). MAD during the open water season was lowest at EL-H1 (0.010 m^3/s) and highest at PL-H1

(2.387 m^3/s), with an average of 0.501 m^3/s for all the gauged drainages in the project area. MAD calculated for the entire year was much lower due to the large portion of the year with zero flow conditions. On average MAD for the full year was 0.167 m^3/s with a minimum of 0.003 m^3/s at EL-H1 and a maximum of 0.799 m^3/s at PL-H1 (Table 4.6-1).

Table 4.6-1. 2011 Annual Runoff and Mean Annual Discharge for the Goose Property Area

Hydro-metric Station	Drainage Area (km^2)	Observed Runoff (mm)	Period of Record (observed)	Estimated Annual Runoff (mm)	MAD (m^3/s)		% Lake Coverage in Drainage Area
					Open Water	Total	
GL-H1	14.0	112	June 10 to September 16	122	0.163	0.054	10.56
GL-H2	1.7	212	June 10 to September 16	227	0.036	0.012	23.05
GL-H3	1.8	477	June 14 to September 16	564	0.099	0.033	7.51
PL-H1	204.4	110	June 14 to September 17	123	2.387	0.799	18.92
PL-H2	101.5	97	June 11 to September 17	108	1.049	0.350	15.06
GI-H1	27.4	134	June 11 to September 16	157	0.406	0.137	13.28
EL-H1	1.4	61	June 13 to September 16	77	0.010	0.003	2.23
WL-H1	35.1	83	June 10 to September 17	97	0.327	0.109	16.59
REFB-H1	5.3	51	June 13 to September 17	56	0.028	0.009	19.13

4.6.3 Seasonal Runoff Distribution

The seasonal runoff distribution was similar for all the gauged drainages in the Project area (Table 4.6-2, Figure 4.6-1). On average, approximately 75% of runoff occurred in the months of June and July and 22% in September. Only 3% of runoff occurred in August and negligible amounts through the remainder of the year. In most drainages the maximum monthly runoff occurred in June, with exception of GI-H1 where there was slightly more runoff in September and equal runoff amounts during June and July.

Table 4.6-2. 2011 Monthly Runoff Distribution (mm) in the Goose Property Area

Hydrometric Station	Jan-May	June	July	August	September	October	Nov-Dec
GL-H1	0	59	30	3	31	0	0
GL-H2	0	131	50	6	40	0	0
GL-H3	0	335	125	0	104	0	0
PL-H1	0	55	41	3	24	0	0
PL-H2	0	43	24	8	33	0	0
GI-H1	0	45	45	16	50	2	0
EL-H1	0	42	13	2	20	0	0
WL-H1	0	52	22	3	19	0	0
REFB-H1	0	33	16	0	7	0	0

4.6.4 Annual Peak and Low Flow

Observed peak flows for most basins in the Project area occurred in mid-June. Instantaneous peak flows ranged from 0.13 m^3/s at EL-H1 to 8.44 m^3/s, at PL-H1, while daily peak flows ranged from 0.09 to 8.19 m^3/s at the same stations respectively. At EL-H1 the reported instantaneous and daily peak flows occurred on different days because daily peak flow was determined using the estimated freshet daily discharges that were not recorded in the 10 minute (instantaneous) data.

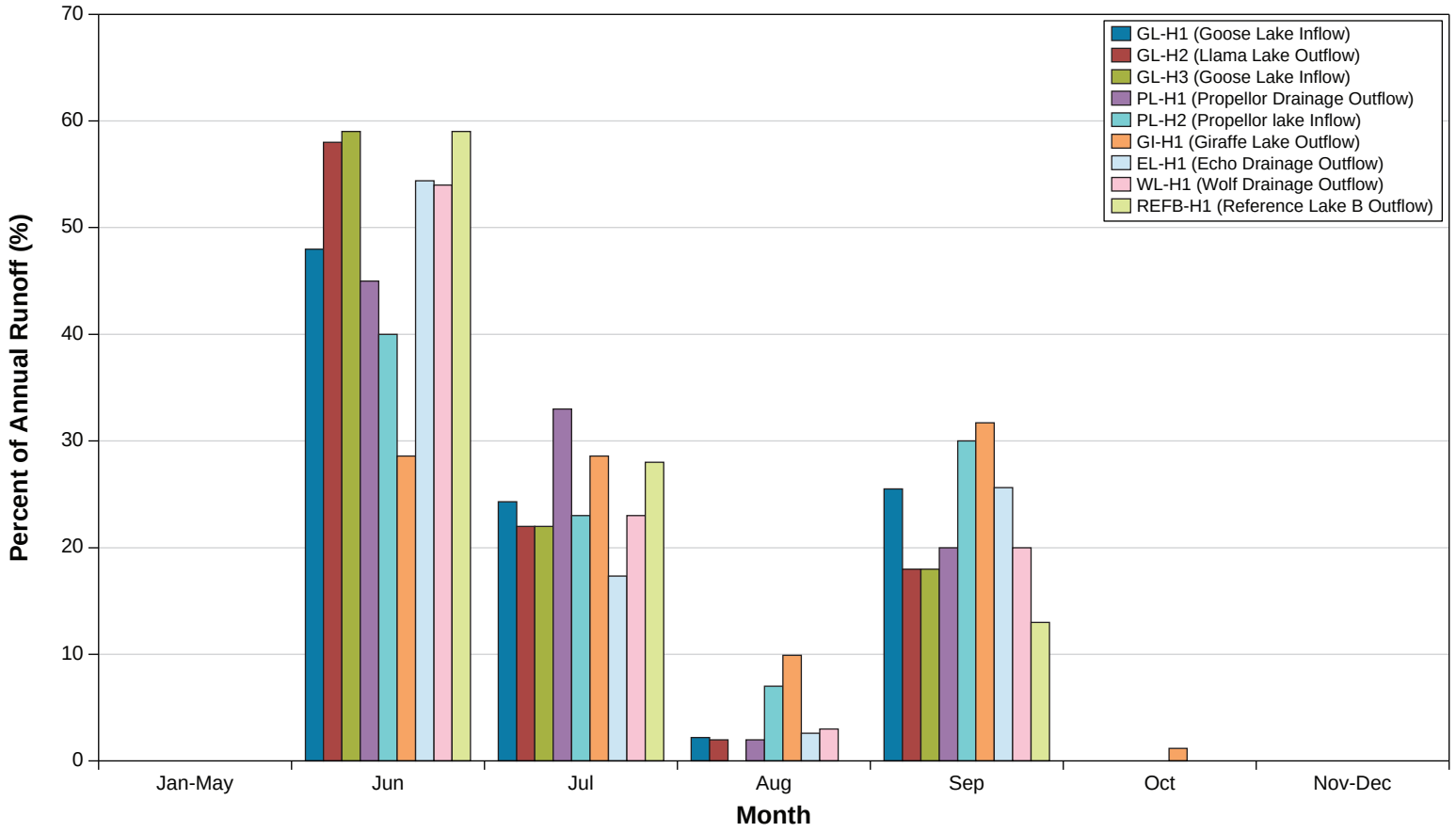

Figure 4.6-1

Sabina GOLD & SILVER CORP.

Monthly Runoff Distribution for the Goose Property Area

Figure 4.6-1

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Peak unit yields were at a minimum of 35.73 L/s/km^2 at GI-H1 and reached a maximum of 355.16 L/s/km^2 at GL-H3 (Table 4.6-3). This wide range of peak flows was due to the locations of the stations and the size of the drainages being monitored. The general trend observed agreed with previous work that reports that smaller drainage basins typically exhibit higher discharge per unit area than larger ones (Linsley et al. 1982; Eaton et al. 2007). As drainage area increases the potential for hydrological losses increases proportionally, since larger catchments tend to have a larger number of land depressions where water is stored compared to smaller ones. Additionally, it takes longer for water to be routed through a larger watershed, thus runoff becomes attenuated. The largest peak unit yields were observed at the station GL-H3. This is likely due to a combination of the small drainage size and basin characteristics that increase direct runoff by reducing the storage capacity and therefore the potential for losses.

Table 4.6-3. 2011 Peak Flows and Peak Unit Yields

Hydrometric Station	Drainage Area (km^2)	Peak Flow (m^3/s)			Peak Unit Yield (L/s/km^2)	
		Instantaneous	Daily	Date	Instantaneous	Daily
GL-H1	14.0	0.70	0.65	Jul 2	50.14	46.68
GL-H2	1.7	0.19	0.18	Jun 19	114.58	107.43
GL-H3	1.8	0.65	0.57	Jun 14	355.16	313.44
PL-H1	204.4	8.44	8.19	Jun 18 / 16	41.27	40.08
PL-H2	101.5	3.88	3.83	Jun 14	38.23	37.68
GI-H1	27.4	0.98	0.96	Jul 3	35.73	35.07
EL-H1	1.4	0.13 E	0.09	*Jul 1 / Jun 11	62.38	64.31
WL-H1	35.1	1.83	1.74	Jun 13	52.19	49.55
REFB-H1	5.3	0.21	0.20	Jun 12	39.49	37.72

**-Instantaneous and daily peak flow occurred on separate days.*
E- Discharge estimate is greater than 1.5 x the maximum measured discharge.

Annual low flows are expected to reach zero in all the basins once freeze-up occurs, and zero flow conditions will last throughout the winter months (approximately October to May). The observed low flows are those that occurred during the 2011 period of record from early-June the mid-September. Observed low flows for the majority of basins in the Project area occurred in mid-August. The three streams monitored by the hydrometric stations GL-H3, EL-H1 and REFB-H1 experienced zero flow conditions during the open water period starting as early as July 15 and continuing up until September 4 at the reference station REFB-H1 (Table 4.6-4).

Table 4.6-4. 2011 Observed Daily Minimum Flows (June through September)

Hydrometric Station	Drainage Area (km^2)	Daily minimum Flow (m^3/s)	Date
GL-H1	14.0	0.001	August 17
GL-H2	1.7	< 0.001	August 10
GL-H3	1.8	0*	July 17 – August 20
PL-H1	204.4	0.060	August 16
PL-H2	101.5	0.122	August 16
GI-H1	27.4	0.002	August 15
EL-H1	1.4	0*	July 17 – August 16
WL-H1	35.1	0.002	August 15
REFB-H1	5.3	0*	July 15 – September 4

** Dry channel conditions between the indicated dates.*

5. Summary

5. Summary

5.1 SUMMARY

The 2011 hydrology baseline program expanded on baseline data collected in 2010. A monitoring network established in 2010 included two hydrometric stations that collectively monitored a drainage area of 15.7 km^2. In 2011 the existing monitoring network was expanded and included nine hydrometric stations that monitored a total drainage area of 209.8 km^2. The 2011 hydrometric monitoring network focussed on basins around the Goose property area with known deposits located within them. Included in the network was one monitoring station located outside the Project watershed area which was established as a reference monitoring site.

The hydrometric network was operated through the open water season from June 10, 2011 to September 17, 2011. During this time period, continuous time series water level (stage) data were collected at each station and a total of 41 manual discharge measurements were completed. Based on the stage and discharge data collected, stage-discharge rating equations were determined and annual hydrographs produced.

The annual hydrographs show that basins within the Project area have a hydrologic regime characterized by snowmelt driven peak flows during the spring freshet and no flows during the winter. Three prominent peaks were observed in each of the hydrographs. The largest peak flows were driven by snowmelt and occurred during the freshet period in early to mid-June in most basins. A second peak was observed in all basins approximately 19 days after the freshet peak and was the result of precipitation events that occurred in late June and early July. After the July elevated flows, discharge steadily decreased throughout the Project area until mid-August. After this date daily discharges were augmented by rainfall events occurring throughout the second half of August and carrying on through September leading to a third peak evident in most of the hydrographs. After the September precipitation event, flows continued to recede until the end of the monitoring period. Peak flows varied substantially between gauged streams. Instantaneous peak flows ranged from 0.13 m^3/s at the hydrometric station EL-H1 (Echo Drainage outflow) to 8.44 m^3/s at the station PL-H1 (Propellor Drainage outflow).

Volumetric outflows from each of the monitored drainages were generally found to be a function of drainage area. The minimum volumetric outflows were observed at EL-H1 (Echo Drainage outflow; drainage area = 1.4 km^2) which had a total annual water output of 0.11 million cubic meters. The maximum annual volumetric output was 25.31 million cubic meters at PL-H1 (Propellor Drainage outflow; drainage area = 204.4 km^2). The calculated peak unit yields varied among the monitored drainages, generally increasing as drainage area decreased. Peak unit yields were at a minimum of 35.73 $L/s/km^2$ at GI-H1 (Giraffe Lake outflow) and reached a maximum of 355.16 $L/s/km^2$ at GL-H3 (Goose Lake inflow).

Average annual runoff from the monitored region was 170 mm. Runoff varied between drainages from a minimum of 51 mm at REFB-H1 to a maximum of 477 mm at GL-H3 (Goose Lake inflow). Approximately 75% of the annual runoff occurred in June and July, 22% in September, as little as 3% in August and negligible amounts for the remainder of the year. All monitored streams can be considered either intermittent or ephemeral. The majority are considered intermittent (seasonal) with zero flow in the winter when they freeze to their bed. Three of the smaller streams were found to be ephemeral, only carrying water immediately after snowmelt or rainfall events. On average the monitored streams flowed for 30% of the year, and they were either frozen or dry for the remainder of the year.

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Appendix 1

Hydrometric Monitoring Station Information

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Appendix 1.1. Station Information Sheet for Hydrometric Station GL-H1

Site ID:	GL-H1	Drainage Area (km^2):	14.0
Site Location:	Near the mouth of the southwestern inflow to Goose Lake		
UTM:	NAD 83, Zone 13W	430,772 E	7,270,016 N

Benchmarks	Elevation	Description
BM3	100.000	Bolt on left bank upstream of the station
BM4	100.218	Rebar on left bank downstream of the station
BM5	100.527	Rebar on left bank at the data logger box

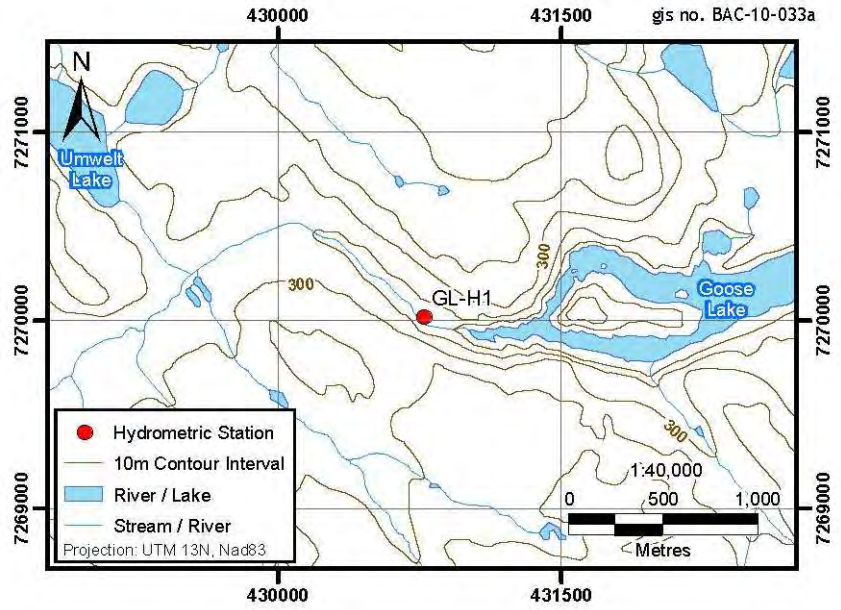
Transducer:	PS-98i	Logger:	ELF-2

Operating Periods:		
2010	June 10- Sep 16	Established June 16, 2010
2011	June 10- Sep 16	

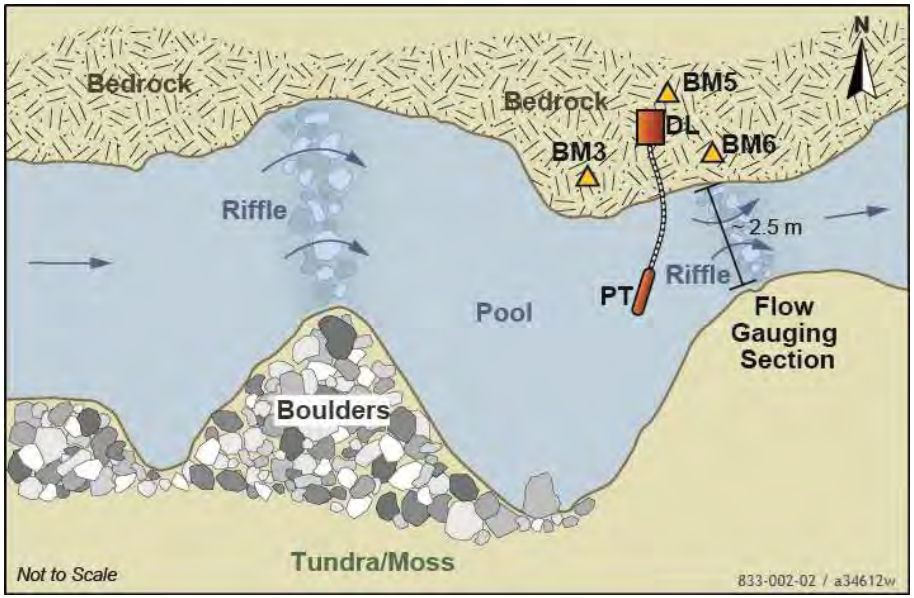
General Comments:

- Location previously established and monitored from 2007 to 2009 as D32 by Gartner Lee.
- Relatively low flow
- Wadeable under all conditions
- Access by helicopter

General Site Information



Site Map



Plan View of Hydrometric Station GL-H1

Low angle view looking upstream towards the monitored stream reach. The enclosure for the data logger can be seen on the left bank. September 16, 2011.

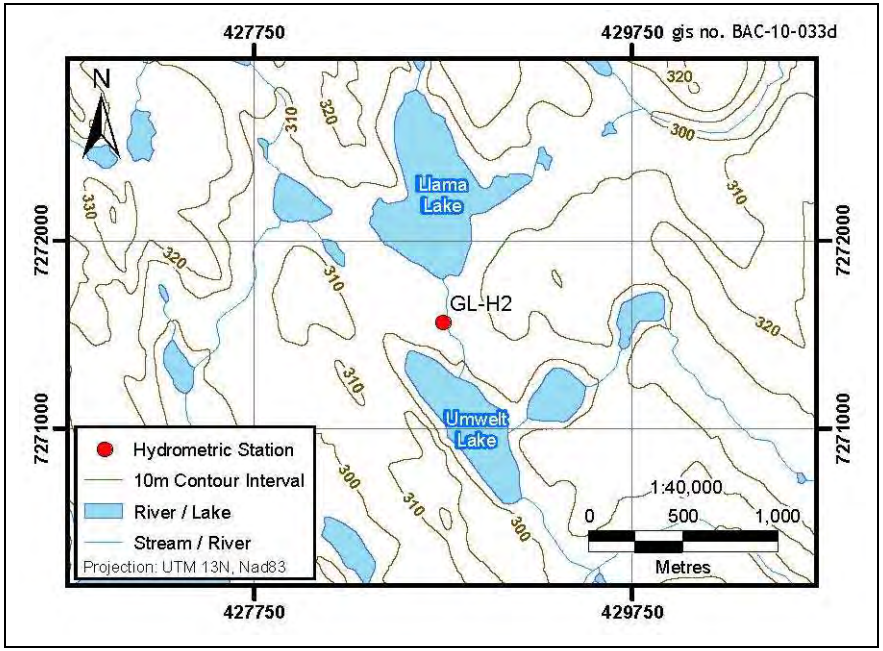
Site Photo

Appendix 1.2. Station Information Sheet for Hydrometric Station GL-H2

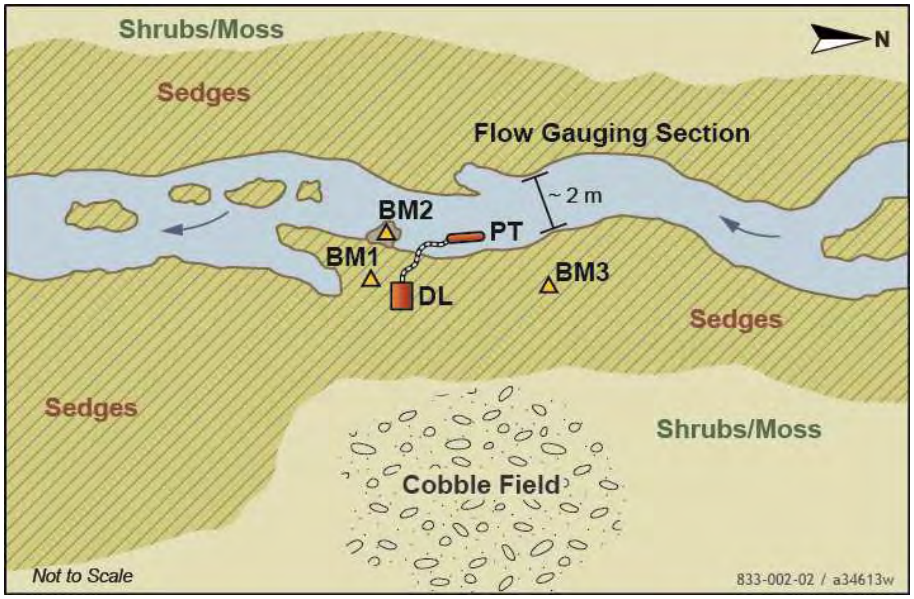
Site ID:	GL-H2	Drainage Area (km^2):	1.7
Site Location:	Llama Lake outflow		
UTM:	NAD 83, Zone 13W	428,746 E	7,271,567 N
Benchmarks	**Elevation**	**Description**	
BM1	100.000	Bolt at base of DL enclosure box	
BM2	99.746	Bolt in boulder embedded in LB	
BM3	99.792	Bolt in buried boulder ~5m upstream of station	
Transducer:	PS-98i	Logger:	ELF-2
Operating Periods:			
2010	July 06- Sept 29	Established June 16, 2010	
2011	June 10 – Sept 16		
General Comments:			

- Relatively low flow
- Wadeable under all conditions
- Access by helicopter

General Site Information



Site Map



Plan View of Hydrometric Station GL-H2

Low angle view looking upstream to the north along the monitored stream reach. September 16, 2011.

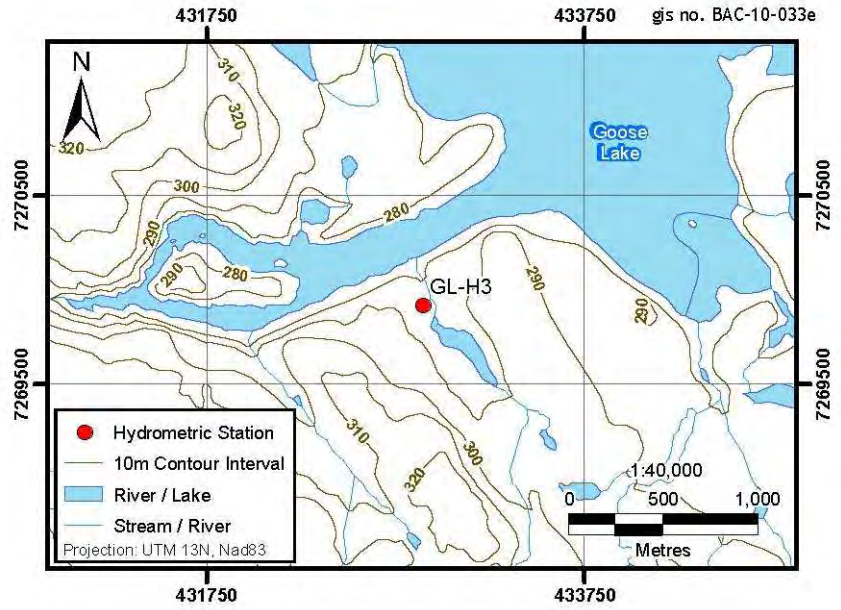
Site Photo

Appendix 1.3. Station Information Sheet for Hydrometric Station GL-H3

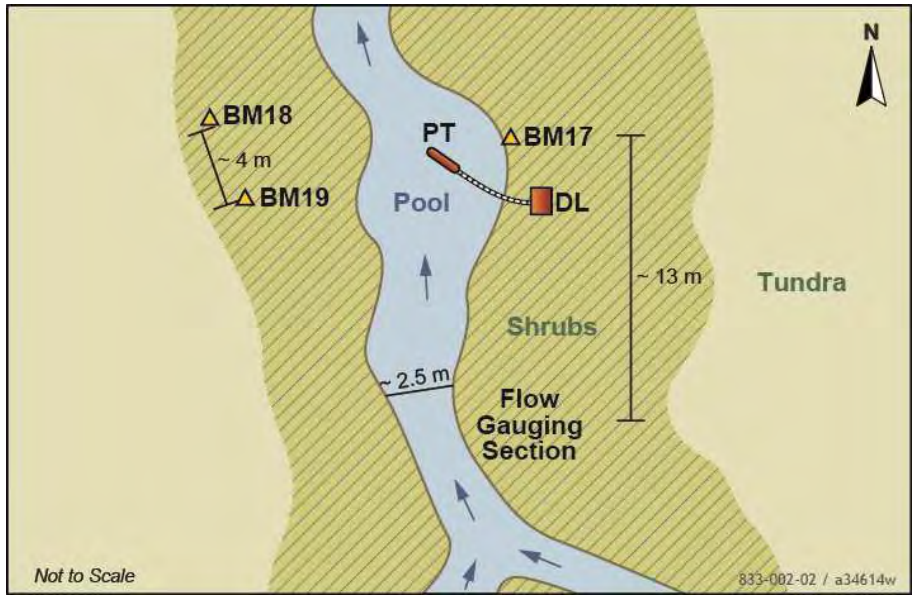
Site ID:	GL-H3	Drainage Area (km^2):	1.8
Site Location:	Near the mouth of a small inflow to the west arm of Goose Lake		
UTM:	NAD 83, Zone 13W	432,891 E	7,269,919 N
Benchmarks	**Elevation**	**Description**	
BM17	100.00	Bolt on right bank downstream of the station	
BM18	100.137	Bolt on left bank downstream of the station	
BM19	100.042	Bolt on left bank even with the station	
Transducer:	PS-98i	Logger:	ELF-2
Operating Periods:			
2011	June 14 - Sep 16	Established June 16, 2011	
General Comments:			

- Zero flow during summer low flow period
- Wadeable under all conditions
- Bench marks marked with rebar stakes for locating
- Access by helicopter or on foot from camp

General Site Information



Site Map



Plan View of Hydrometric Station GL-H3

Low angle view looking downstream along the monitored reach towards Goose Lake's west arm. June 14, 2011.

Site Photo

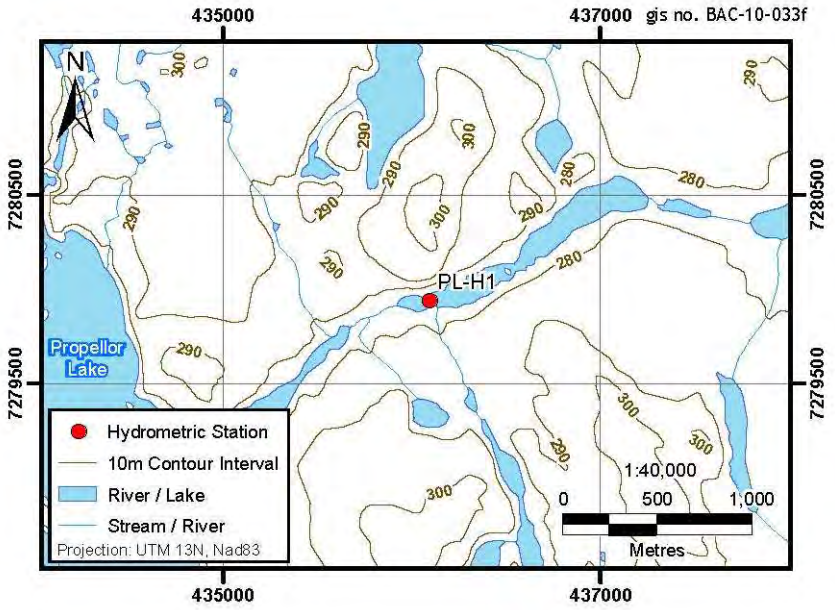
Appendix 1.4. Station Information Sheet for Hydrometric Station PL-H1

Site ID:	PL-H1	Drainage Area (km^2):	204.4
Site Location:	Downstream from Propellor Lake outflow		
UTM:	NAD 83, Zone 13W	436,094 E	7,279,939 W
Benchmarks	**Elevation**	**Description**	
BM8	100.00	Bolt upstream from station	
BM7	99.603	Bolt near station	
BM6	99.539	Bolt sownstream from station	
Transducer:	PS-98i	Logger:	ELF-2
Operating Periods:			
2011	June14 - Sep 17	Established June 14, 2011	

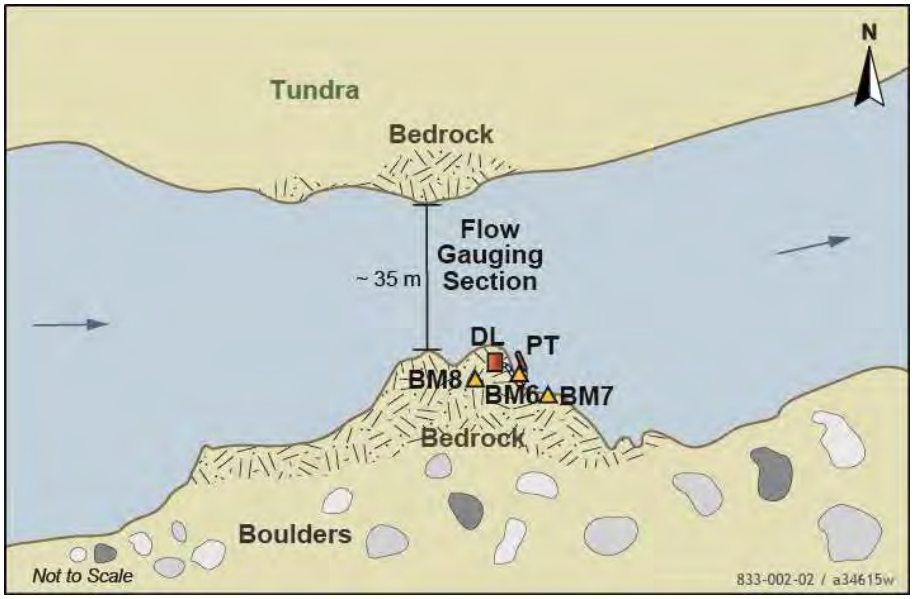
General Comments:

- Boat required to cross channel
- Deep but relatively low velocity reach
- Not wadeable under any conditions
- Access by helicopter

General Site Information



Site Map



Plan View of Hydrometric Station PL-H1

Low angle view looking across the channel and slightly upstream towards station PL-H1 and the monitored reach. July 10, 2011.

Site Photo

Appendix 1.5. Station Information Sheet for Hydrometric Station

Site ID:	PL-H2	Drainage Area (km^2):	101.5
Site Location:	Between the outflow of Goose Lake and the inflow of Propellor Lake		
UTM:	NAD 83, Zone 13 W	435,007 E	7,272,014 N

Benchmarks	Elevation	Description
BM4	100.000	Bolt on in-stream boulder near the station
BM45	99.869	Bolt on in-stream boulder near the station
BM46	100.177	Bolt on in-stream boulder near the station

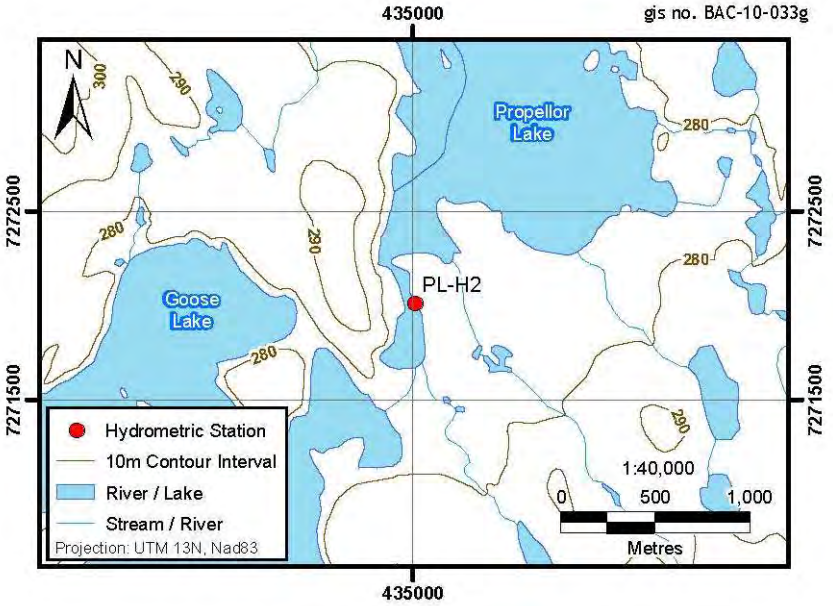
Transducer:	PS-98i	Logger:	ELF-2

Operating Periods:		
2011	June 11 – Sep 17	Established June 11, 2011

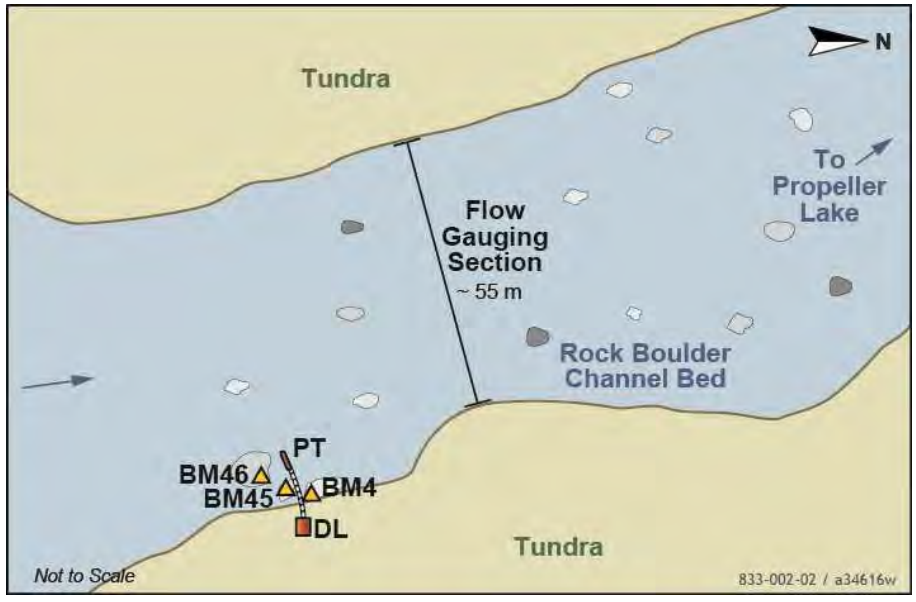
General Comments:

- Wide boulder strewn channel
- Relatively low flow
- Wadeable under all conditions
- Access by helicopter

General Site Information



Site Map



Plan View of Hydrometric Station PL-H2

Low angle view looking downstream from the right bank along the monitored stream reach. June 11, 2011.

Site Photo

Appendix 1.6. Station Information Sheet for Hydrometric Station GI-H1

Site ID:	GI-H1	Drainage Area (km^2):	27.4
Site Location:	Outflow of Giraffe Lake		
UTM:	NAD 83, Zone 13W	432,744 E	7,271,610 N

Benchmarks	Elevation	Description
BM5	100.000	Bolt near station
BM47	99.925	Bolt downstream from station
Bm49	100.038	Bolt downstream from station

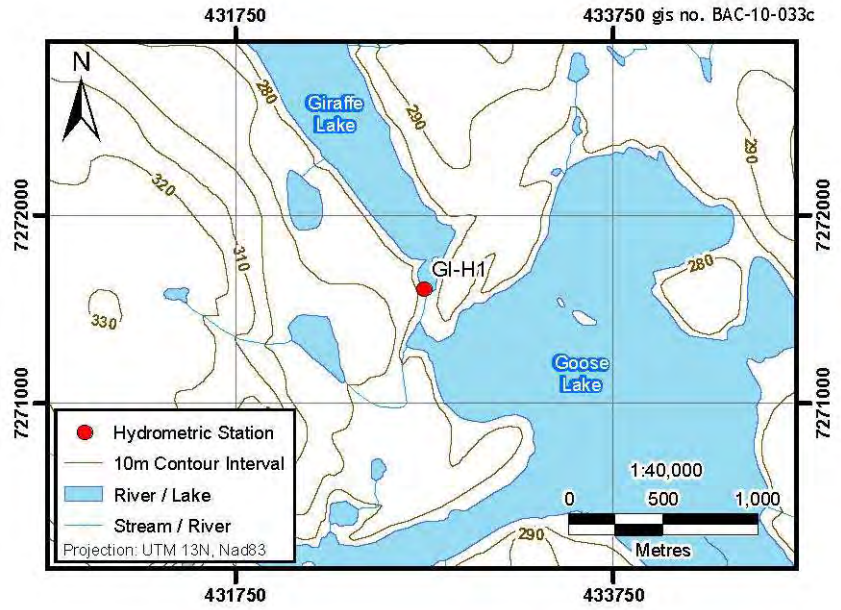
Transducer:	PS-98i	Logger:	ELF2

Operating Periods:		
2011	June 11 - Sep 16	Established June 16, 2011

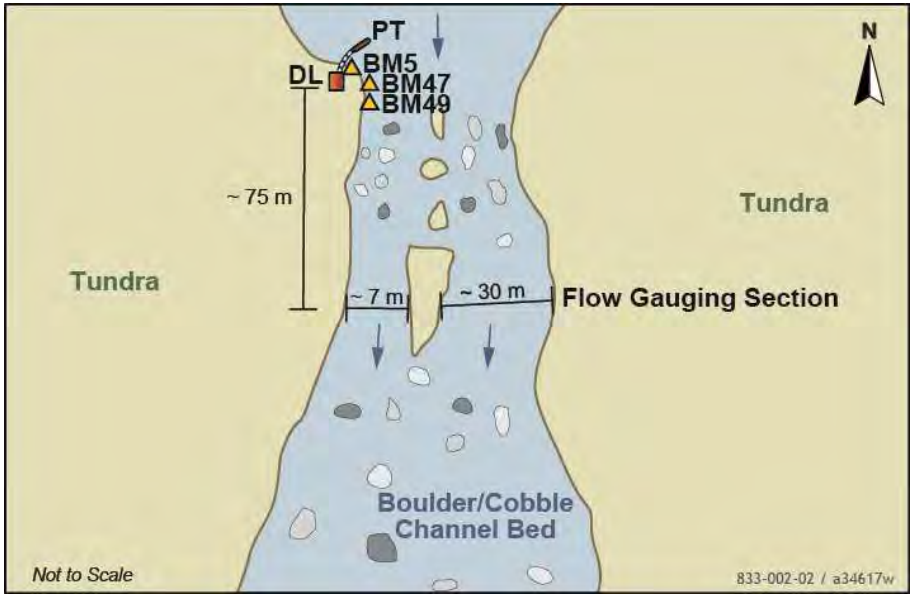
General Comments:

- Wide boulder strewn channel
- Relatively low flow
- Wadeable under all conditions
- Access by helicopter

General Site Information



Site Map



Plan View of Hydrometric Station GI-H1

High angle oblique view of Giraffe Lake outflow. Photograph was taken during very low flow conditions. August 13, 2011.

Site Photo

Appendix 1.7. Station Information Sheet for Hydrometric Station EL-H1

Site ID:	EL-H1	Drainage Area (km^2):	1.4
Site Location:	Near the inflow to Goose Lakes west arm		
UTM:	NAD 83, Zone 13W	432,091 E	7,269,573 N

Benchmarks	Elevation	Description
BM14	100.000	Bolt near the station
BM15	99.915	Bolt downstream from the station
BM16	99.984	Bolt upstream from the station

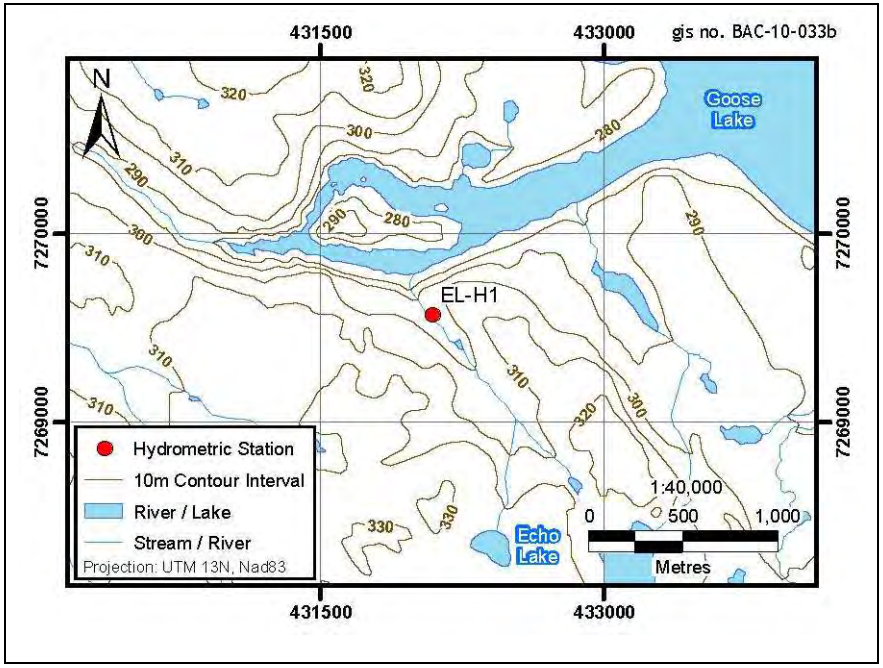
Transducer:	PS-98i	Logger:	ELF-2

Operating Periods:		
2011	June 13 - Sep 16	Established June 13, 2011

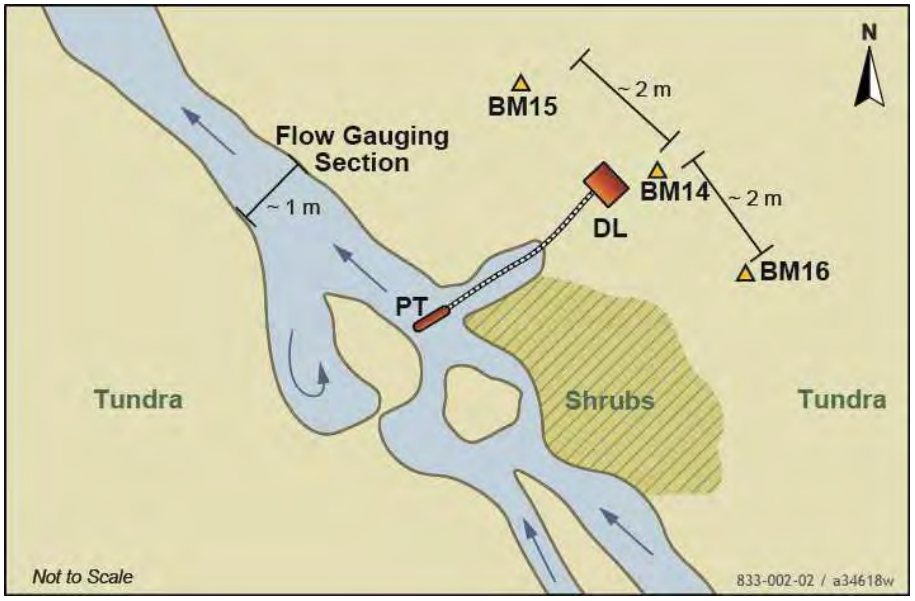
General Comments:

- Ephemeral channel prone to flooding
- Wadeable under all conditions
- Access by helicopter

General Site Information



Site Map



Plan View of Hydrometric Station EL-H1

Low angle view looking downstream along the monitored reach. Note the water flowing through the tundra vegetation of this small ephemeral channel. Due to the ephemeral nature of the stream, the channel is lined with grasses. June 13, 2011.

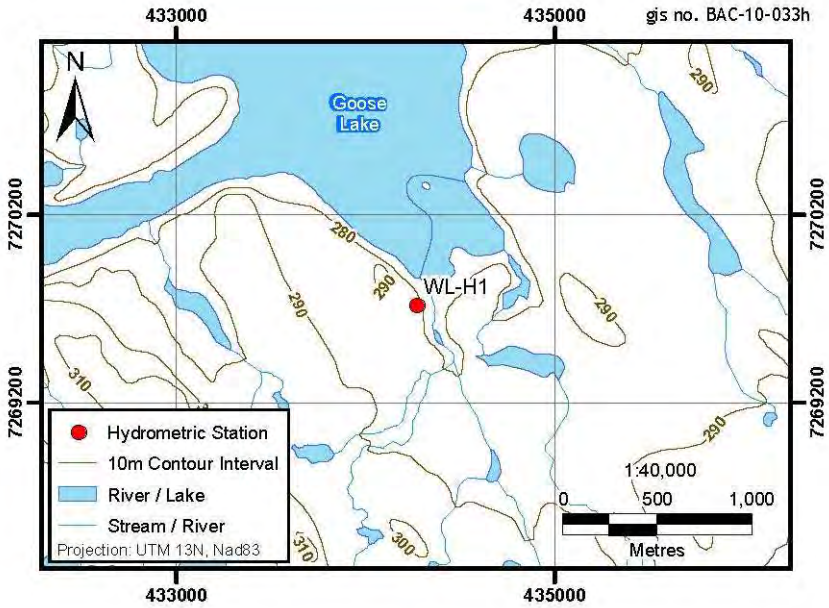
Site Photo

Appendix 1.8. Station Information Sheet for Hydrometric Station WL-H1

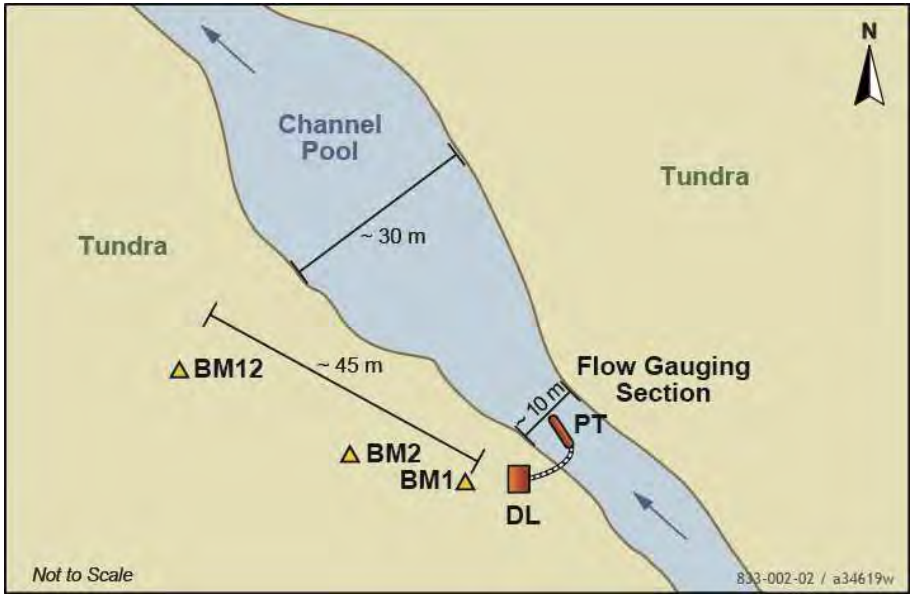
Site ID:	WL-H1	Drainage Area (km^2):	35.1
Site Location:	Near the southern most inflow to Goose Lake		
UTM:	NAD 83, Zone 13W	434,269 E	7,269,719 N
Benchmarks	**Elevation**	**Description**	
BM12	100.00	Bolt ~65m northwest of the station	
BM1	99.207	Tip of drill casing near station	
BM2	99.917	Tip of drill casing between station and BM12	
Transducer:	PS-98i	Logger:	ELF-2
Operating Periods:			
2011	June 10 - Sep 17	Established June 10, 2011	
General Comments:			

- Relatively deep channel
- Relatively low velocity
- Wadeable under most conditions
- Access by helicopter

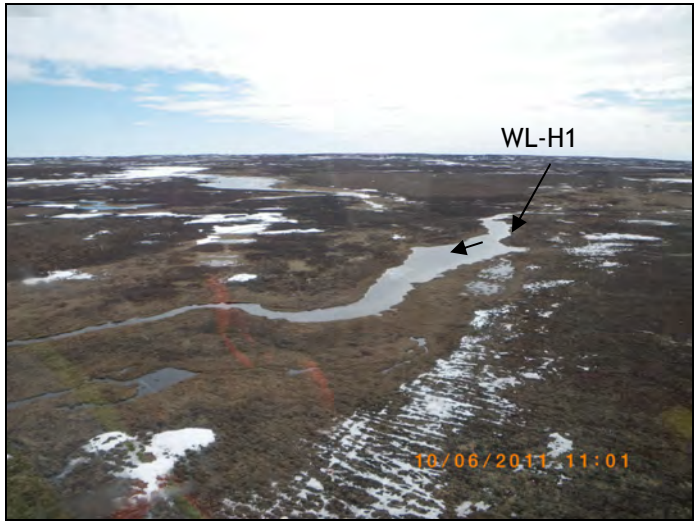
General Site Information



Site Map



Plan View of Hydrometric Station WL-H1



High angle oblique view looking upstream along the monitored reach. The location of the station is indicated in the Photograph. June 10, 2011

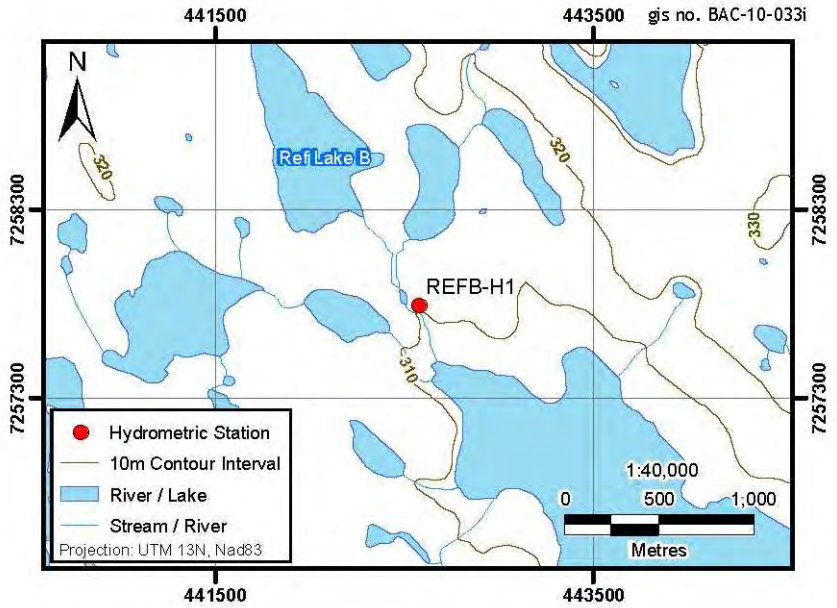
Site Photo

Appendix 1.9. Station Information Sheet for Hydrometric Station REFB-H1

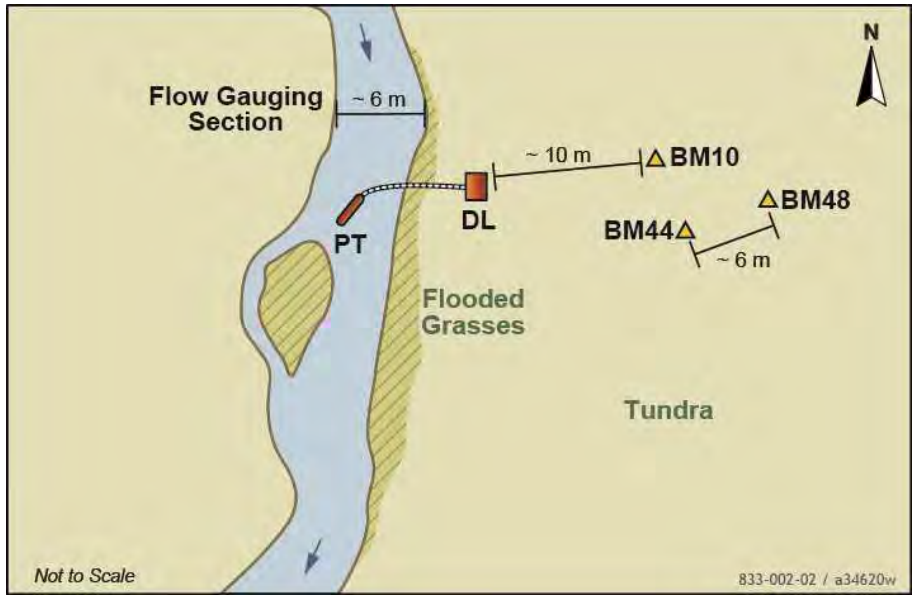
Site ID:	REFB-H1	Drainage Area (km^2):	5.3
Site Location:	Near the outflow of Reference Lake B		
UTM:	NAD 83, Zone 13W	442,573 E	7,257,794 N
Benchmarks	**Elevation**	**Description**	
BM10	100.000	Bolt ~10m west of the data logger	
BM44	99.962	Bolt ~5m south of BM10	
BM48	100.118	Bolt ~ 6m west of BM44	
Transducer:	PS-98i	Logger:	ELF-2
Operating Periods:			
2011	June 13 - Sep 17	Established June 13, 2011	
General Comments:			

- Ephemeral stream
- Soft bed (transducer sinks over the summer)
- Wadeable under all conditions
- Access by helicopter

General Site Information



Site Map



Plan View of Hydrometric Station REFB-H1

High angle oblique view looking east across the monitored reach. The transducer was placed in the pool cantered in the photograph. August 15, 2011.

Site Photo

Appendix 2
Discharge Measurements

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Appendix 2.1. Manual Discharge Measurements at GL-H1 in 2011

Date Monitored:	10-Jun-11	**Pressure Transducer (m):**	0.881
Time (24 hr):	15:40	**Discharge Q (m^3/s):**	0.439
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Notes	Station (m)	Depth (m)	Velocity (m/s)			Calb. Velocity (m/S)	Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%				
left bank	2.00	0.00	0.00			0.03	0.0000	0.0000	0.00
	2.20	0.01	0.00			0.03	0.0010	0.0000	0.01
	2.40	0.21	0.06			0.08	0.0420	0.0033	0.75
	2.60	0.34	0.01			0.03	0.0680	0.0023	0.53
	2.80	0.28	0.07			0.09	0.0560	0.0049	1.12
	3.00	0.25	0.12			0.13	0.0500	0.0066	1.51
	3.20	0.41	0.07			0.09	0.0820	0.0072	1.64
	3.40	0.36	0.12			0.13	0.0720	0.0096	2.18
	3.60	0.38	0.10			0.11	0.0760	0.0087	1.99
	3.80	0.38	0.25			0.25	0.0760	0.0190	4.31
	4.00	0.32	0.26			0.26	0.0640	0.0165	3.76
	4.20	0.39	0.35			0.34	0.0780	0.0265	6.02
	4.40	0.44	0.36			0.35	0.0880	0.0307	6.99
	4.60	0.46	0.39			0.38	0.0920	0.0347	7.91
	4.80	0.38	0.39			0.38	0.0760	0.0287	6.53
	5.00	0.63	0.33			0.32	0.1260	0.0405	9.21
	5.20	0.61	0.40			0.39	0.1220	0.0472	10.75
	5.40	0.66	0.42			0.41	0.1320	0.0536	12.21
	5.60	0.68	0.46			0.44	0.1360	0.0605	13.76
	5.80	0.15	0.28			0.28	0.0300	0.0083	1.89
	6.00	0.15	0.28			0.28	0.0300	0.0083	1.89
	6.20	0.11	0.29			0.29	0.0220	0.0063	1.43
	6.40	0.12	0.27			0.27	0.0240	0.0064	1.46
	6.60	0.14	0.15			0.16	0.0280	0.0045	1.02
	6.80	0.15	0.16			0.17	0.0300	0.0051	1.15
right bank	7.00	0.00	0.00			0.03	0.0000	0.0000	0.00
Total Q								**0.439**	

Appendix 2.1. Manual Discharge Measurements at GL-H1 in 2011

Date Monitored:	15-Jun-11	**Pressure Transducer (m):**	0.948
Time (24 hr):	13:50	**Mean Discharge Q (m^3/s):**	0.615
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Notes	Station (m)	Depth (m)	Velocity (m/s) 60%	20%	80%	Calb. Velocity (m/S)	Cross Sectional Area	Q (m^3/s)	% of Total Q
right bank	7.40	0.00	0.00			0.03	0.0000	0.0000	0.00
	7.30	0.26	0.31			0.30	0.0390	0.0118	1.92
	7.10	0.35	0.11			0.12	0.0700	0.0087	1.41
	6.90	0.22	0.41			0.40	0.0440	0.0175	2.84
	6.70	0.14	0.38			0.37	0.0280	0.0103	1.68
	6.50	0.19	0.44			0.43	0.0380	0.0162	2.63
	6.30	0.85	0.28	0.46	0.10	0.28	0.1700	0.0470	7.64
	6.10	0.77	0.45	0.47	0.42	0.43	0.1540	0.0663	10.77
	5.90	0.69	0.43			0.42	0.1380	0.0574	9.33
rock in 80% reading	5.70	0.79	0.26	0.46	0.06	0.26	0.1580	0.0408	6.64
	5.50	0.62	0.38			0.37	0.1230	0.0453	7.36
	5.30	0.71	0.40			0.39	0.1420	0.0550	8.94
	5.10	0.55	0.41			0.40	0.1100	0.0437	7.10
	4.90	0.56	0.38			0.37	0.1120	0.0412	6.70
	4.70	0.43	0.38			0.37	0.0860	0.0317	5.15
	4.50	0.44	0.34			0.33	0.0880	0.0291	4.72
	4.30	0.44	0.15			0.16	0.0870	0.0139	2.26
	4.10	0.40	0.23			0.23	0.0800	0.0185	3.01
	3.90	0.44	0.18			0.19	0.0880	0.0164	2.67
	3.70	0.50	0.13			0.14	0.1000	0.0142	2.30
	3.50	0.42	0.14			0.15	0.0840	0.0127	2.06
	3.30	0.40	0.12			0.13	0.0800	0.0106	1.73
	3.10	0.27	0.08			0.10	0.0472	0.0046	0.74
	2.95	0.38	0.03			0.05	0.0494	0.0026	0.42
left bank	2.84	0.00	0.00			0.03	0.0000	0.0000	0.00
Total Q								**0.615**	

Note: if taking velocity readings at 20% and 80% of water depth then the 60% velocity value will be calculated as follows.

V60% = (V20% +V80%)/2

Appendix 2.1. Manual Discharge Measurements at GL-H1 in 2011

Date Monitored:	8-Jul-11	**Pressure Transducer (m):**	0.772
Time (24 hr):	16:00	**Mean Discharge Q (m^3/s):**	0.247
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40		

			Velocity (m/s)			Cross Sectional		
Notes	**Station (m)**	**Depth (m)**	**60%**	**20%**	**80%**	**Area**	**Q (m^3/s)**	**% of Total Q**
RB	1.05	0.00	0.00			0.0000	0.0000	0.00
	1.10	0.07	0.10			0.0088	0.0009	0.35
	1.30	0.17	0.08			0.0340	0.0027	1.10
	1.50	0.16	0.14			0.0320	0.0045	1.81
	1.70	0.26	0.12			0.0520	0.0062	2.52
	1.90	0.25	0.14			0.0500	0.0070	2.83
	2.10	0.46	0.09			0.0920	0.0083	3.35
	2.30	0.47	0.08			0.0940	0.0075	3.04
	2.50	0.66	0.24			0.0990	0.0238	9.61
	2.60	0.65	0.19			0.0650	0.0124	4.99
	2.70	0.50	0.36			0.0500	0.0180	7.28
	2.80	0.40	0.43			0.0400	0.0172	6.96
	2.90	0.35	0.48			0.0350	0.0168	6.79
	3.00	0.32	0.44			0.0480	0.0211	8.54
	3.20	0.25	0.43			0.0500	0.0215	8.69
	3.40	0.20	0.43			0.0400	0.0172	6.96
	3.60	0.21	0.37			0.0420	0.0155	6.28
	3.80	0.22	0.33			0.0440	0.0145	5.87
	4.00	0.18	0.36			0.0360	0.0130	5.24
	4.20	0.14	0.37			0.0280	0.0104	4.19
	4.40	0.10	0.34			0.0200	0.0068	2.75
	4.60	0.04	0.23			0.0090	0.0021	0.84
	4.85	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.247**	

Appendix 2.1. Manual Discharge Measurements at GL-H1 in 2011

Date Monitored:	14-Aug-11	**Pressure Transducer (m):**	0.087
Time (24 hr):	11:50	**Mean Discharge Q (m^3/s):**	0.007
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
right bank	1.80	0.00	0.00			0.0000	0.0000	0.00
	1.85	0.09	0.02			0.0068	0.0001	1.96
	1.95	0.10	0.00			0.0100	0.0000	0.00
	2.05	0.11	0.00			0.0110	0.0000	0.00
	2.15	0.10	-0.01			0.0100	-0.0001	-1.45
	2.25	0.10	-0.01			0.0100	-0.0001	-1.45
	2.35	0.12	0.01			0.0120	0.0001	1.74
	2.45	0.10	0.03			0.0075	0.0002	3.26
	2.50	0.09	0.02			0.0045	0.0001	1.30
	2.55	0.08	0.01			0.0040	0.0000	0.58
	2.60	0.11	0.03			0.0055	0.0002	2.39
	2.65	0.20	0.09			0.0100	0.0009	13.03
	2.70	0.19	0.12			0.0095	0.0011	16.51
	2.75	0.17	0.14			0.0085	0.0012	17.23
	2.80	0.16	0.13			0.0080	0.0010	15.06
	2.85	0.13	0.11			0.0065	0.0007	10.35
	2.90	0.12	0.11			0.0060	0.0007	9.56
	2.95	0.11	0.08			0.0055	0.0004	6.37
	3.00	0.10	0.03			0.0075	0.0002	3.26
	3.10	0.02	0.01			0.0020	0.0000	0.29
	3.20	0.06	0.00			0.0105	0.0000	0.00
left bank	3.45	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.007**	

Appendix 2.1. Manual Discharge Measurements at GL-H1 in 2011

Date Monitored:	16-Sep-11	**Pressure Transducer (m):**	0.814
Time (24 hr):	13:08	**Mean Discharge Q (m^3/s):**	0.270
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40		

			Velocity (m/s)			Cross Sectional		
Notes	**Station (m)**	**Depth (m)**	**60%**	**20%**	**80%**	**Area**	**Q (m^3/s)**	**% of Total Q**
right bank	0.35	0.00	0.00			0.0000	0.0000	0.00
	0.40	0.08	0.16			0.0060	0.0010	0.36
	0.50	0.04	0.16			0.0040	0.0006	0.24
	0.60	0.18	0.32			0.0180	0.0058	2.13
	0.70	0.22	0.32			0.0220	0.0070	2.60
	0.80	0.44	0.38			0.0440	0.0167	6.18
	0.90	0.44	0.46			0.0440	0.0202	7.49
	1.00	0.41	0.54			0.0410	0.0221	8.19
	1.10	0.51	0.49			0.0510	0.0250	9.24
	1.20	0.36	0.55			0.0360	0.0198	7.32
	1.30	0.34	0.55			0.0340	0.0187	6.92
	1.40	0.33	0.61			0.0330	0.0201	7.45
	1.50	0.26	0.56			0.0260	0.0146	5.39
	1.60	0.24	0.61			0.0240	0.0146	5.41
	1.70	0.20	0.60			0.0200	0.0120	4.44
	1.80	0.18	0.59			0.0180	0.0106	3.93
	1.90	0.17	0.61			0.0170	0.0104	3.84
	2.00	0.17	0.52			0.0170	0.0088	3.27
	2.10	0.24	0.45			0.0240	0.0108	3.99
	2.20	0.28	0.39			0.0280	0.0109	4.04
	2.30	0.26	0.33			0.0260	0.0086	3.17
	2.40	0.25	0.21			0.0250	0.0053	1.94
	2.50	0.28	0.00			0.0280	0.0000	0.00
	2.60	0.17	0.25			0.0170	0.0043	1.57
	2.70	0.13	0.14			0.0130	0.0018	0.67
	2.80	0.11	0.04			0.0110	0.0004	0.16
	2.90	0.08	0.02			0.0080	0.0002	0.06
	3.00	0.08	0.00			0.0080	0.0000	0.00
left bank	3.10	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.270**	

Appendix 2.2. Manual Discharge Measurements at GL-H2 in 2011

Date Monitored:	10-Jun-11	**Pressure Transducer (m):**	0.297
Time (24 hr):	18:00	**Discharge Q (m^3/s):**	0.075
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Notes	Station (m)	Depth (m)	Velocity (m/s)			Calb. Velocity (m/S)	Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%				
left bank	3.30	0.00	0.00			0.03	0.0000	0.0000	0.00
	3.15	0.14	0.16			0.17	0.0175	0.0030	3.92
	3.05	0.17	0.23			0.23	0.0170	0.0039	5.22
	2.95	0.19	0.25			0.25	0.0190	0.0047	6.29
	2.85	0.19	0.22			0.22	0.0190	0.0042	5.61
	2.75	0.20	0.22			0.22	0.0200	0.0045	5.91
	2.65	0.20	0.18			0.19	0.0200	0.0037	4.95
	2.55	0.19	0.22			0.22	0.0190	0.0042	5.61
behind rock	2.45	0.15	0.01			0.03	0.0150	0.0005	0.68
behind rock	2.35	0.15	0.04			0.06	0.0150	0.0009	1.21
	2.25	0.21	0.16			0.17	0.0210	0.0035	4.70
	2.15	0.21	0.12			0.13	0.0210	0.0028	3.70
	2.05	0.22	0.12			0.13	0.0220	0.0029	3.88
	1.95	0.21	0.07			0.09	0.0210	0.0018	2.45
	1.85	0.22	0.08			0.10	0.0220	0.0021	2.83
	1.75	0.24	0.13			0.14	0.0240	0.0034	4.51
	1.65	0.24	0.08			0.10	0.0240	0.0023	3.09
	1.55	0.20	0.25			0.25	0.0200	0.0050	6.62
	1.45	0.18	0.30			0.29	0.0180	0.0053	7.03
	1.35	0.18	0.29			0.29	0.0180	0.0051	6.82
	1.25	0.18	0.24			0.24	0.0180	0.0043	5.74
	1.15	0.21	0.17			0.18	0.0210	0.0037	4.95
	1.05	0.17	0.13			0.14	0.0145	0.0020	2.72
	0.98	0.15	0.06			0.08	0.0150	0.0012	1.57
right bank	0.85	0.00	0.00			0.03	0.0000	0.0000	0.00
Total Q								**0.075**	

Appendix 2.2. Manual Discharge Measurements at GL-H2 in 2011

Date Monitored:	15-Jun-11	**Pressure Transducer (m):**	0.342
Time (24 hr):	8:20	**Discharge Q (m^3/s):**	0.121
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Notes	Station (m)	Depth (m)	Velocity (m/s)			Calb. Velocity (m/S)	Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%				
right bank	1.50	0.00	0.00			0.03	0.0000	0.0000	0.00
	1.60	0.16	0.08			0.10	0.0160	0.0016	1.28
	1.70	0.16	0.25			0.25	0.0160	0.0040	3.28
	1.80	0.15	0.26			0.26	0.0150	0.0039	3.19
	1.90	0.20	0.28			0.28	0.0200	0.0055	4.55
	2.00	0.21	0.36			0.35	0.0210	0.0073	6.03
	2.10	0.22	0.38			0.37	0.0220	0.0081	6.66
	2.20	0.24	0.32			0.31	0.0240	0.0075	6.17
rock ~1m upstream	2.30	0.27	0.15			0.16	0.0270	0.0043	3.55
rock ~1m upstream	2.40	0.28	0.14			0.15	0.0280	0.0042	3.47
rock ~1m upstream	2.50	0.25	0.21			0.21	0.0250	0.0053	4.39
rock ~1m upstream	2.60	0.24	0.16			0.17	0.0240	0.0040	3.33
rock ~1m upstream	2.70	0.25	0.18			0.19	0.0250	0.0047	3.84
rock ~1m upstream	2.80	0.23	0.20			0.20	0.0230	0.0047	3.87
	2.90	0.24	0.29			0.29	0.0240	0.0068	5.64
rock upstream	3.00	0.26	0.07			0.09	0.0260	0.0023	1.88
rock upstream	3.10	0.16	0.06			0.08	0.0160	0.0013	1.04
	3.20	0.20	0.27			0.27	0.0200	0.0053	4.40
	3.30	0.20	0.36			0.35	0.0200	0.0070	5.74
	3.40	0.20	0.32			0.31	0.0200	0.0062	5.14
	3.50	0.23	0.35			0.34	0.0225	0.0076	6.28
	3.60	0.21	0.37			0.36	0.0210	0.0075	6.20
	3.70	0.20	0.31			0.30	0.0200	0.0061	4.99
	3.80	0.19	0.24			0.24	0.0161	0.0039	3.20
	3.87	0.20	0.13			0.14	0.0160	0.0023	1.87
left bank	3.96	0.00	0.00			0.03	0.0000	0.0000	0.00
Total Q								**0.121**	

Appendix 2.2. Manual Discharge Measurements at GL-H2 in 2011

Date Monitored:	8-Jul-11	**Pressure Transducer (m):**	0.284
Time (24 hr):	14:50	**Discharge Q (m^3/s):**	0.063
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
left bank	0.80	0.00	0.00			0.0000	0.0000	0.00
grass	1.00	0.06	0.00			0.0120	0.0000	0.00
	1.20	0.10	0.02			0.0150	0.0003	0.48
	1.30	0.11	0.14			0.0110	0.0015	2.45
	1.40	0.18	0.22			0.0180	0.0040	6.30
	1.50	0.18	0.21			0.0180	0.0038	6.02
	1.60	0.18	0.29			0.0180	0.0052	8.31
	1.70	0.22	0.29			0.0220	0.0064	10.16
	1.80	0.22	0.27			0.0220	0.0059	9.46
	1.90	0.22	0.31			0.0220	0.0068	10.86
	2.00	0.22	0.17			0.0220	0.0037	5.95
	2.10	0.22	0.13			0.0220	0.0029	4.55
	2.20	0.22	0.04			0.0220	0.0009	1.40
	2.30	0.20	0.27			0.0200	0.0054	8.60
	2.40	0.16	0.20			0.0160	0.0032	5.09
	2.50	0.16	0.16			0.0160	0.0026	4.08
	2.60	0.14	0.28			0.0140	0.0039	6.24
	2.70	0.14	0.15			0.0140	0.0021	3.34
	2.80	0.21	0.10			0.0210	0.0021	3.34
	2.90	0.26	0.07			0.0260	0.0018	2.90
	3.00	0.24	0.01			0.0300	0.0003	0.48
right bank	3.15	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.063**	

Appendix 2.2. Manual Discharge Measurements at GL-H2 in 2011

Date Monitored:	12-Aug-11	**Pressure Transducer (m):**	0.177
Time (24 hr):	14:40	**Discharge Q (m^3/s):**	0.000
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
left bank	1.95	0.00	0.00			0.0000	0.0000	0.00
	2.05	0.09	-0.01			0.0068	-0.0001	-23.08
	2.10	0.12	0.00			0.0090	0.0000	0.00
	2.20	0.15	0.01			0.0150	0.0002	51.28
	2.30	0.21	0.00			0.0210	0.0000	0.00
	2.40	0.22	-0.01			0.0220	-0.0002	-75.21
	2.50	0.23	0.00			0.0230	0.0000	0.00
	2.60	0.22	0.01			0.0220	0.0002	75.21
	2.70	0.20	-0.01			0.0200	-0.0002	-68.38
	2.80	0.21	-0.01			0.0210	-0.0002	-71.79
	2.90	0.14	0.01			0.0140	0.0001	47.86
	3.00	0.17	0.01			0.0170	0.0002	58.12
	3.10	0.13	0.01			0.0130	0.0001	44.44
	3.20	0.17	-0.01			0.0170	-0.0002	-58.12
	3.30	0.16	0.00			0.0160	0.0000	0.00
	3.40	0.16	0.00			0.0160	0.0000	0.00
	3.50	0.14	0.01			0.0105	0.0001	35.90
	3.55	0.11	0.02			0.0055	0.0001	37.61
	3.60	0.11	0.01			0.0055	0.0001	18.80
	3.65	0.16	0.01			0.0080	0.0001	27.35
	3.70	0.12	0.00			0.0090	0.0000	0.00
	3.80	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.000**	

Appendix 2.2. Manual Discharge Measurements at GL-H2 in 2011

Date Monitored:	16-Sep-11	**Pressure Transducer (m):**	0.275
Time (24 hr):	11:00	**Discharge Q (m^3/s):**	0.046
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
right bank	0.50	0.00	0.00			0.0000	0.0000	0.00
	0.60	0.08	-0.02			0.0080	-0.0002	-0.35
	0.70	0.18	0.13			0.0180	0.0023	5.07
	0.80	0.16	0.22			0.0160	0.0035	7.62
	0.90	0.21	0.06			0.0210	0.0013	2.73
	1.00	0.18	0.23			0.0180	0.0041	8.96
	1.10	0.22	0.17			0.0220	0.0037	8.10
	1.20	0.16	0.26			0.0160	0.0042	9.01
	1.30	0.15	0.18			0.0150	0.0027	5.85
	1.40	0.20	0.02			0.0200	0.0004	0.87
	1.50	0.20	0.21			0.0200	0.0042	9.09
	1.60	0.20	0.22			0.0200	0.0044	9.53
	1.70	0.19	0.21			0.0190	0.0040	8.64
	1.80	0.20	0.19			0.0200	0.0038	8.23
	1.90	0.18	0.12			0.0180	0.0022	4.68
	2.00	0.19	0.10			0.0190	0.0019	4.11
	2.10	0.16	0.17			0.0160	0.0027	5.89
	2.20	0.12	0.06			0.0120	0.0007	1.56
	2.30	0.10	0.02			0.0100	0.0002	0.43
	2.40	0.06	0.00			0.0045	0.0000	0.00
	2.45	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.046**	

Appendix 2.3. Manual Discharge Measurements at GL-H3 in 2011

Date Monitored:	14-Jun-11	**Pressure Transducer (m):**	0.962
Time (24 hr):	11:00	**Discharge Q (m^3/s):**	0.648
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Notes	Station (m)	Depth (m)	Velocity (m/s)			Calb. Velocity (m/S)	Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%				
right bank	2.60	0.00	0.00			0.03	0.0000	0.0000	0.00
	2.90	0.17	0.03			0.05	0.0340	0.0018	0.27
	3.00	0.21	0.31			0.30	0.0210	0.0064	0.98
	3.10	0.29	0.60			0.58	0.0290	0.0168	2.59
	3.20	0.30	0.65			0.63	0.0300	0.0188	2.90
	3.30	0.35	0.69			0.67	0.0350	0.0233	3.59
	3.40	0.34	0.61			0.59	0.0340	0.0200	3.09
	3.50	0.36	0.59			0.57	0.0360	0.0205	3.16
	3.60	0.37	0.96			0.92	0.0370	0.0342	5.27
	3.70	0.38	1.16			1.12	0.0380	0.0424	6.54
	3.80	0.44	1.15			1.11	0.0440	0.0487	7.51
	3.90	0.48	1.13			1.09	0.0480	0.0522	8.05
	4.00	0.50	1.19			1.14	0.0500	0.0572	8.83
	4.10	0.47	1.26			1.21	0.0470	0.0569	8.78
	4.20	0.43	1.31			1.26	0.0425	0.0535	8.26
	4.30	0.41	1.33			1.28	0.0410	0.0524	8.09
	4.40	0.40	1.37			1.32	0.0400	0.0527	8.13
	4.50	0.35	0.94			0.90	0.0350	0.0317	4.89
	4.60	0.30	0.79			0.76	0.0300	0.0228	3.52
	4.70	0.24	0.52			0.50	0.0240	0.0121	1.86
	4.80	0.18	0.67			0.65	0.0180	0.0116	1.79
	4.90	0.14	0.52			0.50	0.0245	0.0123	1.90
left bank	5.15	0.00	0.00			0.03	0.0000	0.0000	0.00
Total Q								**0.648**	

Appendix 2.3. Manual Discharge Measurements at GL-H3 in 2011

Date Monitored:	15-Jun-11	**Pressure Transducer (m):**	0.943
Time (24 hr):	17:00	**Discharge Q (m^3/s):**	0.478
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Notes	Station (m)	Depth (m)	Velocity (m/s)			Calb. Velocity (m/S)	Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%				
right bank	2.60	0.00	0.00			0.03	0.0000	0.0000	0.00
	2.80	0.08	0.00			0.03	0.0120	0.0003	0.06
	2.90	0.18	0.00			0.03	0.0180	0.0005	0.09
	3.00	0.20	0.19			0.20	0.0200	0.0039	0.82
	3.10	0.26	0.24			0.24	0.0260	0.0063	1.31
	3.20	0.29	0.75			0.72	0.0290	0.0210	4.38
	3.30	0.32	0.60			0.58	0.0320	0.0185	3.87
	3.40	0.37	0.50			0.48	0.0370	0.0179	3.74
	3.50	0.38	0.51			0.49	0.0380	0.0187	3.91
	3.60	0.36	0.97			0.93	0.0360	0.0336	7.03
	3.70	0.38	1.00			0.96	0.0380	0.0366	7.64
	3.80	0.41	0.95			0.91	0.0410	0.0375	7.84
	3.90	0.45	0.97			0.93	0.0450	0.0420	8.78
	4.00	0.44	0.96			0.92	0.0440	0.0406	8.50
	4.10	0.42	1.05			1.01	0.0420	0.0424	8.87
	4.20	0.39	1.12			1.08	0.0390	0.0420	8.78
	4.30	0.38	1.16			1.12	0.0380	0.0424	8.86
	4.40	0.34	1.09			1.05	0.0340	0.0356	7.45
	4.50	0.31	0.50			0.48	0.0310	0.0150	3.13
	4.60	0.27	0.28			0.28	0.0265	0.0073	1.53
	4.70	0.23	0.36			0.35	0.0225	0.0079	1.64
	4.80	0.16	0.35			0.34	0.0160	0.0054	1.14
	4.90	0.10	0.19			0.20	0.0150	0.0029	0.61
left bank	5.10	0.00	0.00			0.03	0.0000	0.0000	0.00
Total Q								**0.478**	

Appendix 2.3. Manual Discharge Measurements at GL-H3 in 2011

Date Monitored:	9-Jul-11	**Pressure Transducer (m):**	0.902
Time (24 hr):	12:22	**Discharge Q (m^3/s):**	0.075
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
	1.60	0.00	0.00			0.0000	0.0000	0.00
	1.70	0.02	0.00			0.0020	0.0000	0.00
	1.80	0.08	0.00			0.0080	0.0000	0.00
	1.90	0.19	0.00			0.0190	0.0000	0.00
	2.00	0.21	0.00			0.0210	0.0000	0.00
	2.10	0.20	0.01			0.0200	0.0002	0.27
	2.20	0.20	0.02			0.0200	0.0004	0.54
	2.30	0.21	0.03			0.0210	0.0006	0.84
	2.40	0.28	0.02			0.0280	0.0006	0.75
	2.50	0.24	0.08			0.0240	0.0019	2.57
	2.60	0.24	0.26			0.0240	0.0062	8.36
	2.70	0.27	0.30			0.0270	0.0081	10.85
	2.80	0.29	0.30			0.0290	0.0087	11.66
	2.90	0.30	0.32			0.0300	0.0096	12.87
	3.00	0.30	0.33			0.0300	0.0099	13.27
	3.10	0.30	0.34			0.0300	0.0102	13.67
	3.20	0.28	0.34			0.0280	0.0095	12.76
	3.30	0.25	0.31			0.0250	0.0078	10.39
	3.40	0.18	0.05			0.0180	0.0009	1.21
	3.50	0.16	0.00			0.0480	0.0000	0.00
	4.00	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.075**	

Appendix 2.3. Manual Discharge Measurements at GL-H3 in 2011

Date Monitored:	16-Sep-11	**Pressure Transducer (m):**	0.910
Time (24 hr):	16:20	**Discharge Q (m^3/s):**	0.172
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
right bank	0.80	0.00	0.00			0.0000	0.0000	0.00
	0.90	0.09	-0.04			0.0090	-0.0004	-0.21
	1.00	0.12	-0.03			0.0120	-0.0004	-0.21
	1.10	0.17	0.04			0.0170	0.0007	0.39
	1.20	0.20	0.12			0.0200	0.0024	1.39
	1.30	0.24	0.17			0.0240	0.0041	2.37
	1.40	0.27	0.13			0.0270	0.0035	2.04
	1.50	0.31	0.11			0.0310	0.0034	1.98
	1.60	0.38	0.41			0.0380	0.0156	9.05
	1.70	0.40	0.31			0.0400	0.0124	7.20
	1.80	0.42	0.34			0.0420	0.0143	8.29
	1.90	0.40	0.41			0.0400	0.0164	9.52
	2.00	0.40	0.44			0.0400	0.0176	10.22
	2.10	0.43	0.44			0.0430	0.0189	10.99
	2.20	0.44	0.44			0.0440	0.0194	11.24
	2.30	0.42	0.43			0.0420	0.0181	10.49
	2.40	0.42	0.42			0.0420	0.0176	10.24
	2.50	0.35	0.17			0.0350	0.0060	3.46
	2.60	0.27	0.05			0.0270	0.0014	0.78
	2.70	0.20	0.01			0.0300	0.0003	0.17
	2.90	0.10	0.05			0.0200	0.0010	0.58
	3.10	0.12	0.00			0.0180	0.0000	0.00
left bank	3.20	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.172**	

Appendix 2.4. Manual Discharge Measurements at PL-H1 in 2011

Date Monitored:	14-Jun-11	**Pressure Transducer (m):**	0.768
Time (24 hr):	17:00	**Water Temperature-ADCP(°C):**	4
Personnel:	C.Hall, X.Pinto	**Water Temperature-Thermometer(°C):**	n/a
Method:	Velocity - area with ADCP	**Mean Discharge Q (m^3/s):**	7.34
Instrument Model:	Teledyne/RDI StreamPro	**Error (Std dev m^3/s)**	0.15
Instrument Serial#:	947	**Mean % Q Measured**	77.4

	Discharge Q (m^3/s)							% Bad	
Transect #	**Top**	**Mid**	**Bottom**	**Left**	**Right**	**Total Q**	**% Q Measured**	**Ensembles**	**Bins**
1	0.739	5.664	0.826	0.069	0.074	7.372	76.8	8	5
2	0.719	5.544	0.718	0.06	0.08	7.121	77.9	12	4
3	0.733	5.732	0.755	0.084	0.083	7.387	77.6	10	3
4	0.757	5.763	0.806	0.079	0.065	7.470	77.1	11	5
Mean	**0.737**	**5.676**	**0.776**	**0.073**	**0.076**	**7.34**	**77.36**	**10.25**	**4.25**

Date Monitored:	16-Jun-11	**Pressure Transducer (m):**	0.779
Time (24 hr):	9:00	**Water Temperature-ADCP(°C):**	4.3
Personnel:	C.Hall, X.Pinto	**Water Temperature-Thermometer(°C):**	n/a
Method:	Velocity - area with ADCP	**Mean Discharge Q (m^3/s):**	9.08
Instrument Model:	Teledyne/RDI StreamPro	**Error (Std dev m^3/s)**	0.12
Instrument Serial#:	947	**Mean % Q Measured**	76.9

	Discharge Q (m^3/s)							% Bad	
Transect #	**Top**	**Mid**	**Bottom**	**Left**	**Right**	**Total Q**	**% Q Measured**	**Ensembles**	**Bins**
1	0.778	6.27	0.868	0.097	0.076	8.089	77.5	7	7
2	0.767	6.11	0.851	0.093	0.123	7.944	76.9	12	6
3	0.784	6.14	0.928	0.084	0.106	8.042	76.3	20	6
4	0.797	6.34	0.876	0.091	0.135	8.239	77.0	14	5
Mean	**0.782**	**6.215**	**0.881**	**0.091**	**0.110**	**8.08**	**76.93**	**13.25**	**6.00**

Date Monitored:	10-Jul-11	**Pressure Transducer (m):**	0.642
Time (24 hr):	9:30	**Water Temperature-ADCP(°C):**	11.8
Personnel:	C.Hall	**Water Temperature-Thermometer(°C):**	n/a
Method:	Velocity - area with ADCP	**Mean Discharge Q (m^3/s):**	4.57
Instrument Model:	Teledyne/RDI StreamPro	**Error (Std dev m^3/s)**	0.17
Instrument Serial#:	947	**Mean % Q Measured**	61.2

	Discharge Q (m^3/s)							% Bad	
Transect #	**Top**	**Mid**	**Bottom**	**Left**	**Right**	**Total Q**	**% Q Measured**	**Ensembles**	**Bins**
1	0.598	2.64	1.08	0.013	0.06	4.391	60.1	14	4
2	0.637	2.87	1.04	0.028	0.061	4.636	61.9	13	3
3	0.604	2.8	0.999	0.032	0.062	4.497	62.3	12	3
4	0.654	2.89	1.14	0.021	0.07	4.775	60.5	11	5
Mean	**0.623**	**2.800**	**1.065**	**0.024**	**0.063**	**4.57**	**61.20**	**12.50**	**3.75**

Date Monitored:	12-Aug-11	**Pressure Transducer (m):**	0.224
Time (24 hr):	11:00	**Water Temperature-ADCP(°C):**	13.3
Personnel:	C.Hall	**Water Temperature-Thermometer(°C):**	n/a
Method:	Velocity - area with ADCP	**Mean Discharge Q (m^3/s):**	0.12
Instrument Model:	Teledyne/RDI StreamPro	**Error (Std dev m^3/s)**	0.07
Instrument Serial#:	947	**Mean % Q Measured**	55.8

	Discharge Q (m^3/s)							% Bad	
Transect #	**Top**	**Mid**	**Bottom**	**Left**	**Right**	**Total Q**	**% Q Measured**	**Ensembles**	**Bins**
1	0.001	0.021	0.001	0.012	0.035	0.070	30.0	13	61
2	0.012	0.081	0.060	-0.046	-0.053	0.054	150.0	11	63
3	-0.023	0.047	0.000	0.085	0.023	0.132	35.6	12	63
4	0.025	0.016	0.239	-0.035	-0.038	0.207	7.7	16	65
Mean	**0.004**	**0.041**	**0.075**	**0.004**	**-0.008**	**0.12**	**55.83**	**13.00**	**63.00**

Appendix 2.4. Manual Discharge Measurements at PL-H1 in 2011

Date Monitored:	17-Sep-11	**Pressure Transducer (m):**	0.599
Time (24 hr):	8:40	**Water Temperature-ADCP(°C):**	
Personnel:	C.Hall	**Water Temperature-Thermometer(°C):**	
Method:	Velocity - area with ADCP	**Mean Discharge Q (m^3/s):**	3.93
Instrument Model:	Teledyne/RDI StreamPro	**Error (Std dev m^3/s)**	0.04
Instrument Serial#:	947	**Mean % Q Measured**	65.9

	Discharge Q (m^3/s)							% Bad	
Transect #	**Top**	**Mid**	**Bottom**	**Left**	**Right**	**Total Q**	**% Q Measured**	**Ensembles**	**Bins**
1	0.435	2.560	0.776	0.059	0.070	3.900	65.6	11	8
2	0.452	2.600	0.804	0.062	0.068	3.986	65.2	9	9
3	0.448	2.570	0.806	0.040	0.048	3.912	65.7	15	9
4	0.446	2.570	0.794	0.044	0.048	3.902	65.9	8	10
Mean	**0.445**	**2.575**	**0.795**	**0.051**	**0.059**	**3.93**	**65.61**	**10.75**	**9.00**

Appendix 2.5. Manual Discharge Measurements at PL-H2 in 2011

Date Monitored:	11-Jun-11	**Pressure Transducer (m):**	0.503
Time (24 hr):	10:00	**Discharge Q (m^3/s):**	1.813
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Notes	Station (m)	Depth (m)	Velocity (m/s)			Calb. Velocity (m/S)	Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%				
right bank	2.40	0.00	0.00			0.03	0.00	0.00	0.00
	3.00	0.28	0.00			0.03	0.11	0.00	0.16
	3.20	0.34	0.09			0.11	0.17	0.02	0.99
	4.00	0.25	0.05			0.07	0.35	0.02	1.35
	6.00	0.13	0.06			0.08	0.29	0.02	1.27
	8.50	0.23	0.10			0.11	0.46	0.05	2.91
	10.00	0.11	0.17			0.18	0.19	0.03	1.89
	12.00	0.12	0.18			0.19	0.24	0.04	2.47
	14.00	0.16	0.08			0.10	0.32	0.03	1.71
	16.00	0.26	0.16			0.17	0.52	0.09	4.84
	18.00	0.19	0.33			0.32	0.38	0.12	6.73
	20.00	0.28	0.29			0.29	0.56	0.16	8.81
	22.00	0.33	0.35			0.34	0.66	0.22	12.35
	24.00	0.20	0.41			0.40	0.40	0.16	8.76
	26.00	0.27	0.22			0.22	0.54	0.12	6.63
	28.00	0.18	0.25			0.25	0.36	0.09	4.95
	30.00	0.19	0.22			0.22	0.38	0.08	4.66
	32.00	0.19	0.21			0.21	0.38	0.08	4.48
	34.00	0.21	0.16			0.17	0.42	0.07	3.91
	36.00	0.34	0.08			0.10	0.68	0.07	3.63
	38.00	0.27	0.10			0.11	0.54	0.06	3.42
	40.00	0.20	0.08			0.10	0.40	0.04	2.14
	42.00	0.27	0.16			0.17	0.62	0.10	5.78
	44.60	0.19	0.13			0.14	0.38	0.05	2.97
	46.00	0.18	0.25			0.25	0.22	0.05	2.97
	47.00	0.18	0.01			0.03	0.12	0.00	0.21
left bank	47.30	0.00	0.00			0.03	0.00	0.00	0.00
Total Q								**1.813**	

Appendix 2.5. Manual Discharge Measurements at PL-H2 in 2011

Date Monitored:	16-Jun-11	**Pressure Transducer (m):**	0.582
Time (24 hr):	13:00	**Discharge Q (m^3/s):**	3.332
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Notes	Station (m)	Depth (m)	Velocity (m/s)			Calb. Velocity (m/S)	Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%				
right bank	4.20	0.00	0.00			0.03	0.00	0.00	0.00
	7.40	0.35	0.04			0.06	0.67	0.04	1.22
	8.00	0.30	0.23			0.23	0.39	0.09	2.71
	10.00	0.20	0.06			0.08	0.40	0.03	0.95
	12.00	0.16	0.07			0.09	0.32	0.03	0.84
	14.00	0.25	0.21			0.21	0.50	0.11	3.20
	16.00	0.20	0.23			0.23	0.40	0.09	2.78
	18.00	0.31	0.11			0.12	0.62	0.08	2.30
	20.00	0.31	0.19			0.20	0.62	0.12	3.64
	22.00	0.27	0.43			0.42	0.54	0.22	6.74
	24.00	0.28	0.36			0.35	0.56	0.20	5.86
	26.00	0.38	0.20			0.20	0.76	0.16	4.67
	28.00	0.42	0.35			0.34	0.84	0.29	8.55
	30.00	0.39	0.22			0.22	0.78	0.17	5.21
	32.00	0.41	0.29			0.29	0.82	0.23	7.02
	34.00	0.31	0.22			0.22	0.62	0.14	4.14
	36.00	0.43	0.29			0.29	0.86	0.25	7.36
	38.00	0.41	0.12			0.13	0.82	0.11	3.27
	40.00	0.40	0.11			0.12	0.80	0.10	2.97
	42.00	0.27	0.26			0.26	0.54	0.14	4.19
	44.00	0.28	0.21			0.21	0.56	0.12	3.59
	46.00	0.30	0.23			0.23	0.60	0.14	4.17
	48.00	0.25	0.19			0.20	0.50	0.10	2.93
	50.00	0.20	0.22			0.22	0.40	0.09	2.67
	52.00	0.21	0.09			0.11	0.42	0.04	1.33
	54.00	0.21	0.17			0.18	0.42	0.07	2.24
	56.00	0.18	0.17			0.18	0.39	0.07	2.06
	58.30	0.30	0.26			0.26	0.44	0.11	3.37
left bank	58.90	0.00	0.00			0.03	0.00	0.00	0.00
Total Q								**3.332**	

Appendix 2.5. Manual Discharge Measurements at PL-H2 in 2011

Date Monitored:	8-Jul-11	**Pressure Transducer (m):**	0.465
Time (24 hr):	10:20	**Discharge Q (m^3/s):**	1.780
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40.00		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
right bank	1.00	0.00	0.00			0.00	0.00	0.00
	3.00	0.15	0.05			0.30	0.02	0.84
	5.00	0.16	0.01			0.32	0.00	0.18
	7.00	0.13	0.04			0.26	0.01	0.58
	9.00	0.08	0.05			0.16	0.01	0.45
	11.00	0.14	0.10			0.28	0.03	1.57
	13.00	0.22	0.19			0.44	0.08	4.70
	15.00	0.18	0.09			0.36	0.03	1.82
	17.00	0.16	0.28			0.32	0.09	5.03
	19.00	0.25	0.26			0.50	0.13	7.30
	21.00	0.22	0.17			0.44	0.07	4.20
	23.00	0.26	0.20			0.52	0.10	5.84
	25.00	0.30	0.26			0.60	0.16	8.76
	27.00	0.32	0.28			0.64	0.18	10.07
	29.00	0.22	0.31			0.44	0.14	7.66
	31.00	0.36	0.14			0.72	0.10	5.66
	33.00	0.26	0.20			0.52	0.10	5.84
	35.00	0.22	0.25			0.44	0.11	6.18
	37.00	0.28	0.16			0.56	0.09	5.03
	39.00	0.18	0.19			0.36	0.07	3.84
	41.00	0.23	0.09			0.46	0.04	2.33
	43.00	0.21	0.17			0.42	0.07	4.01
	45.00	0.10	0.20			0.20	0.04	2.25
	47.00	0.14	0.03			0.28	0.01	0.47
	49.00	0.13	0.08			0.26	0.02	1.17
	51.00	0.08	0.15			0.16	0.02	1.35
	53.00	0.24	0.05			0.36	0.02	1.01
	54.00	0.31	0.15			0.22	0.03	1.83
left bank	54.40	0.00	0.00			0.00	0.00	0.00
Total Q							**1.780**	

Appendix 2.5. Manual Discharge Measurements at PL-H2 in 2011

Date Monitored:	14-Aug-11	**Pressure Transducer (m):**	0.253
Time (24 hr):	14;00	**Discharge Q (m^3/s):**	0.055
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40.00		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
right bank	1.00	0.00	0.00			0.00	0.00	0.00
	2.00	0.05	0.00			0.05	0.00	0.00
	3.00	0.10	0.02			0.10	0.00	3.65
	4.00	0.00	0.00			0.00	0.00	0.00
	5.00	0.00	0.00			0.00	0.00	0.00
	6.00	0.04	0.00			0.04	0.00	0.00
	7.00	0.06	0.02			0.06	0.00	2.19
	8.00	0.07	0.01			0.07	0.00	1.28
	9.00	0.08	0.05			0.08	0.00	7.31
	10.00	0.10	0.06			0.10	0.01	10.96
	11.00	0.09	0.08			0.09	0.01	13.15
	12.00	0.10	0.01			0.10	0.00	1.83
	13.00	0.09	0.05			0.09	0.00	8.22
	14.00	0.10	0.03			0.10	0.00	5.48
	15.00	0.08	0.10			0.08	0.01	14.62
	16.00	0.07	0.07			0.07	0.00	8.95
	17.00	0.06	0.00			0.06	0.00	0.00
	18.00	0.00	0.00			0.00	0.00	0.00
	19.00	0.11	0.01			0.11	0.00	2.01
	20.00	0.19	0.03			0.19	0.01	10.41
	21.00	0.10	0.00			0.10	0.00	0.00
	22.00	0.00	0.00			0.00	0.00	0.00
	23.00	0.03	0.00			0.03	0.00	0.00
	24.00	0.15	0.00			0.15	0.00	0.00
	25.00	0.09	0.01			0.09	0.00	1.64
	26.00	0.00	0.00			0.00	0.00	0.00
	27.00	0.00	0.00			0.00	0.00	0.00
	28.00	0.08	0.01			0.08	0.00	1.46
	29.00	0.06	0.03			0.12	0.00	6.82
left bank	32.15	0	0			0.00	0.00	0.00
Total Q							**0.055**	

Appendix 2.5. Manual Discharge Measurements at PL-H2 in 2011

Date Monitored:	17-Sep-11	**Pressure Transducer (m):**	0.492
Time (24 hr):	11:41	**Discharge Q (m^3/s):**	1.646
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40.00		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
right bank	2.10	0.00	0.00			0.00	0.00	0.00
	3.00	0.18	0.09			0.26	0.02	1.43
	5.00	0.11	0.09			0.22	0.02	1.20
	7.00	0.06	0.00			0.12	0.00	0.00
	9.00	0.13	0.06			0.26	0.02	0.95
	11.00	0.13	0.17			0.26	0.04	2.68
	13.00	0.17	0.17			0.34	0.06	3.51
	15.00	0.14	0.15			0.28	0.04	2.55
	17.00	0.18	0.26			0.36	0.09	5.68
	19.00	0.22	0.30			0.44	0.13	8.02
	21.00	0.20	0.29			0.40	0.12	7.05
	23.00	0.26	0.15			0.52	0.08	4.74
	25.00	0.27	0.22			0.54	0.12	7.22
	27.00	0.26	0.23			0.52	0.12	7.26
	29.00	0.23	0.09			0.46	0.04	2.51
	31.00	0.30	0.06			0.60	0.04	2.19
	33.00	0.25	0.17			0.50	0.09	5.16
	35.00	0.22	0.21			0.44	0.09	5.61
	37.00	0.27	0.13			0.54	0.07	4.26
	39.00	0.16	0.25			0.32	0.08	4.86
	41.00	0.20	0.25			0.40	0.10	6.07
	43.00	0.18	0.17			0.36	0.06	3.72
	45.00	0.15	0.19			0.30	0.06	3.46
	47.00	0.10	0.15			0.20	0.03	1.82
	49.00	0.22	0.11			0.44	0.05	2.94
	51.00	0.16	0.10			0.32	0.03	1.94
	53.00	0.20	0.09			0.30	0.03	1.64
	54.00	0.26	0.12			0.21	0.02	1.52
left bank	54.60	0.00	0.00			0.00	0.00	0.00
Total Q							**1.646**	

Appendix 2.6. Manual Discharge Measurements at GI-H1 in 2011

Date Monitored:	11-Jun-11	**Pressure Transducer (m):**	0.480
Time (24 hr):	15:00	**Total Discharge Q (m^3/s):**	0.587
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Right Channel			Velocity (m/s)			Calb. Velocity	Cross Sectional		
Notes	Station (m)	Depth (m)	60%	20%	80%	(m/S)	Area	Q (m^3/s)	% of Total Q
right bank	1.60	0.00	0.00			0.03	0.0000	0.0000	0.00
	1.80	0.18	0.36			0.35	0.0360	0.0126	4.82
	2.00	0.13	0.19			0.20	0.0390	0.0076	2.93
	2.40	0.09	0.19			0.20	0.0360	0.0070	2.70
	2.80	0.07	0.08			0.10	0.0280	0.0027	1.04
	3.20	0.20	0.06			0.08	0.0800	0.0063	2.43
	3.60	0.11	0.05			0.07	0.0440	0.0031	1.18
rock upstream	4.00	0.23	0.00			0.03	0.0920	0.0023	0.89
	4.40	0.29	0.12			0.13	0.1160	0.0154	5.91
	4.80	0.17	0.11			0.12	0.0680	0.0084	3.23
	5.20	0.31	0.05			0.07	0.1240	0.0087	3.33
	5.60	0.20	0.19			0.20	0.0600	0.0117	4.51
	5.80	0.29	0.20			0.20	0.0725	0.0148	5.70
	6.10	0.29	0.21			0.21	0.0870	0.0186	7.13
	6.40	0.29	0.27			0.27	0.0870	0.0233	8.93
	6.70	0.33	0.28			0.28	0.0990	0.0274	10.51
	7.00	0.14	0.26			0.26	0.0455	0.0118	4.51
	7.35	0.20	0.13			0.14	0.0700	0.0099	3.81
	7.70	0.25	0.32			0.31	0.0813	0.0254	9.74
	8.00	0.22	0.29			0.29	0.0660	0.0188	7.23
	8.30	0.22	0.19			0.20	0.0770	0.0151	5.78
	8.70	0.14	0.22			0.22	0.0385	0.0086	3.29
	8.85	0.11	0.03			0.05	0.0193	0.0010	0.38
left bank	9.05	0.00	0.00			0.03	0.0000	0.0000	0.00
Total Q (right channel)								**0.260**	

Left Channel			Velocity (m/s)			Calb. Velocity	Cross Sectional		
Notes	Station (m)	Depth (m)	60%	20%	80%	(m/S)	Area	Q (m^3/s)	% of Total Q
right bank	1.60	0.00	0.00			0.03	0.0000	0.0000	0.00
boulder field	2.75	0.17	0.02			0.04	0.1190	0.0051	1.57
boulder field	3.00	0.14	0.01			0.03	0.0735	0.0025	0.77
boulder field	3.80	0.08	0.04			0.06	0.0720	0.0044	1.34
boulder field	4.80	0.15	0.01			0.03	0.1650	0.0056	1.72
boulder field	6.00	0.15	0.07			0.09	0.1425	0.0125	3.83
boulder field	6.70	0.10	0.04			0.06	0.0750	0.0046	1.40
boulder field	7.50	0.06	0.05			0.07	0.0720	0.0050	1.54
boulder field	9.10	0.10	0.01			0.03	0.1000	0.0034	1.04
	9.50	0.07	0.10			0.11	0.0490	0.0056	1.72
	10.50	0.25	0.00			0.03	0.1875	0.0047	1.44
	11.00	0.40	0.07			0.09	0.3400	0.0299	9.14
	12.20	0.21	0.01			0.03	0.2100	0.0072	2.19
	13.00	0.19	0.10			0.11	0.1615	0.0185	5.67
	13.90	0.24	0.10			0.11	0.2400	0.0276	8.43
	15.00	0.22	0.10			0.11	0.2310	0.0265	8.11
	16.00	0.20	0.11			0.12	0.2000	0.0248	7.57
	17.00	0.20	0.18			0.19	0.1500	0.0280	8.56
	17.50	0.27	0.05			0.07	0.1350	0.0094	2.89
	18.00	0.29	0.06			0.08	0.2175	0.0172	5.25
	19.00	0.20	0.09			0.11	0.2000	0.0212	6.47
	20.00	0.23	0.09			0.11	0.2300	0.0243	7.45
	21.00	0.15	0.10			0.11	0.1500	0.0172	5.27
	22.00	0.15	0.09			0.11	0.1500	0.0159	4.86
	23.00	0.11	0.03			0.05	0.0715	0.0037	1.14
	23.30	0.18	0.03			0.05	0.0405	0.0021	0.64
left bank	23.45	0.00	0.00			0.03	0.0000	0.0000	0.00
Total Q (left channel)								**0.327**	

Appendix 2.6. Manual Discharge Measurements at GI-H1 in 2011

Date Monitored:	15-Jun-11	**Pressure Transducer (m):**	0.548
Time (24 hr):	11:00	**Total Discharge Q (m^3/s):**	0.965
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Right Channel			Velocity (m/s)			Calb. Velocity	Cross Sectional		
Notes	Station (m)	Depth (m)	60%	20%	80%	(m/S)	Area	Q (m^3/s)	% of Total Q
right bank	1.90	0.00	0.00			0.03	0.0000	0.0000	0.00
	2.00	0.12	0.18			0.19	0.0120	0.0022	0.62
	2.10	0.14	0.17			0.18	0.0140	0.0025	0.69
	2.20	0.15	0.13			0.14	0.0150	0.0021	0.59
	2.30	0.14	0.17			0.18	0.0560	0.0099	2.77
	3.00	0.16	0.11			0.12	0.0880	0.0109	3.03
	3.40	0.10	0.18			0.19	0.0400	0.0075	2.08
	3.80	0.24	0.08			0.10	0.0960	0.0093	2.59
	4.20	0.21	0.13			0.14	0.0840	0.0119	3.32
	4.60	0.37	0.08			0.10	0.1480	0.0143	3.99
	5.00	0.35	0.20			0.20	0.1400	0.0286	7.98
	5.40	0.26	0.26			0.26	0.1040	0.0269	7.48
	5.80	0.44	0.26			0.26	0.1760	0.0455	12.67
	6.20	0.42	0.16			0.17	0.1680	0.0283	7.89
	6.60	0.27	0.31			0.30	0.1080	0.0328	9.12
	7.00	0.23	0.32			0.31	0.0920	0.0287	8.00
	7.40	0.23	0.30			0.29	0.0920	0.0271	7.54
	7.80	0.31	0.27			0.27	0.1240	0.0332	9.23
	8.20	0.19	0.43			0.42	0.0665	0.0277	7.70
	8.50	0.18	0.10			0.11	0.0720	0.0083	2.30
	9.00	0.10	0.00			0.03	0.0550	0.0014	0.38
left bank	9.60	0.00	0.00			0.03	0.0000	0.0000	0.00
Total Q (right channel)								**0.359**	

Left Channel			Velocity (m/s)			Calb. Velocity	Cross Sectional		
Notes	Station (m)	Depth (m)	60%	20%	80%	(m/S)	Area	Q (m^3/s)	% of Total Q
right bank	1.47	0.00	0.00			0.03	0.0000	0.0000	0.00
	1.70	0.17	0.22			0.22	0.0536	0.0119	1.96
	2.10	0.00	0.00			0.03	0.0000	0.0000	0.00
	2.50	0.00	0.00			0.03	0.0000	0.0000	0.00
	2.70	0.18	0.20			0.20	0.0540	0.0110	1.82
	3.10	0.00	0.00			0.03	0.0000	0.0000	0.00
	3.60	0.00	0.00			0.03	0.0000	0.0000	0.00
	4.00	0.17	0.22			0.22	0.1190	0.0265	4.37
	5.00	0.20	0.15			0.16	0.2000	0.0319	5.27
	6.00	0.14	0.00			0.03	0.1400	0.0035	0.58
	7.00	0.13	0.14			0.15	0.1300	0.0196	3.23
	8.00	0.09	0.06			0.08	0.0900	0.0071	1.17
	9.00	0.13	0.19			0.20	0.1300	0.0254	4.19
	10.00	0.16	0.05			0.07	0.1600	0.0112	1.85
	11.00	0.25	0.17			0.18	0.2500	0.0444	7.32
	12.00	0.25	0.11			0.12	0.2500	0.0310	5.10
	13.00	0.21	0.18			0.19	0.2100	0.0392	6.46
	14.00	0.21	0.21			0.21	0.2100	0.0448	7.39
	15.00	0.19	0.21			0.21	0.1900	0.0406	6.69
	16.00	0.19	0.21			0.21	0.1900	0.0406	6.69
	17.00	0.16	0.17			0.18	0.1600	0.0284	4.69
	18.00	0.17	0.13			0.14	0.1700	0.0241	3.97
	19.00	0.23	0.23			0.23	0.2300	0.0532	8.78
	20.00	0.24	0.16			0.17	0.2400	0.0405	6.68
	21.00	0.16	0.11			0.12	0.1600	0.0198	3.27
	22.00	0.13	0.09			0.11	0.1300	0.0138	2.27
	23.00	0.17	0.05			0.07	0.1700	0.0119	1.96
	24.00	0.10	0.09			0.11	0.1000	0.0106	1.75
	25.00	0.09	0.11			0.12	0.0900	0.0111	1.84
	26.00	0.10	0.01			0.03	0.1250	0.0043	0.70
left bank	27.50	0.00	0.00			0.03	0.0000	0.0000	0.00
Total Q (left channel)								**0.606**	

Appendix 2.6. Manual Discharge Measurements at GI-H1 in 2011

Date Monitored:	8-Jul-11	**Pressure Transducer (m):**	0.561
Time (24 hr):	13:05	**Total Discharge Q (m^3/s):**	0.523
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40.00		

Right Channel			Velocity (m/s)			Cross Sectional		
Notes	**Station (m)**	**Depth (m)**	**60%**	**20%**	**80%**	**Area**	**Q (m^3/s)**	**% of Total Q**
right bank	2.60	0.00	0.00			0.0000	0.0000	0.00
	3.00	0.22	0.13			0.0880	0.0114	4.81
	3.40	0.26	0.09			0.1040	0.0094	3.94
Rock upstream	3.80	0.33	0.00			0.1320	0.0000	0.00
	4.20	0.25	0.09			0.1000	0.0090	3.78
	4.60	0.37	0.06			0.1480	0.0089	3.73
	5.00	0.24	0.16			0.0960	0.0154	6.46
	5.40	0.18	0.08			0.0720	0.0058	2.42
	5.80	0.15	0.14			0.0600	0.0084	3.53
	6.20	0.36	0.15			0.1440	0.0216	9.08
	6.60	0.32	0.04			0.1280	0.0051	2.15
	7.00	0.27	0.12			0.1080	0.0130	5.45
	7.40	0.12	0.15			0.0480	0.0072	3.03
	7.80	0.11	0.12			0.0440	0.0053	2.22
	8.20	0.25	0.25			0.1000	0.0250	10.51
	8.60	0.32	0.03			0.1280	0.0038	1.61
Rock upstream	9.00	0.13	0.00			0.0520	0.0000	0.00
	9.40	0.28	0.33			0.1120	0.0370	15.54
	9.80	0.19	0.33			0.0760	0.0251	10.55
	10.20	0.32	0.03			0.1280	0.0038	1.61
	10.60	0.08	0.27			0.0320	0.0086	3.63
	11.00	0.22	0.16			0.0880	0.0141	5.92
left bank	11.40	0.00	0.00			0.0000	0.0000	0.00
Total Q (right channel)							**0.238**	

Left Channel			Velocity (m/s)			Cross Sectional		
Notes	**Station (m)**	**Depth (m)**	**60%**	**20%**	**80%**	**Area**	**Q (m^3/s)**	**% of Total Q**
right bank	1.80	0.00	0.00			0.0000	0.0000	0.0
	2.00	0.14	0.16			0.0840	0.0134	4.7
	3.00	0.12	0.08			0.1200	0.0096	3.4
	4.00	0.06	0.06			0.0600	0.0036	1.3
	5.00	0.07	0.02			0.0700	0.0014	0.5
	6.00	0.18	0.02			0.1800	0.0036	1.3
	7.00	0.17	0.01			0.1700	0.0017	0.6
	8.00	0.15	0.06			0.1500	0.0090	3.2
	9.00	0.10	0.18			0.1000	0.0180	6.3
	10.00	0.17	0.00			0.1700	0.0000	0.0
	11.00	0.21	0.06			0.2100	0.0126	4.4
	12.00	0.20	0.11			0.2000	0.0220	7.7
	13.00	0.27	0.08			0.2700	0.0216	7.6
	14.00	0.21	0.10			0.2100	0.0210	7.4
	15.00	0.16	0.14			0.1600	0.0224	7.9
	16.00	0.23	0.08			0.2300	0.0184	6.5
	17.00	0.15	0.12			0.1500	0.0180	6.3
	18.00	0.14	0.10			0.1400	0.0140	4.9
	19.00	0.21	0.09			0.2100	0.0189	6.6
	20.00	0.21	0.09			0.2100	0.0189	6.6
	21.00	0.17	0.10			0.1700	0.0170	6.0
	22.00	0.16	0.05			0.1600	0.0080	2.8
	23.00	0.26	0.02			0.2600	0.0052	1.8
	24.00	0.23	0.02			0.2300	0.0046	1.6
	25.00	0.15	0.01			0.1500	0.0015	0.5
	26.00	0.06	0.00			0.0600	0.0000	0.0
	27.00	0.05	0.02			0.0375	0.0008	0.3
	27.50	0.05	0.00			0.1000	0.0000	0.0
left bank	31.00	0.00	0.00			0.0000	0.0000	0.0
Total Q (left channel)							**0.285**	

Appendix 2.6. Manual Discharge Measurements at GI-H1 in 2011

Date Monitored:	13-Aug-11	**Pressure Transducer (m):**	0.372
Time (24 hr):	9:30	**Total Discharge Q (m^3/s):**	0.041
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40.00		

Right Channel			**Velocity (m/s)**			**Cross Sectional**		
Notes	**Station (m)**	**Depth (m)**	**60%**	**20%**	**80%**	**Area**	**Q (m^3/s)**	**% of Total Q**
right bank	2.65	0.00	0.00			0.0000	0.0000	0.00
Rocks	3.75	0.00	0.00			0.0000	0.0000	0.00
Rocks	4.00	0.07	0.00			0.0210	0.0000	0.00
	4.35	0.18	0.01			0.0495	0.0005	2.58
	4.55	0.07	0.02			0.0158	0.0003	1.64
	4.80	0.14	0.01			0.0315	0.0003	1.64
	5.00	0.10	0.07			0.0200	0.0014	7.30
	5.20	0.11	0.05			0.0220	0.0011	5.74
	5.40	0.11	0.13			0.0220	0.0029	14.91
	5.60	0.21	0.01			0.0420	0.0004	2.19
	5.80	0.08	0.11			0.0160	0.0018	9.18
	6.00	0.13	0.13			0.0195	0.0025	13.22
	6.10	0.21	0.12			0.0210	0.0025	13.14
	6.20	0.16	0.13			0.0240	0.0031	16.27
	6.40	0.09	0.12			0.0180	0.0022	11.26
Rocks	6.60	0.00	0.00			0.0000	0.0000	0.00
Rocks	7.10	0.00	0.00			0.0000	0.0000	0.00
	7.20	0.07	0.01			0.0105	0.0001	0.55
	7.40	0.06	0.01			0.0075	0.0001	0.39
Rocks	7.45	0.00	0.00			0.0000	0.0000	0.00
left bank	9.50	0.00	0.00			0.0000	0.0000	0.00
Total Q (right channel)							**0.019**	

Left Channel			**Velocity (m/s)**			**Cross Sectional**		
Notes	**Station (m)**	**Depth (m)**	**60%**	**20%**	**80%**	**Area**	**Q (m^3/s)**	**% of Total Q**
	3.15	0.00	0.00			0.0000	0.0000	0.0
	3.25	0.14	0.04			0.0595	0.0024	10.9
	4.00	0.00	0.00			0.0000	0.0000	0.0
	4.90	0.27	0.02			0.2700	0.0054	24.6
	6.00	0.23	0.04			0.2415	0.0097	44.1
	7.00	0.00	0.00			0.0000	0.0000	0.0
	10.70	0.00	0.00			0.0000	0.0000	0.0
	11.20	0.15	0.00			0.0750	0.0000	0.0
	11.70	0.12	0.01			0.0780	0.0008	3.6
	12.50	0.07	-0.01			0.0455	-0.0005	-2.1
	13.00	0.00	0.00			0.0000	0.0000	0.0
	13.50	0.09	0.01			0.0450	0.0005	2.1
	14.00	0.08	0.02			0.0400	0.0008	3.7
	14.50	0.13	0.03			0.0650	0.0020	8.9
	15.00	0.11	0.01			0.0550	0.0006	2.5
	15.50	0.00	0.00			0.0000	0.0000	0.0
	16.00	0.08	0.01			0.0400	0.0004	1.8
	16.50	0.06	0.00			0.0450	0.0000	0.0
	17.50	0.08	0.00			0.0800	0.0000	0.0
	18.50	0.06	0.00			0.0600	0.0000	0.0
	19.50	0.08	0.00			0.0800	0.0000	0.0
	20.50	0.02	0.00			0.0130	0.0000	0.0
	20.80	0.14	0.00			0.1050	0.0000	0.0
	22.00	0.00	0.00			0.0000	0.0000	0.0
	23.00	0.08	0.00			0.0800	0.0000	0.0
	24.00	0.00	0.00			0.0000	0.0000	0.0
	25.00	0.09	0.00			0.2340	0.0000	0.0
left bank	29.20	0.00	0.00			0.0000	0.0000	0.0
Total Q (left channel)							**0.022**	

Appendix 2.6. Manual Discharge Measurements at GI-H1 in 2011

Date Monitored:	16-Sep-11	**Pressure Transducer (m):**	0.561
Time (24 hr):	8:00	**Total Discharge Q (m^3/s):**	0.403
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40.00		

Right Channel			Velocity (m/s)			Cross Sectional		
Notes	Station (m)	Depth (m)	60%	20%	80%	Area	Q (m^3/s)	% of Total Q
right bank	0.00	0.00	0.00			0.0000	0.0000	0.00
	0.40	0.05	0.07			0.0200	0.0014	0.83
rock	0.80	0.28	0.04			0.1120	0.0045	2.67
	1.20	0.00	0.00			0.0000	0.0000	0.00
	1.60	0.08	0.01			0.0320	0.0003	0.19
	2.00	0.11	0.00			0.0440	0.0000	0.00
	2.40	0.14	0.05			0.0560	0.0028	1.67
	2.80	0.05	0.02			0.0200	0.0004	0.24
	3.20	0.17	0.03			0.0680	0.0020	1.21
	3.60	0.18	0.10			0.0720	0.0072	4.29
	4.00	0.18	0.00			0.0720	0.0000	0.00
	4.40	0.21	0.13			0.0840	0.0109	6.50
	4.80	0.23	0.08			0.0920	0.0074	4.38
	5.20	0.20	0.15			0.0800	0.0120	7.14
	5.60	0.38	0.14			0.1520	0.0213	12.67
	6.00	0.21	0.20			0.0840	0.0168	10.00
	6.40	0.09	0.32			0.0360	0.0115	6.86
	6.80	0.19	0.33			0.0760	0.0251	14.93
	7.20	0.25	0.28			0.1000	0.0280	16.67
	7.60	0.26	0.14			0.1040	0.0146	8.67
	8.00	0.12	0.05			0.0360	0.0018	1.07
left bank	8.20	0.00	0.00			0.0000	0.0000	0.00
Total Q (right channel)							**0.168**	

Left Channel			Velocity (m/s)			Cross Sectional		
Notes	Station (m)	Depth (m)	60%	20%	80%	Area	Q (m^3/s)	% of Total Q
right bank	0.00	0.00	0.00			0.0000	0.0000	0.0
	1.00	0.20	0.02			0.2000	0.0040	1.7
	2.00	0.24	0.06			0.2400	0.0144	6.1
	3.00	0.08	0.01			0.0800	0.0008	0.3
	4.00	0.23	0.04			0.2300	0.0092	3.9
rock	5.00	0.00	0.00			0.0000	0.0000	0.0
	6.00	0.09	0.00			0.0900	0.0000	0.0
	7.00	0.08	-0.07			0.0800	-0.0056	-2.4
	8.00	0.06	0.07			0.0600	0.0042	1.8
	9.00	0.32	0.04			0.3200	0.0128	5.5
	10.00	0.16	0.09			0.1600	0.0144	6.1
	11.00	0.11	0.08			0.1100	0.0088	3.8
	12.00	0.26	0.09			0.2600	0.0234	10.0
	13.00	0.08	0.06			0.0800	0.0048	2.0
	14.00	0.19	0.11			0.1900	0.0209	8.9
	15.00	0.23	0.05			0.2300	0.0115	4.9
	16.00	0.20	0.08			0.2000	0.0160	6.8
	17.00	0.26	0.09			0.2600	0.0234	10.0
	18.00	0.20	0.13			0.2000	0.0260	11.1
	19.00	0.12	0.12			0.1200	0.0144	6.1
	20.00	0.15	0.08			0.1500	0.0120	5.1
	21.00	0.26	0.05			0.2600	0.0130	5.5
	22.00	0.28	0.03			0.2800	0.0084	3.6
	23.00	0.14	0.03			0.1400	0.0042	1.8
	24.00	0.08	-0.08			0.0800	-0.0064	-2.7
	25.00	0.00	0.00			0.0000	0.0000	0.0
	26.00	0.00	0.00			0.0000	0.0000	0.0
left bank	27.80	0.00	0.00			0.0000	0.0000	0.0
Total Q (left channel)							**0.235**	

Appendix 2.7. Manual Discharge Measurements at EL-H1 in 2011

Date Monitored:	13-Jun-11	**Pressure Transducer (m):**	0.520
Time (24 hr):	14:30	**Discharge Q (m^3/s):**	0.037
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Notes	Station (m)	Depth (m)	Velocity (m/s) 60%	20%	80%	Calb. Velocity (m/S)	Cross Sectional Area	Q (m^3/s)	% of Total Q
right bank	3.60	0.00	0.00			0.03	0.0000	0.0000	0.00
	3.70	0.09	0.00			0.03	0.0090	0.0002	0.62
	3.80	0.09	0.00			0.03	0.0090	0.0002	0.62
	3.90	0.12	0.00			0.03	0.0120	0.0003	0.82
	4.00	0.14	0.05			0.07	0.0140	0.0010	2.67
	4.10	0.19	0.05			0.07	0.0190	0.0013	3.62
	4.20	0.22	0.09			0.11	0.0220	0.0023	6.34
	4.30	0.21	0.08			0.10	0.0210	0.0020	5.54
	4.40	0.24	0.05			0.07	0.0240	0.0017	4.57
	4.50	0.19	0.01			0.03	0.0190	0.0006	1.76
	4.60	0.16	0.00			0.03	0.0160	0.0004	1.09
	4.70	0.16	0.06			0.08	0.0160	0.0013	3.44
	4.80	0.16	0.08			0.10	0.0160	0.0016	4.22
	4.90	0.16	0.10			0.11	0.0160	0.0018	5.01
	5.00	0.17	0.10			0.11	0.0170	0.0020	5.32
	5.10	0.20	0.20			0.20	0.0200	0.0041	11.15
	5.20	0.22	0.32			0.31	0.0220	0.0069	18.71
	5.30	0.22	0.22			0.22	0.0220	0.0049	13.34
	5.40	0.22	0.17			0.18	0.0220	0.0039	10.65
left bank	5.50	0.15	0.00			0.03	0.0075	0.0002	0.51
Total Q								**0.037**	

Date Monitored:	15-Jun-11	**Pressure Transducer (m):**	0.506
Time (24 hr):	14:50	**Discharge Q (m^3/s):**	0.023
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Notes	Station (m)	Depth (m)	Velocity (m/s) 60%	20%	80%	Calb. Velocity (m/S)	Cross Sectional Area	Q (m^3/s)	% of Total Q
right bank	3.90	0.00	0.00			0.03	0.0000	0.0000	0.00
	4.10	0.08	0.07			0.09	0.0120	0.0011	4.53
	4.20	0.23	0.05			0.07	0.0230	0.0016	6.91
	4.30	0.19	0.10			0.11	0.0190	0.0022	9.37
	4.40	0.16	0.06			0.08	0.0160	0.0013	5.43
	4.50	0.14	0.02			0.04	0.0140	0.0006	2.59
	4.60	0.14	0.00			0.03	0.0140	0.0004	1.51
	4.70	0.14	0.00			0.03	0.0140	0.0004	1.51
	4.80	0.14	0.03			0.05	0.0140	0.0007	3.13
	4.90	0.12	0.12			0.13	0.0120	0.0016	6.85
	5.00	0.14	0.14			0.15	0.0140	0.0021	9.07
	5.10	0.16	0.10			0.11	0.0160	0.0018	7.89
	5.20	0.19	0.21			0.21	0.0190	0.0041	17.43
	5.30	0.19	0.23			0.23	0.0190	0.0044	18.90
	5.40	0.13	0.05			0.07	0.0163	0.0011	4.88
left bank	5.55	0.00	0.00			0.03	0.0000	0.0000	0.00
Total Q								**0.0233**	

Appendix 2.7. Manual Discharge Measurements at EL-H1 in 2011

Date Monitored:	9-Jul-11	**Pressure Transducer (m):**	0.405
Time (24 hr):	10:50	**Discharge Q (m^3/s):**	0.002
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40.00		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
left bank	1.00	0.04	0.00			0.0010	0.0000	0.00
	1.05	0.04	0.00			0.0020	0.0000	0.00
	1.10	0.08	0.01			0.0040	0.0000	2.50
	1.15	0.12	0.04			0.0060	0.0002	15.00
	1.20	0.20	0.04			0.0100	0.0004	25.00
	1.25	0.26	0.03			0.0130	0.0004	24.38
	1.30	0.26	0.02			0.0130	0.0003	16.25
	1.35	0.25	0.00			0.0125	0.0000	0.00
	1.40	0.18	0.01			0.0090	0.0001	5.63
	1.45	0.17	0.01			0.0085	0.0001	5.31
	1.50	0.19	0.01			0.0095	0.0001	5.94
	1.55	0.17	0.00			0.0085	0.0000	0.00
	1.60	0.17	0.00			0.0085	0.0000	0.00
	1.65	0.15	0.00			0.0075	0.0000	0.00
	1.70	0.14	0.00			0.0070	0.0000	0.00
	1.75	0.14	0.00			0.0070	0.0000	0.00
	1.80	0.14	0.00			0.0070	0.0000	0.00
	1.85	0.14	0.00			0.0070	0.0000	0.00
	1.90	0.14	0.00			0.0175	0.0000	0.00
right bank	2.10	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.002**	

Appendix 2.7. Manual Discharge Measurements at EL-H1 in 2011

Date Monitored:	16-Sep-11	**Pressure Transducer (m):**	0.449
Time (24 hr):	14:43	**Discharge Q (m^3/s):**	0.013
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40.00		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
right bank	0.40	0.00	0.00			0.0000	0.0000	0.00
	0.50	0.06	0.00			0.0060	0.0000	0.00
	0.60	0.09	0.00			0.0068	0.0000	0.00
	0.65	0.13	0.02			0.0065	0.0001	1.00
	0.70	0.20	0.05			0.0100	0.0005	3.84
	0.75	0.21	0.05			0.0105	0.0005	4.04
	0.80	0.20	0.06			0.0100	0.0006	4.61
	0.85	0.21	0.09			0.0105	0.0009	7.27
	0.90	0.20	0.12			0.0100	0.0012	9.23
	0.95	0.20	0.12			0.0100	0.0012	9.23
	1.00	0.20	0.09			0.0100	0.0009	6.92
	1.05	0.21	0.05			0.0105	0.0005	4.04
	1.10	0.12	0.13			0.0060	0.0008	6.00
	1.15	0.12	0.13			0.0060	0.0008	6.00
	1.20	0.13	0.18			0.0065	0.0012	9.00
	1.25	0.13	0.15			0.0065	0.0010	7.50
	1.30	0.12	0.14			0.0060	0.0008	6.46
	1.35	0.10	0.12			0.0050	0.0006	4.61
	1.40	0.10	0.09			0.0050	0.0005	3.46
	1.45	0.10	0.09			0.0050	0.0005	3.46
	1.50	0.09	0.07			0.0045	0.0003	2.42
	1.55	0.06	0.04			0.0030	0.0001	0.92
left bank	1.60	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.013**	

Appendix 2.8. Manual Discharge Measurements at WL-H1 in 2011

Date Monitored:	13-Jun-11	**Pressure Transducer (m):**	0.948
Time (24 hr):	9:30	**Discharge Q (m^3/s):**	1.973
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Notes	Station (m)	Depth (m)	Velocity (m/s)			Calb. Velocity (m/S)	Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%				
left bank	1.85	0.00	0.00			0.03	0.0000	0.0000	0.00
	2.50	0.45	0.00			0.03	0.2138	0.0054	0.27
	2.80	0.65	0.07			0.09	0.1625	0.0143	0.72
	3.00	0.66	0.07			0.09	0.2310	0.0203	1.03
	3.50	0.77	0.13	0.15	0.10	0.14	0.3850	0.0528	2.68
	4.00	0.82	0.13	0.15	0.11	0.14	0.4100	0.0581	2.95
	4.50	0.96	0.14	0.16	0.11	0.15	0.4800	0.0702	3.56
	5.00	1.04	0.24	0.27	0.20	0.24	0.5200	0.1227	6.22
	5.50	1.08	0.27	0.32	0.22	0.27	0.5400	0.1444	7.32
	6.00	1.05	0.32	0.34	0.29	0.31	0.5250	0.1616	8.19
	6.50	1.03	0.32	0.33	0.31	0.31	0.5150	0.1608	8.15
	7.00	1.04	0.35	0.37	0.32	0.33	0.3640	0.1218	6.17
	7.20	1.00	0.35	0.38	0.31	0.33	0.2000	0.0669	3.39
	7.40	1.00	0.37	0.38	0.36	0.36	0.2000	0.0717	3.63
	7.60	1.00	0.37	0.40	0.33	0.35	0.2000	0.0707	3.59
	7.80	1.00	0.42	0.43	0.40	0.40	0.2000	0.0803	4.07
	8.00	1.00	0.38	0.41	0.35	0.37	0.2000	0.0736	3.73
	8.20	1.00	0.39	0.40	0.37	0.37	0.2000	0.0746	3.78
	8.40	1.00	0.41	0.43	0.39	0.40	0.2000	0.0794	4.02
	8.60	0.95	0.38	0.39	0.36	0.36	0.1900	0.0690	3.50
	8.80	0.95	0.38	0.40	0.35	0.36	0.1900	0.0690	3.50
	9.00	0.99	0.34	0.31	0.37	0.33	0.1980	0.0654	3.31
	9.20	1.00	0.37	0.36	0.38	0.36	0.2000	0.0717	3.63
	9.40	0.98	0.35	0.33	0.36	0.33	0.1960	0.0656	3.32
	9.60	0.96	0.32	0.28	0.36	0.31	0.2880	0.0899	4.56
	10.00	0.81	0.25	0.27	0.22	0.24	0.2430	0.0595	3.02
	10.20	0.68	0.14			0.15	0.2210	0.0333	1.69
	10.65	0.00	0.00			0.03	0.0000	0.0000	0.00
right bank	12.80	0.00	0.00			0.03	0.0000	0.0000	0.00
Total Q								**1.973**	

Note: if taking velocity readings at 20% and 80% of water depth then the 60% velocity value will be calculated as follows

V60% = (V20% +V80%)/2

Appendix 2.8. Manual Discharge Measurements at WL-H1 in 2011

Date Monitored:	17-Jun-11	**Pressure Transducer (m):**	0.893
Time (24 hr):	8:00	**Discharge Q (m^3/s):**	0.840
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Notes	Station (m)	Depth (m)	Velocity (m/s) 60%	20%	80%	Calb. Velocity (m/S)	Cross Sectional Area	Q (m^3/s)	% of Total Q
right bank	3.40	0.00	0.00			0.03	0.0000	0.0000	0.00
	4.20	0.54	0.00			0.03	0.2700	0.0068	0.81
	4.40	0.69	0.15			0.16	0.1380	0.0220	2.63
	4.60	0.74	0.16			0.17	0.1480	0.0250	2.97
	4.80	0.86	0.17	0.19	0.14	0.17	0.1720	0.0298	3.55
	5.00	0.91	0.16	0.18	0.14	0.17	0.1820	0.0307	3.66
	5.20	0.93	0.18	0.18	0.17	0.18	0.1860	0.0339	4.04
	5.40	0.91	0.19	0.20	0.18	0.20	0.1820	0.0356	4.24
	5.60	0.93	0.16	0.17	0.15	0.17	0.1860	0.0314	3.74
	5.80	0.91	0.19	0.20	0.18	0.20	0.1820	0.0356	4.24
	6.00	0.93	0.20	0.21	0.18	0.20	0.1860	0.0372	4.43
	6.20	0.95	0.20	0.21	0.18	0.20	0.1900	0.0380	4.53
	6.40	0.94	0.20	0.20	0.19	0.20	0.1880	0.0376	4.48
	6.60	0.93	0.18	0.18	0.17	0.18	0.1860	0.0339	4.04
	6.80	0.95	0.17	0.18	0.16	0.18	0.1900	0.0338	4.02
	7.00	0.94	0.19	0.18	0.19	0.19	0.1880	0.0359	4.28
	7.20	0.95	0.20	0.19	0.21	0.20	0.1900	0.0389	4.63
	7.40	0.96	0.19	0.19	0.19	0.20	0.1920	0.0376	4.47
	7.60	0.98	0.16	0.16	0.15	0.16	0.1960	0.0322	3.83
	7.80	0.97	0.15	0.16	0.14	0.16	0.1940	0.0310	3.69
	8.00	0.98	0.12	0.12	0.12	0.13	0.2205	0.0293	3.49
	8.25	0.99	0.11	0.08	0.13	0.12	0.2475	0.0295	3.52
	8.50	1.00	0.10	0.08	0.12	0.11	0.2500	0.0287	3.42
	8.75	1.00	0.11	0.11	0.11	0.12	0.2500	0.0310	3.69
	9.00	1.04	0.08	0.08	0.08	0.10	0.3380	0.0327	3.90
	9.40	0.97	0.05	0.01	0.08	0.07	0.3880	0.0254	3.03
	9.80	0.90	0.02	0.02	0.02	0.04	0.4950	0.0213	2.54
	10.50	0.79	0.01	0.01	0.00	0.03	0.6715	0.0199	2.37
	11.50	0.60	0.00			0.03	0.6000	0.0151	1.79
left bank	12.50	0.00	0.00			0.03	0.0000	0.0000	0.00
Total Q								**0.840**	

Note: if taking velocity readings at 20% and 80% of water depth then the 60% velocity value will be calculated as follows

V60% = (V20% +V80%)/2

Appendix 2.8. Manual Discharge Measurements at WL-H1 in 2011

Date Monitored:	9-Jul-11	**Pressure Transducer (m):**	0.768
Time (24 hr):	14:30	**Discharge Q (m^3/s):**	0.370
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40.00		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
left bank	0.85	0.00	0.00			0.0000	0.0000	0.00
	1.00	0.09	0.00			0.0293	0.0000	0.00
	1.50	0.36	0.01			0.1800	0.0018	0.49
	2.00	0.50	0.03			0.2500	0.0075	2.02
	2.50	0.60	0.06			0.3000	0.0180	4.86
	3.00	0.70	0.06			0.3500	0.0210	5.67
	3.50	0.77	0.06	0.05	0.06	0.3850	0.0212	5.72
	4.00	0.88	0.07	0.08	0.05	0.4400	0.0286	7.72
	4.50	0.94	0.06	0.06	0.05	0.4700	0.0259	6.98
	5.00	0.96	0.07	0.07	0.07	0.4800	0.0336	9.07
	5.50	0.94	0.08	0.07	0.08	0.4700	0.0353	9.51
	6.00	0.92	0.08	0.08	0.07	0.4600	0.0345	9.31
	6.50	0.88	0.08	0.07	0.09	0.4400	0.0352	9.50
	7.00	0.86	0.07	0.07	0.06	0.4300	0.0280	7.54
	7.50	0.82	0.06	0.05	0.06	0.4100	0.0226	6.09
	8.00	0.73	0.07			0.3650	0.0256	6.90
	8.50	0.66	0.05			0.3300	0.0165	4.45
	9.00	0.45	0.05			0.2250	0.0113	3.04
	9.50	0.28	0.03			0.1400	0.0042	1.13
	10.00	0.12	0.00			0.0570	0.0000	0.00
right bank	10.45	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.370**	

Note: if taking velocity readings at 20% and 80% of water depth then the 60% velocity value will be calculated as follows.
V60% = (V20% +V80%)/2

Appendix 2.8. Manual Discharge Measurements at WL-H1 in 2011

Date Monitored:	15-Aug-11	**Pressure Transducer (m):**	0.474
Time (24 hr):	10:23	**Discharge Q (m^3/s):**	0.003
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40.00		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
left bank	1.25	0.00	0.00			0.0000	0.0000	0.00
	1.30	0.04	0.00			0.0030	0.0000	0.00
	1.40	0.07	0.00			0.0070	0.0000	0.00
	1.50	0.06	0.01			0.0060	0.0001	2.29
	1.60	0.06	0.01			0.0060	0.0001	2.29
	1.70	0.10	0.00			0.0100	0.0000	0.00
	1.80	0.12	-0.01			0.0120	-0.0001	-4.57
	1.90	0.14	0.01			0.0140	0.0001	5.33
	2.00	0.12	0.00			0.0120	0.0000	0.00
	2.10	0.14	0.01			0.0140	0.0001	5.33
	2.20	0.12	0.02			0.0120	0.0002	9.14
	2.30	0.14	0.01			0.0140	0.0001	5.33
	2.40	0.14	-0.01			0.0140	-0.0001	-5.33
	2.50	0.12	-0.01			0.0120	-0.0001	-4.57
	2.60	0.12	0.01			0.0120	0.0001	4.57
	2.70	0.13	0.01			0.0130	0.0001	4.95
	2.80	0.11	0.01			0.0110	0.0001	4.19
	2.90	0.14	0.00			0.0140	0.0000	0.00
	3.00	0.10	0.00			0.0100	0.0000	0.00
	3.10	0.14	0.02			0.0140	0.0003	10.67
	3.20	0.12	0.04			0.0090	0.0004	13.71
	3.25	0.11	0.01			0.0055	0.0001	2.10
	3.30	0.10	0.05			0.0050	0.0003	9.52
	3.35	0.10	0.06			0.0050	0.0003	11.43
	3.40	0.09	0.08			0.0068	0.0005	20.57
	3.50	0.08	0.01			0.0080	0.0001	3.05
	3.60	0.10	0.00			0.0100	0.0000	0.00
right bank	3.70	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.003**	

Appendix 2.8. Manual Discharge Measurements at WL-H1 in 2011

Date Monitored:	17-Sep-11	**Pressure Transducer (m):**	0.774
Time (24 hr):	13:30	**Discharge Q (m^3/s):**	0.371
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40.00		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
right bank	1.80	0.00	0.00			0.0000	0.0000	0.00
	2.30	0.25	-0.01			0.1500	-0.0015	-0.40
	3.00	0.50	-0.01			0.3000	-0.0030	-0.81
	3.50	0.79	-0.01	-0.01	-0.01	0.3950	-0.0040	-1.07
	4.00	0.89	0.03	0.02	0.03	0.4450	0.0111	3.00
	4.50	0.93	0.06	0.06	0.06	0.4650	0.0279	7.53
	5.00	0.90	0.08	0.08	0.07	0.4500	0.0338	9.11
	5.50	0.90	0.09	0.10	0.07	0.4500	0.0383	10.32
	6.00	0.82	0.08	0.09	0.06	0.4100	0.0308	8.30
	6.50	0.79	0.09	0.09	0.08	0.3950	0.0336	9.06
	7.00	0.75	0.09	0.10	0.07	0.3750	0.0319	8.60
	7.50	0.68	0.09			0.3400	0.0306	8.26
	8.00	0.64	0.08			0.3200	0.0256	6.91
	8.50	0.64	0.08			0.3200	0.0256	6.91
	9.00	0.63	0.07			0.3150	0.0221	5.95
	9.50	0.57	0.07			0.2850	0.0200	5.38
	10.00	0.48	0.07			0.2400	0.0168	4.53
	10.50	0.41	0.08			0.2050	0.0164	4.43
	11.00	0.35	0.06			0.1750	0.0105	2.83
	11.50	0.27	0.03			0.1418	0.0043	1.15
left bank	12.05	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.371**	

Note: if taking velocity readings at 20% and 80% of water depth then the 60% velocity value will be calculated as follows.
V60% = (V20% +V80%)/2

Appendix 2.9. Manual Discharge Measurements at REFB-H1 in 2011

Date Monitored:	12-Jun-11	**Pressure Transducer (m):**	0.345
Time (24 hr):	14:50	**Discharge Q (m^3/s):**	0.206
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Notes	Station (m)	Depth (m)	Velocity (m/s)			Calb. Velocity (m/S)	Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%				
left bank	7.50	0.00	0.00			0.03	0.0000	0.0000	0.00
grass	8.00	0.14	0.00			0.03	0.0700	0.0018	0.85
grass	8.50	0.18	0.00			0.03	0.0900	0.0023	1.09
grass	9.00	0.19	0.00			0.03	0.0950	0.0024	1.16
grass	9.50	0.20	0.01			0.03	0.0800	0.0027	1.32
	9.80	0.25	0.18			0.19	0.0625	0.0117	5.65
	10.00	0.27	0.09			0.11	0.0540	0.0057	2.77
	10.20	0.25	0.27			0.27	0.0500	0.0134	6.48
	10.40	0.27	0.27			0.27	0.0540	0.0144	7.00
	10.60	0.29	0.27			0.27	0.0580	0.0155	7.51
	10.80	0.33	0.25			0.25	0.0660	0.0165	7.98
	11.00	0.34	0.24			0.24	0.0680	0.0164	7.92
	11.20	0.34	0.18			0.19	0.0680	0.0127	6.15
	11.40	0.34	0.24			0.24	0.0680	0.0164	7.92
	11.60	0.33	0.29			0.29	0.0660	0.0188	9.12
	11.80	0.32	0.31			0.30	0.0640	0.0194	9.40
	12.00	0.30	0.19			0.20	0.0600	0.0117	5.69
	12.20	0.25	0.03			0.05	0.0625	0.0033	1.58
grass	12.50	0.20	0.04			0.06	0.0700	0.0043	2.07
grass	12.90	0.19	0.00			0.03	0.1615	0.0041	1.96
grass	14.20	0.17	0.06			0.08	0.1360	0.0107	5.20
grass	14.50	0.11	0.07			0.09	0.0275	0.0024	1.17
right bank	14.70	0.00	0.00			0.03	0.0000	0.0000	0.00
Total Q								**0.206**	

Appendix 2.9. Manual Discharge Measurements at REFB-H1 in 2011

Date Monitored:	9-Jul-11	**Pressure Transducer (m):**	0.266
Time (24 hr):	8:25	**Discharge Q (m^3/s):**	0.031
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40.00		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
right bank	1.80	0.00	0.00			0.0000	0.0000	0.00
edge of flooded grass	2.50	0.14	0.00			0.0560	0.0000	0.00
	2.60	0.18	0.03			0.0180	0.0005	1.74
	2.70	0.20	0.07			0.0200	0.0014	4.52
	2.80	0.20	0.08			0.0200	0.0016	5.17
	2.90	0.18	0.11			0.0180	0.0020	6.40
	3.00	0.21	0.14			0.0210	0.0029	9.50
	3.10	0.19	0.19			0.0190	0.0036	11.66
	3.20	0.19	0.10			0.0190	0.0019	6.14
	3.30	0.18	0.06			0.0180	0.0011	3.49
	3.40	0.16	0.05			0.0160	0.0008	2.58
	3.50	0.14	0.04			0.0140	0.0006	1.81
	3.60	0.14	0.04			0.0140	0.0006	1.81
	3.70	0.16	0.02			0.0160	0.0003	1.03
	3.80	0.16	0.01			0.0160	0.0002	0.52
	3.90	0.14	0.03			0.0140	0.0004	1.36
	4.00	0.15	0.04			0.0150	0.0006	1.94
	4.10	0.21	0.02			0.0210	0.0004	1.36
	4.20	0.20	0.09			0.0200	0.0018	5.81
	4.30	0.17	0.11			0.0170	0.0019	6.04
	4.40	0.16	0.10			0.0160	0.0016	5.17
	4.50	0.15	0.17			0.0150	0.0025	8.24
	4.60	0.14	0.12			0.0140	0.0017	5.43
	4.70	0.14	0.09			0.0140	0.0013	4.07
	4.80	0.14	0.06			0.0140	0.0008	2.71
	4.90	0.12	0.03			0.0120	0.0004	1.16
	5.00	0.11	0.01			0.0110	0.0001	0.36
edge of flooded grass	5.10	0.10	0.00			0.0175	0.0000	0.00
left bank	5.35	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.031**	

Appendix 2.9. Manual Discharge Measurements at REFB-H1 in 2011

Date Monitored:	17-Sep-11	**Pressure Transducer (m):**	0.269
Time (24 hr):	13:05	**Discharge Q (m^3/s):**	0.023
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40.00		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
right bank	1.20	0.00	0.00			0.0000	0.0000	0.00
	2.00	0.07	0.00			0.0630	0.0000	0.00
	3.00	0.09	0.00			0.0900	0.0000	0.00
	4.00	0.06	0.00			0.0510	0.0000	0.00
edge of flooded grass	4.70	0.18	0.03			0.0765	0.0023	10.07
	4.85	0.21	0.04			0.0315	0.0013	5.53
	5.00	0.20	0.09			0.0300	0.0027	11.84
	5.15	0.20	0.07			0.0300	0.0021	9.21
	5.30	0.19	0.04			0.0285	0.0011	5.00
	5.45	0.17	0.05			0.0255	0.0013	5.59
	5.60	0.19	0.04			0.0285	0.0011	5.00
	5.75	0.15	0.04			0.0225	0.0009	3.95
	5.90	0.14	0.00			0.0210	0.0000	0.00
	6.05	0.13	0.04			0.0195	0.0008	3.42
	6.20	0.14	0.04			0.0210	0.0008	3.68
	6.35	0.20	0.06			0.0300	0.0018	7.89
	6.50	0.20	0.05			0.0300	0.0015	6.58
	6.65	0.15	0.08			0.0225	0.0018	7.89
	6.80	0.14	0.09			0.0210	0.0019	8.29
	6.95	0.14	0.04			0.0210	0.0008	3.68
	7.10	0.12	0.03			0.0180	0.0005	2.37
edge of flooded grass	7.25	0.12	0.00			0.0540	0.0000	0.00
	8.00	0.06	0.00			0.0525	0.0000	0.00
	9.00	0.02	0.00			0.0145	0.0000	0.00
left bank	9.45	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.023**	

Appendix 3
Rating Curves

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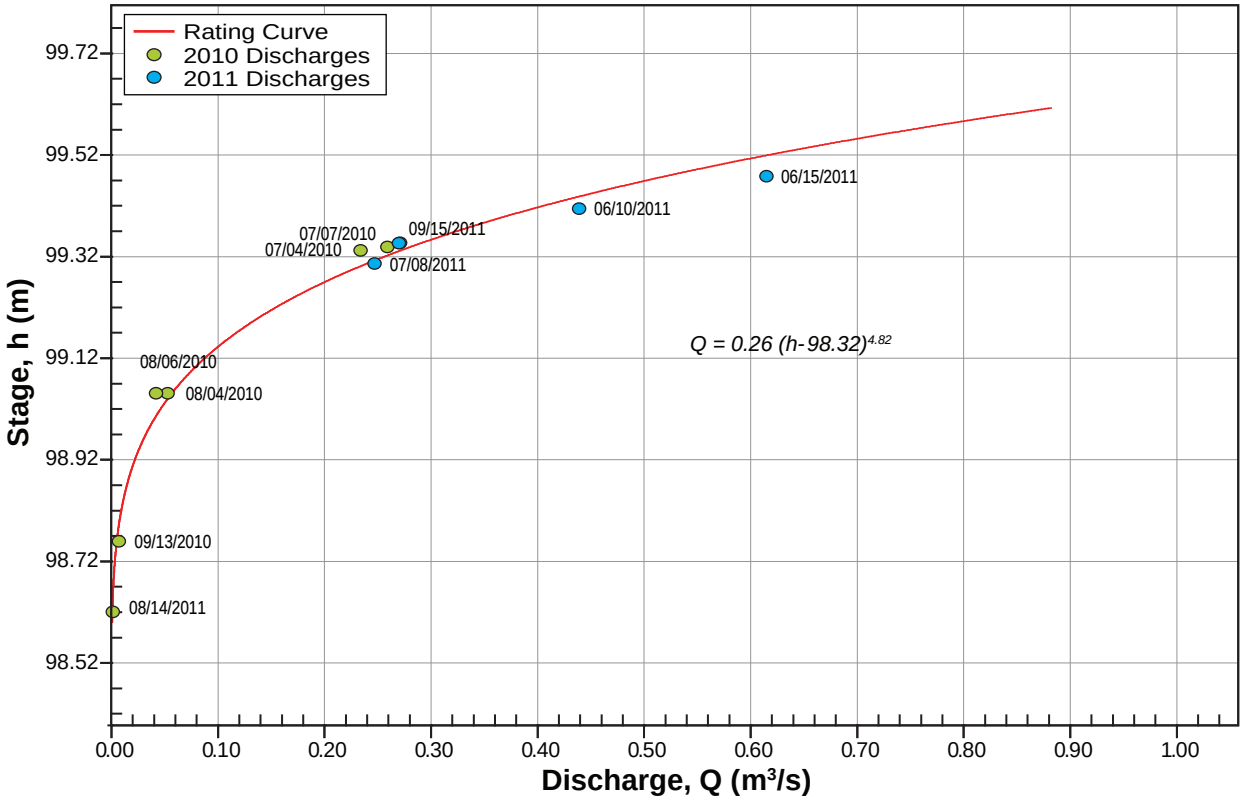
GL-H1, looking upstream along the monitored reach. The water elevation in the pool where the transducer is positioned is controlled by the bedrock channel constriction downstream. The yellow tape across the channel indicates the channel cross section where mannual flow measurements were conducted. Photograph taken September 16, 2011.



Note: pressure transducer stage readings are referenced to datum

Sabina GOLD & SILVER CORP.

GL-H1 - Stage-Discharge Rating Curve
(Rating Period from July 7, 2010 to September 16, 2011)

Appendix 3.1

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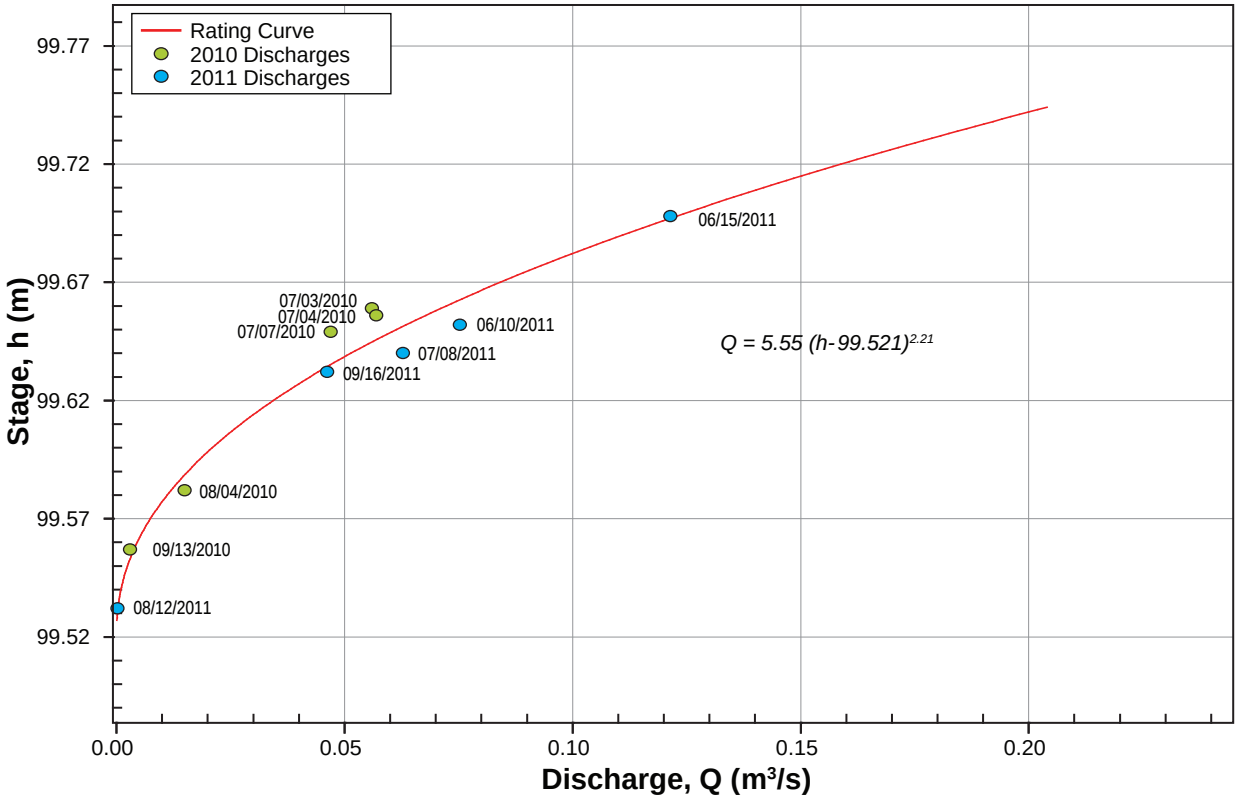
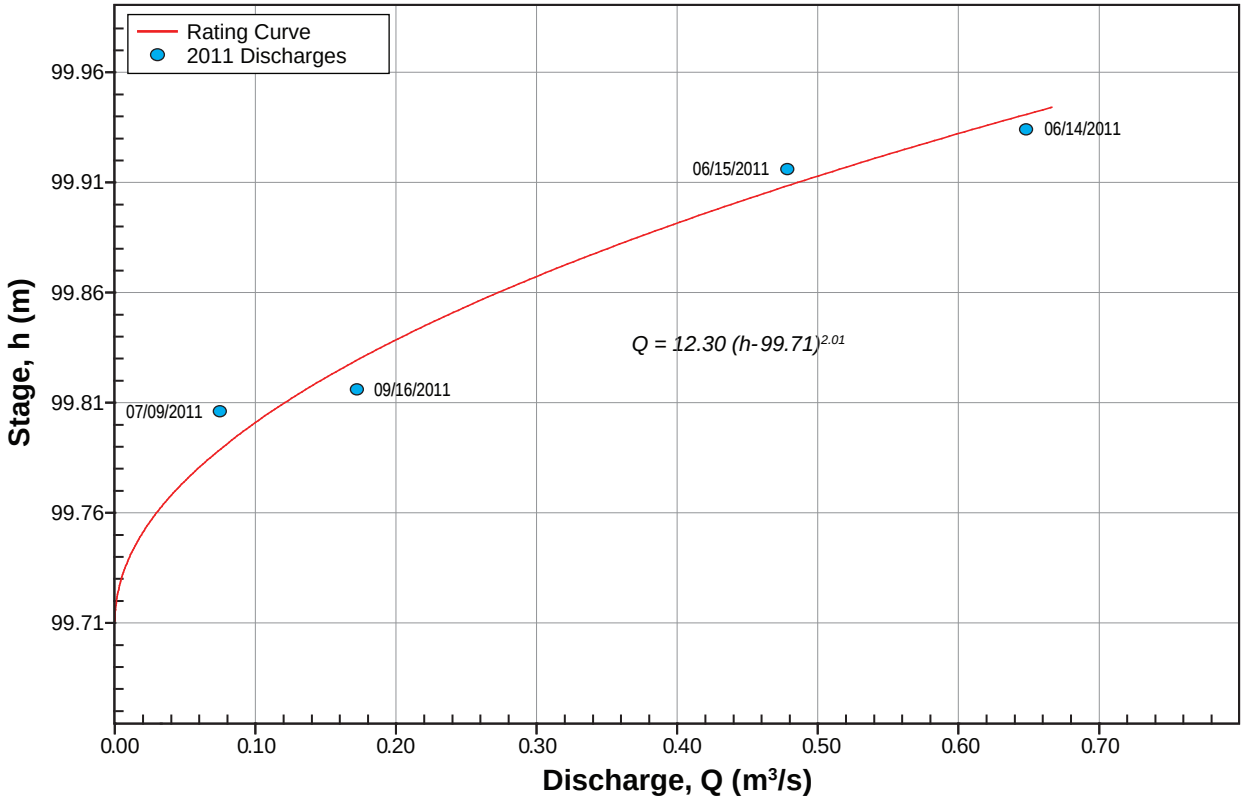
GL-H2, looking upstream from the hydrometric station along the monitored reach. The location of the pressure transducer is indicated in the photograph. This is a low energy system typicall of small streams in the region. Vegitation along the sides of the stream contribute to bank stability and flow in the stream is well confined within the channel. Photograph taken on July 8, 2011.



Note: pressure transducer stage readings are referenced to datum

Appendix 3.2

GL-H2 - Stage-Discharge Rating Curve
(Rating Period from July 3, 2010 to September 19, 2011)



Note: pressure transducer stage readings are referenced to datum

Sabina GOLD & SILVER CORP.

GL-H3 - Stage-Discharge Rating Curve
(Rating Period from June 13 to September 17, 2011)

Appendix 3.3

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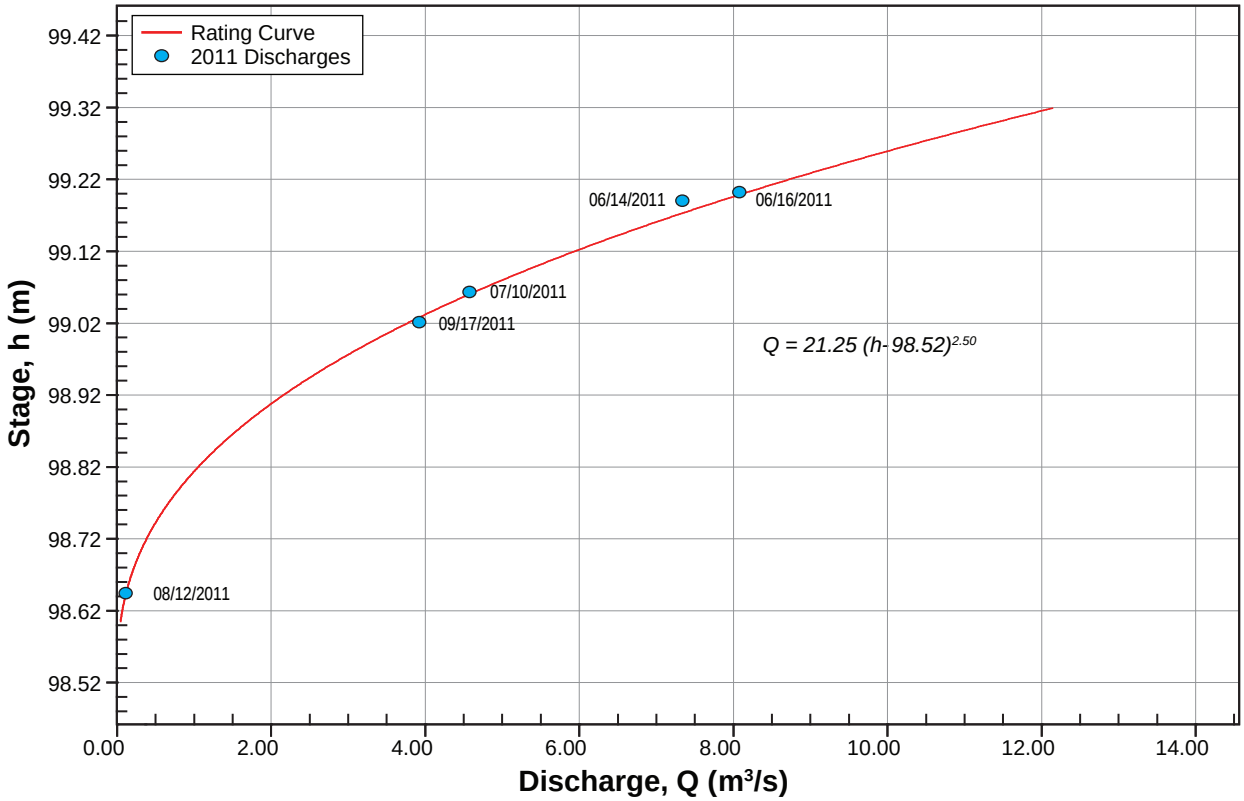
PL-H1, looking upstream from the station installed on the right bank. The monitored reach is a low energy stream confined within a boulder lined channel and bedrock banks. Photograph taken July 10, 2011.



Note: pressure transducer stage readings are referenced to datum

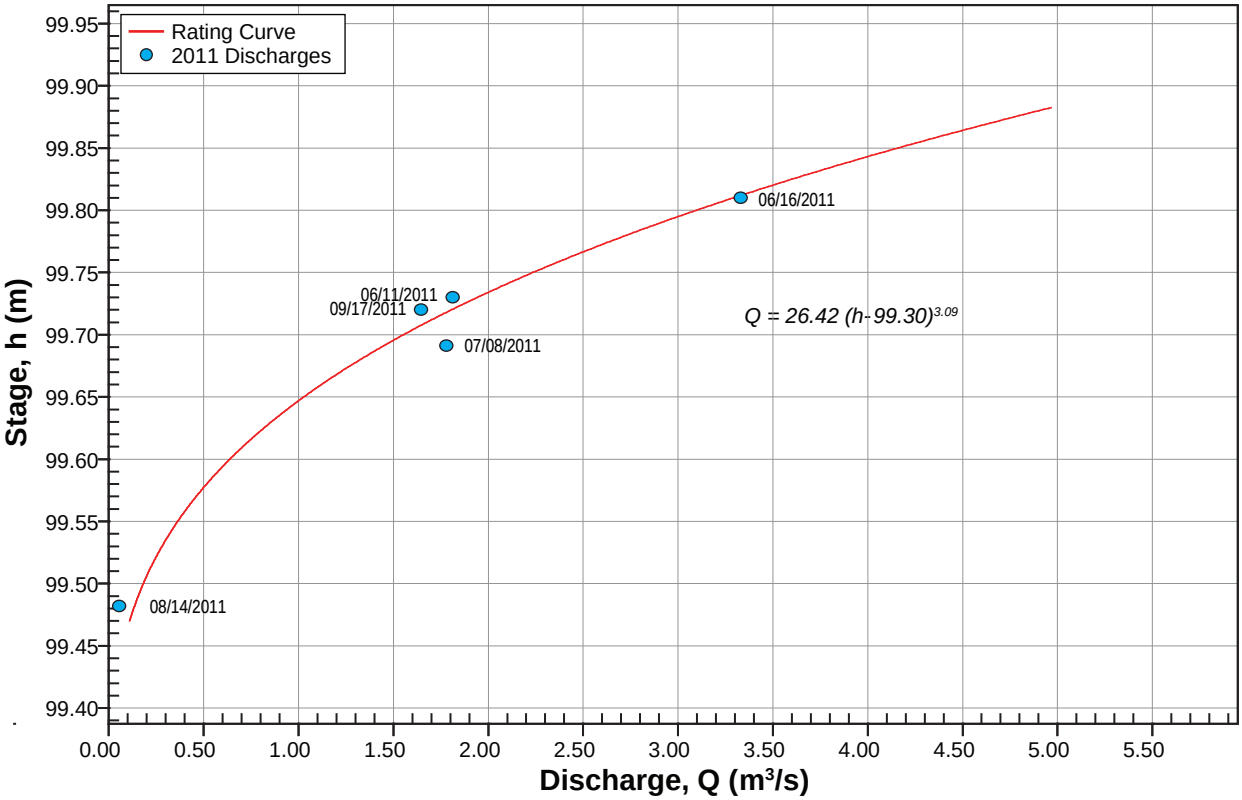
Sabina GOLD & SILVER CORP.

PL-H1 - Stage-Discharge Rating Curve
(Rating Period from June 12 to September 18, 2011)

Appendix 3.4

Rescan™ Engineers & Scientists

PL-H2, looking downstream from the station. The monitored reach is approximately 55 m wide at this location. The channel has a cobble/boulder bed substrate and is confined by low vegetated banks. Photograph taken on July 8, 2011.



Note: pressure transducer stage readings are referenced to datum

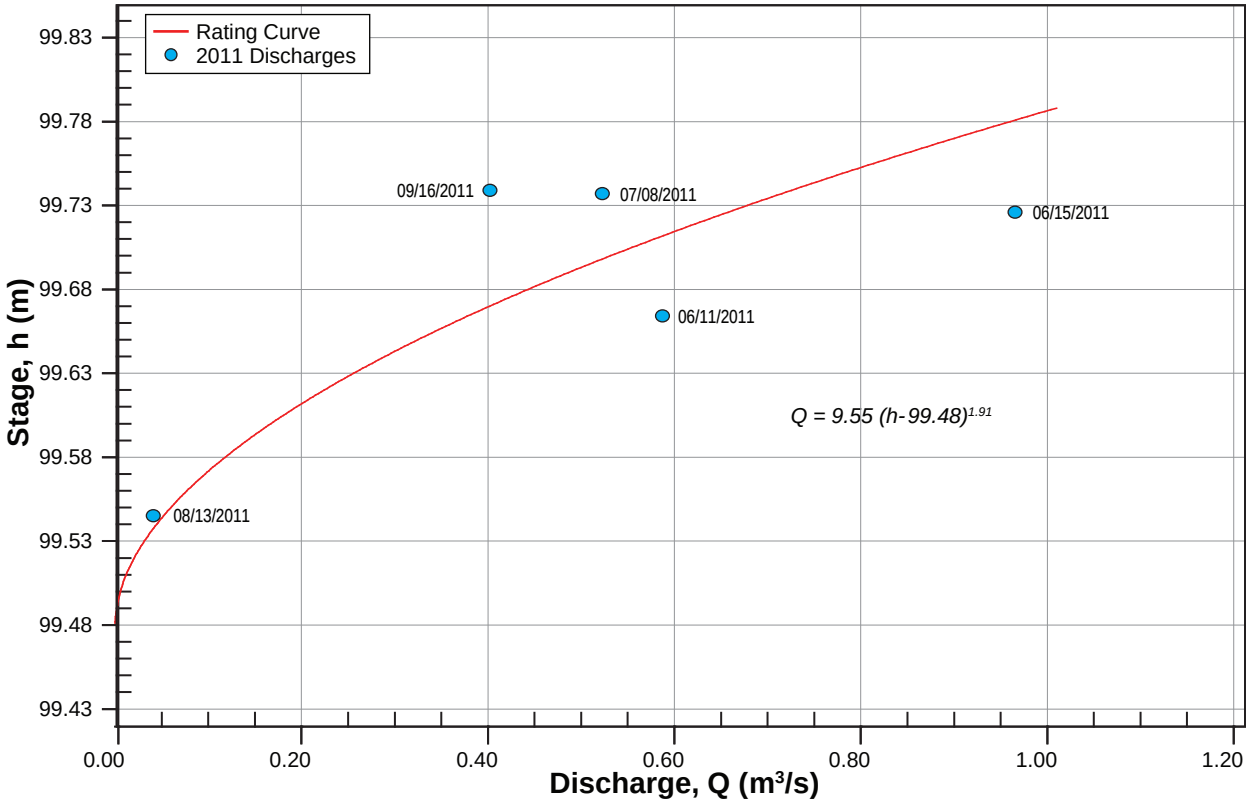
Sabina GOLD & SILVER CORP.

PL-H2 - Stage-Discharge Rating Curve
(Rating Period from June 10 to September 19, 2011)

Appendix 3.5

Rescan™ Engineers & Scientists

GI-H1, looking out over Giraffe Lake where the station is located at the outflow. The stage at the transducer location is governed by a section control located downstream in the channel. The section control is a riffle where boulders protrude from the water surface at all stages. Photograph taken on June 11, 2011.



Note: pressure transducer stage readings are referenced to datum

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GI-H1 - Stage-Discharge Rating Curve
(Rating Period from June 10 to September 16, 2011)

Appendix 3.6

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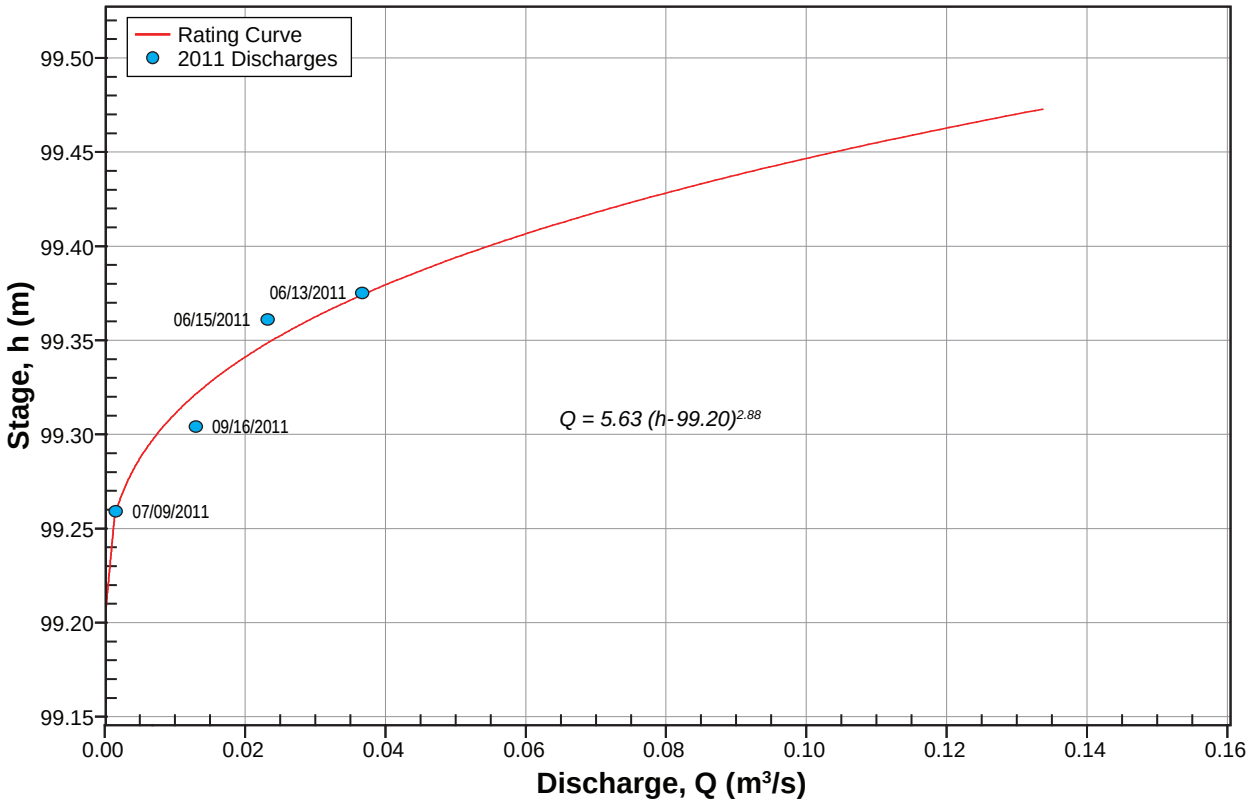
EL-H1, looking downstream along the channel. Note the water flowing through the tundra vegetation of this small ephemeral channel. The stream was observed to only flow during spring freshet and for short periods after precipitation events. Due to the ephemeral nature of the stream, the channel is lined with grasses. Photograph taken on June 13, 2011.



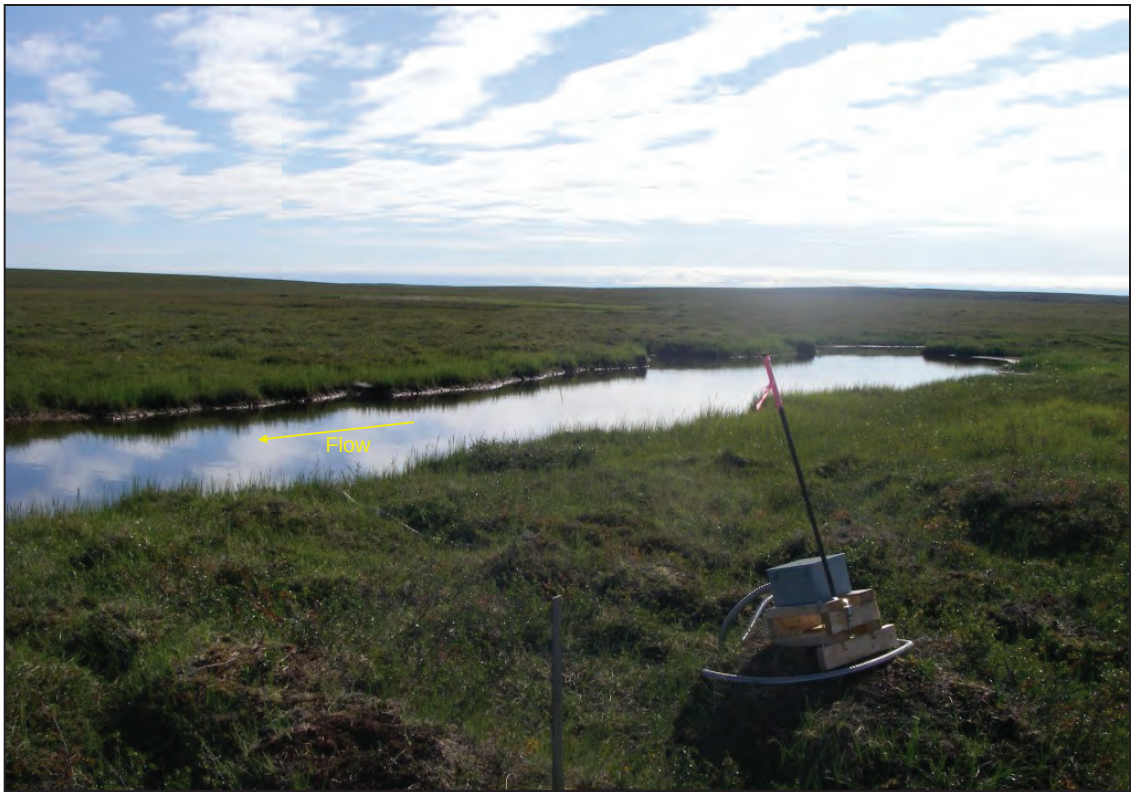
Note: pressure transducer stage readings are referenced to datum

Sabina GOLD & SILVER CORP.

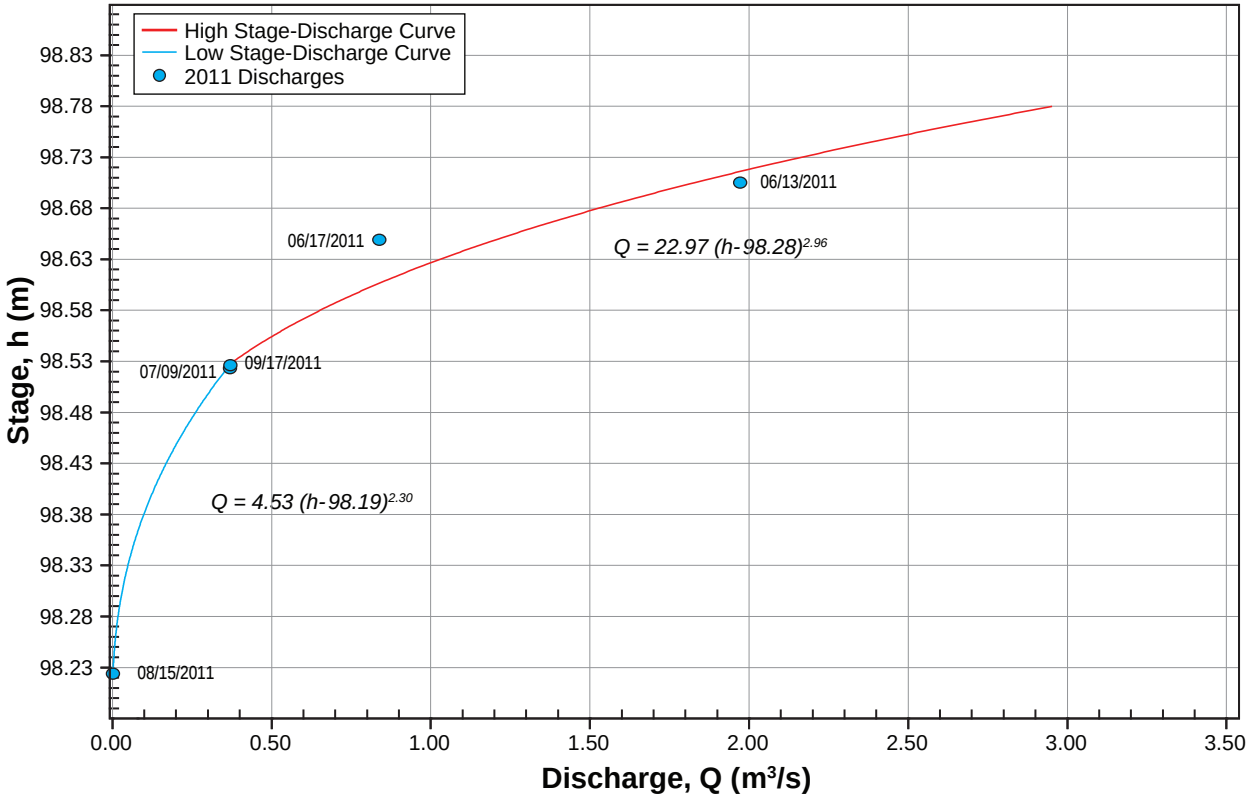
EL-H1 - Stage-Discharge Rating Curve
(Rating Period from June 11 to September 18, 2011)

Appendix 3.7

Rescan™ Engineers & Scientists



WL-H1, looking upstream along the monitored reach during low flow conditions. During low to medium flows conditions the stream is well confined by steep, almost vertical banks. In contrast, during high flow conditions the stream overflows onto the adjacent low gradient flood plain. This leads to different rating relationships between low and high stage conditions. Photograph taken on August 14, 2011.



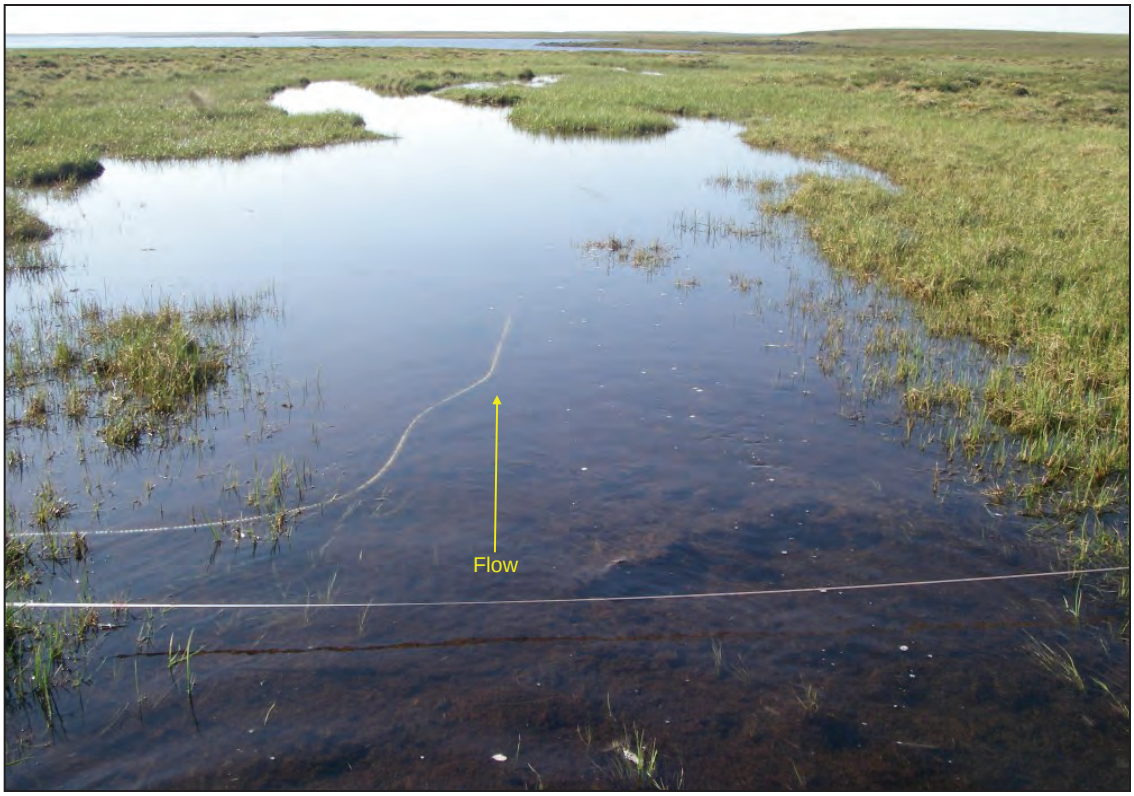
Note: pressure transducer stage readings are referenced to datum

Sabina GOLD & SILVER CORP.

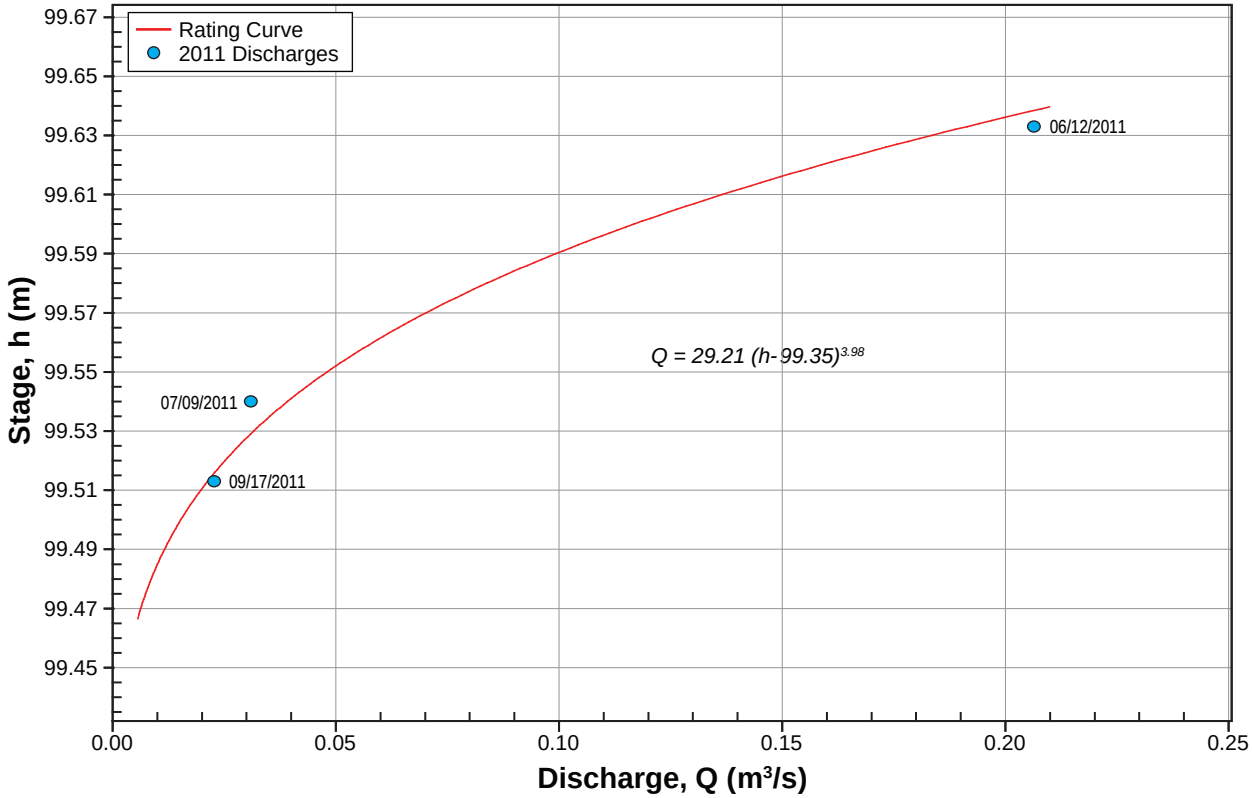
WL-H1 - Stage-Discharge Rating Curve
(Rating Period from June 12 to September 18, 2011)

Appendix 3.8

Rescan™ Engineers & Scientists



REFB-H1, looking downstream along the monitored reach. Note the water flowing through the gass along the edges of the channel. Vegetation growth in the channel is made possible by the periods of low flow during summer months when little to no flow conditions were observed. The tape across the channel indicates where mannual flow measurements were conducted. Photograph taken July 9, 2011.



Note: pressure transducer stage readings are referenced to datum

Appendix 3.9

REFB-H1 - Stage-Discharge Rating Curve
(Rating Period from June 12 to September 18, 2011)

Appendix 4
Mean Daily Discharge Tables

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Appendix 4.1. Summary of Daily Mean Discharge [Q] at Hydrometric Station GL-H1

2011	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.339	0.005	0.026	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.653	0.004	0.024	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.561	0.004	0.023	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.483	0.003	0.029	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.003*	0.414	0.003	0.045	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.007*	0.347	0.002	0.160	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.017*	0.290	0.002	0.206	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.038*	0.247	0.002	0.192	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.087*	0.214	0.001	0.170	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.451	0.189	0.001	0.321	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.477	0.164	0.001	0.502	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.511	0.145	0.001	0.462	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.601	0.130	0.001	0.404	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.583	0.106	0.001	0.360	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.548	0.088	0.001	0.332	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.554	0.073	0.001	0.303	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.574	0.060	0.006	*0.275*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.579	0.051	0.010	*0.247*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.579	0.044	0.014	*0.219*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.535	0.037	0.017	*0.191*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.487	0.031	0.018	*0.163*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.443	0.026	0.026	*0.135*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.403	0.022	0.037	*0.107*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.367	0.019	0.040	*0.079*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.336	0.016	0.040	*0.051*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.313	0.013	0.039	*0.022*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.269	0.011	0.036	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.233	0.010	0.034	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*		*0.000*	*0.000*	*0.000*	0.232	0.008	0.031	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.000*	0.256	0.007	0.029	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.000*		0.006	0.027		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.316**	**0.155**	**0.014**	**0.168**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.601**	**0.653**	**0.040**	**0.502**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.006**	**0.001**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**9.486**	**4.806**	**0.438**	**5.045**	**0.000**	**0.000**	**0.000**

Note: Estimated values are italicized

Appendix 4.2. Summary of Daily Mean Discharge [Q] at Hydrometric Station GL-H2

2011	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.097	0.000	0.006	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.118	0.000	0.005	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.118	0.001	0.006	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.107	0.000	0.010	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.093	0.000	0.015	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.002*	0.078	0.000	0.020	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.004*	0.065	0.000	0.022	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.008*	0.053	0.000	0.026	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.016*	0.045	0.000	0.024	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.063	0.038	0.000	0.046	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.066	0.032	0.000	0.063	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.078	0.027	0.000	0.064	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.099	0.021	0.000	0.056	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.124	0.017	0.000	0.051	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.127	0.013	0.000	0.049	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.141	0.011	0.000	0.045	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.157	0.008	0.003	*0.042*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.170	0.007	0.004	*0.038*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.180	0.005	0.006	*0.035*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.175	0.004	0.006	*0.031*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.167	0.004	0.007	*0.028*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.155	0.003	0.007	*0.024*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.139	0.003	0.008	*0.021*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.126	0.002	0.008	*0.017*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.117	0.002	0.009	*0.014*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.107	0.002	0.009	*0.010*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.084	0.002	0.008	*0.007*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.077	0.001	0.008	*0.003*	*0.000*	*0.000*	*0.000*
29	*0.000*		*0.000*	*0.000*	*0.000*	0.073	0.001	0.008	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.000*	0.078	0.000	0.008	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.000*		0.000	0.007		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.085**	**0.032**	**0.004**	**0.026**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.180**	**0.118**	**0.009**	**0.064**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**2.537**	**0.977**	**0.110**	**0.779**	**0.000**	**0.000**	**0.000**

Note: Estimated values are italicized

Appendix 4.3. Summary of Daily Mean Discharge [Q] at Hydrometric Station GL-H3

2011	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.271	0.000	0.000	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.478	0.000	0.000	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.434	0.000	0.000	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.351	0.000	0.012	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.273	0.000	0.067	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.002*	0.221	0.000	0.113	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.004*	0.178	0.000	0.116	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.008*	0.142	0.000	0.093	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.016*	0.107	0.000	0.097	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.323*	0.073	0.000	0.245	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.345*	0.051	0.000	0.267	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.376*	0.036	0.000	0.225	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.455*	0.019	0.000	0.193	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.575	0.009	0.000	0.181	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.528	0.003	0.000	0.157	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.487	0.000	0.000	0.141	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.468	0.000	0.000	*0.114*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.442	0.000	0.000	*0.087*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.420	0.000	0.000	*0.060*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.379	0.000	0.000	*0.033*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.335	0.000	0.000	*0.006*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.309	0.000	0.002	*0.000*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.281	0.000	0.001	*0.000*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.252	0.000	0.001	*0.000*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.218	0.000	0.001	*0.000*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.166	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.160	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.176	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*		*0.000*	*0.000*	*0.000*	0.174	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.000*	0.201	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.000*		0.000	0.000		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.237**	**0.085**	**0.000**	**0.074**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.575**	**0.478**	**0.002**	**0.267**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**7.104**	**2.646**	**0.005**	**2.209**	**0.000**	**0.000**	**0.000**

Note: Estimated values are italicized

Appendix 4.4. Summary of Daily Mean Discharge [Q] at Hydrometric Station PL-H1

2011	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	5.009	0.344	0.212	*0.601*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	6.460	0.321	0.204	*0.371*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	7.115	0.273	0.224	*0.141*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.002*	7.398	0.248	0.291	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.005*	7.086	0.234	0.353	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.012*	6.576	0.222	0.467	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.030*	6.036	0.202	0.592	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.072*	5.553	0.182	0.623	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.176*	5.033	0.159	0.754	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.427*	4.566	0.138	1.296	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.038*	4.170	0.129	2.098	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	6.134	3.832	0.116	2.658	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	6.726	3.470	0.084	3.265	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	7.595	3.138	0.075	3.748	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	8.081	2.735	0.069	3.778	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	8.194	2.411	0.060	3.905	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	8.168	2.168	0.174	3.821	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	8.133	1.968	0.248	*3.591*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	8.000	1.763	0.261	*3.361*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	7.832	1.510	0.241	*3.131*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	7.577	1.297	0.239	*2.901*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	7.185	1.155	0.262	*2.671*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	6.769	1.032	0.266	*2.441*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	6.328	0.924	0.271	*2.211*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	5.949	0.847	0.269	*1.981*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	5.582	0.756	0.250	*1.751*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	5.227	0.623	0.252	*1.521*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	4.899	0.552	0.254	*1.291*	*0.000*	*0.000*	*0.000*
29	*0.000*		*0.000*	*0.000*	*0.000*	4.684	0.515	0.253	*1.061*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.000*	4.770	0.429	0.256	*0.831*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.000*		0.378	0.234		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**4.320**	**3.113**	**0.212**	**1.901**	**0.036**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**8.194**	**7.398**	**0.344**	**3.905**	**0.601**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.378**	**0.060**	**0.204**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**129.596**	**96.506**	**6.586**	**57.029**	**1.112**	**0.000**	**0.000**

Note: Estimated values are italicized

Appendix 4.5. Summary of Daily Mean Discharge [Q] at Hydrometric Station PL-H2

2011	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.697	0.147	0.517	*0.150*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.668	0.150	0.541	*0.030*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	2.849	0.160	0.587	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	2.483	0.160	0.662	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.003*	2.183	0.158	0.783	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.008*	1.873	0.153	1.109	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.018*	1.630	0.144	1.345	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.040*	1.430	0.136	1.316	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.091*	1.255	0.131	1.292	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.208*	1.139	0.128	1.758	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.972*	1.024	0.132	2.466	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.361	0.944	0.138	2.527	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	3.394	0.823	0.143	2.430	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	3.825	0.738	0.142	2.267	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	3.578	0.636	0.138	2.025	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	3.318	0.610	0.122	1.889	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	3.169	0.557	0.214	1.830	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	3.094	0.497	0.314	*1.710*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	3.020	0.422	0.422	*1.590*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.909	0.398	0.407	*1.470*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.707	0.369	0.419	*1.350*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.506	0.353	0.420	*1.230*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.294	0.322	0.496	*1.110*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.125	0.311	0.520	*0.990*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.985	0.287	0.520	*0.870*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.907	0.262	0.538	*0.750*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.715	0.241	0.541	*0.630*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.603	0.224	0.545	*0.510*	*0.000*	*0.000*	*0.000*
29	*0.000*		*0.000*	*0.000*	*0.000*	1.479	0.209	0.555	*0.390*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.000*	1.535	0.179	0.542	*0.270*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.000*		0.166	0.513		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**1.696**	**0.928**	**0.298**	**1.274**	**0.006**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**3.825**	**2.849**	**0.555**	**2.527**	**0.150**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.166**	**0.122**	**0.270**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**50.869**	**28.776**	**9.246**	**38.213**	**0.180**	**0.000**	**0.000**

Note: Estimated values are italicized

Appendix 4.6. Summary of Daily Mean Discharge [Q] at Hydrometric Station GI-H1

2011	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.707	0.053	0.280	*0.190*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.905	0.103	0.280	*0.153*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.961	0.129	0.290	*0.117*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.920	0.091	0.390	*0.081*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.003*	0.868	0.063	0.448	*0.045*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.007*	0.815	0.060	0.491	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.015*	0.769	0.047	0.525	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.034*	0.713	0.043	0.571	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.077*	0.686	0.035	0.528	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.174*	0.648	0.027	0.710	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.393*	0.612	0.035	0.875	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.451	0.587	0.077	0.886	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.581	0.532	0.047	0.817	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.656	0.493	0.007	0.774	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.665	0.449	0.002	0.769	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.716	0.422	0.002	0.732	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.758	0.378	0.134	*0.696*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.823	0.342	0.259	*0.660*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.862	0.293	0.310	*0.624*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.867	0.272	0.298	*0.588*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.854	0.259	0.261	*0.551*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.832	0.240	0.241	*0.515*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.797	0.223	0.297	*0.479*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.771	0.213	0.284	*0.443*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.749	0.191	0.296	*0.407*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.708	0.191	0.312	*0.371*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.633	0.205	0.268	*0.334*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.612	0.108	0.296	*0.298*	*0.000*	*0.000*	*0.000*
29	*0.000*		*0.000*	*0.000*	*0.000*	0.598	0.112	0.286	*0.262*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.000*	0.626	0.100	0.297	*0.226*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.000*		0.063	0.291		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.476**	**0.461**	**0.160**	**0.527**	**0.019**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.867**	**0.961**	**0.312**	**0.886**	**0.190**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.063**	**0.002**	**0.226**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**14.267**	**14.277**	**4.952**	**15.821**	**0.586**	**0.000**	**0.000**

Note: Estimated values are italicized

Appendix 4.7. Summary of Daily Mean Discharge [Q] at Hydrometric Station EL-H1

2011	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.056	0.000	0.001	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.071	0.000	0.001	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.036	0.000	0.002	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.021	0.000	0.015	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.011	0.000	0.034	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.002*	0.007	0.000	0.025	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.004*	0.004	0.000	0.018	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.007*	0.002	0.000	0.012	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.013*	0.002	0.000	0.011	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.050*	0.001	0.000	0.062	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.088*	0.001	0.000	0.043	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.072*	0.001	0.000	0.024	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.055	0.001	0.000	0.016	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.038	0.000	0.000	0.012	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.034	0.000	0.000	0.010	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.039	0.000	0.000	0.009	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.042	0.000	0.000	*0.007*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.038	0.000	0.001	*0.005*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.036	0.000	0.004	*0.004*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.028	0.000	0.004	*0.002*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.022	0.000	0.003	*0.000*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.017	0.000	0.004	*0.000*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.013	0.000	0.004	*0.000*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.009	0.000	0.002	*0.000*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.008	0.000	0.002	*0.000*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.008	0.000	0.001	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.005	0.000	0.001	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.006	0.000	0.001	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*		*0.000*	*0.000*	*0.000*	0.007	0.000	0.001	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.000*	0.022	0.000	0.001	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.000*		0.000	0.001		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.022**	**0.007**	**0.001**	**0.010**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.088**	**0.071**	**0.004**	**0.062**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.668**	**0.213**	**0.032**	**0.315**	**0.000**	**0.000**	**0.000**

Note: Estimated values are italicized

Appendix 4.8. Summary of Daily Mean Discharge [Q] at Hydrometric Station WL-H1

2011	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.730	0.013	0.066	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.255	0.016	0.064	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.161	0.014	0.081	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.967	0.011	0.138	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.002*	0.785	0.009	0.252	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.004*	0.638	0.008	0.336	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.009*	0.533	0.007	0.353	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.019*	0.452	0.006	0.305	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.040*	0.378	0.005	0.293	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.362*	0.329	0.005	0.633	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.394*	0.291	0.006	0.735	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.439*	0.258	0.006	0.637	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.737	0.210	0.005	0.570	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.556	0.176	0.003	0.541	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.348	0.141	0.002	0.463	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.246	0.115	0.004	0.416	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.187	0.103	0.034	0.375	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.135	0.096	0.042	*0.335*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.083	0.085	0.061	*0.295*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.025	0.066	0.082	*0.255*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.937	0.055	0.097	*0.215*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.872	0.049	0.113	*0.175*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.791	0.044	0.103	*0.135*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.726	0.040	0.108	*0.095*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.640	0.036	0.101	*0.055*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.532	0.033	0.090	*0.015*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.535	0.028	0.087	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.539	0.021	0.084	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*		*0.000*	*0.000*	*0.000*	0.500	0.020	0.082	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.000*	0.565	0.016	0.080	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.000*		0.013	0.073		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.707**	**0.294**	**0.044**	**0.261**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**1.737**	**1.255**	**0.113**	**0.735**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.013**	**0.002**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**21.223**	**9.122**	**1.358**	**7.833**	**0.000**	**0.000**	**0.000**

Note: Estimated values are italicized

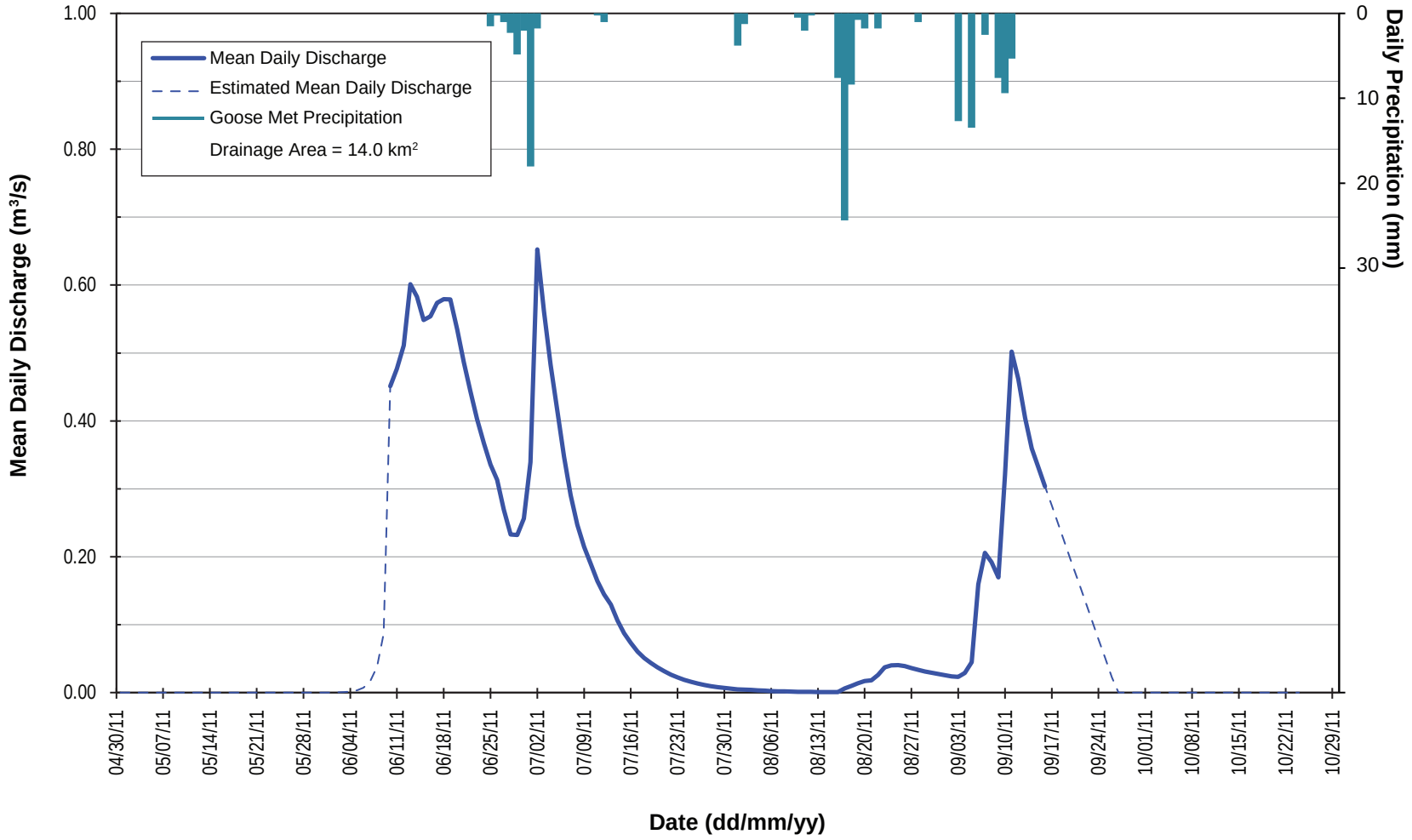
Appendix 4.9. Summary of Daily Mean Discharge [Q] at Hydrometric Station REFB-H1

2011	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.102	0.000	0.000	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.161	0.000	0.000	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.156	0.000	0.000	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.128	0.000	0.000	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.102	0.000	0.012	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.002*	0.079	0.000	0.009	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.004*	0.060	0.000	0.008	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.007*	0.045	0.000	0.018	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.014*	0.038	0.000	0.009	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.104*	0.030	0.000	0.047	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.112*	0.022	0.000	0.066	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.200	0.018	0.000	0.061	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.188	0.011	0.000	0.047	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.177	0.003	0.000	0.035	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.159	0.000	0.000	0.034	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.144	0.000	0.000	0.026	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.131	0.000	0.000	0.021	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.118	0.000	0.000	*0.017*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.105	0.000	0.000	*0.012*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.093	0.000	0.000	*0.007*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.085	0.000	0.000	*0.003*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.071	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.055	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.042	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.043	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.049	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.028	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.023	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*		*0.000*	*0.000*	*0.000*	0.024	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.000*	0.040	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.000*		0.000	0.000		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.067**	**0.031**	**0.000**	**0.014**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.200**	**0.161**	**0.000**	**0.066**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**2.021**	**0.956**	**0.000**	**0.433**	**0.000**	**0.000**	**0.000**

Note: Estimated values are italicized

Appendix 5
Annual Hydrographs

Rescan™
Engineers and Scientists



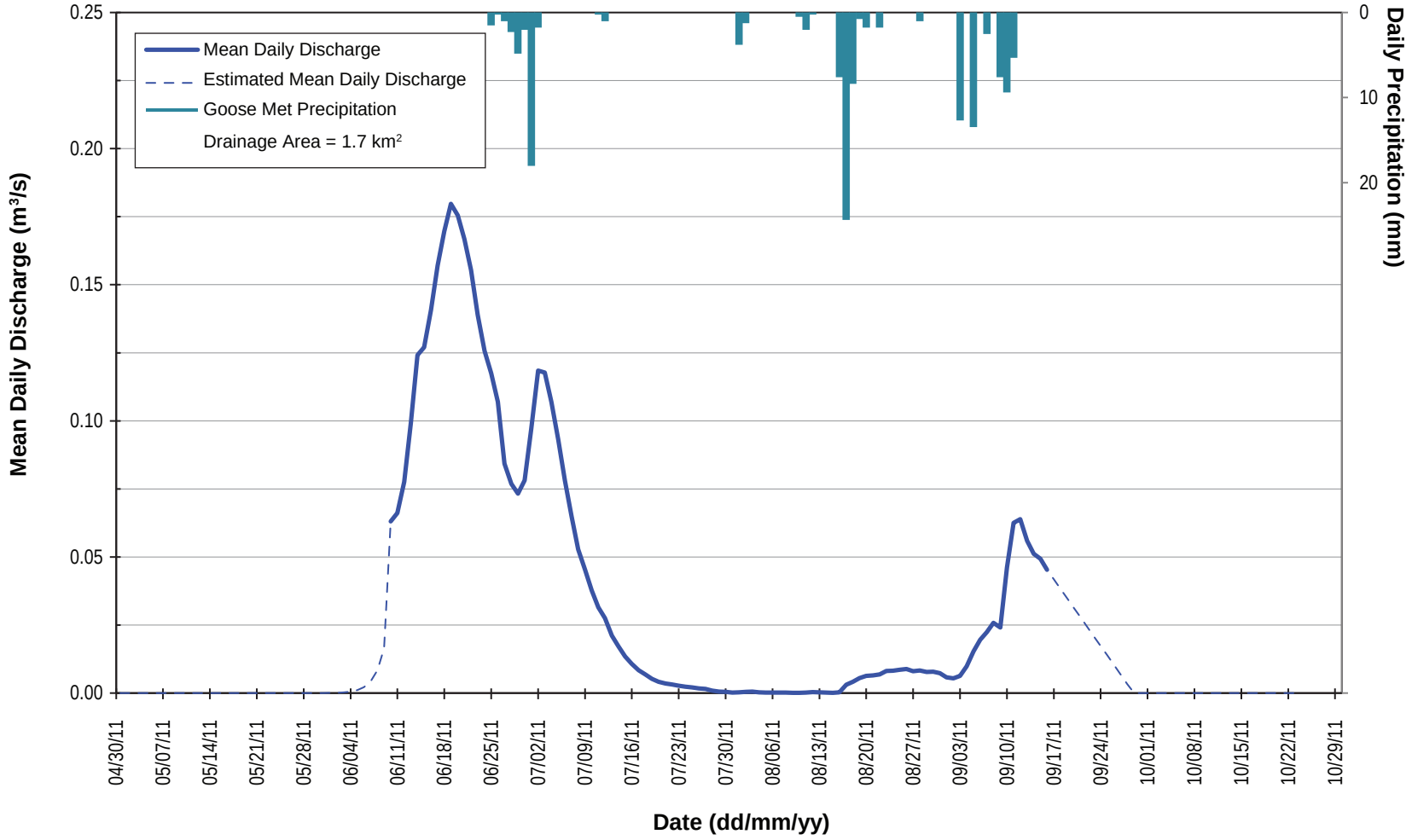
Appendix 5.1

Sabina GOLD & SILVER CORP.

Annual Hydrograph at GL-*H1* Hydrometric Monitoring Station, 2011

Appendix 5.1

Rescan™ Engineers & Scientists



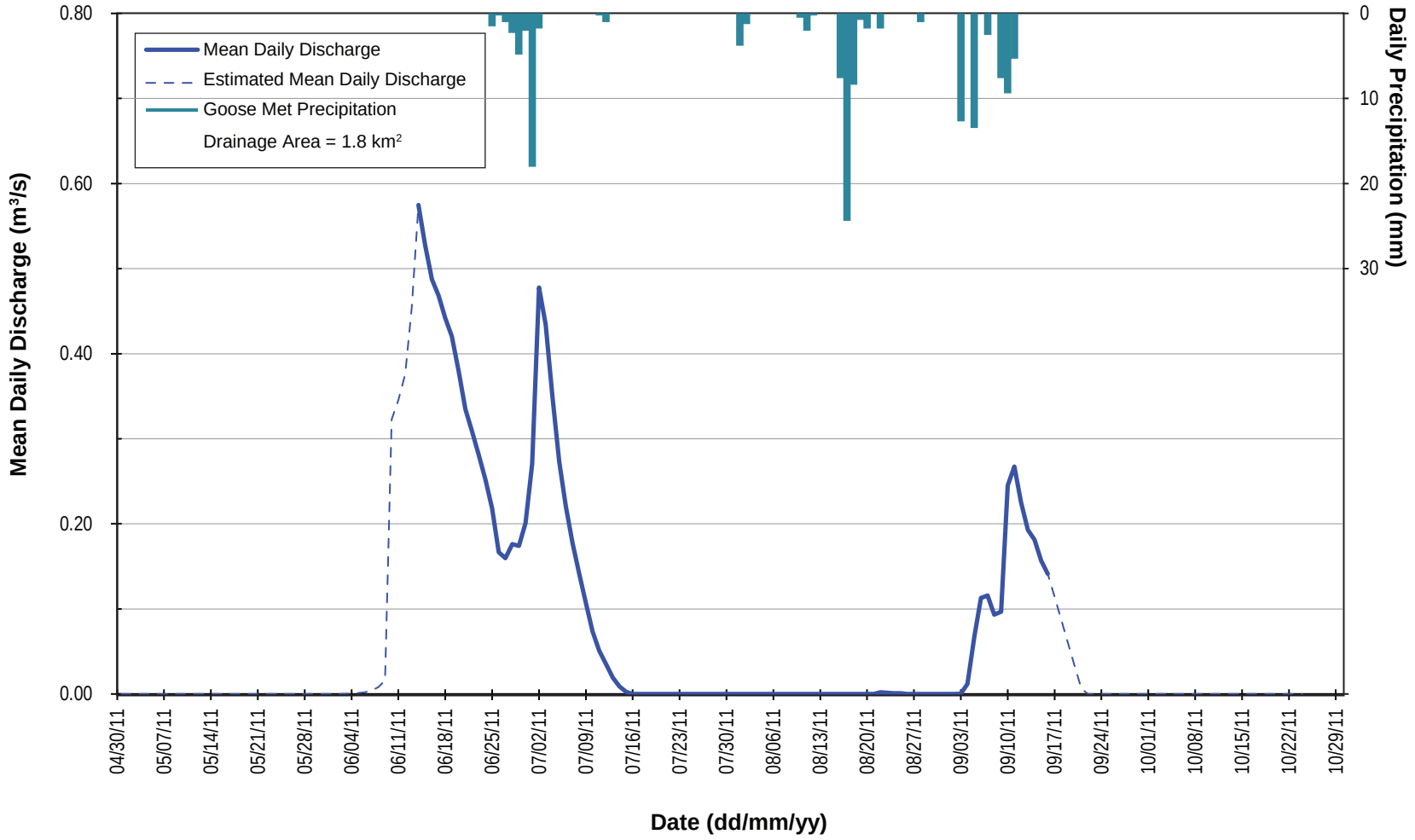
Appendix 5.2

Sabina GOLD & SILVER CORP.

Annual Hydrograph at GL-*H2* Hydrometric Monitoring Station, 2011

Appendix 5.2

Rescan™ Engineers & Scientists



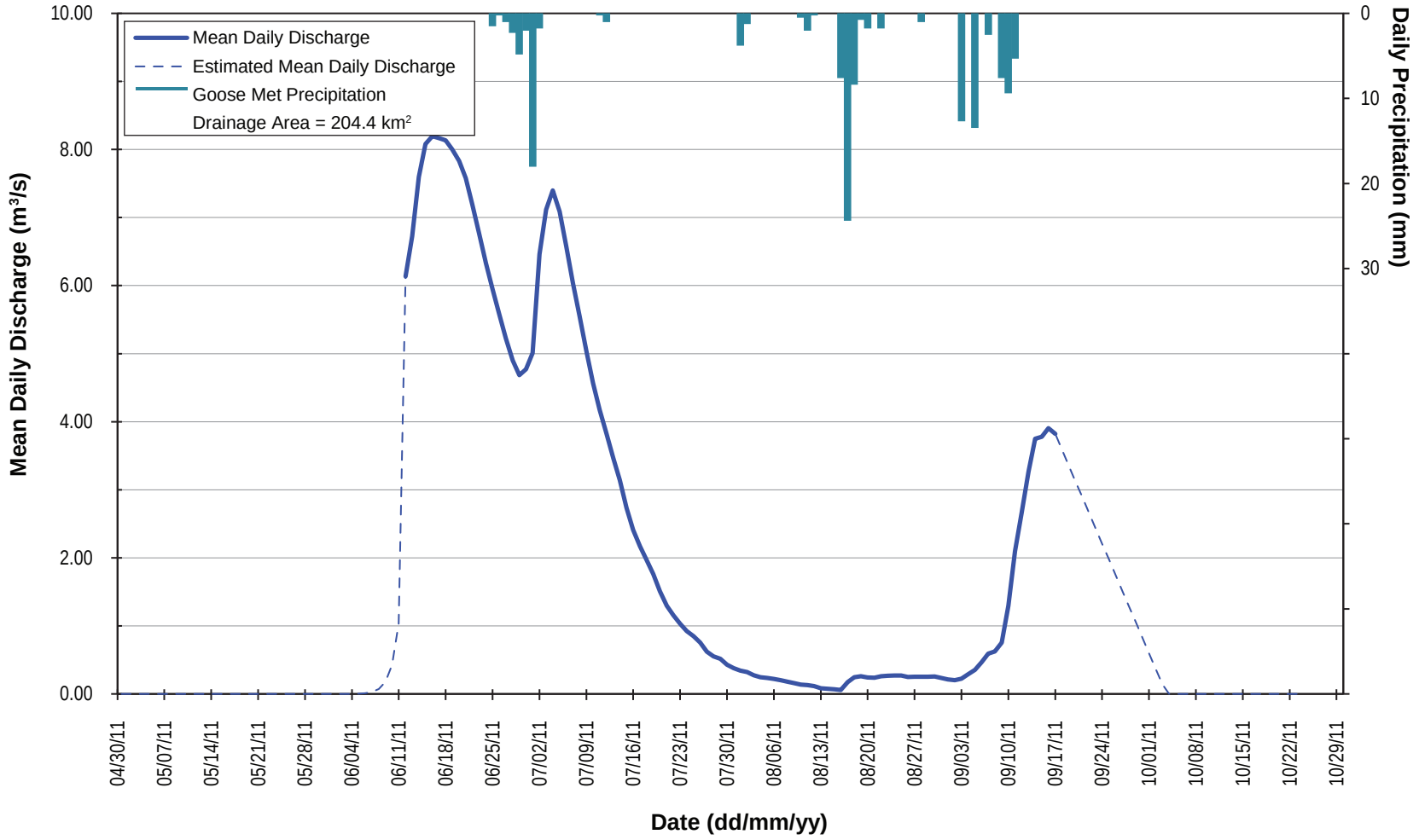
Appendix 5.3

Sabina GOLD & SILVER CORP.

Annual Hydrograph at GL-*H3*
Hydrometric Monitoring Station, 2011

Appendix 5.3

Rescan™ Engineers & Scientists



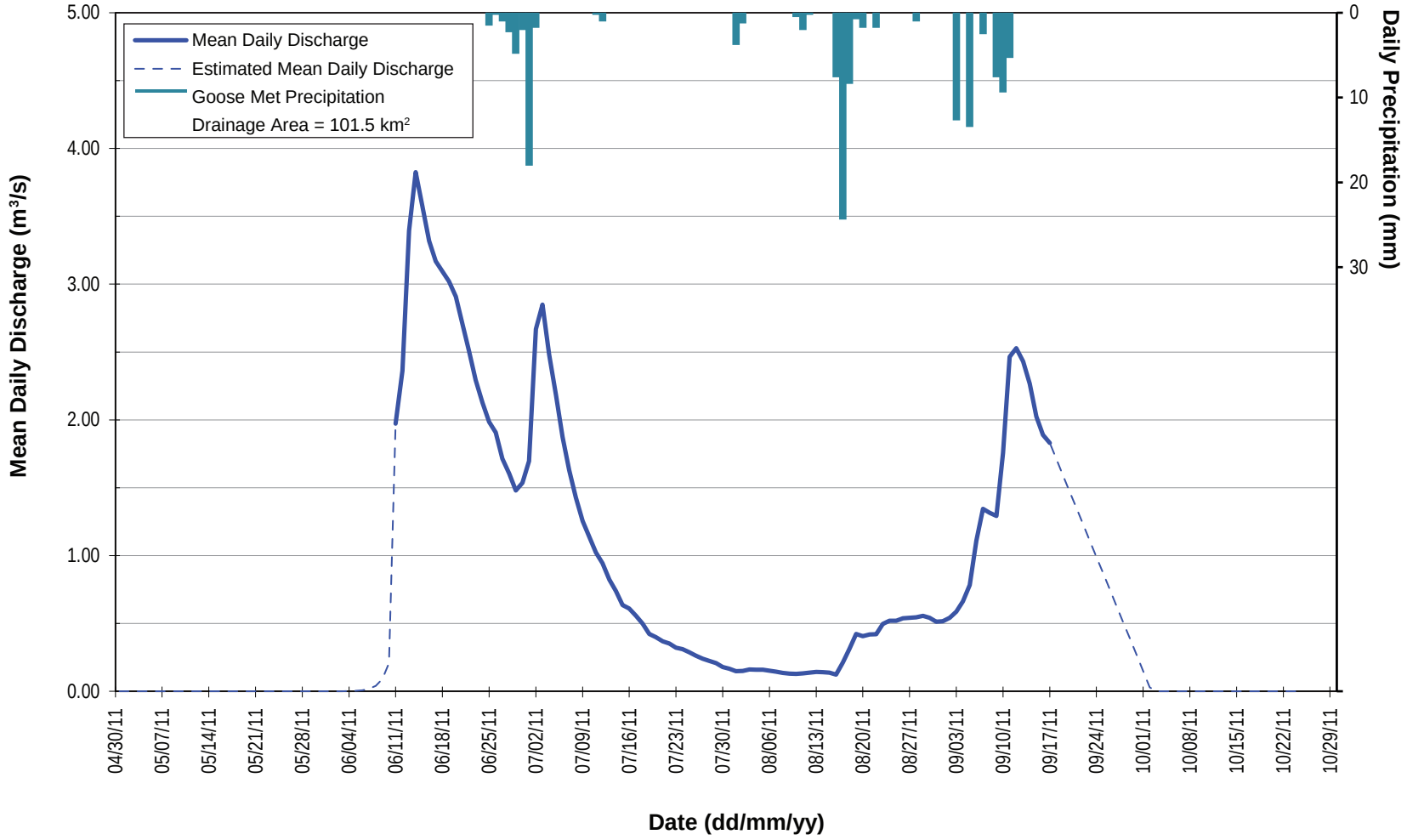
Appendix 5.4

Sabina GOLD & SILVER CORP.

Annual Hydrograph at PL-*H1*
Hydrometric Monitoring Station, 2011

Appendix 5.4

Rescan™ Engineers & Scientists

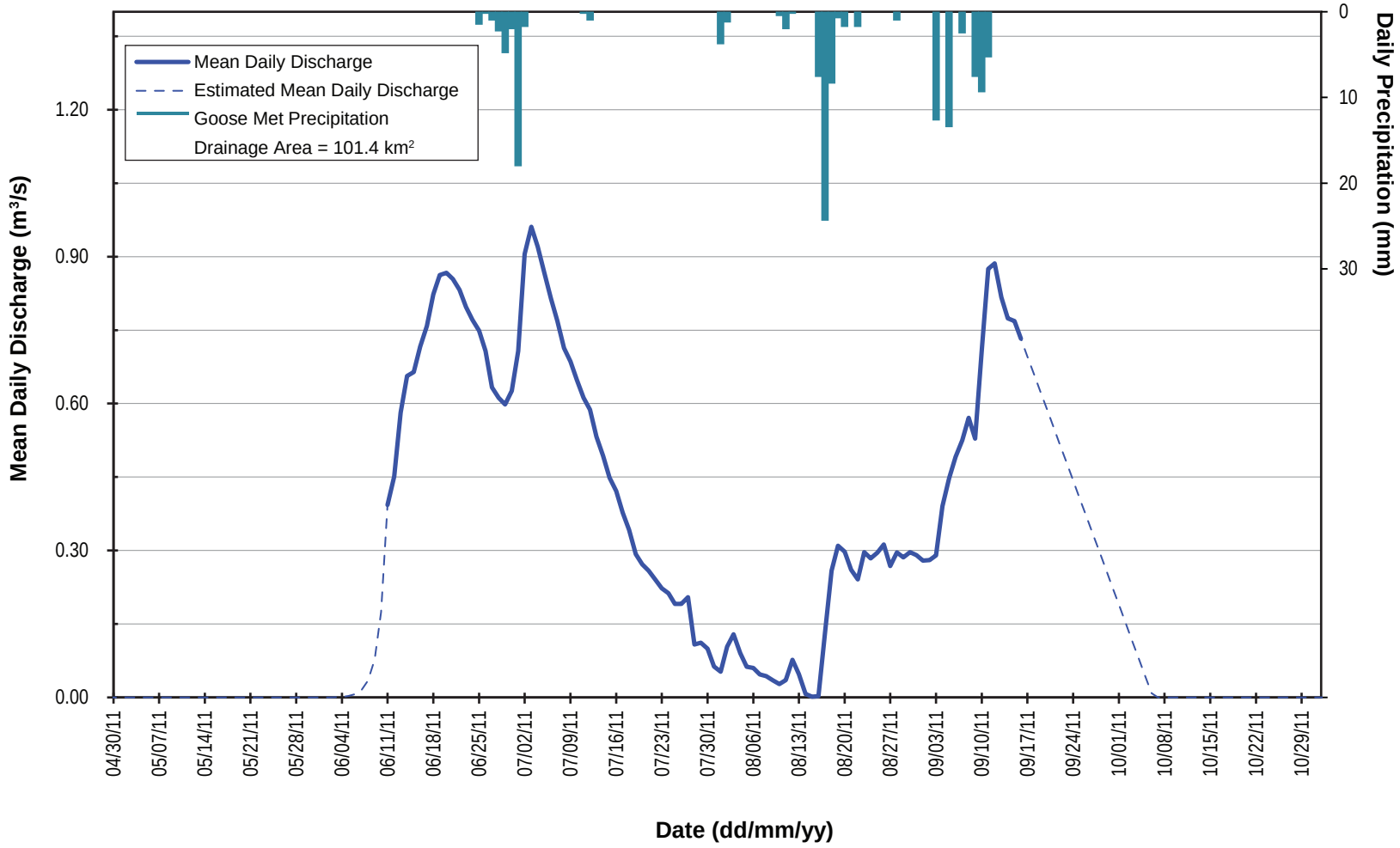


Sabina GOLD & SILVER CORP.

Annual Hydrograph at PL-*H2* Hydrometric Monitoring Station, 2011

Appendix 5.5

Rescan™ Engineers & Scientists



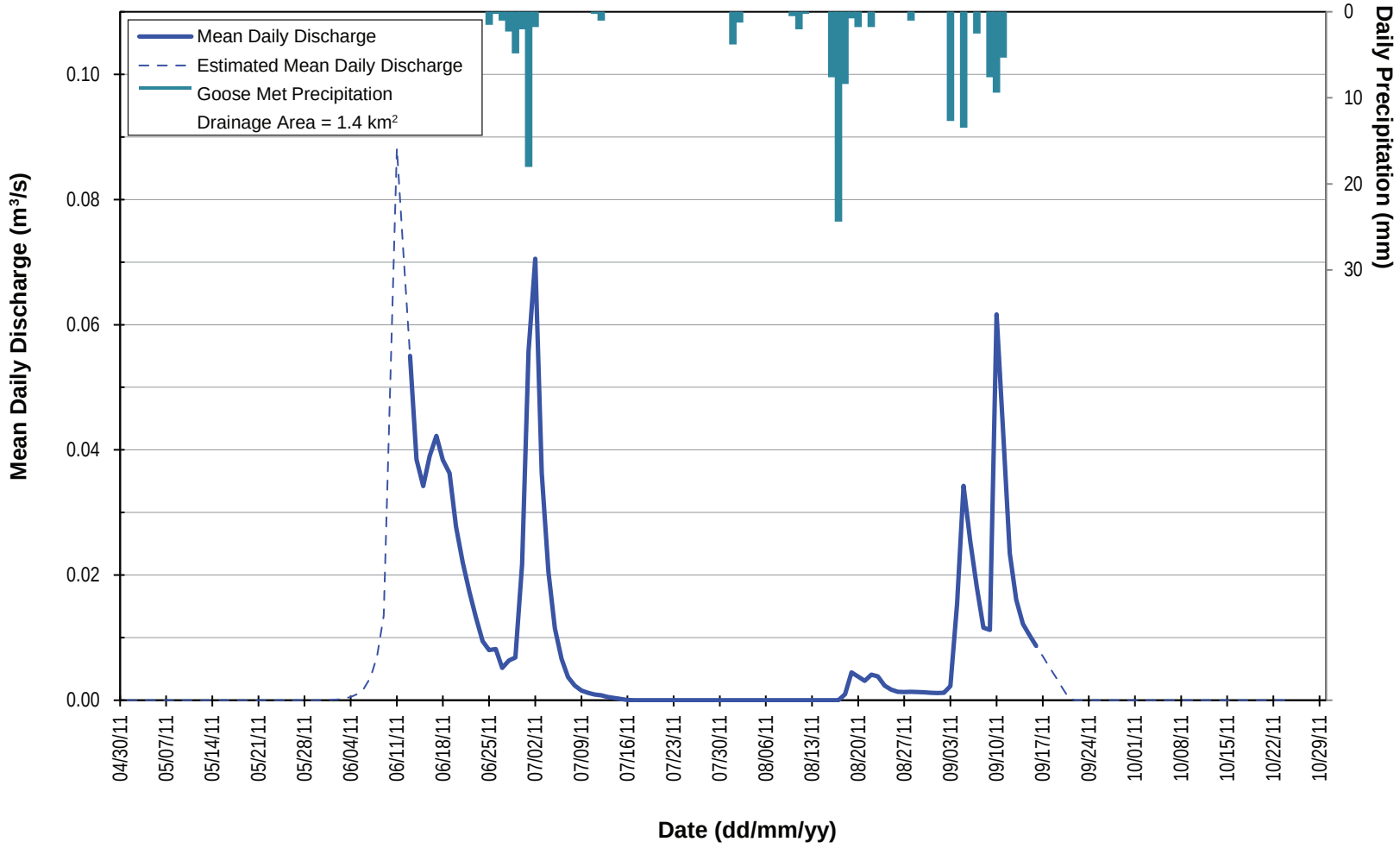
Appendix 5.6

Sabina GOLD & SILVER CORP.

Annual Hydrograph at GI-*H1* Hydrometric Monitoring Station, 2011

Appendix 5.6

Rescan™ Engineers & Scientists

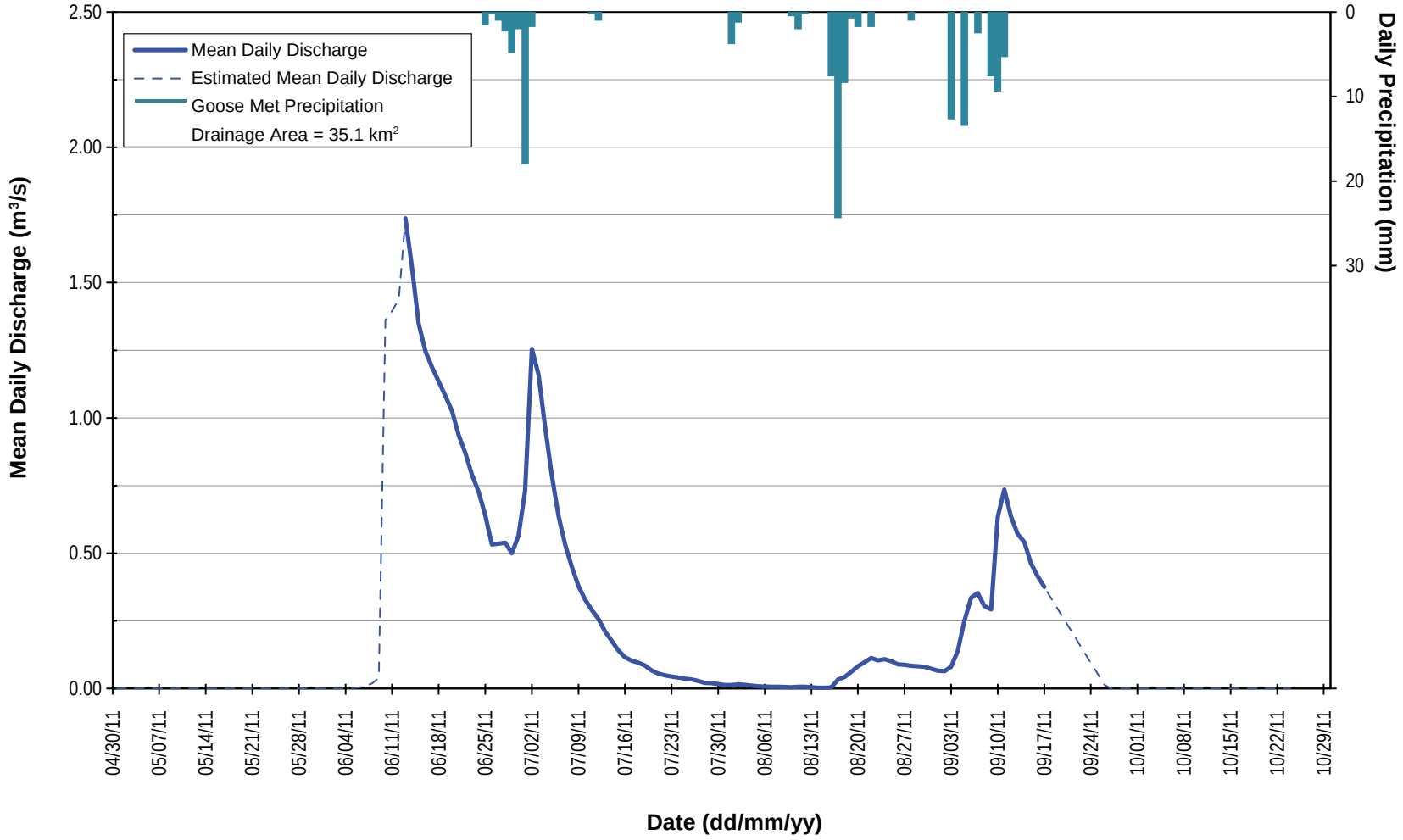


Sabina GOLD & SILVER CORP.

Annual Hydrograph at EL-*H1* Hydrometric Monitoring Station, 2011

Appendix 5.7

Rescan™ Engineers & Scientists



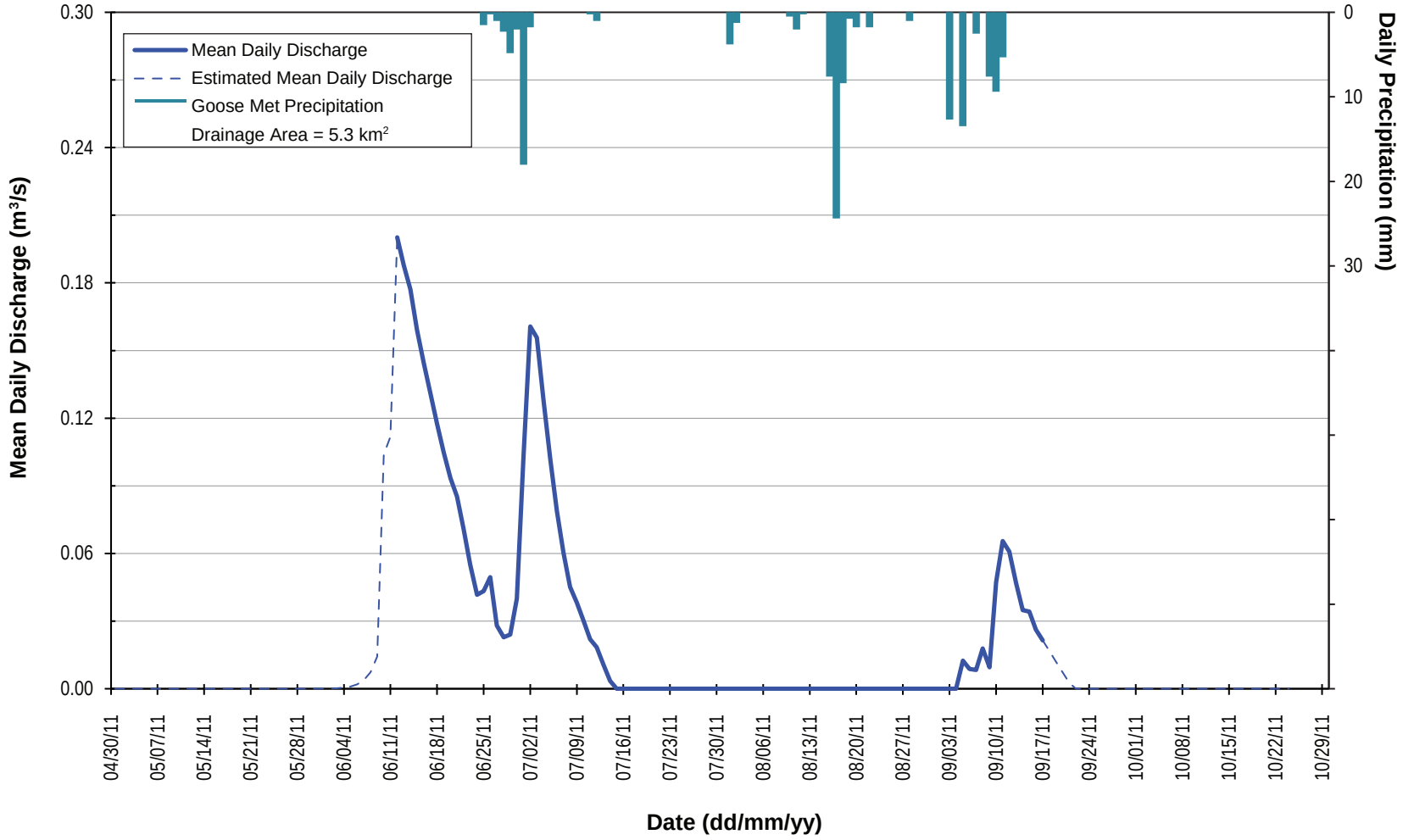
Appendix 5.8

Sabina GOLD & SILVER CORP.

Annual Hydrograph at WL-*H1* Hydrometric Monitoring Station, 2011

Appendix 5.8

Rescan™ Engineers & Scientists



Sabina GOLD & SILVER CORP.

Annual Hydrograph at REFB-*H1*
Hydrometric Monitoring Station, 2011

Appendix 5.9

Rescan™ Engineers & Scientists

Appendix 6
Channel Geometry Surveys

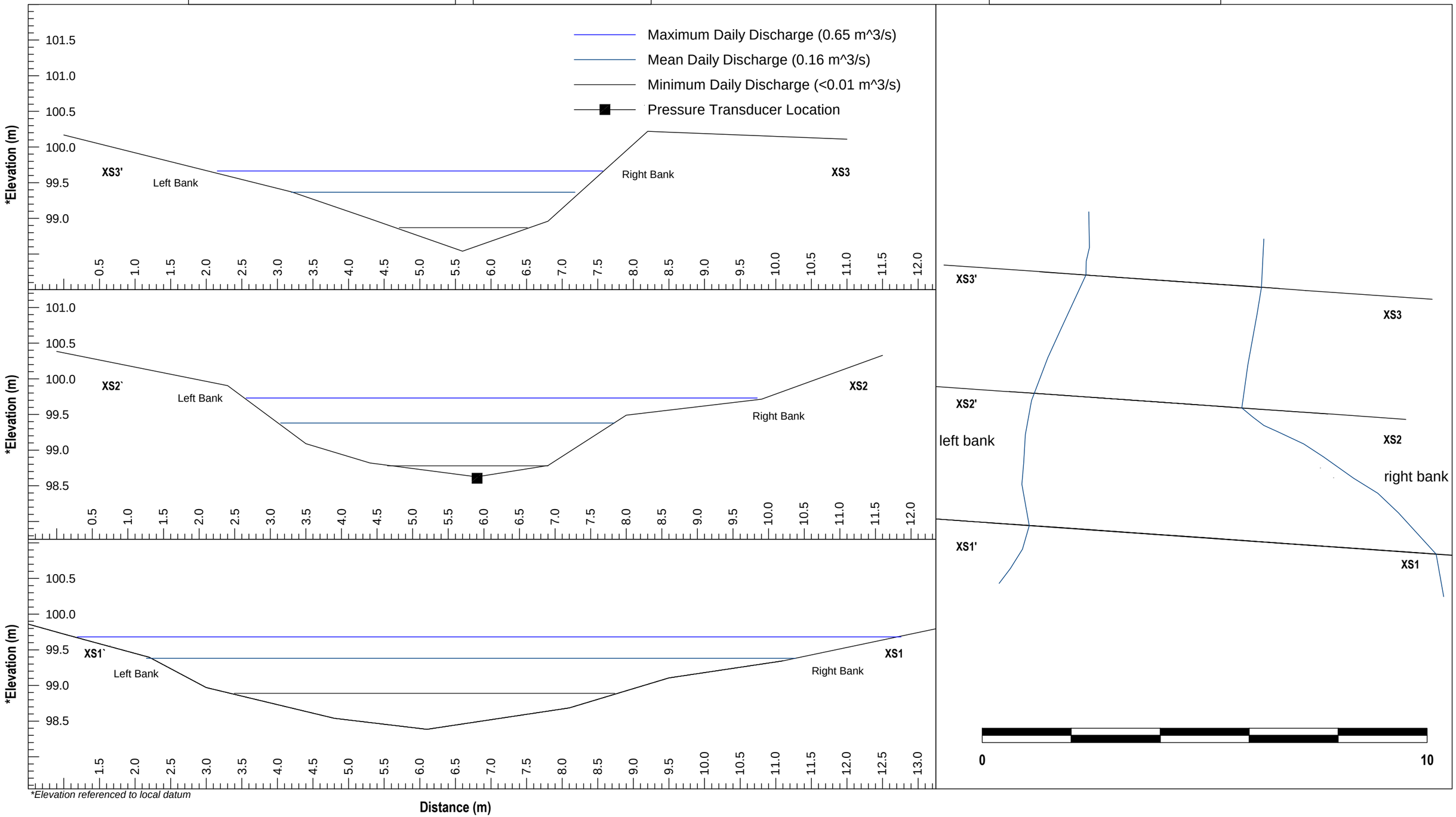
Rescan™
Engineers and Scientists

Station GL-H1 Cross Sections

Profile Vert Scale 1:50
Profile Horz Scale 1:50

Station GL-H1 Plan View

Plan Scale 1:80



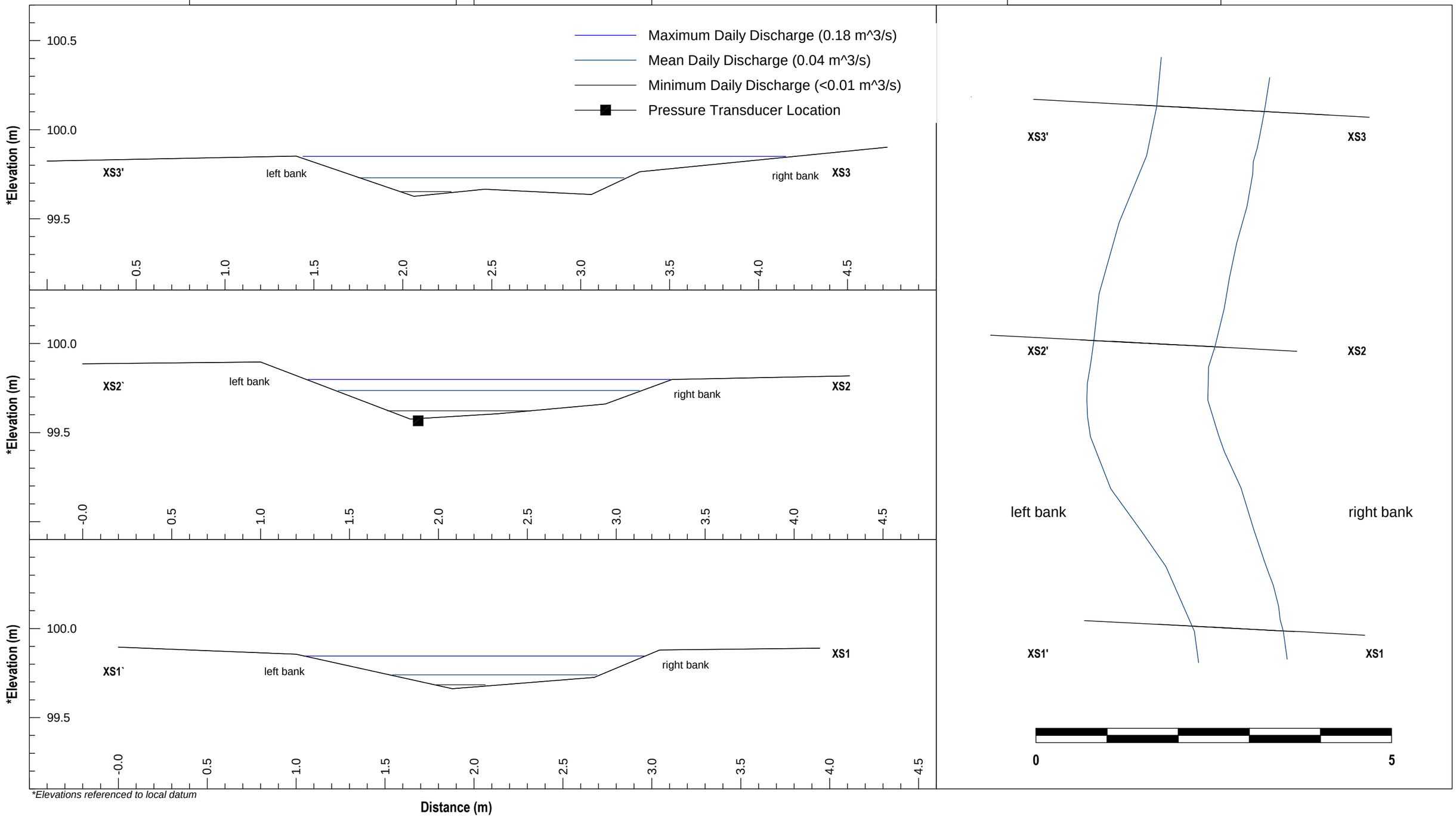
Appendix 6.1: 2011 Channel Geometry Survey at Hydrometric Monitoring station GL-H1

Station GL-H2 Cross Sections

Profile Vert Scale 1:20
Profile Horz Scale 1:20

Station GL-H2 Plan View

Plan Scale 1:50



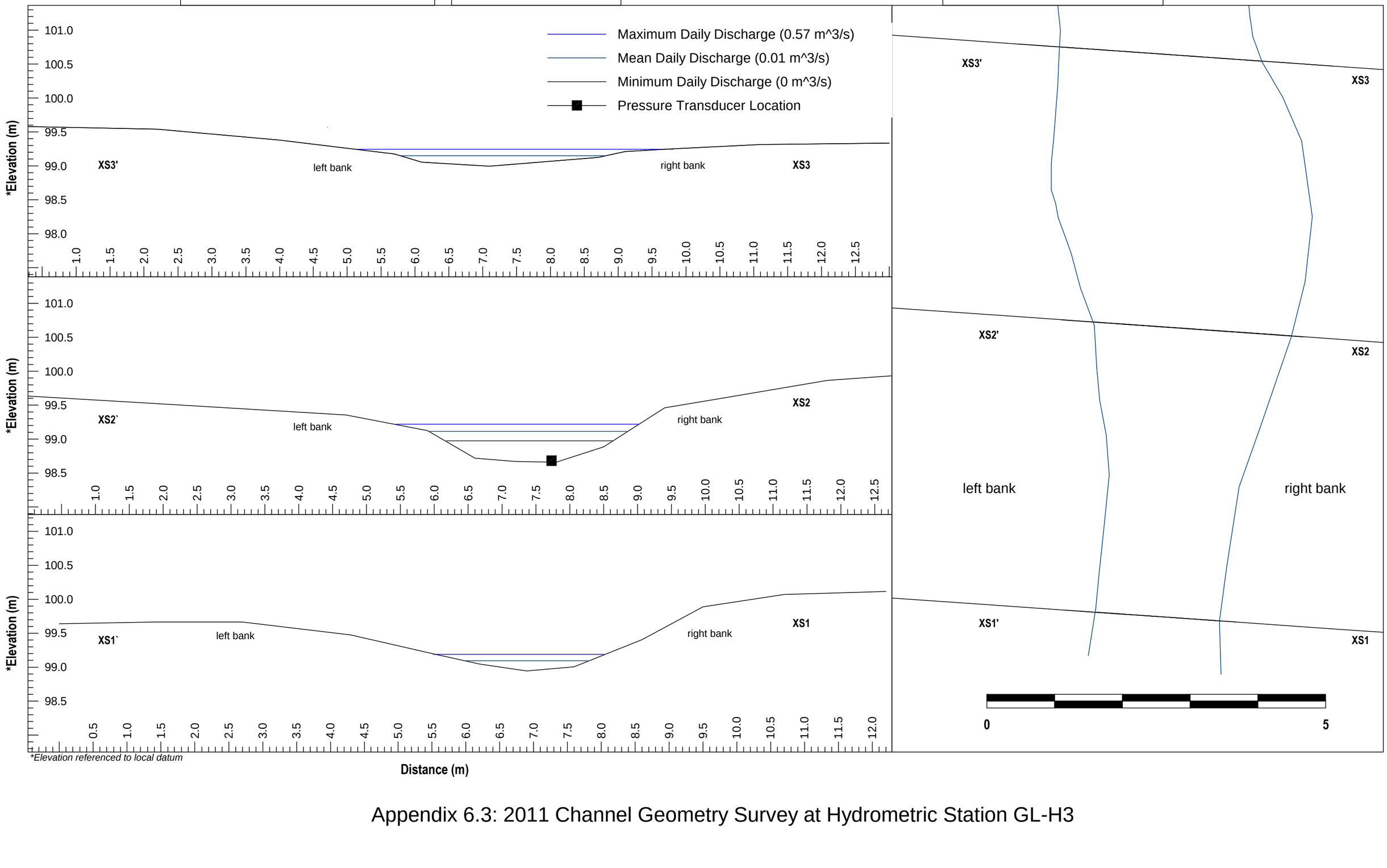
Appendix 6.2: 2011 Channel Geometry Survey at Hydrometric Monitoring Station GL-H2

Station GL-H3 Cross Sections

Profile Vert Scale 1:50
Profile Horz Scale 1:50

Station GL-H3 Plan View

Plan Scale 1:50



*Elevation referenced to local datum

Appendix 6.3: 2011 Channel Geometry Survey at Hydrometric Station GL-H3

Station PL-H1 Cross Sections

Profile Vert Scale 1:75
Profile Horz Scale 1:150

Maximum Daily Discharge (8.19 m^3/s)
Mean Daily Discharge (0.33 m^3/s)
Minimum Daily Discharge (0.10 m^3/s)
Pressure Transducer Location

***Elevation (m)**

103
102
101
100
99
98
97
96
95

XS1`

left bank

right bank

XS1

5 10 15 20 25 30 35 40 45 50 55 60

Distance (m)

Station PL-H1 Plan View

Plan Scale 1:200

XS1'

left bank

right bank

XS1

0 **25**

**Elevation referenced to local datum*

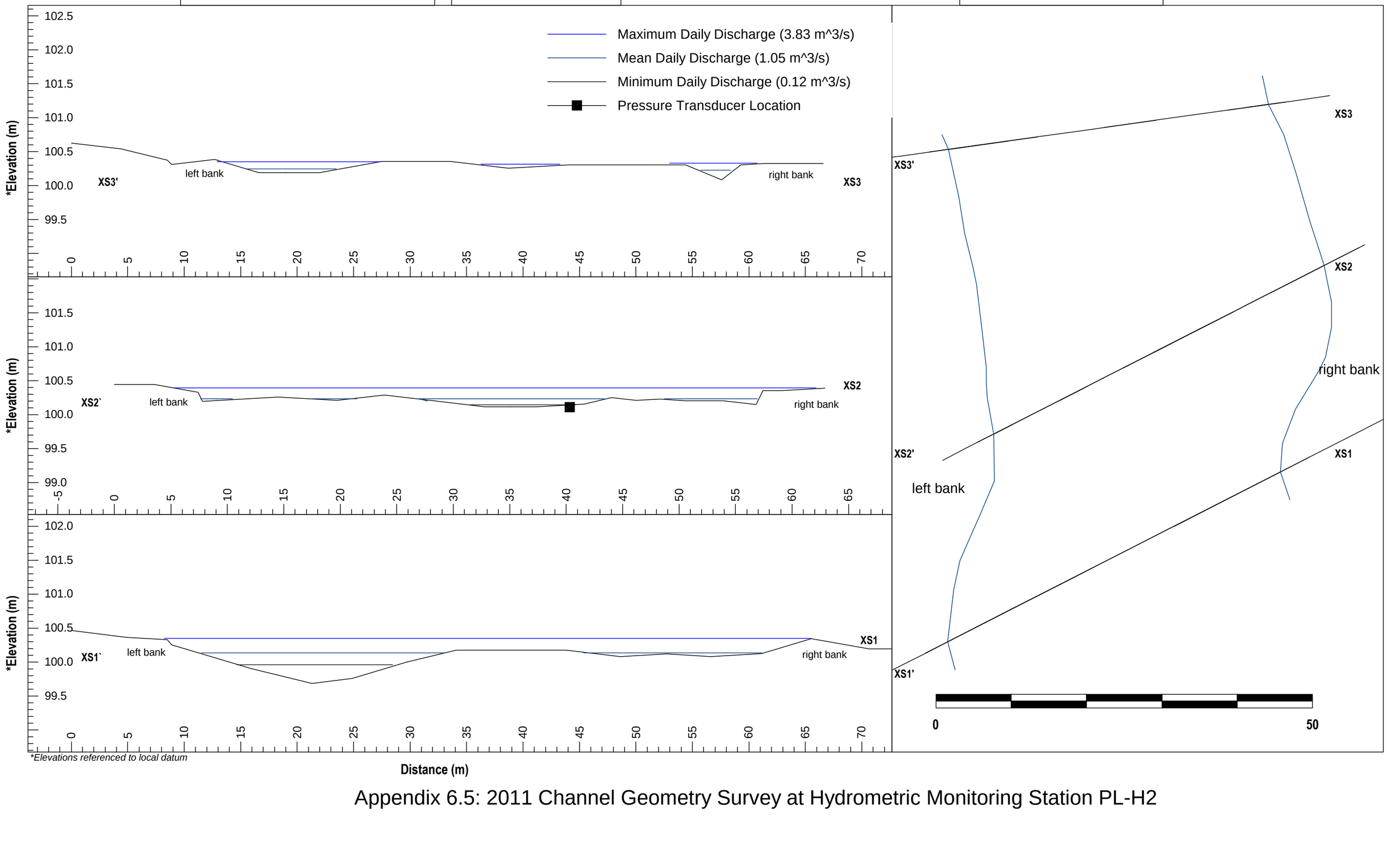
Appendix 6.4: 2011 Channel Geometry Survey at Hydrometric Monitoring Station PL-H1

Station PL-H2 Cross Sections

Profile Vert Scale 1:50
Profile Horz Scale 1:300

Station PL-H2 Plan View

Plan Scale 1:450



*Elevations referenced to local datum

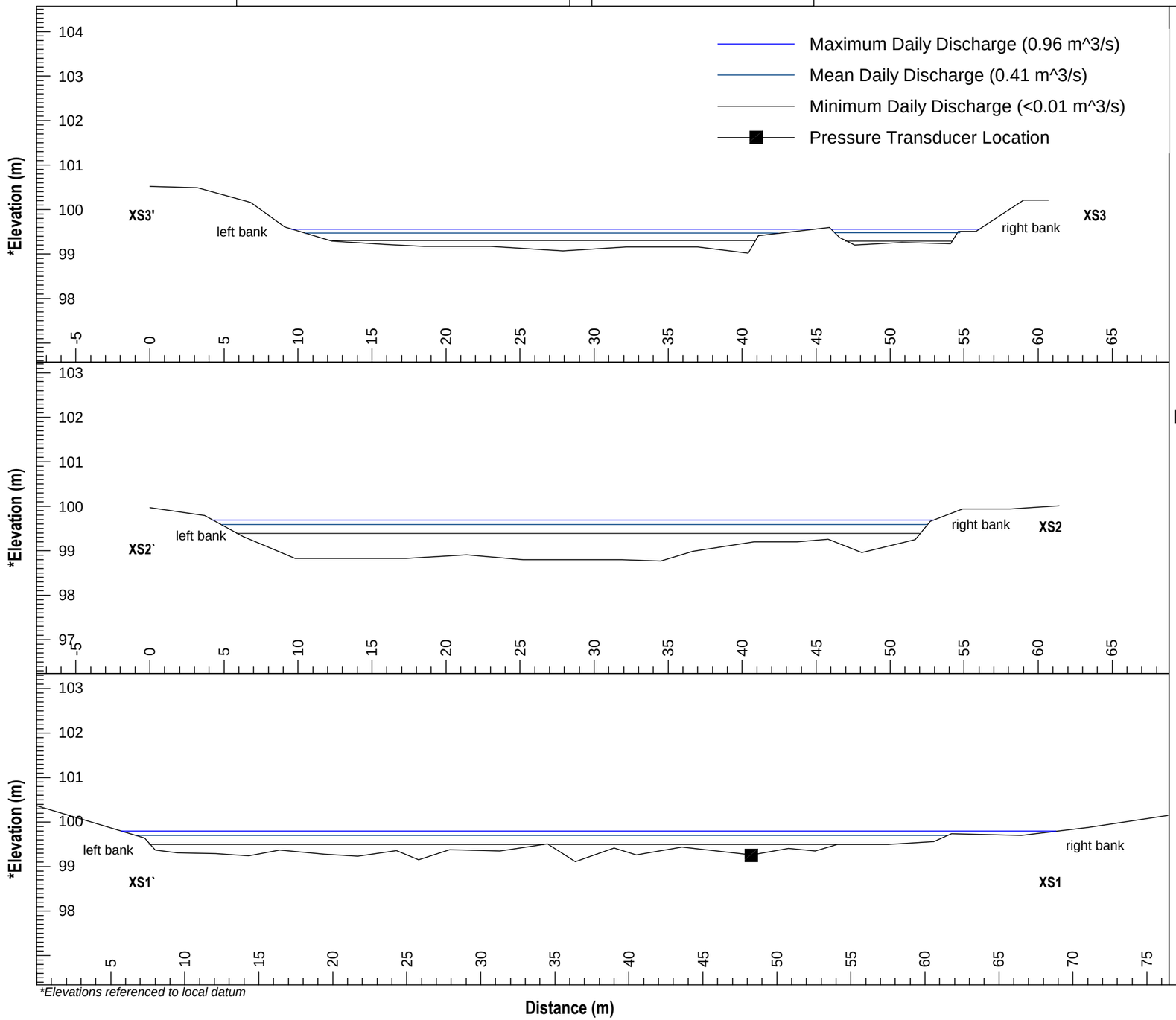
Appendix 6.5: 2011 Channel Geometry Survey at Hydrometric Monitoring Station PL-H2

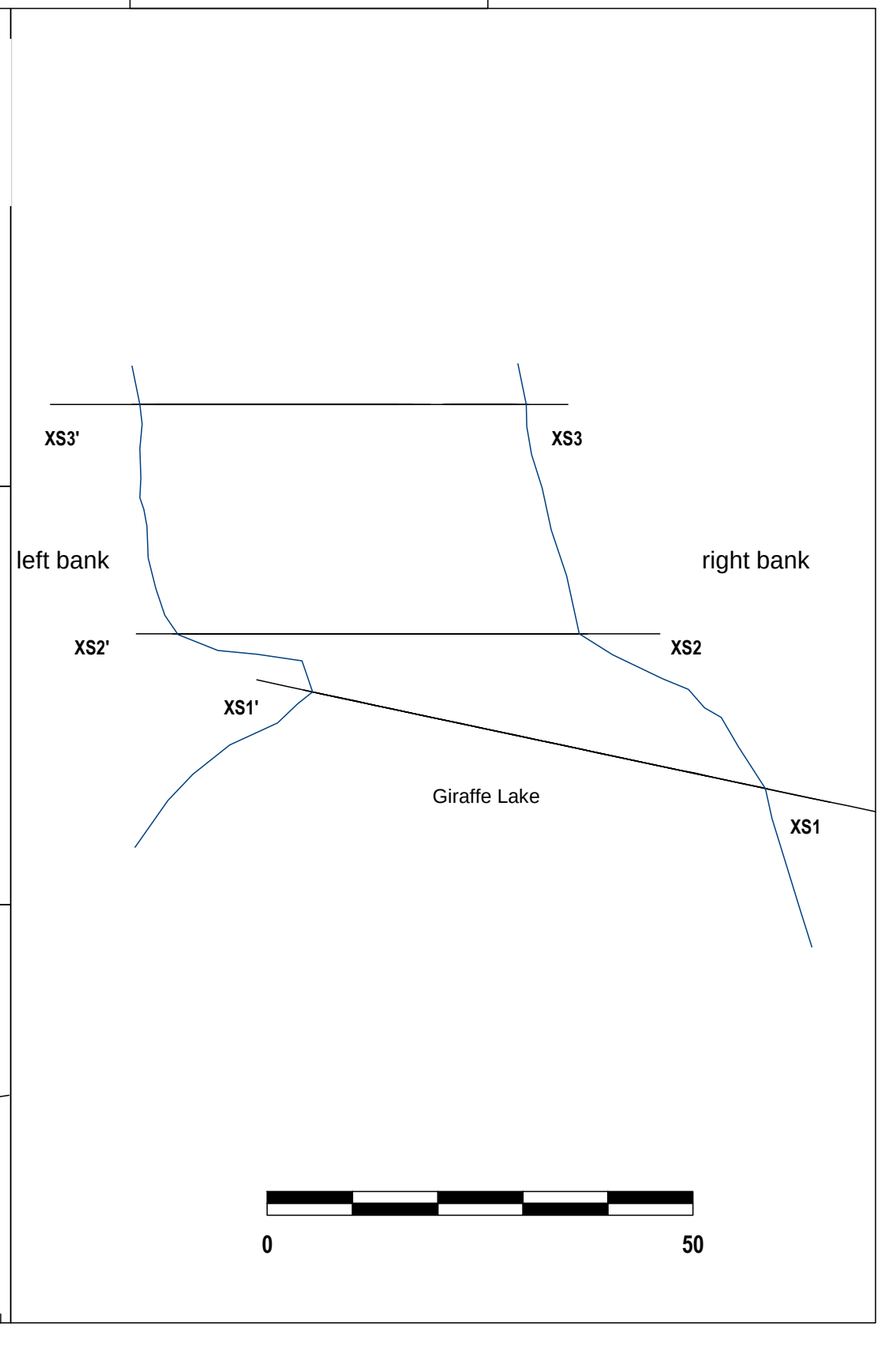
Station GI-H1 Cross Sections

Profile Vert Scale 1:100
Profile Horz Scale 1:300

Station GI-H1 Plan View

Plan Scale 1:700





*Elevations referenced to local datum

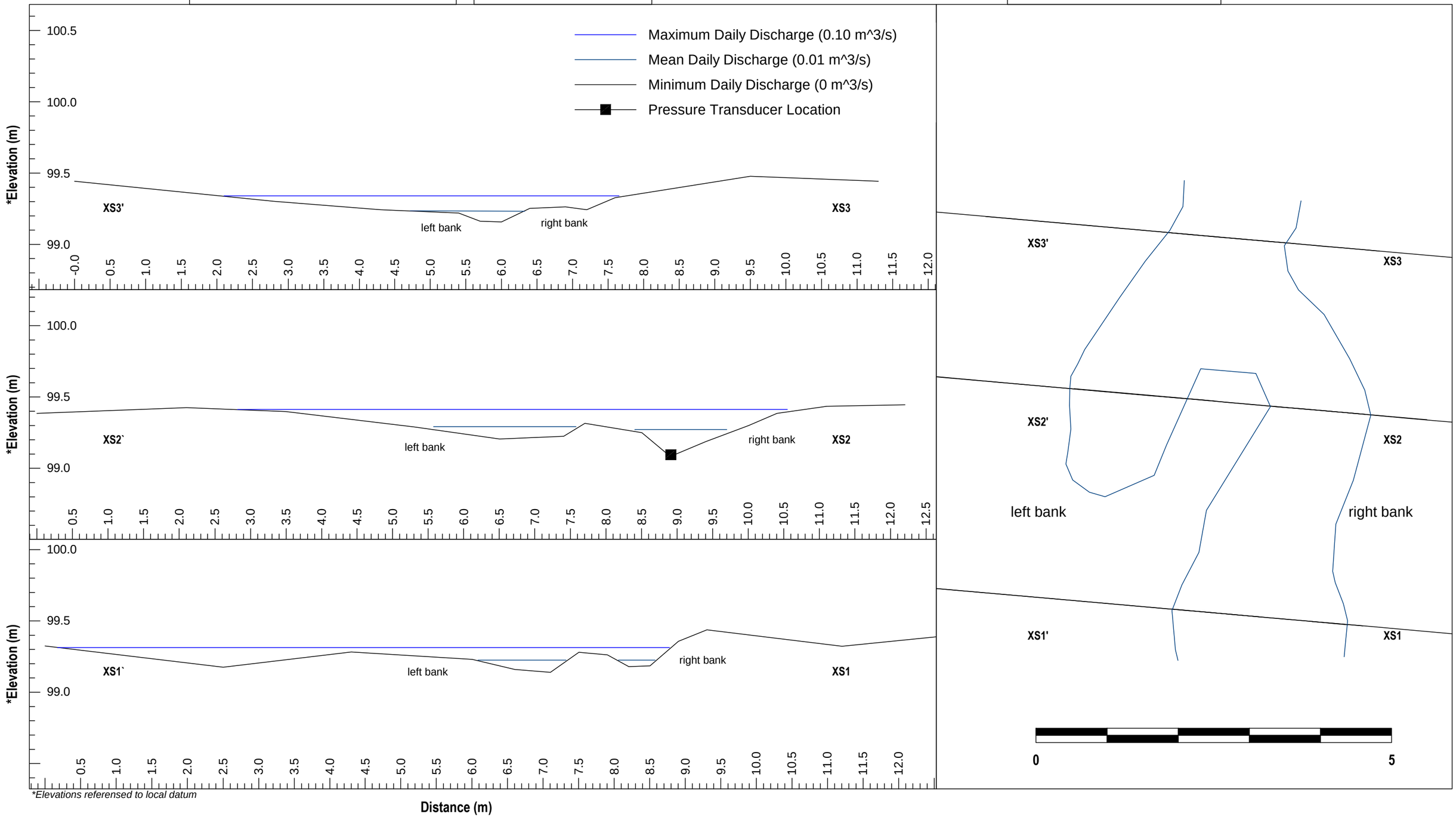
Appendix 6.6: 2011 Channel Geometry Survey at Hydrometric Monitoring Station GI-H1

Station EL-H1 Cross Sections

Profile Vert Scale 1:25
Profile Horz Scale 1:50

Station EL-H1 Plan View

Plan Scale 1:50



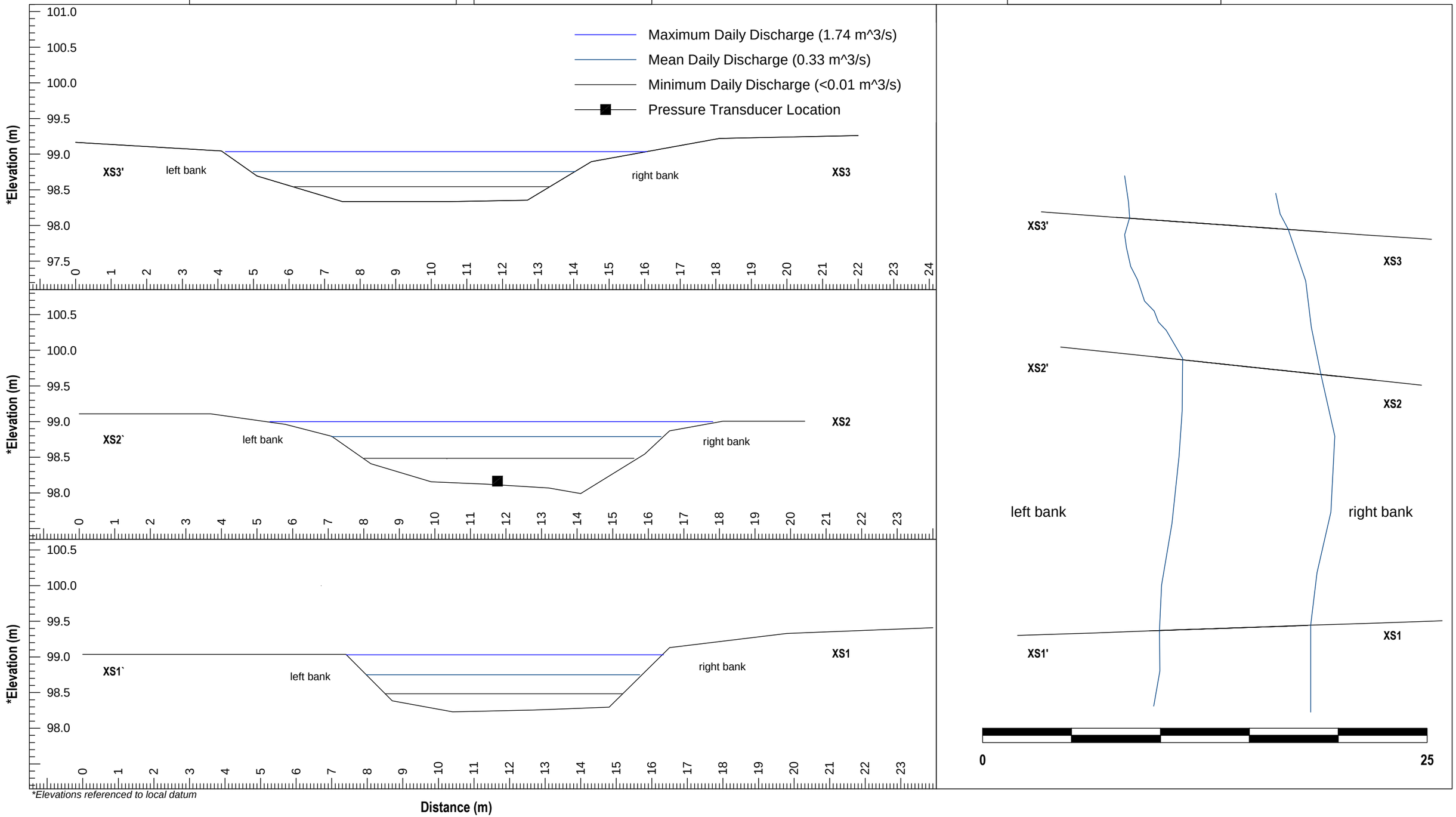
Appendix 6.7: 2011 Channel Geometry Survey at Hydrometric Monitoring Station EL-H1

Station WL-H1 Cross Sections

Profile Vert Scale 1:50
Profile Horz Scale 1:100

Station WL-H1 Plan View

Plan Scale 1:200

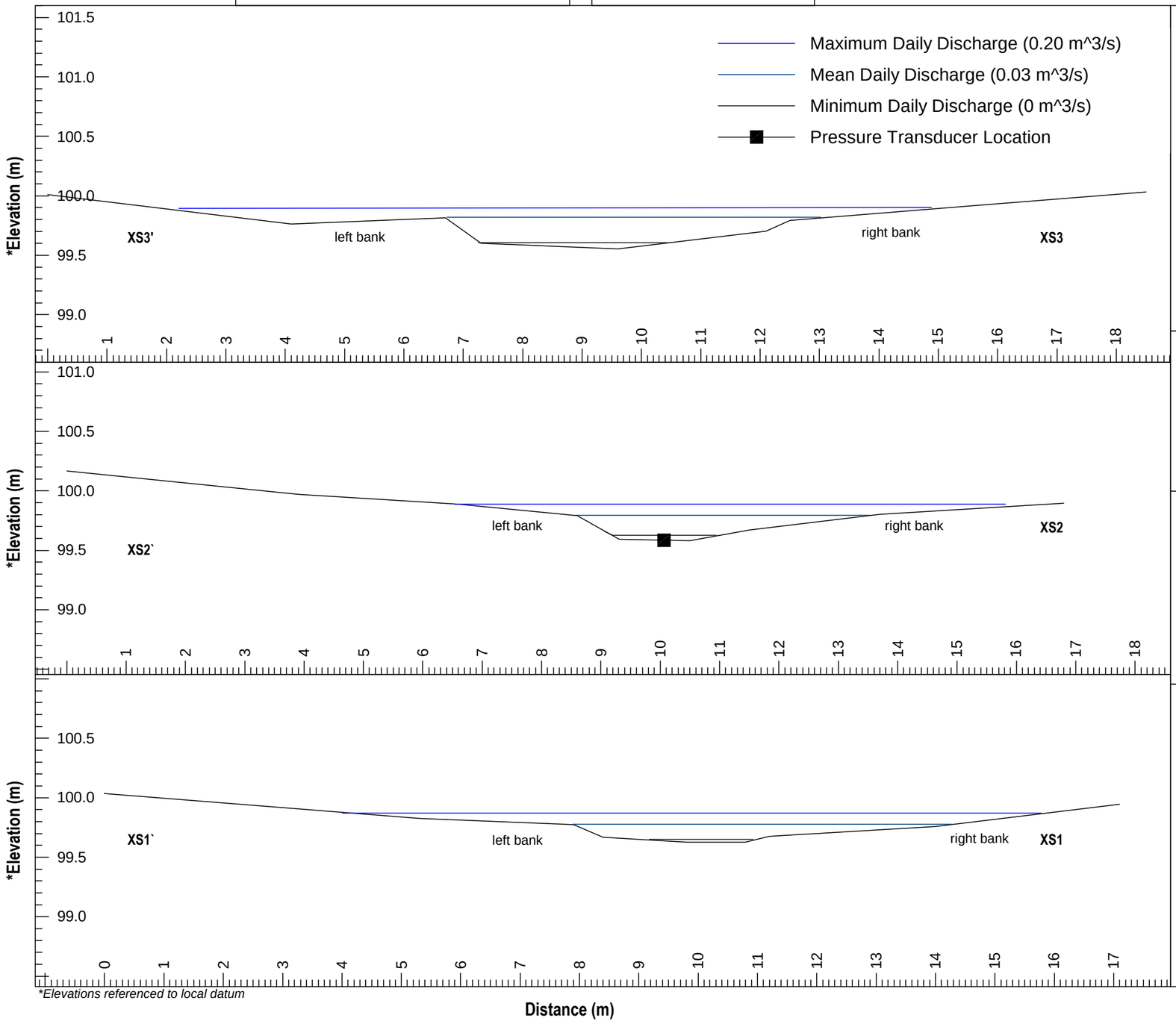


*Elevations referenced to local datum

Appendix 6.8: 2011 Channel Geometry Survey at Hydrometric Monitoring Station WL-H1

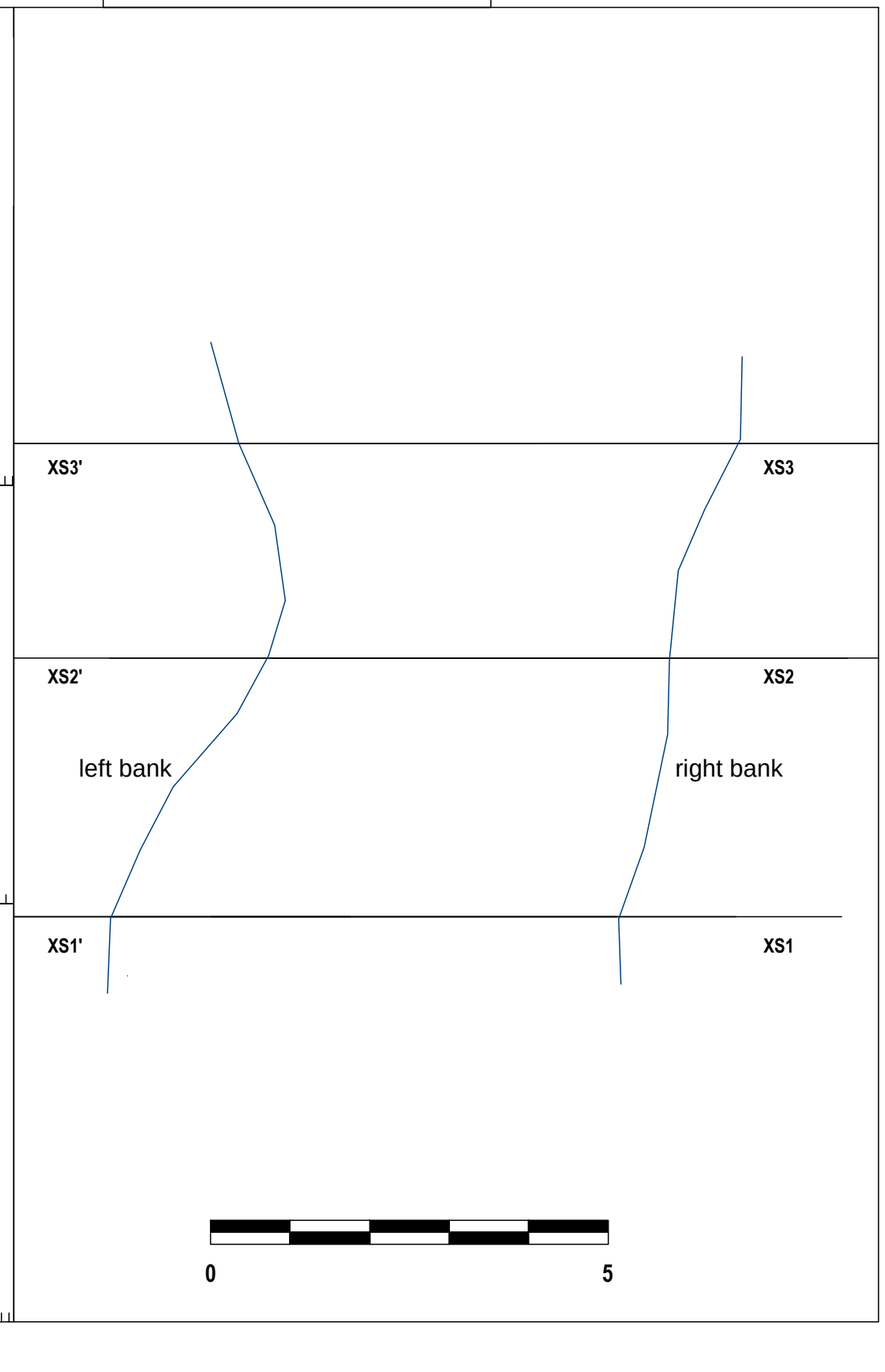
Station REFB-H1 Cross Sections

Profile Vert Scale 1:38
Profile Horz Scale 1:75



Station REFB-H1 Plan View

Plan Scale 1:75



Appendix 6.9: 2011 Channel Geometry Survey at Hydrometric Station REFB-H1

Appendix V6-1B

Back River Project: 2012 Hydrology Baseline Report

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BACK RIVER PROJECT
2012 Hydrology Baseline Report

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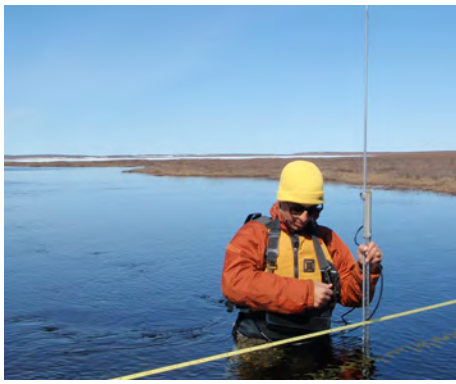

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November 2012

BACK RIVER PROJECT
2012 HYDROLOGY BASELINE REPORT

November 2012
Project #0833-002-02

Citation:
Rescan. 2012. *Back River Project: 2012 Hydrology Baseline Report*. Prepared for Sabina Gold & Silver Corp. by Rescan Environmental Services Ltd.

Prepared for:

Sabina Gold & Silver Corp.

Prepared by:

Rescan™ Environmental Services Ltd.
Vancouver, British Columbia

Executive Summary

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Executive Summary

The Back River Project lies in the West Kitikmeot region of Nunavut and is situated within the continuous permafrost zone of the continental Canadian Arctic. It consists of several property areas, and the baseline work in 2012 focused on the Goose Property and the George Property areas.

The 2012 monitoring network on the Goose Property included nine hydrometric stations that were operated in 2011 and the addition of three new hydrometric stations, monitoring a total drainage area of 391.3 km^2. The monitoring network on the George Property comprised three hydrometric stations installed in 2012, monitoring a total drainage area of 33.47 km^2. The hydrometric networks were operated through the open water season from June 5, 2012 to September 14, 2012. During this time period, continuous time series water level (stage) data were collected at each station and a total of 82 manual discharge measurements were completed. Based on the stage and discharge data collected, stage-discharge rating equations were determined and annual hydrographs produced.

The annual hydrographs in 2012 were characterized by snowmelt-driven high flows during the spring freshet. One prominent snowmelt-driven high flow event occurred in each of the hydrographs during the freshet period in early May to mid-June in most basins. One minor rainfall-driven flow occurred in early September. Instantaneous peak flows ranged from 0.130 m^3/s at BL-H1 to 21.9 m^3/s at PL-H1 in the Goose Property area and from 0.569 m^3/s at REFC-H1 to 2.16 m^3/s at the station KL-H1 in the George Property area. Daily peak unit yield varied from 26.5 $L/s/km^2$ at BL-H1 to 286.7 $L/s/km^2$ at GL-H3 in the Goose Property area and from 44.6 $L/s/km^2$ at REFC-H1 to 72.5 $L/s/km^2$ at KL-H1 in the George Property.

Volumetric outflows from each of the monitored drainages were generally found to be a function of drainage area. Within the Goose Property area, the minimum annual volumetric output was 0.08 million m^3 at EL-H1, while the maximum annual volumetric output was 27.39 million m^3 at PL-H1. Within the George Property area, the minimum annual volumetric output was 0.59 million m^3 at REFC-H1 and the maximum annual volumetric output was 3.43 million m^3 at KL-H1.

Average annual runoff was 99 mm for the Goose Property area and 116 mm for the George Property area. Annual Runoff varied from a minimum of 36 mm at BL-H1 to a maximum of 219 mm at GL-H3 in the Goose Property area, and from a minimum of 61 mm at REFC-H1 to a maximum of 143 mm at KL-H1 and KL-H2 in the George Property area.

In all drainages the maximum monthly runoff occurred in June. Approximately 85% of annual runoff for the Goose Property area and 74% for the George Property area occurred in this month. On average, the monitored streams flowed for 27% of the year in the Goose Property area and for 31% of the year in the George Property area, and they were either frozen or dry for the remainder of the year.

Snow depth, snow water equivalent, and snow density were surveyed on twelve snow courses, at nine locations within the Goose Property and four locations within the George Property. The recorded SWE values varied from 12.1cm to 35.3cm on the Goose Property and from 12.2 cm to 24 cm on the George Property. The recorded snow densities varied from 33% to 37% on the Goose Property and from 28% to 41% on the George Property.

Acknowledgements

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Acknowledgements

This Report was prepared by Rescan Environmental Services Ltd. (Rescan) for Sabina Gold and Silver Corporation (Sabina). Field data collection was conducted by Eli Heyman (B.Sc.), Coby Hall (B.Sc.), and Chris Ho. The report was prepared and written by Cenling Xia (Ph.D., P. Eng.) and Eli Heyman (B.Sc.), and technically reviewed by David Luzi (M.Sc.). The project was managed by Deborah Muggli (Ph.D., M.Sc., R.P.Bio.). Field assistance and on-site logistical support were gratefully provided by Sabina personnel, and Northern Air Support provided helicopter services.

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BACK RIVER PROJECT
2012 HYDROLOGY BASELINE REPORT

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Glossary and Abbreviations

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Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

ADCP	Acoustic Doppler current profiler.
Annual runoff	Annual runoff is a measure of the hydrologic response of a watershed. It is often presented as a depth of water, in mm, over an entire watershed allowing direct comparison with precipitation totals.
Arctic nival	Hydrological regime defined by Church (1974). In this regime snow melt is the major hydrological event producing runoff and continuous permafrost impedes deep infiltration reducing base flow and winter flow.
Baseflow	The groundwater component of flow discharge that is attributed to soil moisture and groundwater drainage into a channel.
Break-up	The melting and dissipation of this ice cover on a water body.
Canadian Shield	A vast geologic area of exposed Precambrian crystalline igneous and high-grade metamorphic rocks that form tectonically stable areas covered by a thin layer of soil. It has a deep, common, joined bedrock region in eastern and central Canada and stretches North from the Great Lakes to the Arctic Ocean, covering over half of Canada.
Drainage Basin	The zone or portion of land that contributes water to the surface water runoff that flows past a given point along a stream channel.
Ephemeral	A stream which flows only during or after rain or snow-melt and has no baseflow component.
Freeze-up	The formation of an ice cover on a water body.
Freshet	In channels, the relatively high annual peak water discharge period resulting from spring/summer meltwater runoff of the snowpack accumulated over the winter.
Hydrograph	A graphical plot of water discharge versus time.
Intermittent	A stream which flows only part of the year.
ISO	International Organization for Standardization
MAD	The mean annual discharge (MAD), computed as an average discharge over the year.
NAD 83	North American Datum 1983. A datum is a reference system for computing or correlating the results of a survey. The NAD83 datum is based on the spheroid (GRS80).
Permafrost	Bedrock, organic or earth material that has temperatures below 0°C persisting over at least two consecutive years.
Snow Water Equivalent (SWE)	The amount of water stored in the snowpack. It represents the depth of water present if the snowpack were to melt instantaneously.

Stage	The depth of water in a water course or channel.
Stage-Discharge Curve	A curve derived from concurrently measured stage and discharge data that is used to estimate the discharge for any given observed stage. Often referred to as a rating curve for a hydrometric station.
Talik	An unfrozen section of ground within a layer of discontinuous permafrost. Taliks can also be found underneath water bodies in a layer of continuous permafrost.
Unit Yield	It is a ratio of water discharges normalized to the drainage area for a basin. This parameter allows for direct comparison of the hydrological response of basins with different size drainage areas.
WSC	Water Survey of Canada.
UTM	Universal Transverse Mercator. A mathematical transformation (map projection) of the earth's surface to create a flat map sheet.

1. Introduction

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1. Introduction

The Back River Project (the Project) is an exploration gold project owned by Sabina Gold and Silver Corporation (Sabina) located in the West Kitikmeot region of Nunavut. Exploration programs were run out of both the Goose and George camps in 2012 (Figure 1-1).

For 2012, Sabina contracted Rescan Environmental Services (Rescan) to conduct a comprehensive baseline program that covered the geographical area of the Goose Property, the George Property, and a Marine Laydown Area located on the southern part of Bathurst Inlet. The following components were included in the 2012 baseline program:

- Meteorology
- Air Quality and Dust
- Noise
- Hydrology and Bathymetry
- Freshwater Water Quality, Sediment Quality, Aquatic Biology
- Freshwater Fish and Fish Habitat
- Marine Water Quality, Sediment Quality, Aquatic Biology
- Marine Fish and Fish Habitat
- Wildlife (Terrestrial and Marine)
- Wildlife DNA Study (Grizzly Bear and Wolverine)
- Ecosystem Mapping
- Vegetation and Wetlands (including Rare Plants)
- Soils and Terrain
- Country Foods
- Archaeology
- Socio-Economics
- Land Use
- Metal Leaching/Acid Rock Drainage (ML/ARD)

The 2012 baseline program was designed around potential infrastructure and known deposits at the Goose Property, the George Property, and the Marine Laydown Area. It was assumed that access from the Marine Laydown Area to George and Goose properties would be by winter road, and that access between the George and Goose properties would also be by winter road.

This report presents the results from the hydrology portion of the 2012 baseline program. The Hydrology Baseline Program included the collection of site-specific data from streams and rivers in the Goose Property area and the George Property area. Monitoring was focussed on drainages that contain known deposits, the farthest downstream river associated with the property and all the main inflows and outflows of Goose Lake and George Lake which are central to each of the properties. Additionally, monitoring sites were established as reference drainages for the Goose Property area and George Property area.

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Back River Project Location

Figure 1-1

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The objectives of the 2012 hydrology program were:

- the continued operation of the nine hydrometric monitoring stations in the Goose Property area that were established in 2011;
- the expansion of the 2011 hydrometric monitoring network with the installation and operation of three additional hydrometric monitoring stations in the Goose Property area;
- the installation and operation of the hydrometric monitoring network with two hydrometric monitoring stations on the George Property area and a reference station adjacent to the area;
- the development of stage-discharge relations for each of the hydrometric monitored stations;
- the calculation of water discharges and production of annual hydrographs for each of the monitored drainage basins; and
- the calculation of hydrologic indices, including annual runoff, seasonal runoff distribution, peak flows, and low flows.

A description of the hydrological setting, overall sampling design, and the methods used for data collection is provided in Chapter 2 of this report. Results of the 2012 monitoring program are provided in Chapter 3. All raw data collected in 2012 are provided as appendices to this report.

2. Hydrological Setting

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2. Hydrological Setting

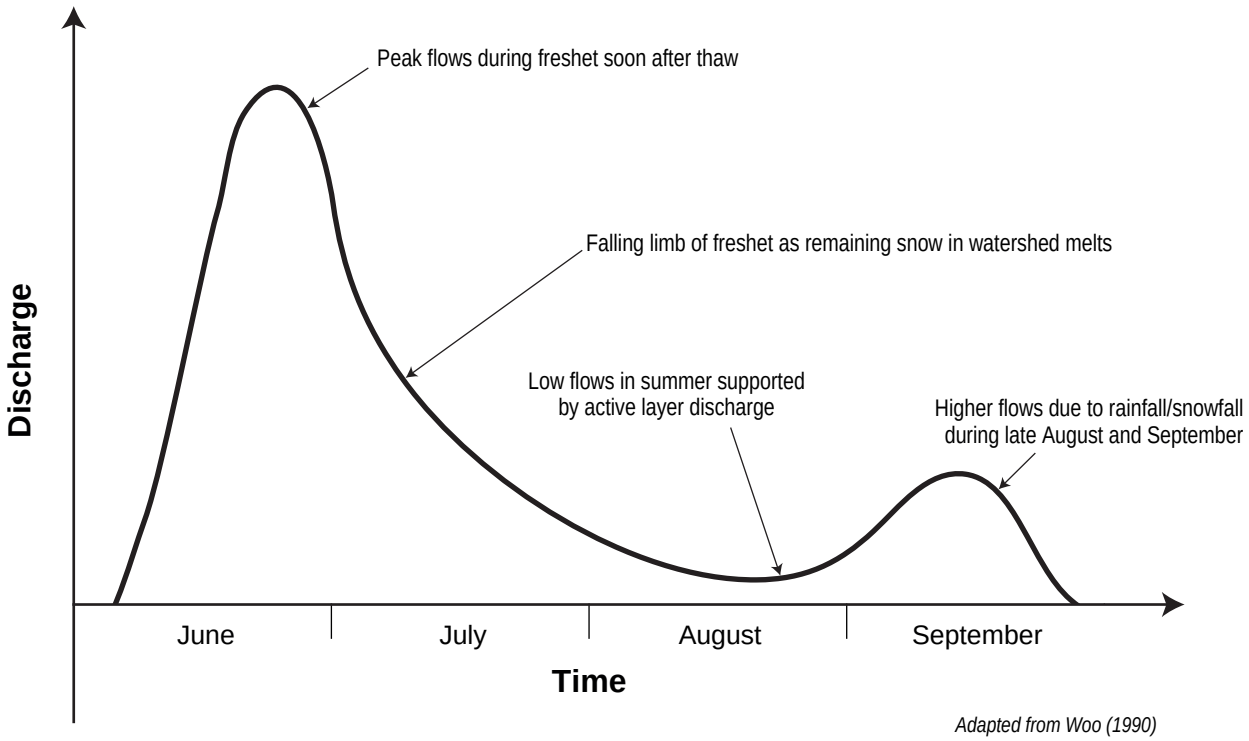
2.1 ARCTIC HYDROLOGY

The Project area lies within the continuous permafrost zone of the continental Canadian Arctic. The presence of permafrost is hydrologically significant as it has a very low hydraulic conductivity and thus acts as a barrier to deep groundwater recharge. This process increases surface runoff and decreases subsurface flow. Compared to non-permafrost regions, permafrost watersheds tend to have higher peak flow and lower base flow (Kane 1997). Hydrologic processes in permafrost watersheds are generally dominated by snow accumulation and melt, surface runoff, and runoff routed through lakes. The annual flow hydrograph is defined by the long cold winters and the short summers. Most of the annual runoff occurs during spring freshet and is derived from the melting snow pack. Additionally, frontal systems may generate precipitation events that produce moderate runoff. Following freshet, a low flow period typically develops through July and August. Due to the presence of permafrost, there is limited groundwater support for smaller streams; however, there may be interaction between groundwater systems and larger rivers and/or lakes through taliks or openings in the permafrost. As a result of the permafrost, baseflow in streams is supported only by flow through the shallow upper active layer of the soil and release from storage features including lakes and wetlands. Overall, surface runoff in Arctic basins is largely controlled by snowmelt and the presence of permafrost, which accentuates runoff peaks while reducing base flow conditions (Woo 1990).

The hydrologic year for the region is defined by break-up and freeze-up. According to regional data from the Water Survey of Canada (WSC), break-up typically occurs in early June and freeze-up in early October. Water is stored in the snowpack during winter and is released as temperatures increase during the spring freshet. Small to medium sized streams typically freeze dry during the winter, due to the limited storage capacity of the surrounding landscape. Even some large rivers in the continuous permafrost region cease to flow after freeze-up (Woo 1990).

A conceptual hydrograph showing typical annual discharge patterns for small watersheds is shown in Figure 2.1-1. The hydrograph is characterized by a steep rising limb leading to a peak during the freshet period and a second rainfall-generated peak that can be observed in certain years in late August or early to mid-September. Generally, within the continuous permafrost region discharge is dominated by snowmelt floods, referred to as a nival regime. Church (1974) distinguished between a Subarctic and an Arctic Nival regime. The Subarctic regime experiences limited winter low flow sustained by the discharge of intrapermafrost and subpermafrost groundwater, and a spring freshet associated with ice jams. During summer, low flow conditions predominate, but large flood peaks can be generated by frontal precipitation systems in zones of discontinuous permafrost. The Arctic Nival regime has one major flood period in the spring, followed by a rapid recession to base flow, with the occasional peak related to rainstorm events. Winter flow is absent because the suprapermafrost groundwater reservoir is too limited to maintain flow.

In very small basins the freshet can be as short as a few days and will often occur immediately after ice break-up in the lakes, if lakes are present in the basin. Streamflow in these basins may cease after freshet and streams remain dry until the late summer rains begin. In contrast to smaller basins, in rivers draining larger watersheds the freshet peak may be delayed after ice break-up. The delay occurs as snowmelt from upper portions of the larger watershed is routed through the system. Smaller basins can also have more dramatic responses to precipitation than larger watersheds. In larger watersheds the presence of lakes creates significant flow attenuation, which may diminish the magnitude of peak flows.



Adapted from Woo (1990)

Note: Approximate scale only

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Theoretical Typical Annual Flow Hydrograph for a Small Arctic Watershed

Figure 2.1-1

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The amount of runoff during summer and fall is controlled by rainfall and evaporation. Open water evaporation rates in summer often exceed total rainfall such that soil moisture deficits build up in the shallow active layer of the soil and summer rainfall may produce little or no runoff from hillslopes in the permafrost zone (Quinton and Marsh 1998). In this case, streamflow increases only due to rain falling directly onto lake surfaces or when there is high intensity or lower intensity/longer duration rainfall.

A number of factors influence the volume of freshet runoff in Arctic watersheds, these factors include:

- *Amount of snowpack available to be melted in spring*. Snowpack depth is dependent on the amount of snowfall during the previous winter and the amount of snow remaining in each watershed in May or June. Snow can be lost or redistributed due to sublimation, melting, or wind;
- *Rate of temperature rise in spring*. This can greatly affect peak flow rates as a rapid increase in temperature after the snowpack is already saturated can produce high melt rates. Differential melt rates on north and south facing slopes can also occur which may affect the size of the area contributing to the melt;
- *Timing of opening of stream channels linking lakes*. Snowmelt from hillslopes surrounding lakes can occur before the stream channels draining the lakes become ice free. In this case, meltwater can be stored in the lake and then released once the channels are open to flow; and
- *Soil moisture conditions and lake levels at the end of the previous summer*. If there was a dry summer during the previous year, lake levels could have been lowered and a soil moisture deficit could have developed within the hillslopes surrounding the lakes. As a result, a portion of the annual runoff will recharge the lakes and soil moisture and not be transmitted from the watershed as streamflow.

2.2 AVAILABLE REGIONAL HYDROLOGIC DATA

Regional data are available from hydrometric stations operated by WSC (Table 2.2-1 and Figure 2.2-1). Data from the five stations with the closest proximity to the Project area were analyzed to provide background information on the regional surface water hydrology.

Table 2.2-1. Regional Water Survey of Canada (WSC) Stations Relevant to the Study Area

Station Name	Station Number	Geographic Location		Drainage Area (km^2)	Period of Record
Back River below Beechy Lake	10RA001	65°11'14"N	106°5'9"W	19,600	1978 - present
Baily River near the mouth	10RA002	65°0'38"N	104°29'26"W	14,500	1978 - present
Burnside River near the mouth	10QC001	66°43'34"N	108°48'47"W	16,800	1976 - present
Gordon River near the mouth	10QC002	66°48'36"N	107°6'4"W	1,530	1977 - 1994
Ellice River near the mouth	10QD001	67°42'30"N	104°8'21"W	16,900	1971 - present

Analysis of historical data revealed the break-up in these rivers has typically occurred in between late May to early June and freeze-up in early October (Figure 2.2-2). Peak flows generally were observed in early to mid-June during freshet and some stations recorded a second substantial peak in late summer or early autumn. The Gordon River and Ellice River hydrometric stations frequently report zero flow throughout the winter.

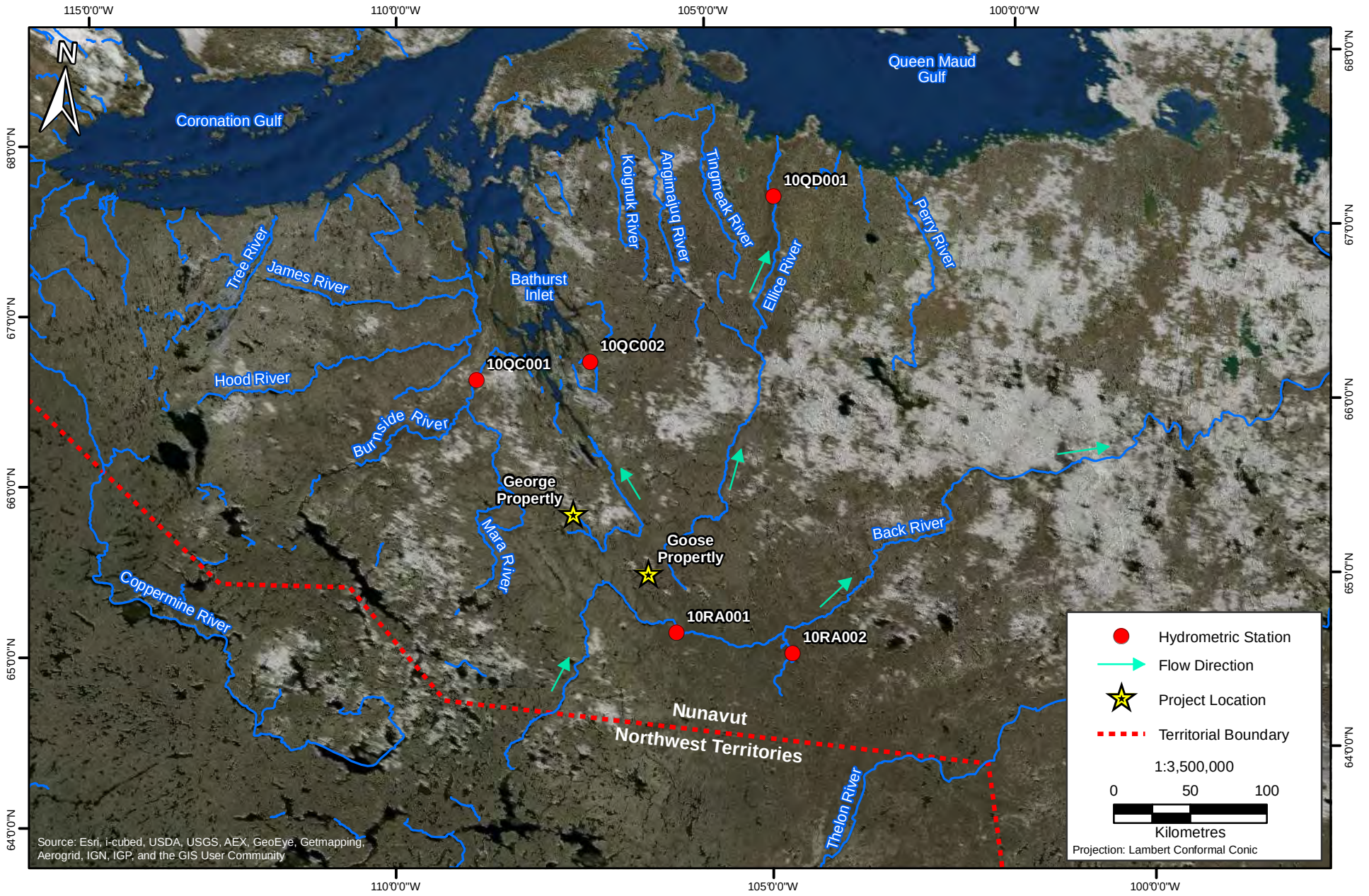

Figure 2.2-1

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Water Survey of Canada (WSC) Hydrometric Stations Relevant to the Study Area

Figure 2.2-1

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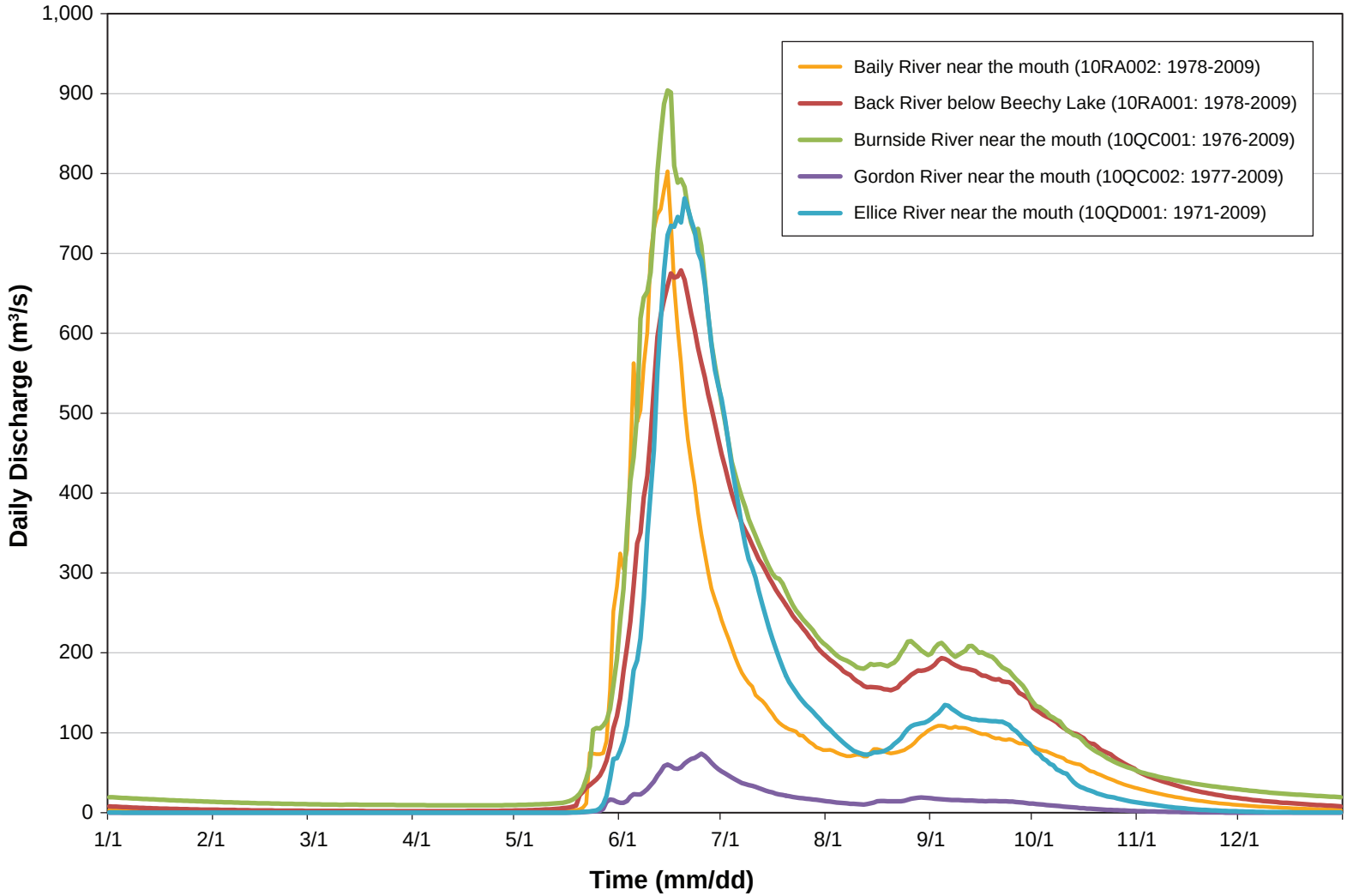

Figure 2.2-2

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Historical Hydrographs of Water Survey of Canada (WSC) Hydrometric Stations Relevant to the Study Area

Figure 2.2-2

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2.3 STUDY AREA

The study area is located near the watershed boundaries of the Ellice River, the Back River, and the Western River (Figure 2.3-1). The Ellice River discharges north to the Arctic Ocean into the Queen Maud Gulf approximately 300 km from the project area and the Western River discharges north to the Bathurst inlet approximately 80 km from the project area. The Back River flows northeast to its mouth at Cockburn Bay on the Arctic Ocean in the eastern portion of the Kitikmeot Region, south of Gjoa Haven.

For the Goose Property, the 2012 study area was expanded from 209.8 km^2 in 2011 to a total drainage area of 391.3 km^2. Figure 2.3-2 shows the locations of the hydrometric stations within the sub-watershed boundaries of the Goose Property, whereas Figure 2.3-3 shows the upstream drainage boundaries associated with each station. The study was designed to monitor a 204.4 km^2 area within the Ellice River watershed and a 181.6 km^2 area within the Back River watershed, encompassing the potential infrastructure within the Goose Property. An additional reference station was located in a 5.3 km^2 drainage basin within the Back River watershed approximately 14 km to the south of the potential infrastructure (Figure 2.3-3).

For the George Property, the 2012 study area comprised a total drainage area of 33.47 km^2. Figure 2.3-4 shows the locations of the hydrometric stations within the sub-watershed boundaries of the George Property, whereas Figure 2.3-5 shows the upstream drainage boundaries associated with each station. The study was designed to monitor a 24.0 km^2 area encompassing the potential infrastructure within the George Property which is located within the Western watershed. An additional reference station was located in a 9.47 km^2 drainage basin approximately 40 km to the northeast of the potential infrastructure (Figure 2.3-5).

The basins within the Project area are characterized by extensive networks of lakes, low relief hummocky topography, and exposed bedrock uplands (Plates 2.3-1 and 2.3-2).

Plate 2.3-1. High angle oblique view showing the extensive lake coverage and low relief hummocky topography typical of the Goose and the George Property areas. This photograph was taken of the George Camp and surrounding area on July 7, 2012.

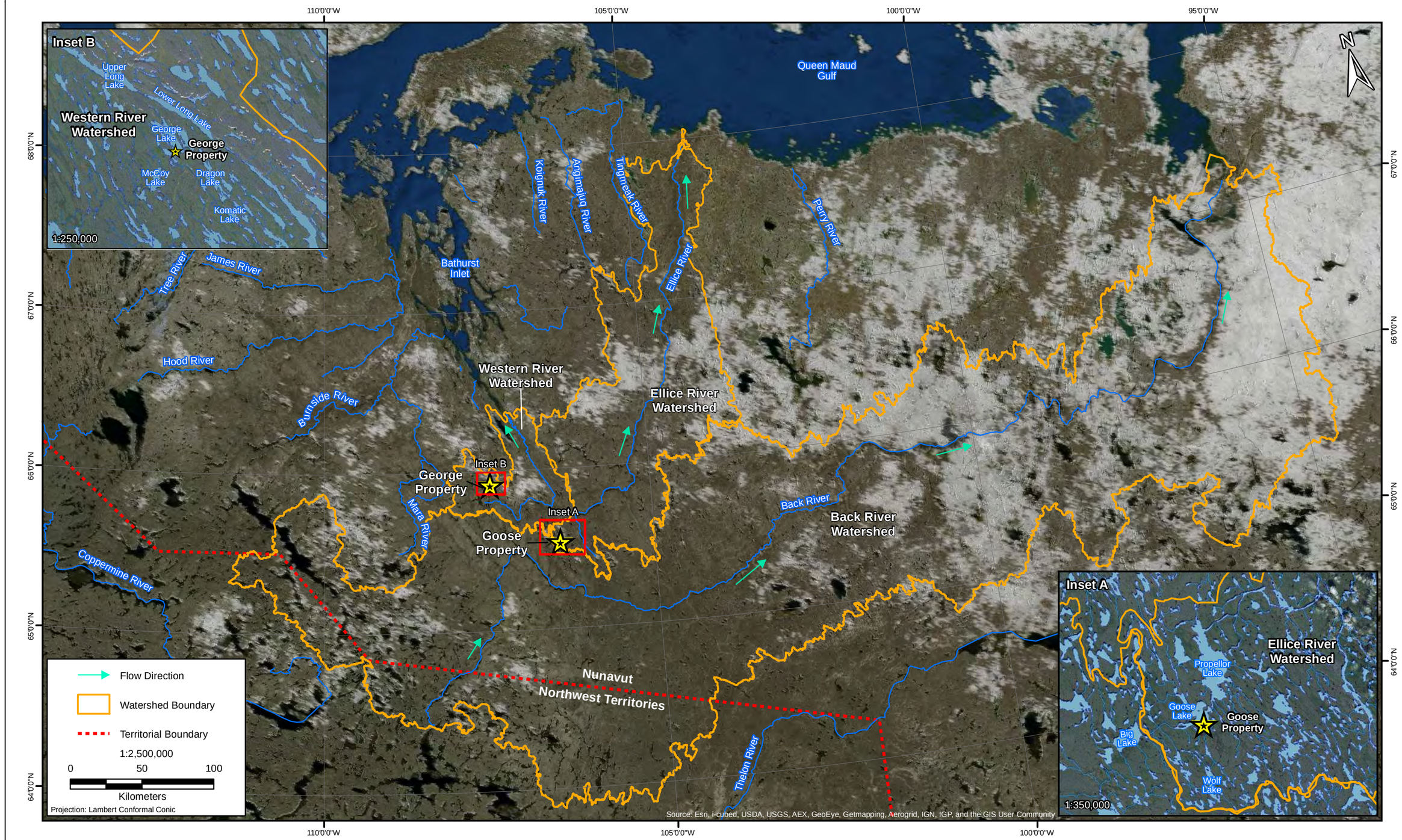

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Figure 2.3-1

Regional Watersheds of the Back River Project

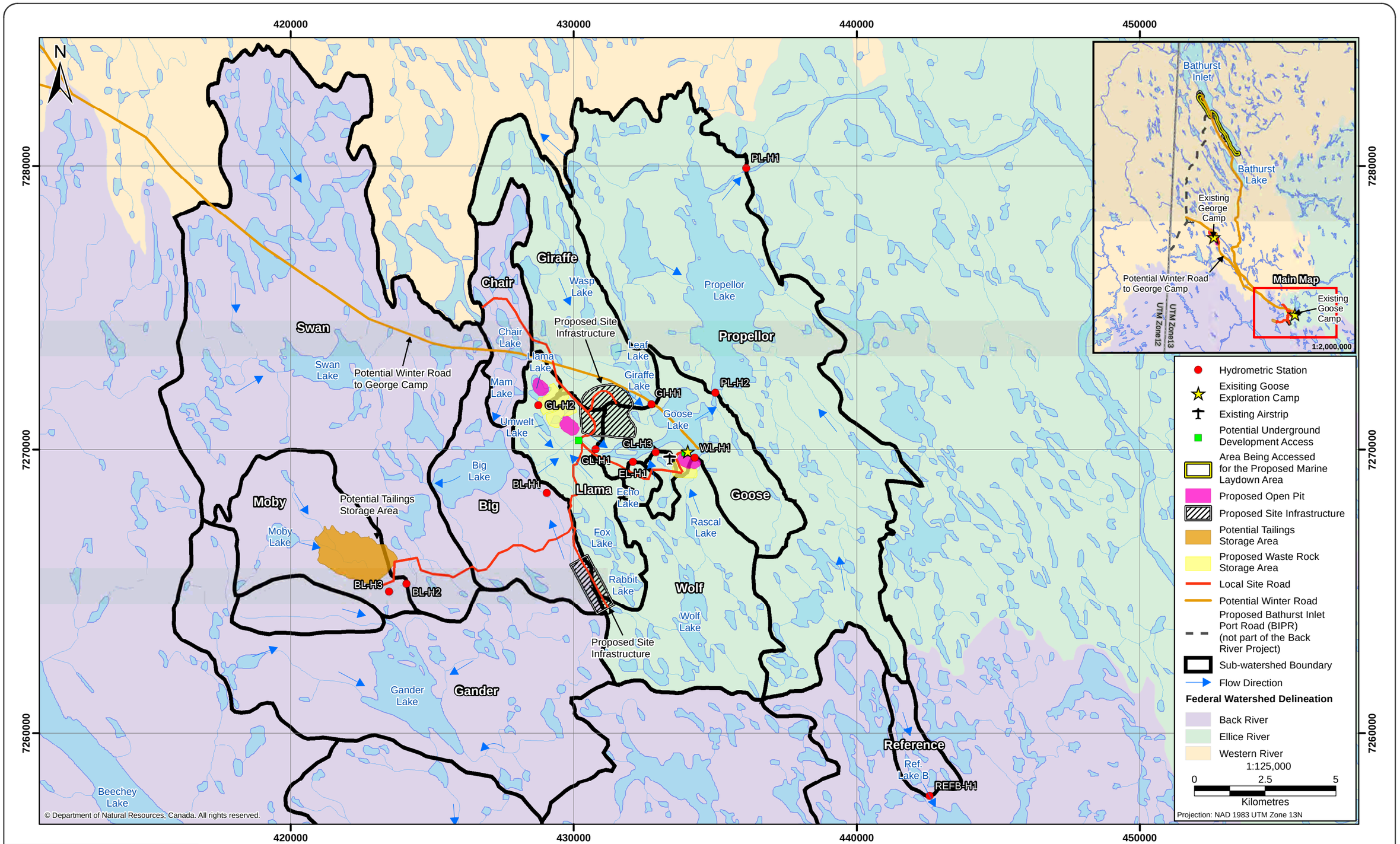

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Figure 2.3-2

2012 Study Area within the Back River Project - Goose Area

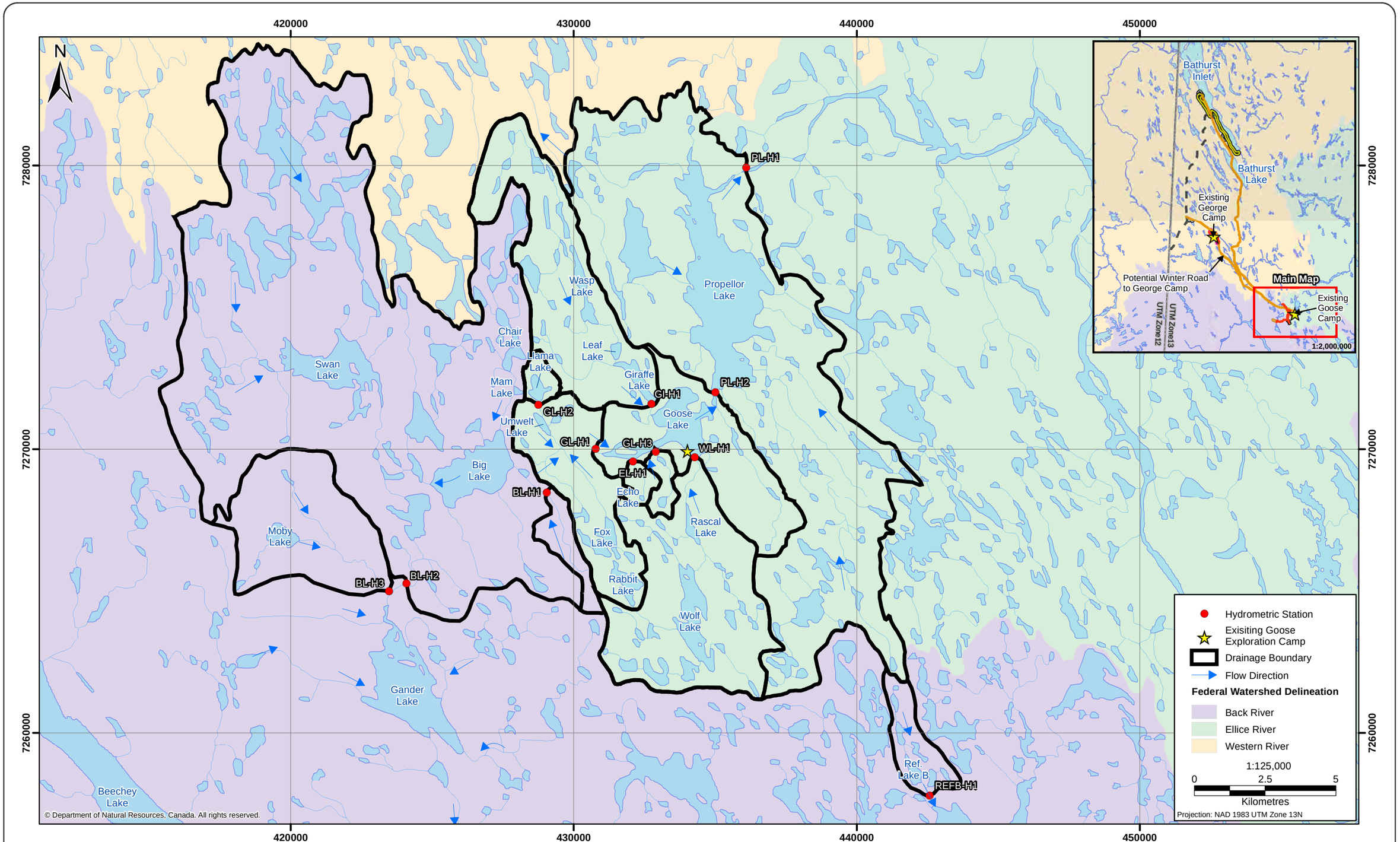

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Figure 2.3-3

2012 Study Area Drainage Basins - Goose Area

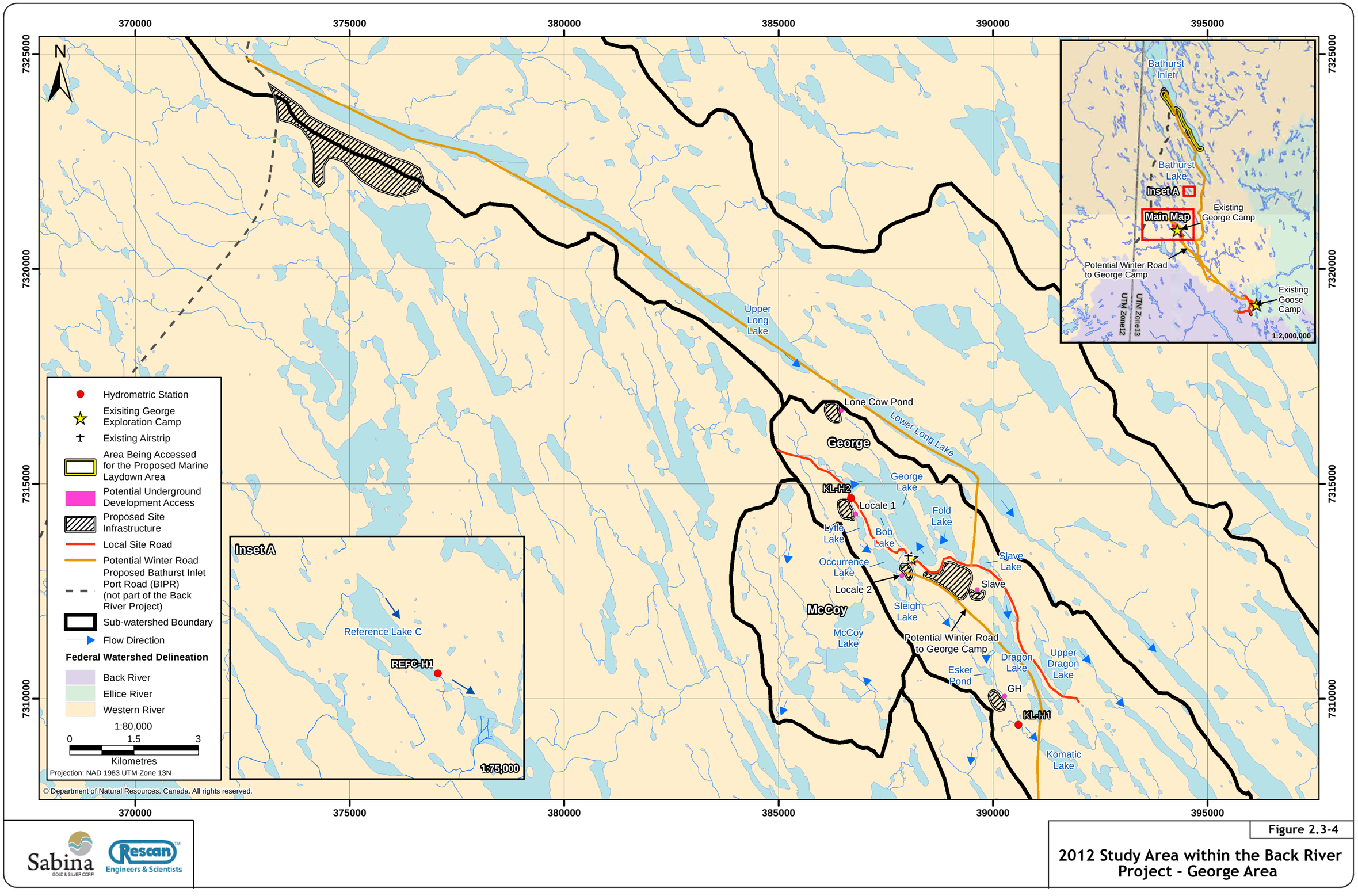

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Figure 2.3-4

2012 Study Area within the Back River Project - George Area

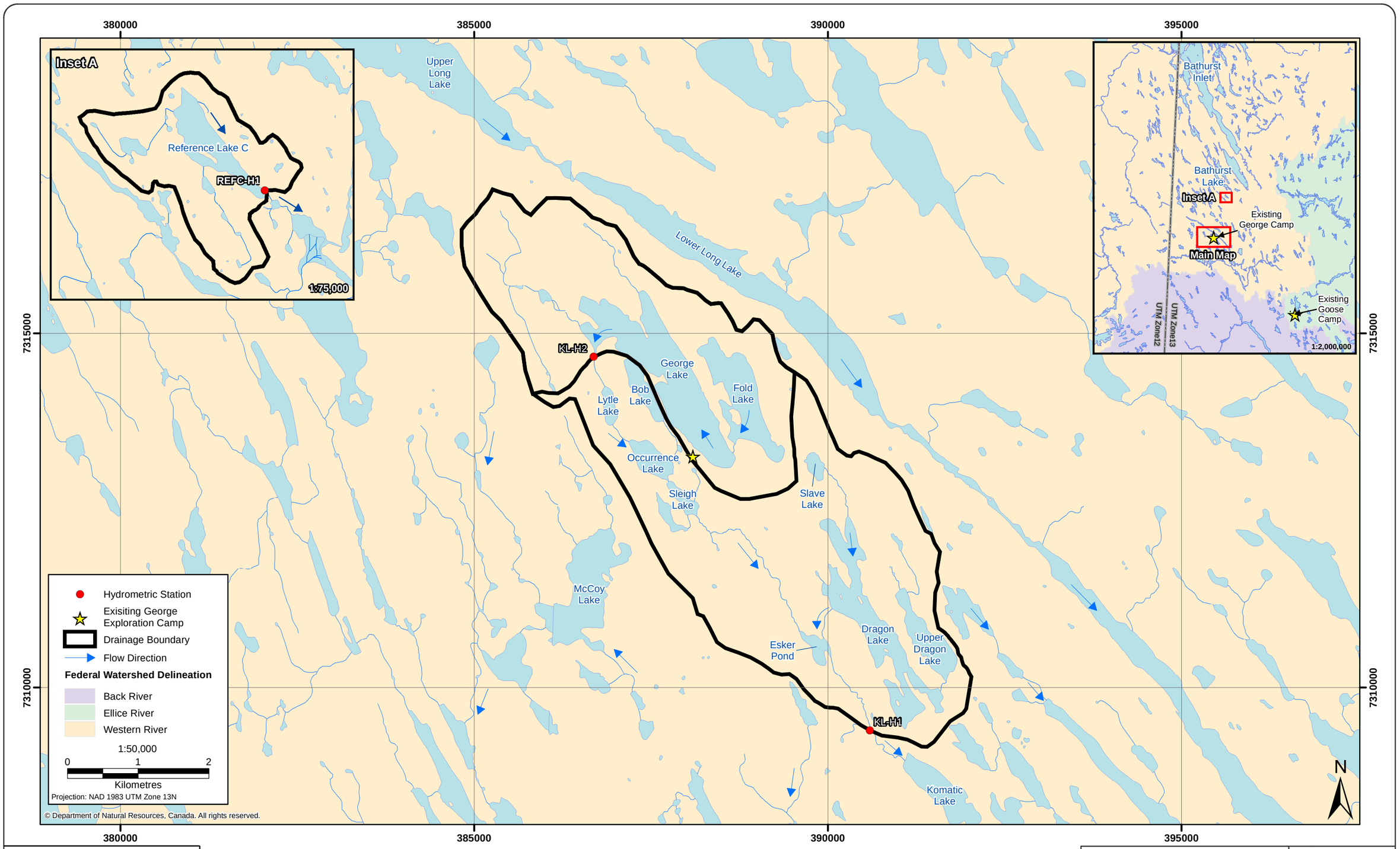

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Figure 2.3-5

2012 Study Area Drainage Basins - George Area

Plate 2.3-2. Looking south along the outflow from Llama Lake on the Goose Property. Note the relatively low relief topography, bedrock outcrops and low tundra vegetation typical of the region. This photograph was taken on September 7, 2012.

For the Goose Property, the study area has approximately 13% lake coverage, an average ground slope of 2.8%, and a total relief of 313 m. The gauged streams within the study area range from small ephemeral channels, less than 1 m in width, to larger streams with widths exceeding 50 m. Larger streams are located at the outlets of the larger lakes. Although some large rivers in the region may still have flow during the winter, it is likely that most stream channels around the Project area freeze to their bed and have zero flow during the winter months. Based on available data from WSC, the Ellice River near its mouth typically stops flowing over the winter period.

For the George Property, the study area has approximately 20% lake coverage, an average ground slope of 5.4%, and a total relief of 325 m. This region exhibits higher relief than the Goose Property, with ridges of bedrock and esker deposits separating well-defined glacial valleys. The gauged streams on the George Property were deep and narrow and meandered within the over-widened valleys created by glaciers.

3. Methodology

3. Methodology

3.1 HYDROMETRIC MONITORING NETWORK

A network of hydrometric monitoring stations was established to collect continuous water level data at selected locations within the Project area. The automated stations recorded stream water level data at ten minute intervals during the open water season.

3.1.1 2010 Network

In 2010, a small network of two hydrometric monitoring stations within the Goose Property area was operated from July 3 to September 13, 2010 (Table 3.1-1).

Table 3.1-1. 2010 Hydrometric Monitoring Stations in the Goose Property Area

Hydrometric Station	Location	Geographic Coordinates*		Drainage Area (km^2)	Period of Operation	Monitoring Type
		Easting	Northing			
GL-H1	Goose Lake inflow	430,772	7,270,016	14.0	July 3 to Sept. 13	stream water level
GL-H2	Llama Lake outflow	428,746	7,271,567	1.7	July 3 to Sept. 13	stream water level

** UTM, Datum NAD 83, Zone 13 W*

3.1.2 2011 Network

In 2011, a network of nine hydrometric monitoring stations was operated from June 10 to September 17 in the Goose Property area. The 2011 network included the remobilization of the two stations established in 2010, plus the installation of six new stations within the Goose Property area and one reference station south of the Project drainage boundary. The network focused on monitoring basins and sub-basins around the known deposits in the Project area, and the furthest downstream river associated with the property at Propellor Lake outflow. Location, drainage area and period of operation for each station in the 2011 network are provided in Table 3.1-2.

Table 3.1-2. 2011 Hydrometric Monitoring Stations in the Goose Property Area

Hydrometric Station	Location	Geographic Coordinates*		Drainage Area (km^2)	Period of Operation	Monitoring Type
		Easting	Northing			
GL-H1	Goose Lake inflow	430,772	7,270,016	14.0	June 10 to Sept. 16	stream water level
GL-H2	Llama Lake outflow	428,746	7,271,567	1.7	June 10 to Sept. 16	stream water level
GL-H3	Goose Lake inflow	432,891	7,269,919	1.8	June 14 to Sept. 16	stream water level
PL-H1	Propellor Lake outflow	436,094	7,279,939	204.4	June 14 to Sept. 17	stream water level
PL-H2	Propellor Lake inflow	435,007	7,272,014	101.5	June 11 to Sept. 17	stream water level
GI-H1	Giraffe Lake outflow	432,744	7,271,610	27.4	June 11 to Sept. 16	stream water level
EL-H1	Echo Drainage outflow	432,091	7,269,573	1.4	June 13 to Sept. 16	stream water level
WL-H1	Wolf Drainage outflow	434,269	7,269,719	35.1	June 10 to Sept. 17	stream water level
REFB-H1	Reference B Lake Outflow	442,573	7,257,794	5.3	June 13 to Sept. 17	stream water level

** UTM, Datum NAD 83, Zone 13 W.*

3.1.3 2012 Network

2012 was the first year of hydrometric monitoring in the George Property area. The network in the Goose Property area was operated from June 5 to September 14 and the network in the George Property area was operated from June 10 to September 12. The 2012 networks focused on monitoring basins and sub-basins around the known deposits in each property area. Location, drainage area and period of operation for each station in the 2012 network are provided in Tables 3.1-3 and 3.1-4, and Figures 3.1-1 through 3.1-9. Station information sheets are provided in Appendix 1.

Table 3.1-3. 2012 Hydrometric Monitoring Stations in the Goose Property Area

Hydrometric Station	Location	Geographic Coordinates*		Drainage Area (km^2)	Period of Operation	MonitoringType
		Easting	Northing			
GL-H1	Goose Lake inflow	430,772	7,270,016	18.0**	June 5 to Sept. 7	stream water level
GL-H2	Llama Lake outflow	428,746	7,271,567	1.7	June 5 to Sept. 7	stream water level
GL-H3	Goose Lake inflow	432,891	7,269,919	1.8	June 7 to Sept. 9	stream water level
PL-H1	Propellor Lake outflow	436,094	7,279,939	204.4	June 6 to Sept. 8	stream water level
PL-H2	Propellor Lake inflow	435,007	7,272,014	101.5	June 12 to Sept. 12	stream water level
GI-H1	Giraffe Lake outflow	432,744	7,271,610	27.4	June 9 to Sept. 14	stream water level
EL-H1	Echo Drainage outflow	432,091	7,269,573	1.4	June 6 to Sept. 7	stream water level
WL-H1	Wolf Drainage outflow	434,269	7,269,719	32.7**	June 7 to Sept. 14	stream water level
REFB-H1	Reference B Lake outflow	442,573	7,257,794	5.3	June 9 to Sept. 13	stream water level
BL-H1	Big Lake inflow	429,044	7,268,478	3.59	June 12 to Sept. 10	stream water level
BL-H2	Swan Lake	424,087	7,265,274	160.0	June 8 to Sept. 9	stream water level
BL-H3	Moby Lake outflow	423,467	7,264,998	21.4	June 8 to Sept. 9	stream water level

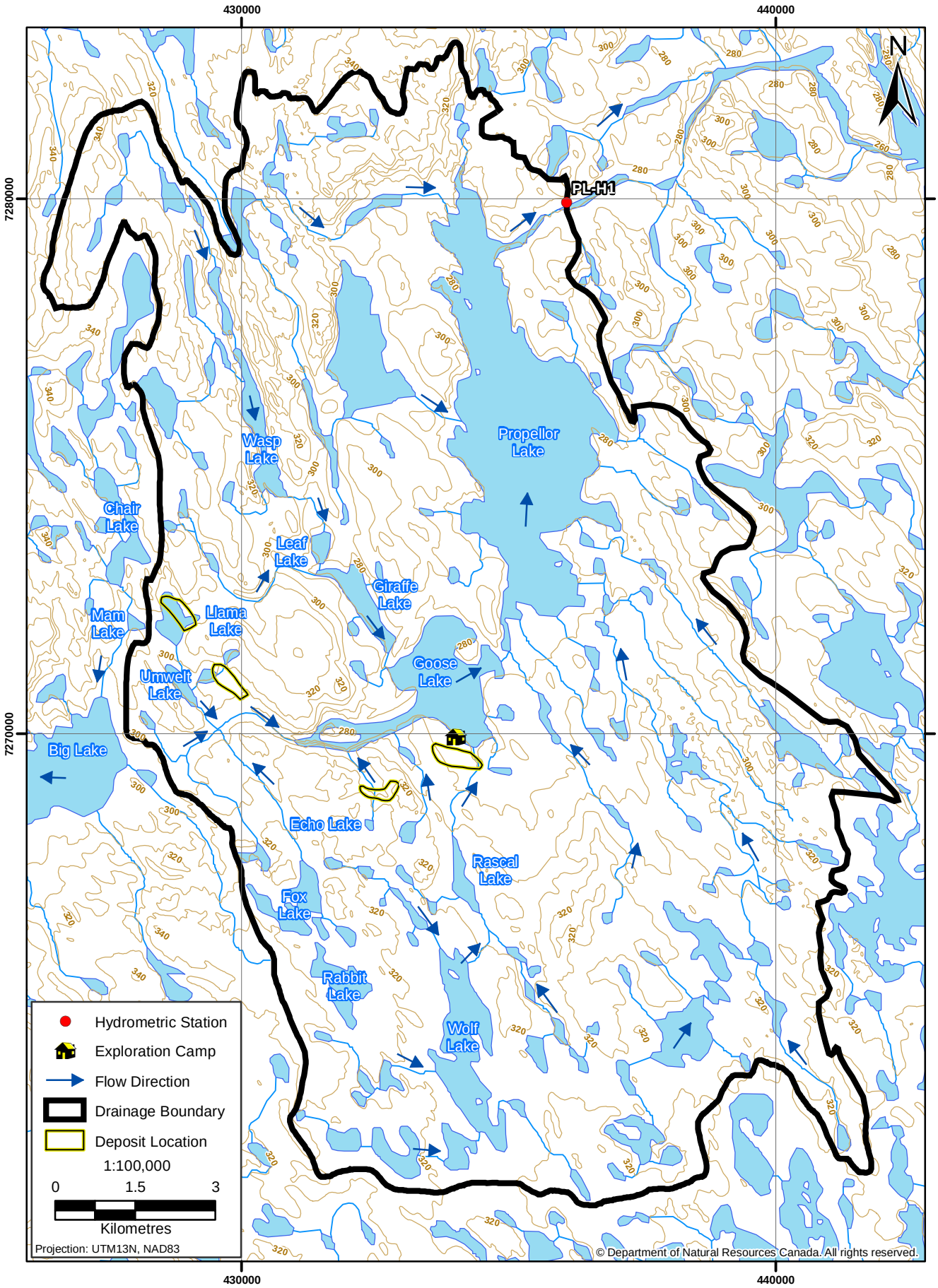
** UTM, Datum NAD 83, Zone 13 W*
*** Adjusted in 2012*

Table 3.1-4. 2012 Hydrometric Monitoring Stations in the George Property Area

Hydrometric Station	Location	Geographic Coordinates*		Drainage Area (km^2)	Period of Operation	Monitoring Type
		Easting	Northing			
REFC-H1	Reference Lake C outflow	396,495	7,335,612	9.47	June 11 to Sept. 11	stream water level
KL-H1	Komatic Lake inflow	390,592	7,309,400	24.0	June 10 to Sept. 12	stream water level
KL-H2	George Lake outflow	386,687	7,314,673	9.66	June 10 to Sept. 12	stream water level

** UTM, Datum NAD 83, Zone 13 W*

The 2012 network in the Goose Property area included the remobilization of the nine stations established in 2011, plus the installation of three new stations. All of the three new stations were located within the Back River Watershed. The 2012 network in the George Property area included the installation of three new stations. Two of the stations, KL-H1 and KL-H2, encompassed the George Property, and the other one, REFC-H1, operated as a reference station.



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Drainage Boundary for Propellor Lake Hydrometric Monitoring Station PL-H1

Figure 3.1-1

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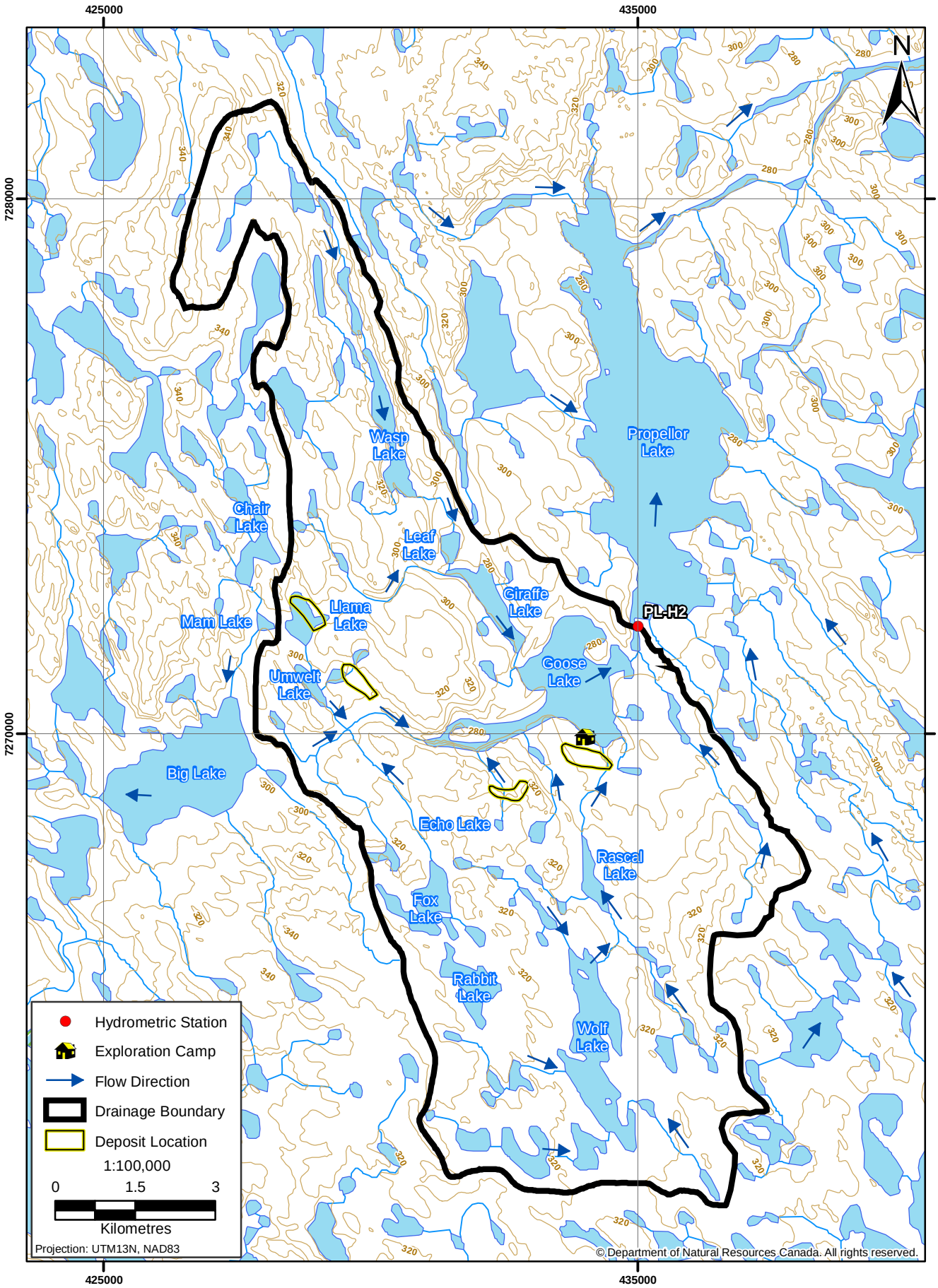
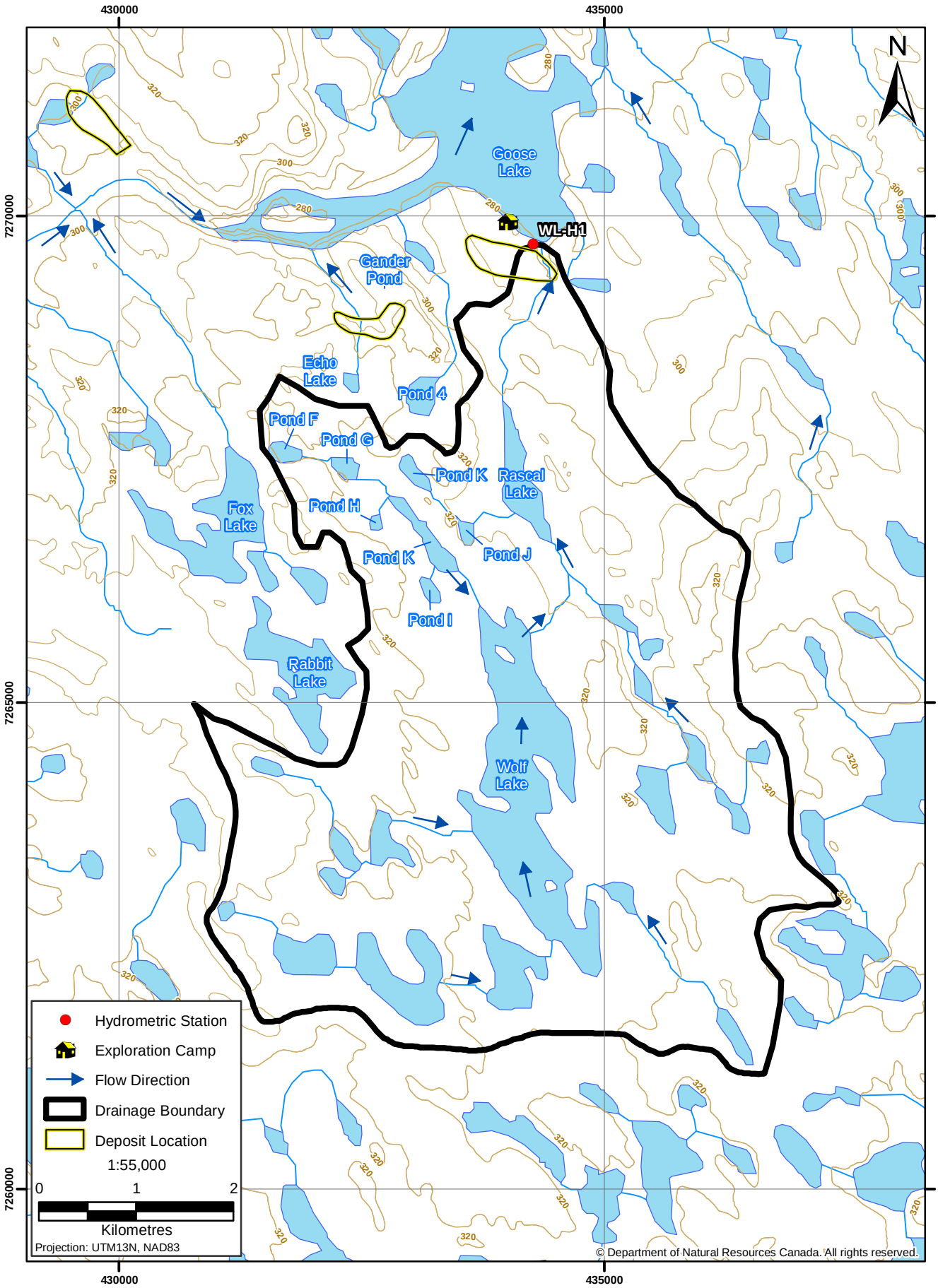


Sabina GOLD & SILVER CORP

Drainage Boundary for Propellor Lake Hydrometric Monitoring Station PL-H2

Figure 3.1-2

Rescan Engineers & Scientists



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Drainage Boundary for Goose Lake Hydrometric Monitoring Station WL-H1

Figure 3.1-3

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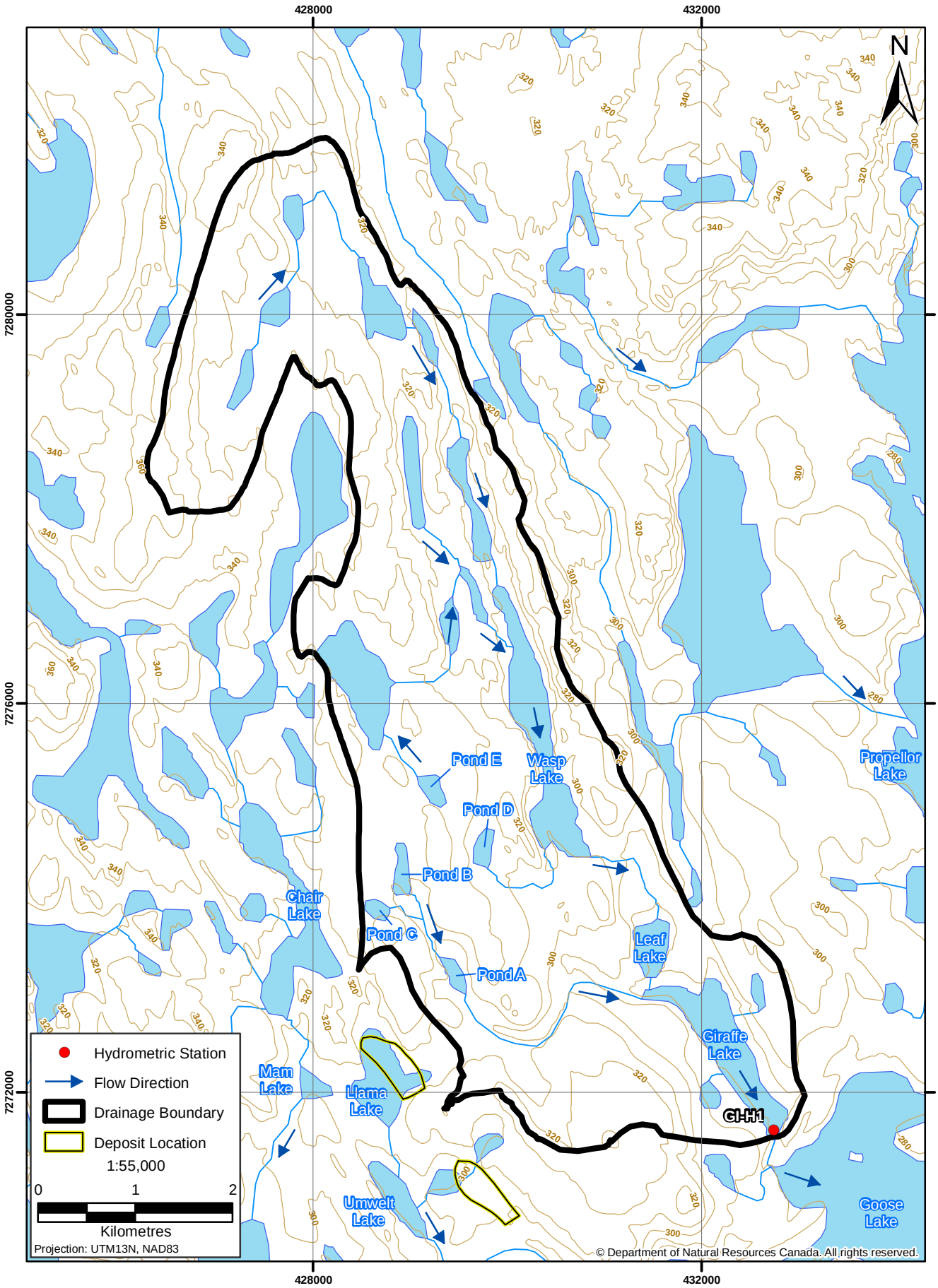

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Drainage Boundary for Giraffe Lake Hydrometric Monitoring Station GI-H1

Figure 3.1-4

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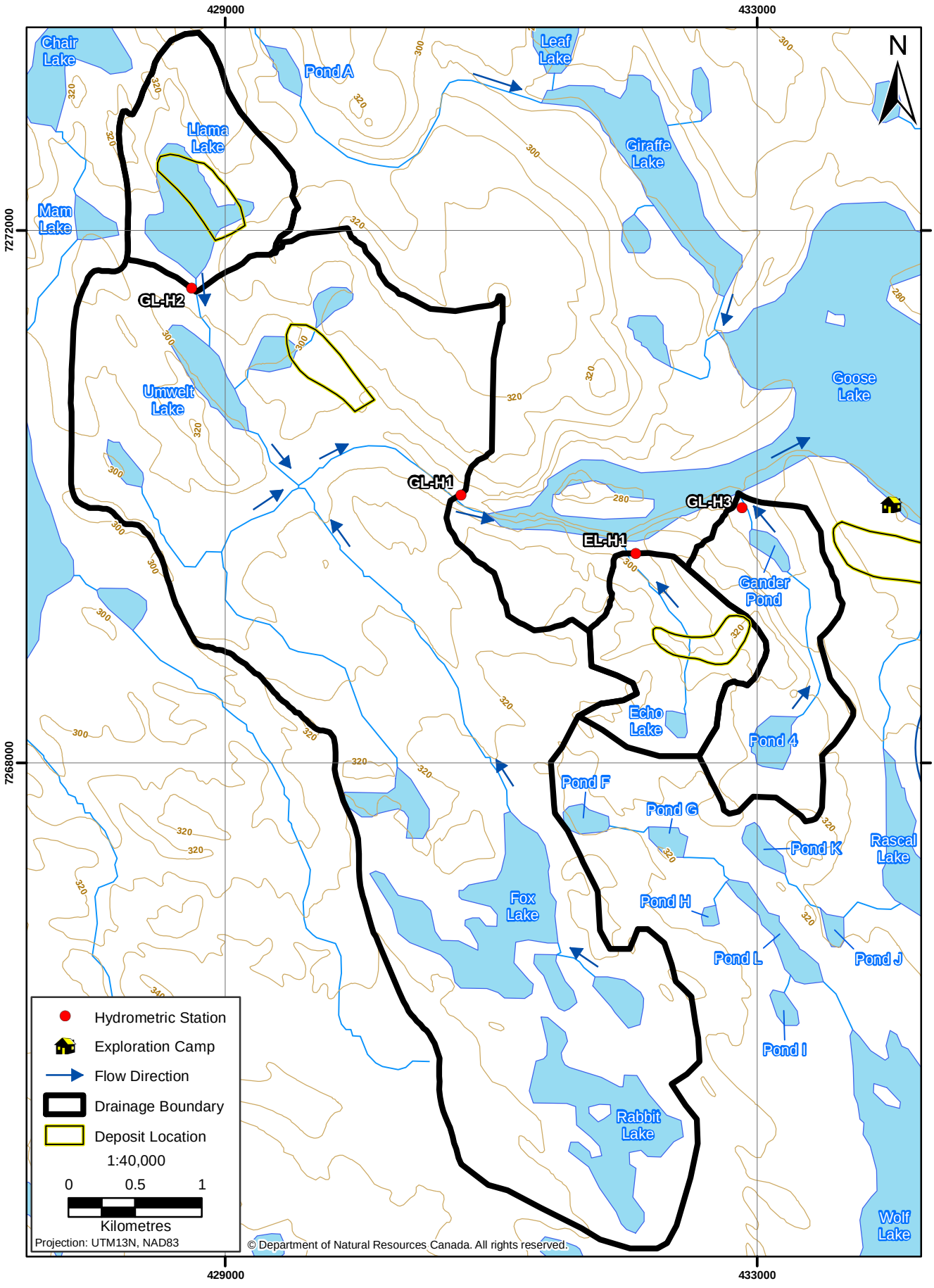

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Drainage Boundaries for GL-H1, GL-H2, GL-H3 and EL-H1 Hydrometric Monitoring Stations

Figure 3.1-5

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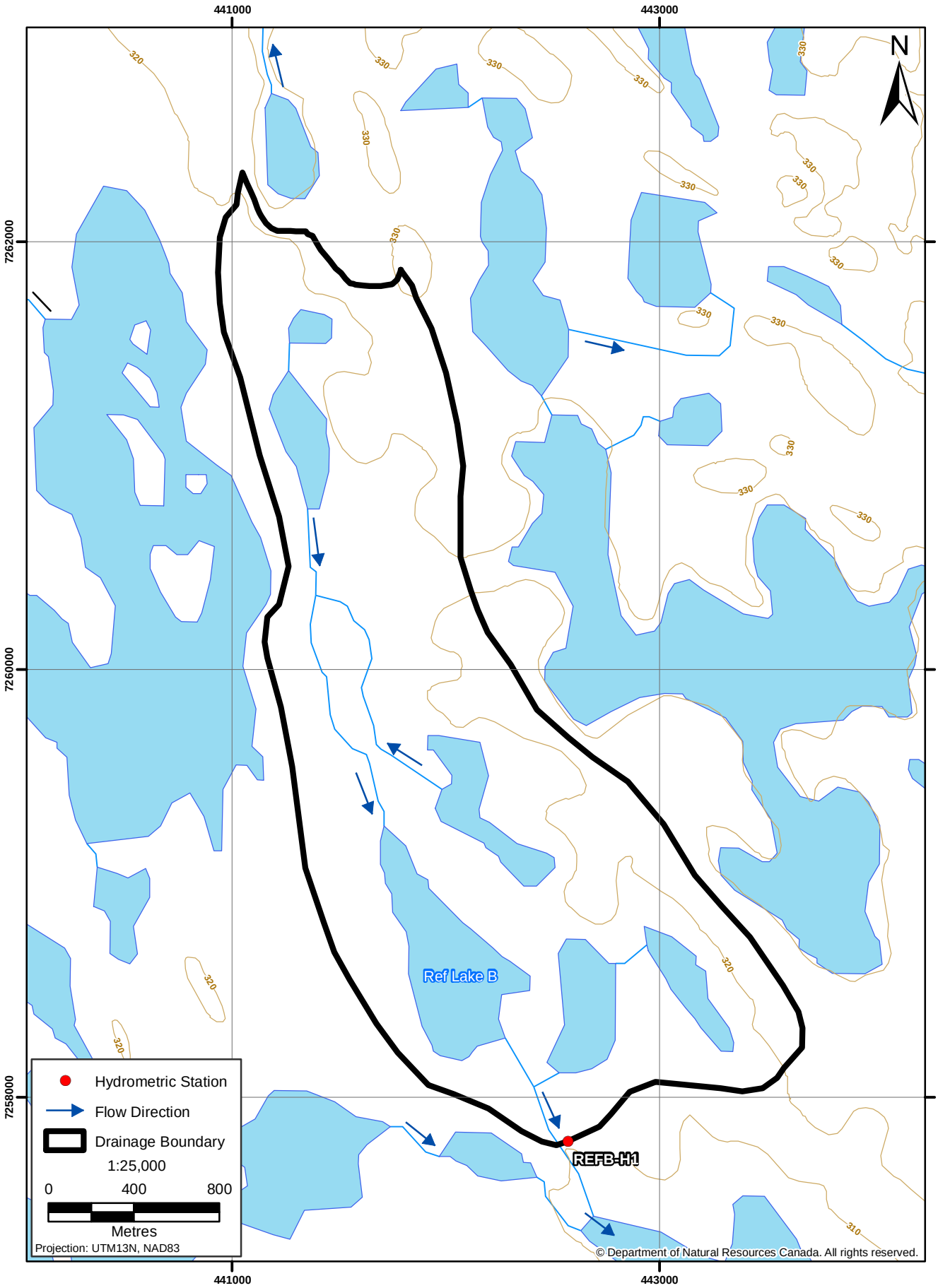

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Drainage Boundary for Reference Lake B Hydrometric Monitoring Station REFB-H1

Figure 3.1-6

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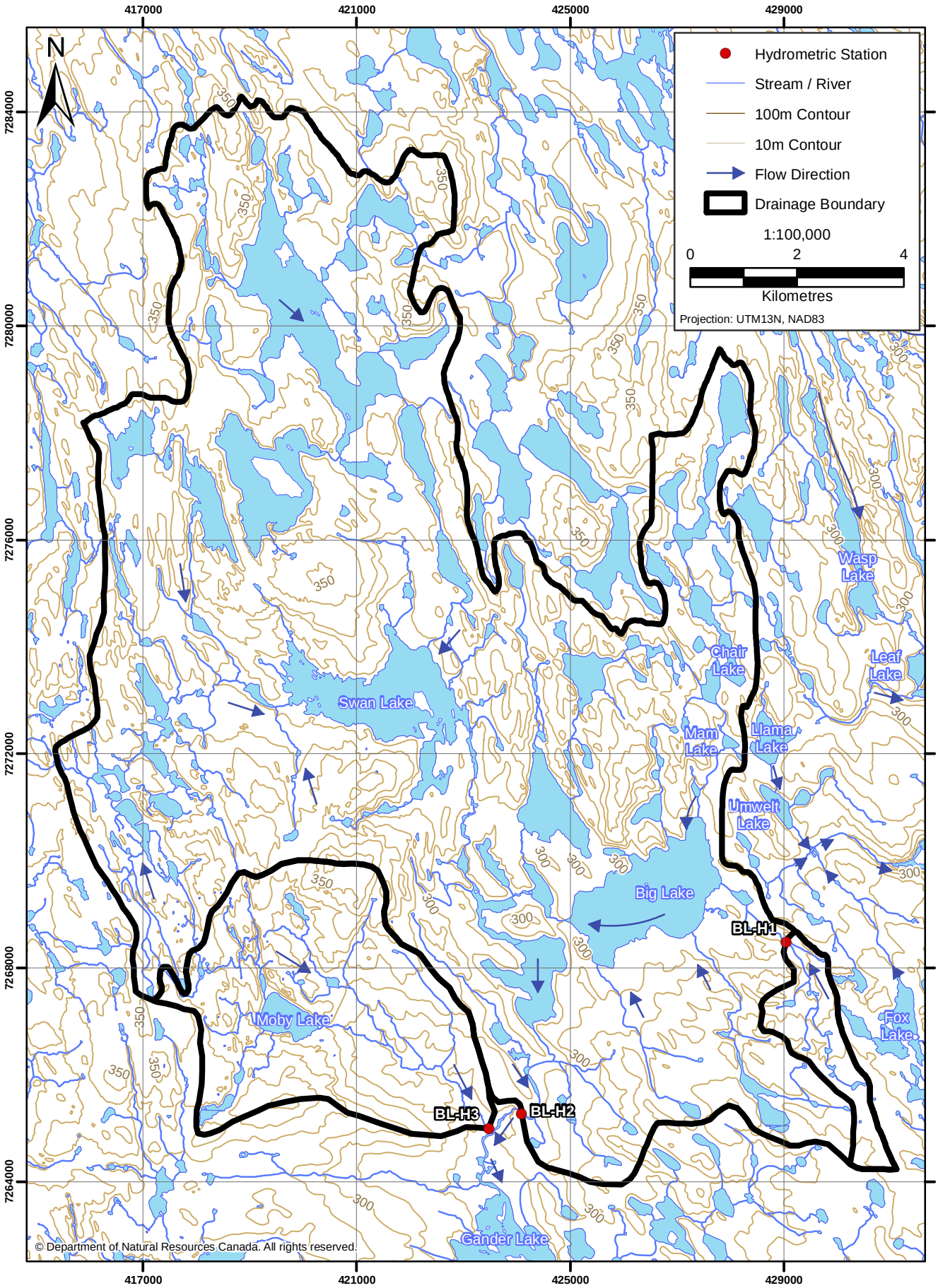

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Drainage Boundaries for BL-H1, BL-H2, and BL-H3 Hydrometric Monitoring Stations

Figure 3.1-7

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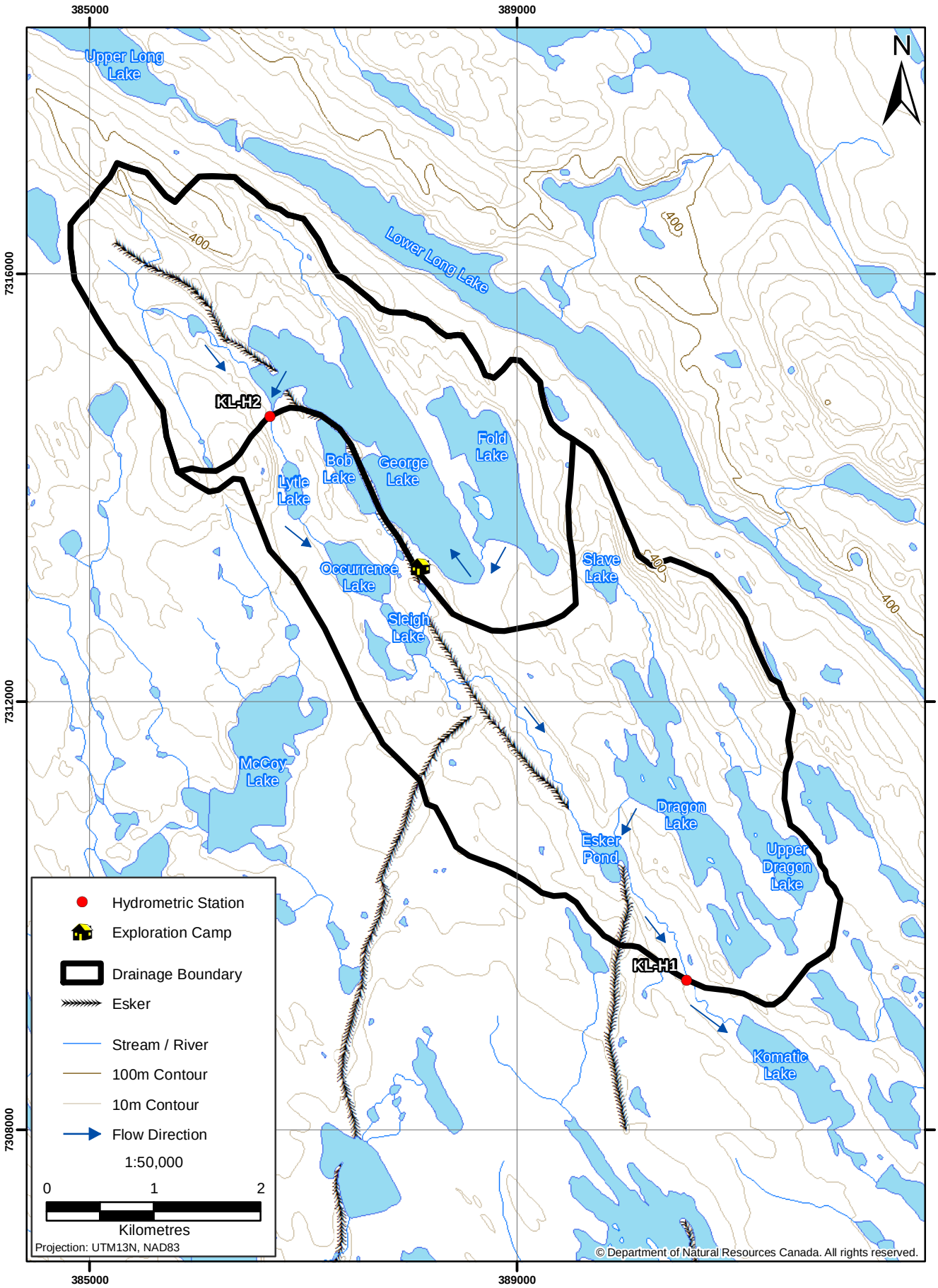

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Drainage Boundaries for KL-H1 and KL-H2 Hydrometric Monitoring Stations

Figure 3.1-8

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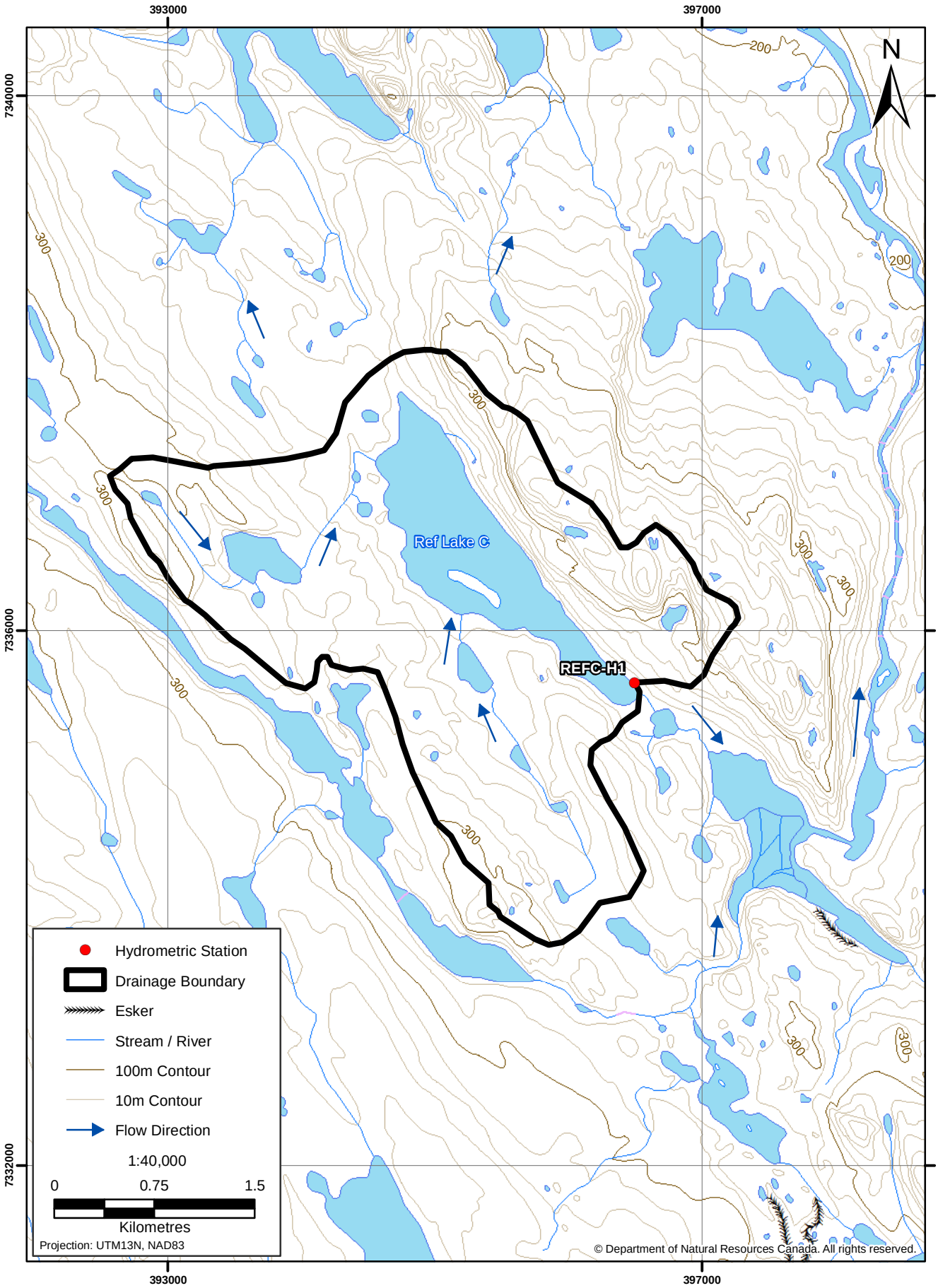

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Drainage Boundary for REFC-H1 Hydrometric Monitoring Station

Figure 3.1-9

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3.2 HYDROMETRIC MONITORING STATION SETUPS

Hydrometric monitoring stations were setup within the Project area to obtain water level data at selected stream and lake sites. Several factors influenced the selection of the location for the monitoring sites in 2012: the monitored watershed contained known mineral deposits; the location was either a main inflow or outflow of Goose Lake or George Lake (located at the centre of the deposit area); and the location was at the drainage outlet of the watershed associated with the property. Specific station locations were determined during the initial field reconnaissance conducted in June of 2012. Further, sites were selected to best meet the basic criteria required for desirable gauging locations. Such criteria include: the ability to obtain accurate water level data and to measure discharge at all stages; a stable natural control of water elevation at the site; and accessibility during the entire operational period.

Each hydrometric monitoring station, including the nine established in 2011, consisted of a PS-98i® 0-5 PSI vented pressure transducer (Instrumentation Northwest Inc.) paired with an ELF-2 data logger (Terrascience Ltd.) or an AquiStar® PT2X Integrated transducer (INW). The instrumentation measured and recorded water levels at 10 minute intervals. Pressure transducers were encased within an aluminum flex conduit which was secured to angle iron (1.5 m lengths by 50 mm width and 6 mm thickness) and laid flat on the stream/lake bed in order to keep the transducer weighted in place. The flex conduit housing the transducer cable was routed to a steel weather proof enclosure containing the data logger. The box was securely installed above the high water mark. An example of a typical station set-up is shown in Plate 3.2-1.

3.3 DISCHARGE MEASUREMENTS

At each hydrometric station, current velocity measurements were performed so that discharges could be determined. Measurements were taken throughout the open water season in order to obtain a wide range of discharges under different flow conditions. Four site visits were conducted during mid-June, mid-July, mid-August, and mid-September time periods.

Manual flow measurements were carried out at each site using two different methods depending on the flow conditions and morphology of the stream. At one site where the channel was too deep to wade, an acoustic Doppler current profiler (ADCP) was used to determine discharge. At all the rest of the sites, where the stream channels could be safely waded, a handheld current velocity meter was used.

3.3.1 Current Velocity Measurements

The location of the metered section at each site was determined based on channel geometry and flow conditions at time of measurement. Generally, the stream was measured along a straight reach near the station where the bed was as uniform as possible. Areas with submerged vegetation and/or immovable rocks were avoided where possible.

Current velocities were measured using either a mechanical current meter (Swoffer 2100^{TM}) fitted with a 75 mm diameter propeller or an electromagnetic current meter (Marsh-McBirney Flo-mate^{TM}). A fixed sampling interval of 40 seconds was selected for each velocity measurement, during which an average velocity was determined.

Water discharge was computed from stream velocity measurements by employing the velocity - area method, which determines discharge per unit width for each sounding or vertical. In this method it is assumed that the velocity sampled at each vertical represents the mean velocity in a segment. The segment area extends laterally from half the distance from the preceding vertical to half the distance to the next, and vertically from the water surface to the sounded depth. The partial

discharges across the channel are then summed to obtain the estimated total discharge measurement. Typically a minimum of 20 current velocity measurements are obtained across the width of a channel with the aim of having each measurement interval accounting for less than 10% of the total discharge (Plate 3.3-1).

Plate 3.2-1. Photographs illustrating the hydrometric monitoring station design.

At each sounding point, if the observed water depth was less than 0.75 m, the current water velocities were measured at 60% of the flow depth of water. The measurement at 60% of the flow depth is generally accepted as representing the mean velocity of the vertical water section (Herschy 2009). When water depths were greater than 0.75 m, current velocities were measured at 20% and 80% of the flow depth of water and the average of the two readings was taken as the mean velocity for the vertical. In all cases, the adopted methods followed standard WSC operating procedures (Terzi 1981).

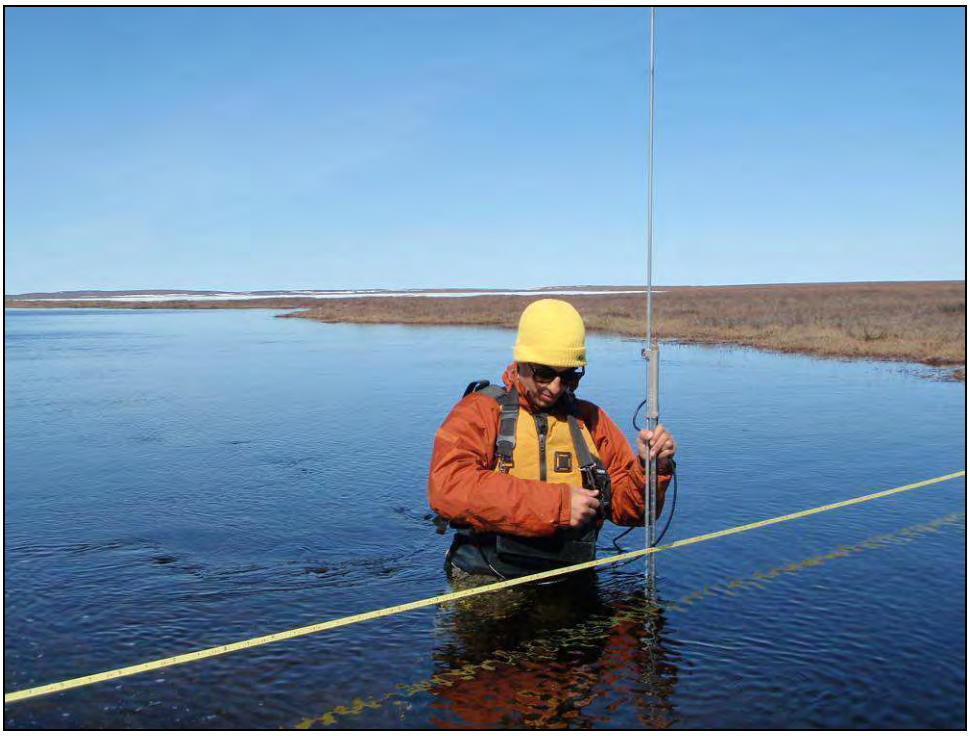

Plate 3.3-1. Velocity-area discharge measurements at hydrometric station WL-H1 using a handheld current velocity meter. Photograph taken on June 7, 2012.

3.3.2 ADCP Measurements

At one hydrometric station, water depth was too high during the open water season to allow field personnel to safely wade and measure discharge with a handheld current velocity meter. Therefore, discharge was measured at this site by means of a StreamPro® (Teledyne RD Instruments) acoustic Doppler current profiler (ADCP). All measurements were conducted according to standard operating procedures (Rehmel et al. 2003, WSC 2004).

The location of the ADCP measurements was selected following the same general principles as with the handheld current velocity meter. In addition, the section was chosen where the channel was relatively narrow to allow for better instrument control during the ADCP measurements.

At the selected location a boat was used to ferry personnel and a rope system across the channel. A cableway was used to manoeuvre the ADCP in controlled transects perpendicular to the direction of flow (Plate 3.3-2). Multiple transects were conducted until a minimum of four transects recorded discharges that were all within 5% of the measured mean discharge. The total discharge measurement was computed by taking the average of the four valid transects.

3.4 HYDROMETRIC STATION SURVEYS

3.4.1 Levelling Surveys

At stations where water surface elevation or stage is measured it is common practice to determine the stage above a specified reference surface or gauge datum. In order to check for the accuracy and consistency of the recorded data, it is necessary to periodically verify the elevation of the gauge in relation to the established station datum. To check and ensure that the gauge is properly set to the station datum, differential levelling techniques are used.

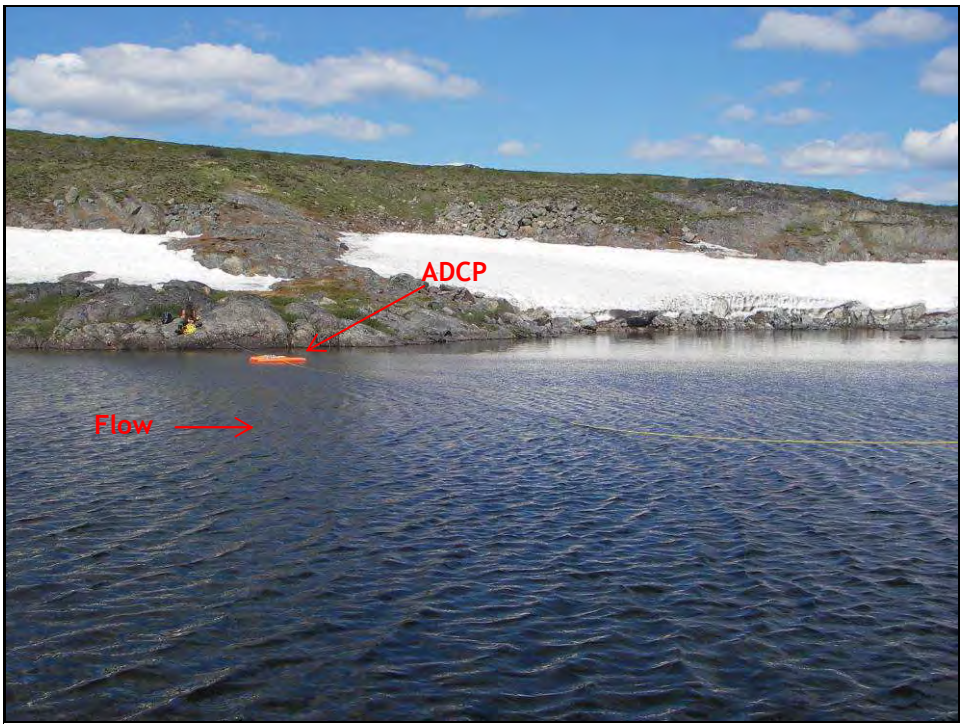

Plate 3.3-2. Discharge measurements at hydrometric station PL-H1 using an acoustic Doppler current profiler (ADCP). Photograph taken on July 14, 2012.

To establish and maintain vertical elevation control at the Project hydrometric monitoring locations, three local benchmarks were installed at each station. Benchmarks consisted of 76 mm concrete expansion bolts secured in bedrock or large stable boulders found in the vicinity of the stations. One benchmark at each station was assigned to be the primary reference point, and assigned an arbitrary local elevation of 100.000 m. All recorded water levels were then referenced to this primary benchmark.

Throughout the 2012 monitoring period, hydrometric levelling surveys were conducted during site visits in early June, mid-July, etc. Each survey was completed using an engineer's level and a calibrated levelling rod.

3.4.2 Channel Geometry Surveys

Surveys were completed at each monitored hydrometric station in order to define the channel geometry of the gauged stream section. At the majority of hydrometric stations, a suitable channel reach with a total length of approximately three to six channel widths was selected, using the hydrometric station as the midpoint of the surveyed section. Three evenly spaced cross-sections, perpendicular to the channel reach, were surveyed using an engineer's level and calibrated levelling rod.

For the stations located at the outflows of Giraffe Lake (GI-H1), George Lake (KL-H2) and Reference Lake C (REFC-H1), a near-shore longitudinal profile was measured at the station. Two additional channel cross-sections were measured downstream from these stations. At the outflow of Propellor Lake (PL-H1), information of the channel bed topography was obtained from the ADCP, and was merged with topographic information of the adjacent banks surveyed using an engineer's level and rod. At each station, all surveyed cross-sections were referenced to the established arbitrary local datum.

3.5 STAGE – DISCHARGE RELATIONS

In 2012, stage-discharge relations were developed for each hydrometric station. For stations that operated before 2012, data collected before and during 2012 were combined in the development of the stage-discharge relations. Stage-discharge relations are expressed as rating curves. Rating curves are used to convert water level data (stage) recorded by the hydrometric monitoring stations into a continuous discharge time-series or hydrograph. The quality of a rating curve is a function of the number and accuracy of the individual data points that are used to generate the curve as well as the hydraulic characteristics of the monitoring location. To develop a robust stage-discharge relation 10 to 15 manual streamflow measurements are recommended. Although a rating curve can be developed with as few as three points, each additional point adds increased robustness, particularly if the newly added measurements have a different magnitude than preceding measurements. Flow measurements at the higher end of the flow range are especially important as they help to define the upper end of the rating curve, which is important for quantifying hydrologically important periods such as peak flow and rainfall-runoff. The stage-discharge relation can also change from low flow periods to high flow periods, due to alterations in the geometry of the channel. When this is the case, a two-stage rating relation may be developed. One relation satisfies low stage conditions, while the other relation represents high stage conditions.

In the absence of a stage–discharge measurement corresponding to high flow conditions, the rating curve is often extrapolated to a high flow value that is beyond the range of the observed data used to generate the curve. Most stage-discharge relations in this study were extrapolated to values less than or equal to 1.5 times the greatest measured discharge. Any discharge extrapolation beyond that limit is not recommended as the resulting value will have a high uncertainty associated with it (ISO 2010). The stage-discharge relation for the hydrometric stations GL-H1, GL-H2, EL-H1, BL-H1, BL-H3, and REFC-H1 was extended beyond 1.5 times the highest measured discharge to account for the range of measured stages; therefore there is greater uncertainty in the high discharges calculated at these stations.

Rating curves were developed using Aquarius™ Time Series Hydrologic Software (Aquatics Informatics Inc.). The software uses standard methods outlined by the United States Geological Survey and the International Organization for Standardization (Kennedy 1984, ISO 2010). Plotted on a logarithmic scale, a least-squares regression procedure was used to produce a line of best fit and logarithmic equation for the concurrently measured water level (stage) and discharge data. Taking the antilogarithmic transformation, discharge was determined by a power function of the form:

$$Q = C\,(h - a)^{b} \qquad (1)$$

where Q is the discharge (m^3/s), C and b are regression coefficients, h is the stage (water level; m), and a is the stage at zero flow (datum correction; m).

3.6 DAILY DISCHARGE HYDROGRAPHS

Annual hydrographs, presented as daily discharge, were generated for each of the hydrometric monitoring stations operated in 2012. Daily discharge is the average discharge calculated over a 24 hour period.

For the operational period at each station, discharges were calculated by applying the developed rating curves to the recorded stage data. Prior to recorded stage data, rising limbs of the hydrographs were estimated assuming a logarithmic growth function. The onset of the spring freshet was determined using available temperature data from the George and Goose meteorological stations along with 2012 provisional daily discharge hydrograph of the regional WSC stations shown in Table 2.2-1. The recession

limb of each hydrograph was extended down to a zero flow date based on a linear decay function. This function is an extrapolation of the initial recession of the hydrograph that was captured in the data record.

3.7 MONTHLY VOLUMETRIC OUTFLOW

At each hydrometric station, the monthly and annual volumetric water outflows were determined. Volumetric outflows are expressed in millions of cubic meters per month for each of the monitored basins.

3.8 FLOW DURATION ANALYSIS

Flow duration analysis considers the percent of time that a specific discharge level has been exceeded or equalled during a period of record. A flow duration curve is the relation between the magnitudes of streamflow at a point and the frequency (probability) with which those magnitudes are exceeded over an extended period of time (Dingman 2002).

For each monitored basin within the Project area, a flow duration curve was generated. The flow duration curve is a useful planning tool in evaluating water discharge, as a function of basin characteristics.

A flow duration curve is constructed by ranking discharge values over a period of record, and then calculating their associated probabilities of exceedance using the following equation:

$$P = [M/(n+1)] \times 100\% \qquad (2)$$

Where *P* is the probability that a given flow will be equalled or exceed, *M* is the ranked position on the listing, and n is the number of events for the period of record (Dingman 2002).

3.9 HYDROLOGIC INDICES

Calculated annual runoff, seasonal runoff distribution, mean annual discharge (MAD), peak flow, and low flow are important hydrologic indices that provide useful information when undertaking a hydrologic assessment for design of mine Project infrastructure as well as when managing the water resources once a mine has entered operations.

3.9.1 Annual Runoff

Calculated annual runoff (expressed as a depth) represents the difference between annual precipitation, snowmelt, and evaporation. It is a valuable metric for obtaining gross estimates of the water available from a basin. Because it is standardized by watershed area it is also a useful index for comparing the hydrologic response of basins of different sizes. Annual runoff was expressed as observed annual runoff and as estimated annual runoff. Observed annual runoff only included runoff values for the period of record at each hydrometric station. Estimated annual runoff was the total runoff for the entire open water season, which includes both estimated and observed values.

3.9.2 Seasonal Runoff Distribution

Seasonal runoff distribution was determined by summing the daily runoff by month for each basin. Monthly runoff as a depth and as a percent of the total annual runoff was calculated and presented to illustrate the spatial and temporal distribution of runoff in the Project area.

3.9.3 Mean Annual Discharge

The mean annual discharge (MAD), computed as an average discharge over the year, is an additional variable that gives an indication of the potential amount of water a basin can provide as a function of drainage area, geology, and climate.

3.9.4 Annual Peak and Low Flow

Peak flows represent the maximum flow rate of a catchment during a year in response to precipitation events or snowmelt. Peak flows are used in combination with flood frequency analysis techniques in order to estimate design flows used in the sizing of ditches, diversion channels, or stream crossings. Conversely, low flows provide an estimate of the normal baseflow conditions during the open water season, which is important to the sustained health of a stream's aquatic community.

3.10 SNOW COURSE SURVEYS

Snow course surveys are manual measurements of snowpack used to provide estimates of available runoff during spring freshet conditions. Snow surveys collect snow depth and density data in order to calculate Snow Water Equivalent (SWE) for a specific region of interest (Woo 1997). SWE is the amount of water stored in the snowpack, and represents the depth of water present if the snowpack were to melt instantaneously.

There were twelve snow courses conducted in 2012, eight within the Goose Property and four within the George Property. Each snow course was a transect of 10 sampling points spaced by 25 meters. All snow courses were sampled once in mid-April 2012 in order to measure maximum snowpack depth. The transects throughout both the George Property and the Goose Property were intended to characterize the regional snowpack for the Project area. Different terrain types (hill slopes, gullies, channel banks, etc.) were sampled within the snow course network to determine the average snow conditions within the Project area. Snow course locations on the Goose Property are shown in Figure 3.10-1 and listed in Table 3.10-1. Snow course locations on the George Property are shown in Figure 3.10-2 and listed in Table 3.10-2.

Table 3.10-1. 2012 Snow Course Survey Locations in the Goose Property Area

Station Number	Geographic Coordinates*		2012 Sampling Date	Station Location
	Easting	Northing		
SC-01	436502	7279764	April 25	PL-H1 drainage
SC-02	420367	7274271	April 21	BL-H2 drainage
SC-03	422265	7265136	April 24	BL-H3 drainage
SC-04	428855	7271553	April 21	GL-H2 drainage
SC-05	435325	7269732	April 24	PL-H2 drainage
SC-06	442629	7257810	April 23	REFB-H1 drainage
SC-07	431670	7261290	April 23	South of WL-H1 drainage
SC-08	433071	7269498	April 25	GL-H3 drainage

**UTM, Datum NAD 83, Zone 13 W*

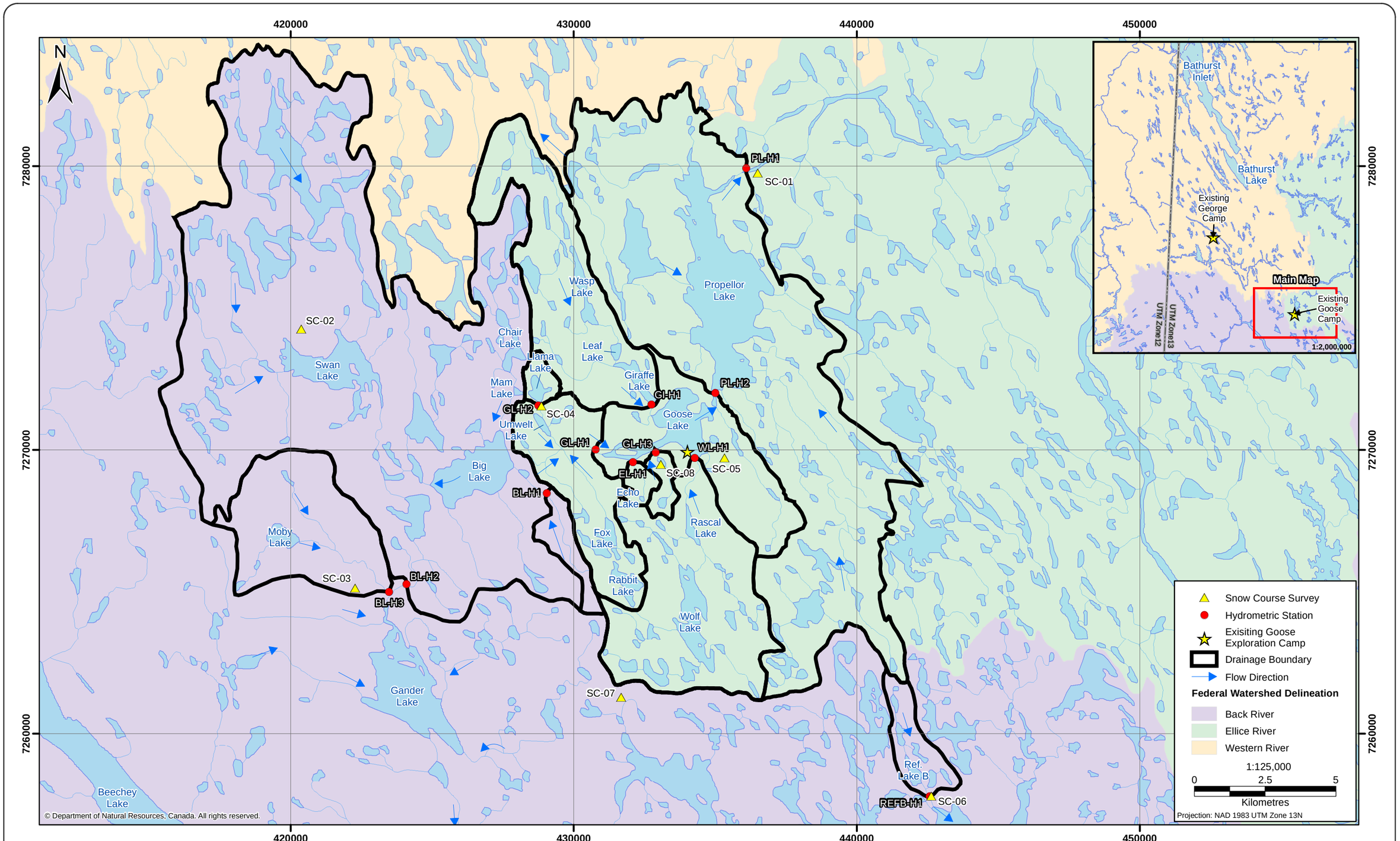

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Figure 3.10-1

2012 Snow Course Survey Locations within the Back River Project - Goose Area

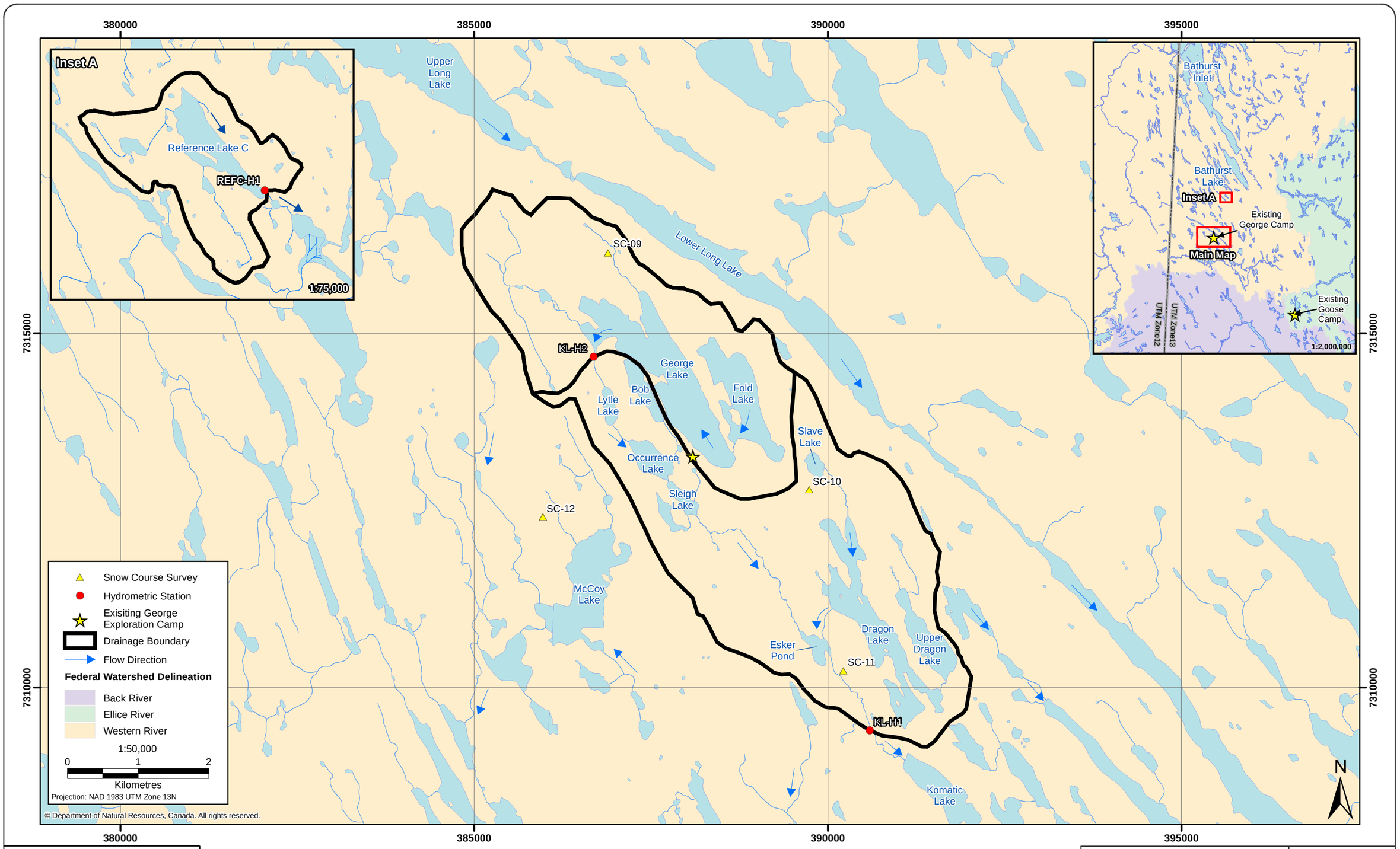

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Figure 3.10-2

2012 Snow Course Survey Locations within the Back River Project - George Area

Table 3.10-2. 2012 Snow Course Survey Locations in the George Property Area

Station Number	Geographic Coordinates*		2012 Sampling Date	Station Location
	Easting	Northing		
SC-09	386892	7316137	April 20	KL-H2 drainage (North of George Lake)
SC-10	389735	7312798	April 20	KL-H2 drainage (South of George Lake)
SC-11	390220	7310240	April 22	KL-H1 drainage
SC-12	385971	7312414	April 22	Dragon Lake drainage

** UTM, Datum NAD 83, Zone 13 W*

The Standard Federal Snow Sampler was used for all measurements. Snow depth was measured by pushing the tube down through the snowpack to the ground surface and extracting a core (Plate 3.10-1). To obtain an accurate snow core sample, the base of the tube was examined to determine if the tube had reached ground level. Any soil from the bottom end of the tube was cleared out.

The Standard Snow Sampling Procedure was used for all snow courses except at sites SC-09 and SC-10 where the Bulk Sampling Procedure was used due to the shallow depth of snow pack (BC MOE 1981, 1982). When the Standard Snow Sampling Procedure was used, the amount of water in the snowpack was determined by weighing the tube with its snow core (Plate 3.10-2). The density of a snow core was calculated by:

$$\rho = w/(\pi d r^2) \qquad (3)$$

where ρ is the snow density (kg/m^3 or %), w is the weight of the snow core, d is snow depth, and r is the inside radius of the core cutter (Woo 1997). An average of all the samples taken along the transect was calculated to represent the snow course.

Plate 3.10-1. Snow course sampling, drilling snow core.

Plate 3.10-2. Snow course sampling, weighing snow core.

When the Bulk Sampling Procedure was used, instead of measuring the SWE of individual snow cores, the content of all snow cores from the transect was emptied into a container, then this container was weighed in order to determine the total value for SWE in the entire snow course. This value was then divided by the number of samples to obtain the average SWE for the snow course. The snow density of the snow course was calculated as:

$$\rho = SWE/d \qquad (4)$$

where *SWE* is the average snow water equivalent of the snow course and *d* is the average depth of the samples (BC MOE 1981).

4. Results

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4. Results

Results from the 2012 hydrology program are presented as follows: (1) completed discharge measurements, (2) hydrometric surveys, (3) determined stage-discharge relations, (4) daily discharge hydrographs, (5) volumetric outflows, (6) flow duration analysis, and (7) hydrologic indices for the Project area.

4.1 DISCHARGE MEASUREMENT SUMMARY

Discharge measurements were taken during the June freshet period at each hydrometric station with additional measurements conducted in July, August, and September 2012, for a total of 82 measurements. The measurements were collected through the open water season in order to obtain a range of discharges at different flow conditions (Table 4.1-1 and Appendix 2).

Table 4.1-1. Summary of Discharge Measurements in the Project Area in 2012

Hydrometric Station	Date Measured	Pressure Transducer Stage (m)*	Measured Discharge (m^3/s)	Method (Equipment Used)
GL-H1	June 13	99.402	0.384	Velocity-Area (FlowMate)
	July 12	99.089	0.0842	Velocity-Area (FlowMate)
	August 10	98.653	0.00452	Velocity-Area (FlowMate)
	September 7	98.664	0.00652	Velocity-Area (Swoffer)
GL-H2	June 12	99.678	0.116	Velocity-Area (FlowMate)
	July 6	99.601	0.0270	Velocity-Area (FlowMate)
	August 10	99.531	0.00127	Velocity-Area (FlowMate)
	September 7	99.538	0.00151	Velocity-Area (Swoffer)
GL-H3	June 7	99.837	0.335	Velocity-Area (FlowMate)
	June 13	99.748	0.0503	Velocity-Area (FlowMate)
	July 9	99.678	0.0167	Velocity-Area (FlowMate)
	August 15	99.567	No Flow	
	September 9	99.641	0.00352	Velocity-Area (Swoffer)
PL-H1	June 6	99.433	19.27	Velocity-Area (ADCP)
	June 14	99.154	6.922	Velocity-Area (ADCP)
	July 14	98.819	1.473	Velocity-Area (ADCP)
	July 15	98.809	1.051	Velocity-Area (FlowMate)
	August 13	98.624	0.316	Velocity-Area (FlowMate)
	September 8	98.563	0.116	Velocity-Area (FlowMate)
PL-H2	June 12	99.770	3.456	Velocity-Area (FlowMate)
	June 16	99.708	1.731	Velocity-Area (FlowMate)
	July 7	99.596	0.668	Velocity-Area (FlowMate)
	August 11	99.481	0.0421	Velocity-Area (FlowMate)
	September 13	99.530	0.172	Velocity-Area (FlowMate)

(continued)

Table 4.1-1. Summary of Discharge Measurements in the Project Area in 2012 (continued)

Hydrometric Station	Date Measured	Pressure Transducer Stage (m)*	Measured Discharge (m^3/s)	Method (Equipment Used)
GI-H1	June 9	99.781	1.827	Velocity-Area (FlowMate)
	June 14	99.721	0.841	Velocity-Area (FlowMate)
	July 13	99.648	0.131	Velocity-Area (FlowMate)
	August 14	99.561	0.0342	Velocity-Area (FlowMate)
	September 10	99.552	0.0295	Velocity-Area (FlowMate)
	September 14	99.546	0.0456	Velocity-Area (FlowMate)
EL-H1	June 13	99.308	0.00675	Velocity-Area (FlowMate)
	June 17	99.279	0.00263	Velocity-Area (FlowMate)
	July 9	99.207	No Flow	
	August 14	99.172	No Flow	
	September 7	99.329	0.00818	Velocity-Area (Swoffer)
WL-H1	June 7	98.766	1.743	Velocity-Area (FlowMate)
	June 13	98.679	1.069	Velocity-Area (FlowMate)
	July 5	98.370	0.189	Velocity-Area (FlowMate)
	August 11	98.262	0.0494	Velocity-Area (FlowMate)
	September 14	98.297	0.0508	Velocity-Area (FlowMate)
REFB-H1	June 14	99.558	0.113	Velocity-Area (FlowMate)
	June 17	99.512	0.0127	Velocity-Area (FlowMate)
	July 7	99.444	0.0099	Velocity-Area (FlowMate)
	August 11	99.353	No Flow	
	September 13	99.394	0.00202	Velocity-Area (FlowMate)
BL-H1	June 12	99.755	0.0569	Velocity-Area (FlowMate)
	June 16	99.701	0.0213	Velocity-Area (FlowMate)
	July 13	99.611	0.00837	Velocity-Area (FlowMate)
	August 10	99.587	0.00106	Velocity-Area (FlowMate)
	August 15	99.619	0.00308	Velocity-Area (FlowMate)
	September 10	99.684	0.00871	Velocity-Area (Swoffer)
BL-H2	June 8	99.223	10.17	Velocity-Area (FlowMate)
	June 16	99.003	3.98	Velocity-Area (FlowMate)
	July 8	98.819	1.67	Velocity-Area (FlowMate)
	August 14	98.673	0.339	Velocity-Area (FlowMate)
	September 6	98.632	0.125	Velocity-Area (Swoffer)
	September 9	98.679	0.260	Velocity-Area (Swoffer)
BL-H3	June 8	100.173	0.969	Velocity-Area (FlowMate)
	June 16	99.913	0.232	Velocity-Area (FlowMate)
	July 8	99.780	0.0604	Velocity-Area (FlowMate)
	August 11	99.785	0.0304	Velocity-Area (FlowMate)
	September 9	99.862	0.0862	Velocity-Area (Swoffer)

(continued)

Table 4.1-1. Summary of Discharge Measurements in the Project Area in 2012 (completed)

Hydrometric Station	Date Measured	Pressure Transducer Stage (m)*	Measured Discharge (m^3/s)	Method (Equipment Used)
REFC-H1	June 11	99.345	0.249	Velocity-Area (FlowMate)
	June 15	99.310	0.143	Velocity-Area (FlowMate)
	July 10	99.214	0.0447	Velocity-Area (FlowMate)
	August 12	99.104	0.00207	Velocity-Area (FlowMate)
	September 12	99.050	0.000388	Velocity-Area (FlowMate)
KL-H1	June 10	99.055	1.267	Velocity-Area (FlowMate)
	June 15	98.943	0.719	Velocity-Area (FlowMate)
	July 11	98.748	0.284	Velocity-Area (FlowMate)
	August 12	98.612	0.0604	Velocity-Area (FlowMate)
	September 12	98.688	0.132	Velocity-Area (FlowMate)
KL-H2	June 10	99.636	0.497	Velocity-Area (FlowMate)
	June 15	99.580	0.271	Velocity-Area (FlowMate)
	July 12	99.509	0.179	Velocity-Area (FlowMate)
	August 12	99.422	0.0245	Velocity-Area (FlowMate)
	September 12	99.437	0.374	Velocity-Area (FlowMate)

** Pressure transducer stage referenced to site-specific arbitrary datum*

Two discharge measurements were taken during the freshet period at most of the hydrometric stations to capture the range of flow conditions observed. Discharge measurements were not conducted at the hydrometric stations GL-H3 and REFB-H1 during the August visit and at the hydrometric station EL-H1 during both the July and August visits as these streams were dry.

4.2 HYDROMETRIC STATION SURVEYS

4.2.1 Levelling Surveys

Levelling surveys were completed during each flow measurement during the 2012 field season. A summary of the survey control points at each station are provided in the station information sheets (Appendix 1). Survey data from the nine re-established stations were used to reference the 2012 stage data to existing benchmarks installed in 2011.

At the majority of new stations the surveys confirmed that the pressure transducers measuring water level remained stationary and properly calibrated during the monitoring period. At stations GL-H1, KL-H1, KL-H2, REFB-H1, and REFC-H1 the transducers drifted vertically during the field season and the survey data were used to confirm the changes in elevation of the pressure transducers and to correct for the errors in the stage time series.

4.2.2 Channel Geometry Surveys

Channel geometry surveys conducted at each hydrometric monitoring location are provided in Appendix 3. Surveys of the monitored reaches provide a physical representation of the channel geometry. These data will be used to determine channel stability and shifts on an annual basis. Cross-sections of the channels at the installed pressure transducers also show the 2012 minimum, mean, and maximum observed water level elevations.

4.3 STAGE-DISCHARGE RATING CURVES

At each of the hydrometric stations that were established in 2010 or 2011, the data collected before 2012 were combined with the data collected in 2012. This increased the range and the robustness of the rating curves. A wider range of flows were measured in 2012. This helped to better define the upper and lower ends of the preliminary rating curves that were developed in 2011. At each of the six new stations that were installed in 2012, five to six discharge measurements were conducted during the open water season. These measurements were used in the development of preliminary rating equations. Additional discharge measurements will continue to increase the range and robustness of the stage-discharge relations.

For stations where no substantial break points were observed, a single rating curve was fit to the full range of flows measured. A two stage (Low/High) rating curve was developed for stations where the monitored reach was confined to a fairly deep channel with steep banks during low to medium flow conditions; however, during high flow conditions the banks were overtopped and the stream was able to flood the flat tundra adjacent to the channel. Rating equations are summarized in Table 4.3-1 and rating curves are provided in Appendix 3.

Table 4.3-1. Summary of 2012 Rating Equations for the Hydrometric Monitoring Stations in the Project Area

Hydrometric Station		Rating Equation Q = C (h-a)b	Root Mean Square
GL-H1	Low Stage	$Q = 0.210(h-98.424)^{2.499}$	9.7
	High Stage	$Q = 2.171(h-98.895)^{2.497}$	
GL-H2		$Q = 3.335(h-99.528)^{1.847}$	7.7
GL-H3	Low Stage	$Q = 0.882(h-99.606)^{1.541}$	7.1
	High Stage	$Q = 6.351(h-99.710)^{1.608}$	
PL-H1	Low Stage	$Q = 21.534(h-98.549)^{2.107}$	10.0
	High Stage	$Q = 25.993(h-98.504)^{2.094}$	
PL-H2	Low Stage	$Q = 2.896(h-99.450)^{1.205}$	10.8
	High Stage	$Q = 34.591(h-99.450)^{2.113}$	
GI-H1	Low Stage	$Q = 0.745(h-99.370)^{1.875}$	8.1
	High Stage	$Q = 48.020(h-99.585)^{2.083}$	
EL-H1		$Q = 2.751(h-99.223)^{2.363}$	
WL-H1	Low Stage	$Q = 10.109(h-98.20)^{2.249}$	11.9
	High Stage	$Q = 7.368(h-98.20)^{2.573}$	
REFB-H1	Low Stage	$Q = 4.769(h-99.446)^{2.017}$	7.0
	High Stage	$Q = 4.558(h-99.50)^{1.526}$	
BL-H1	Low Stage	$Q = 0.377(h-98.546)^{1.843}$	4.0
	High Stage	$Q = 3.291(h-99.669)^{1.812}$	
BL-H2		$Q = 21.441(h-99.510)^{2.467}$	9.3
BL-H3		$Q = 3.151(h-99.714)^{1.781}$	5.9
REFC-H1		$Q = 11.852(h-99.144)^{2.405}$	8.6
KL-H1		$Q = 3.595\ (h-98.480)^{2.030}$	9.3
KL-H2		$Q = 3.561(h-99.383)^{1.509}$	12.1

Q= discharge (m^3/s); h= recorded stage (m)

Also included in the table is the Root Mean Square (RMS) which is used by the Aquarius® software as an overall measure of error of the stage-discharge relation. The RMS is a statistical parameter that describes how well the values predicted by the stage-discharge relation fit or represent the observed data. The departure from true values computed by this statistic combines both bias and lack of precision. The lower the RMS, the better the estimated values provided by the rating relationship.

4.4 ANNUAL HYDROGRAPHS

The 2012 annual daily discharge hydrographs presented in Figures 4.4-1 through 4.4-8 show similar trends over the year at each of the monitored locations in the Back River Project area. Daily discharge tables are provided in Appendix 4 and individual hydrographs in Appendix 5.

Based on air temperature recorded time series at the Goose and George meteorological stations, break-up was estimated to occur in late May (Figure 4.4-9). It was assumed that the break-up started on May 26 when the air temperatures in the Project area were consistently above the freezing point. One prominent high flow recession event driven by snowmelt was observed in each of the hydrographs during the freshet period. Only one minor rainfall-driven flow event was observed during early September. After the September precipitation event, flows continued to recede until the end of the monitoring period, which coincided with mean daily air temperatures dropping below the freezing level.

Based on the continuous time series of water level recorded at these sites, it is clear that the largest peak flow occurred during the freshet period from late May to early June. Provisional data recorded in 2012 at four WSC stations relevant to the Project area support the conclusion as well (Figure 4.4-9). The largest or the first peak flows at all these WSC stations occurred between May 30 and June 9. When the influence of drainage size is considered, the timing of peak flows in the Project area should be earlier than the WSC stations.

Pressure transducers were installed at all stations as soon as it was possible at all sites given ice conditions in the streams and lakes. However, it is usually not possible to get the instrumentation installed prior to the initial melting, and so regional data were used to help determine the onset of freshet. To estimate the spring freshet peak, linear extrapolation was used to extend the recession limb of the recorded freshet data back to June 2, which was selected based on regional streamflow and local climatic data. The exception was station BL-H2, where it was assumed that the observed peak occurred on June 8.

Compared to last year, the 2012 discharge hydrographs demonstrated a different pattern. In 2011 there were three prominent high flows - one was driven by snowmelt and the other two by rainfall (Rescan 2012). However, in 2012 there was only one high flow and it was driven by snowmelt, while the rainfall-driven flow was minor.

In addition, both the freshet break-up and peak flow in 2012 occurred earlier than in 2011. In 2012 the break-up occurred in late May and freshet peak flow occurred in early June, while the 2011 break-up occurred in early June and freshet peak flow occurred in mid-June.

4.4.1 Volumetric Outflow

The total monthly and annual volumetric water outflows for each of the drainages are presented in Tables 4.4-1 and 4.4-2. Outflows from each of the monitored drainages were generally found to be a function of drainage area. In the Goose Property area, the minimum volumetric outflows were observed at EL-H1 (drainage area = 1.4 km^2) which had a total annual water output of 0.08 million cubic meters. The maximum annual volumetric output was 27.39 million cubic meters at PL-H1 (drainage area = 204.4 km^2). In the George Property area, the minimum volumetric outflows were observed at REFC-H1 (drainage area = 9.47 km^2) which had a total annual water output of 0.59 million cubic meters. The maximum annual volumetric output was 3.43 million cubic meters at KL-H1 (drainage area = 24.0 km^2).

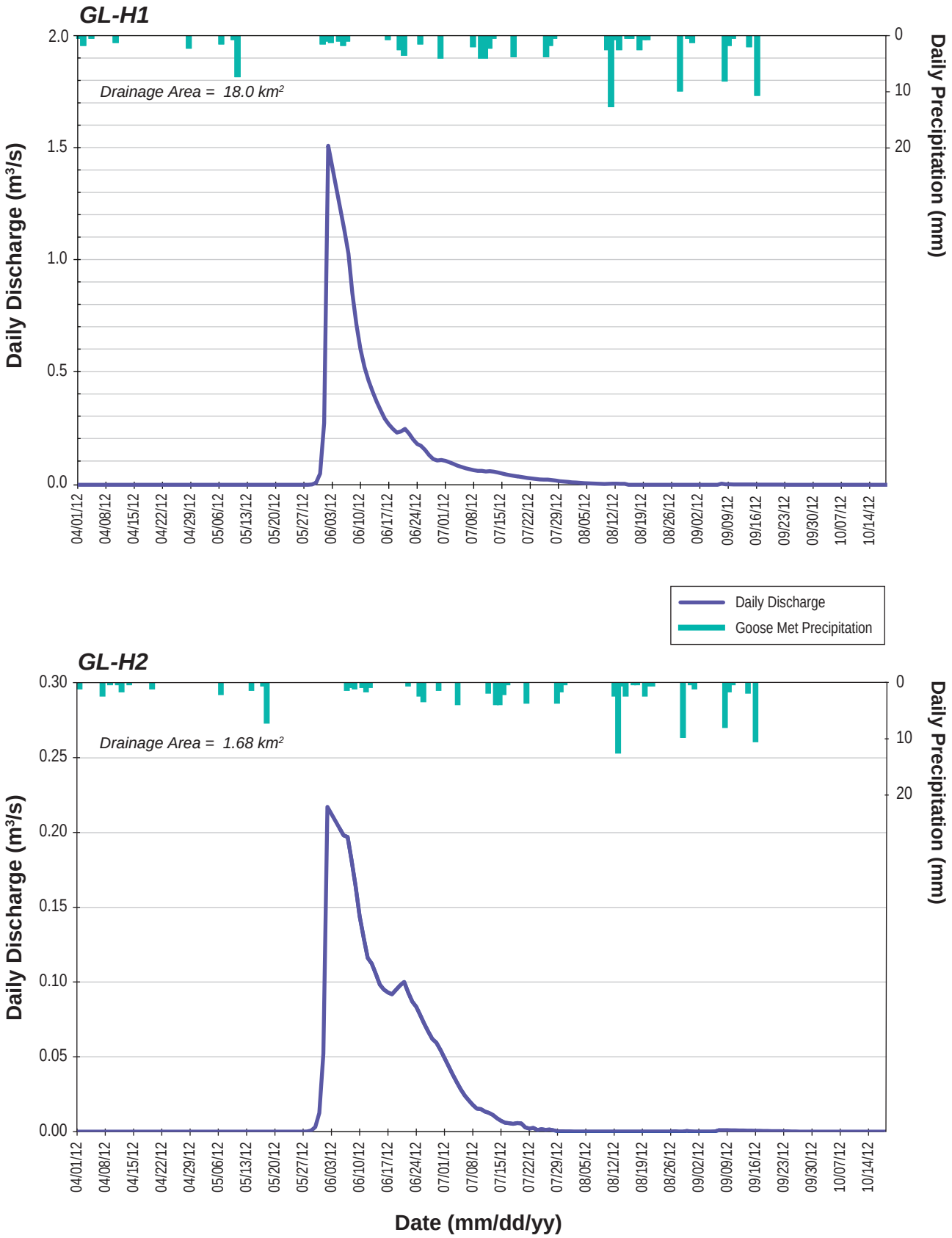

Figure 4.4-1

Annual Hydrograph at GL-H1 and GL-H2 Hydrometric Monitoring Stations, 2012

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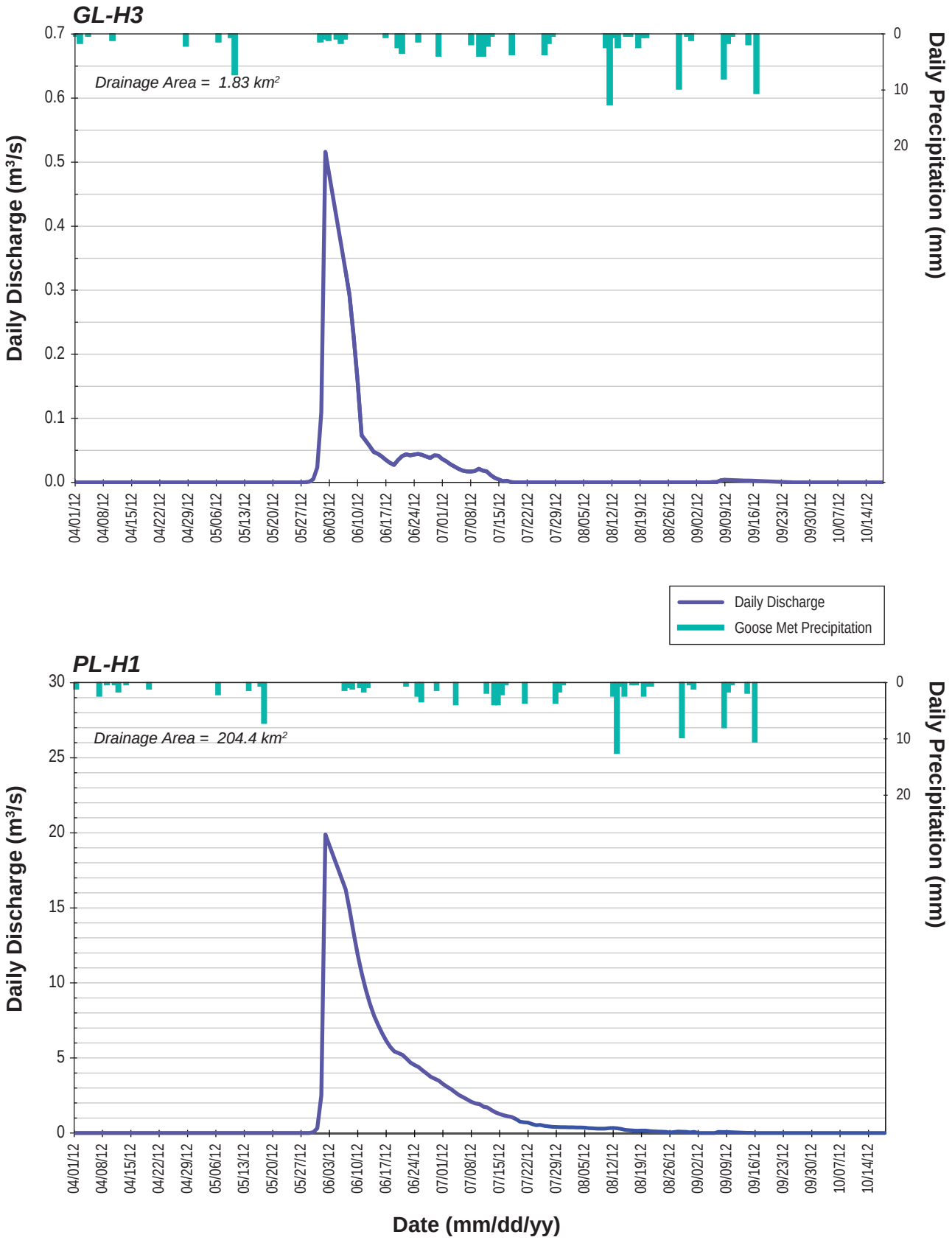

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Annual Hydrograph at GL-H3 and PL-H1 Hydrometric Monitoring Stations, 2012

Figure 4.4-2

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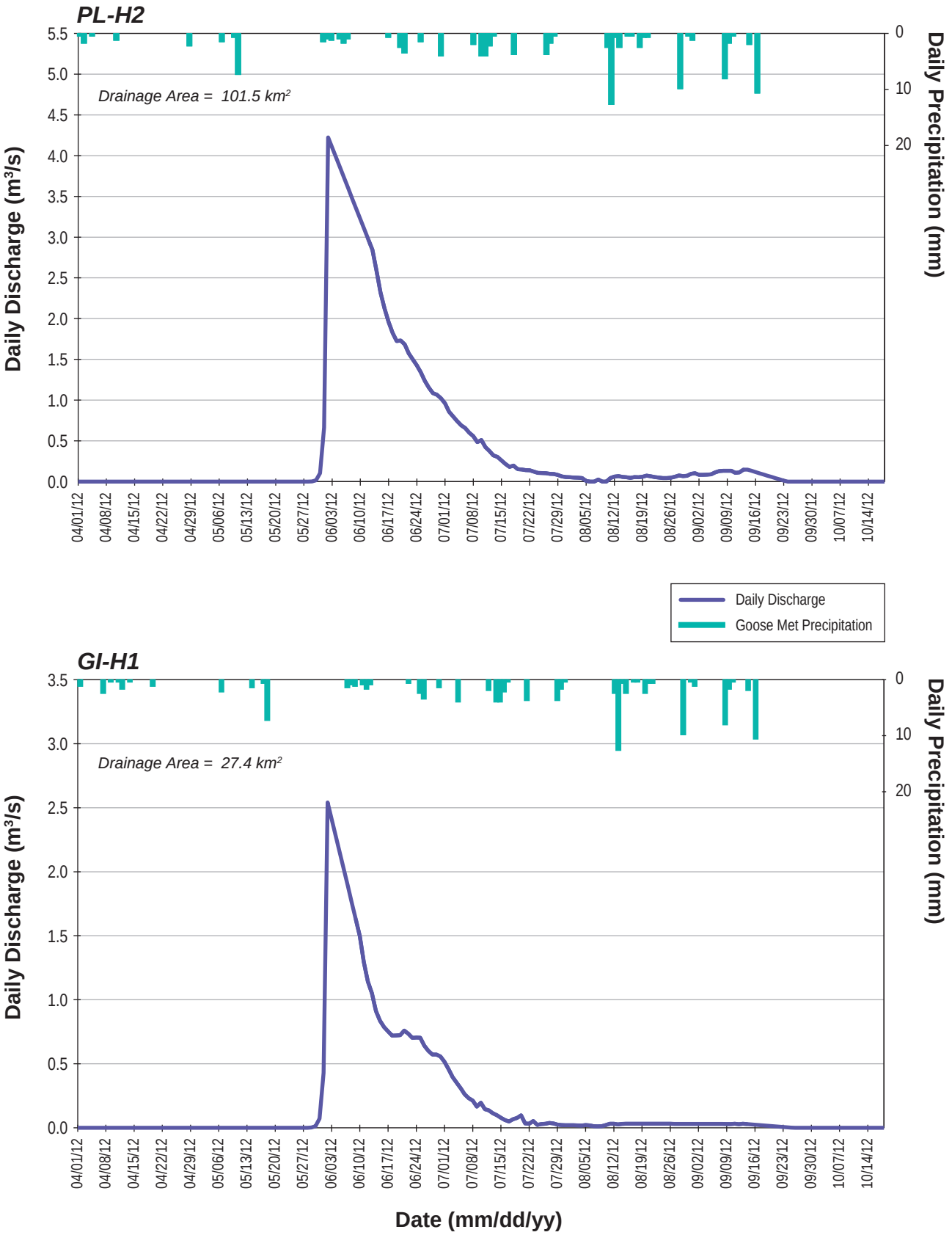

Annual Hydrograph at PL-H2 and GI-H1 Hydrometric Monitoring Stations, 2012

Figure 4.4-3

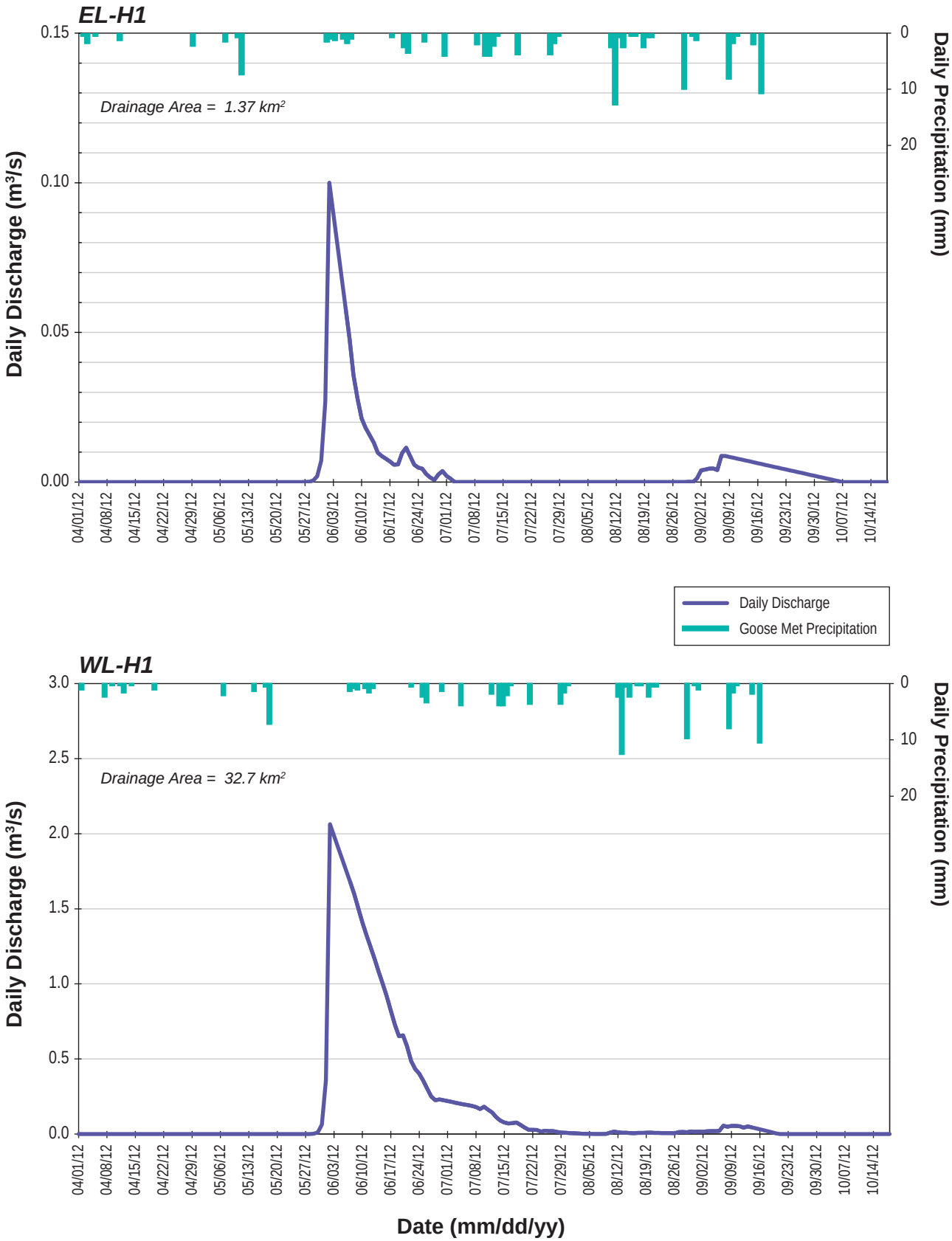

Figure 4.4-4

Annual Hydrograph at EL-H1 and WL-H1 Hydrometric Monitoring Stations, 2012

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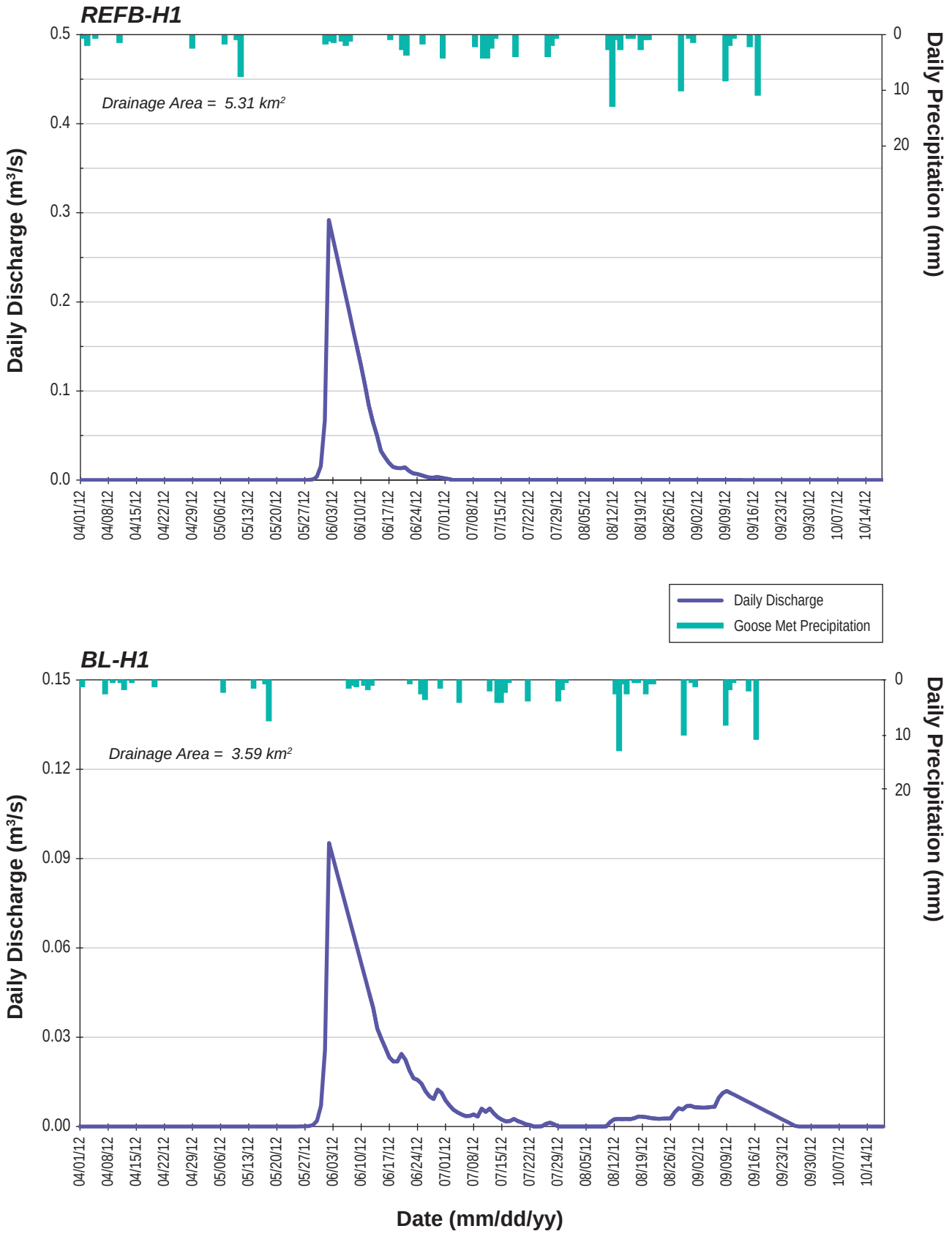

Figure 4.4-5

Annual Hydrograph at REFB-H1 and BL-H1 Hydrometric Monitoring Stations, 2012

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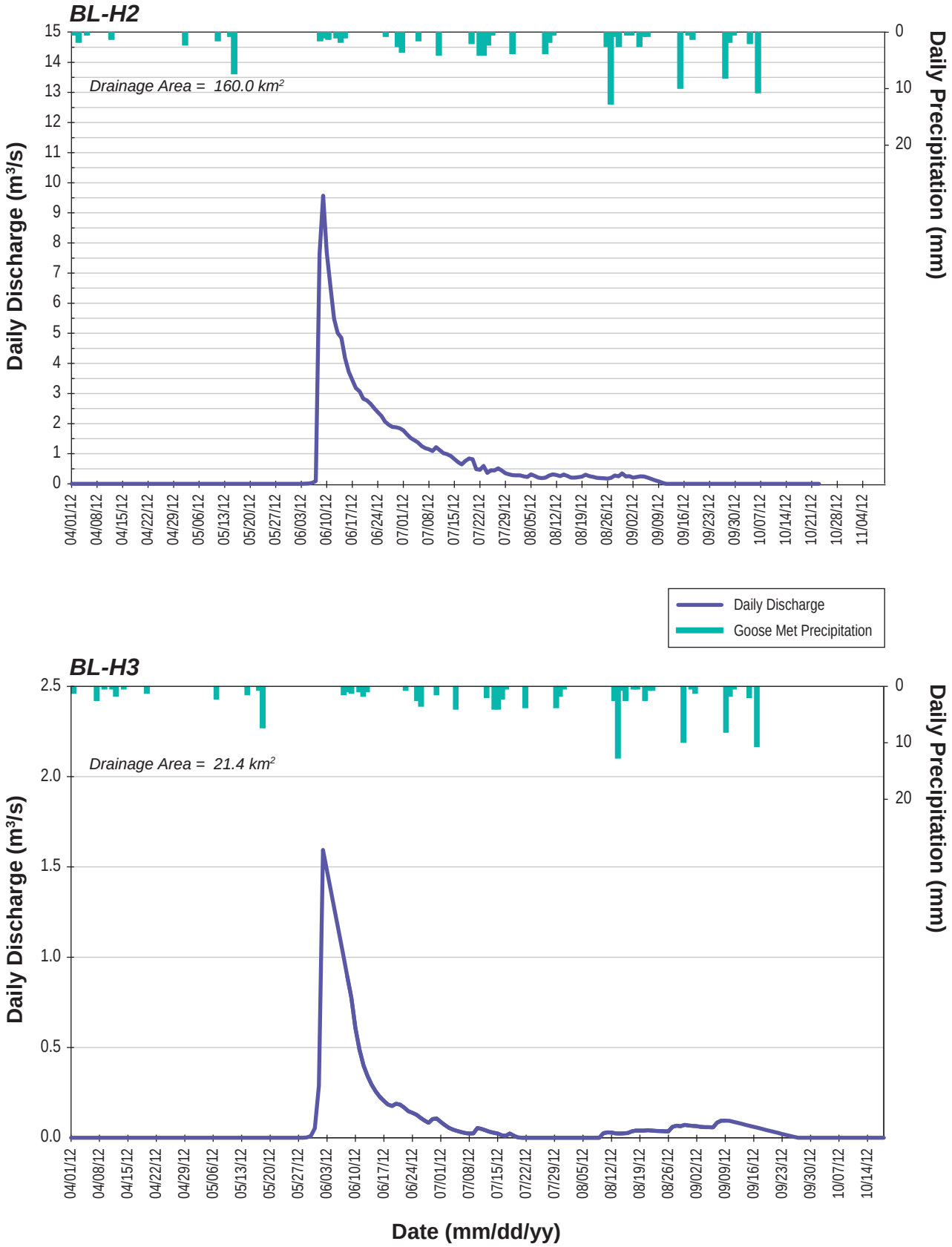

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Annual Hydrograph at BL-H2 and BL-H3 Hydrometric Monitoring Stations, 2012

Figure 4.4-6

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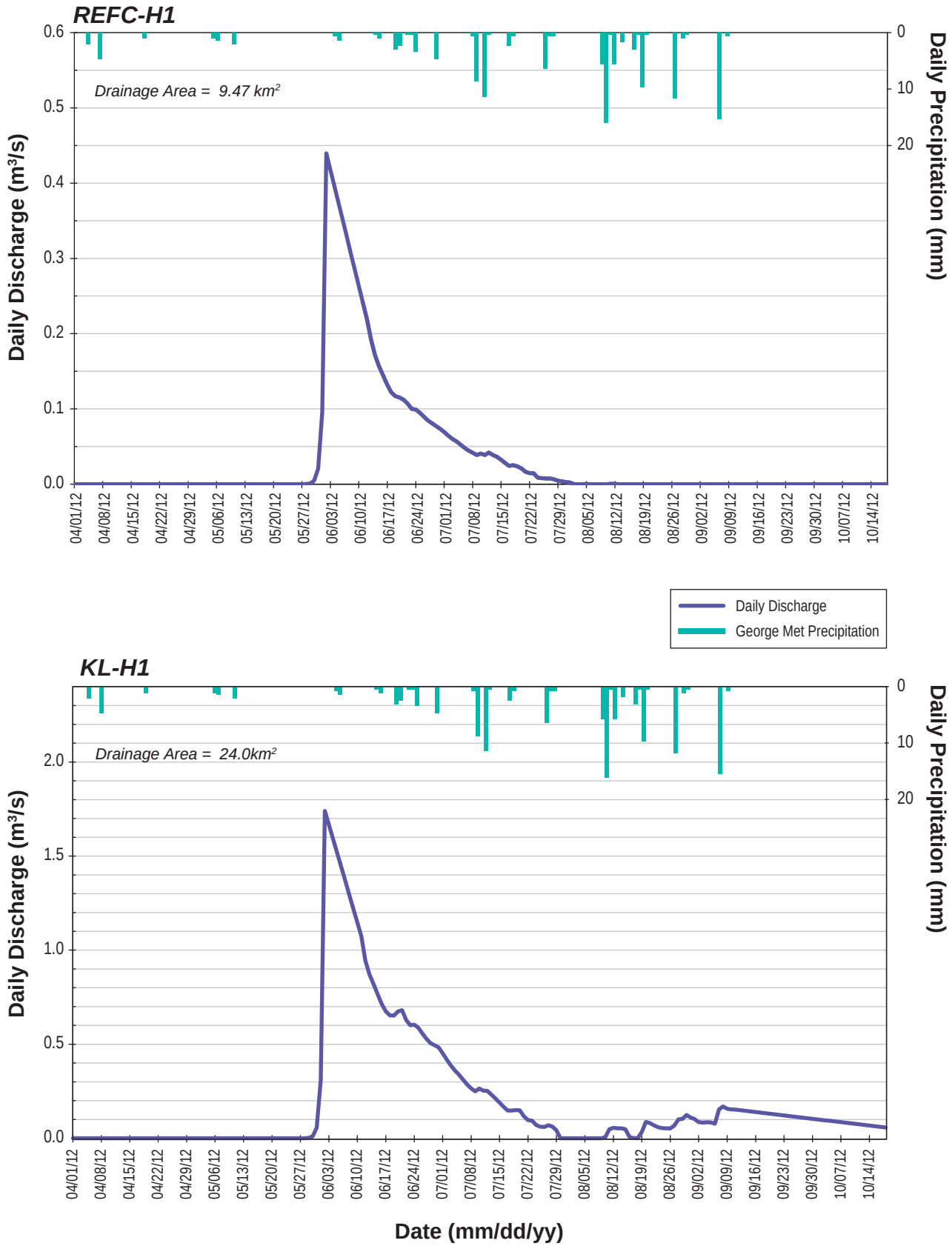

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Annual Hydrograph at REFC-H1 and KL-H1 Hydrometric Monitoring Stations, 2012

Figure 4.4-7

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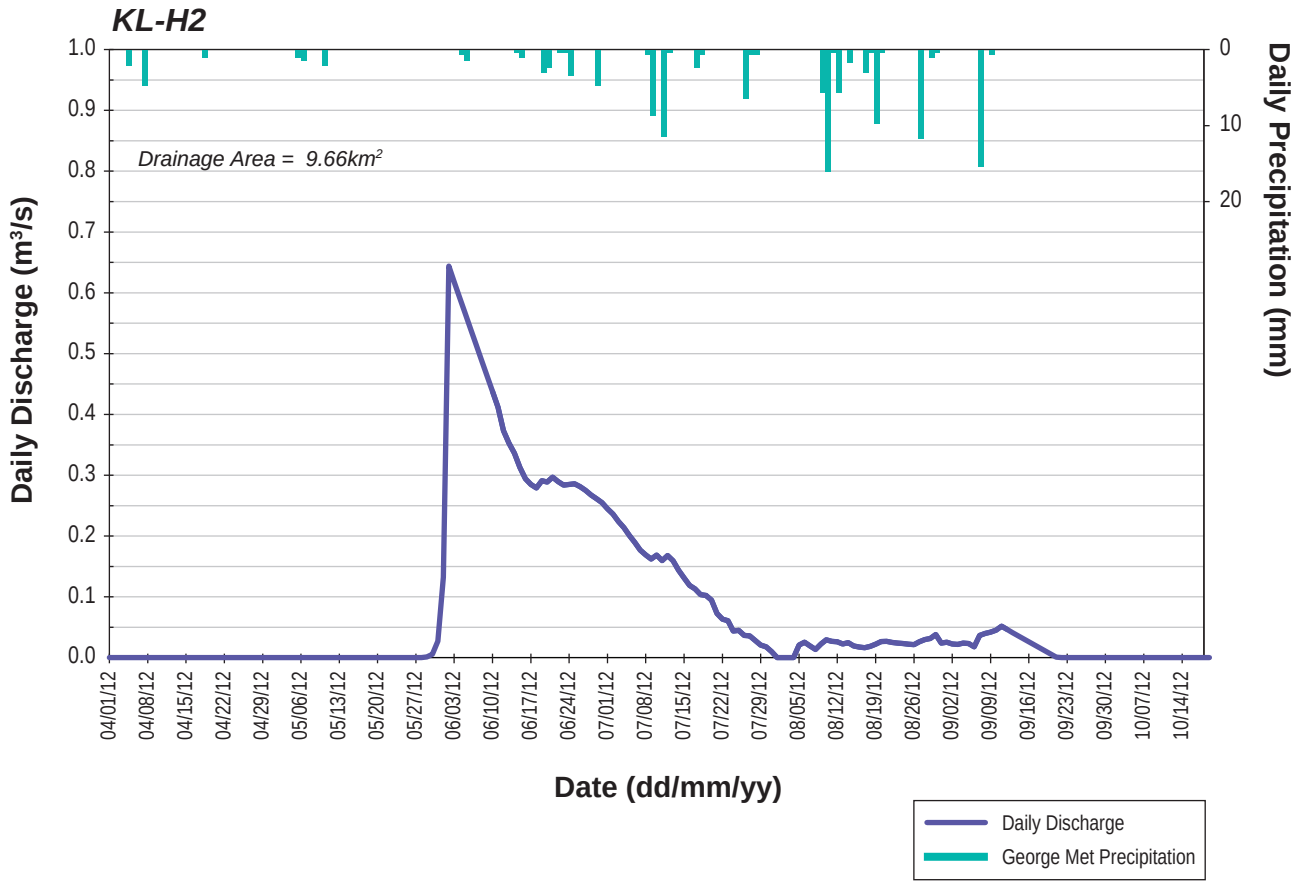

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Annual Hydrograph at KL-H2
Hydrometric Monitoring Stations, 2012

Figure 4.4-8

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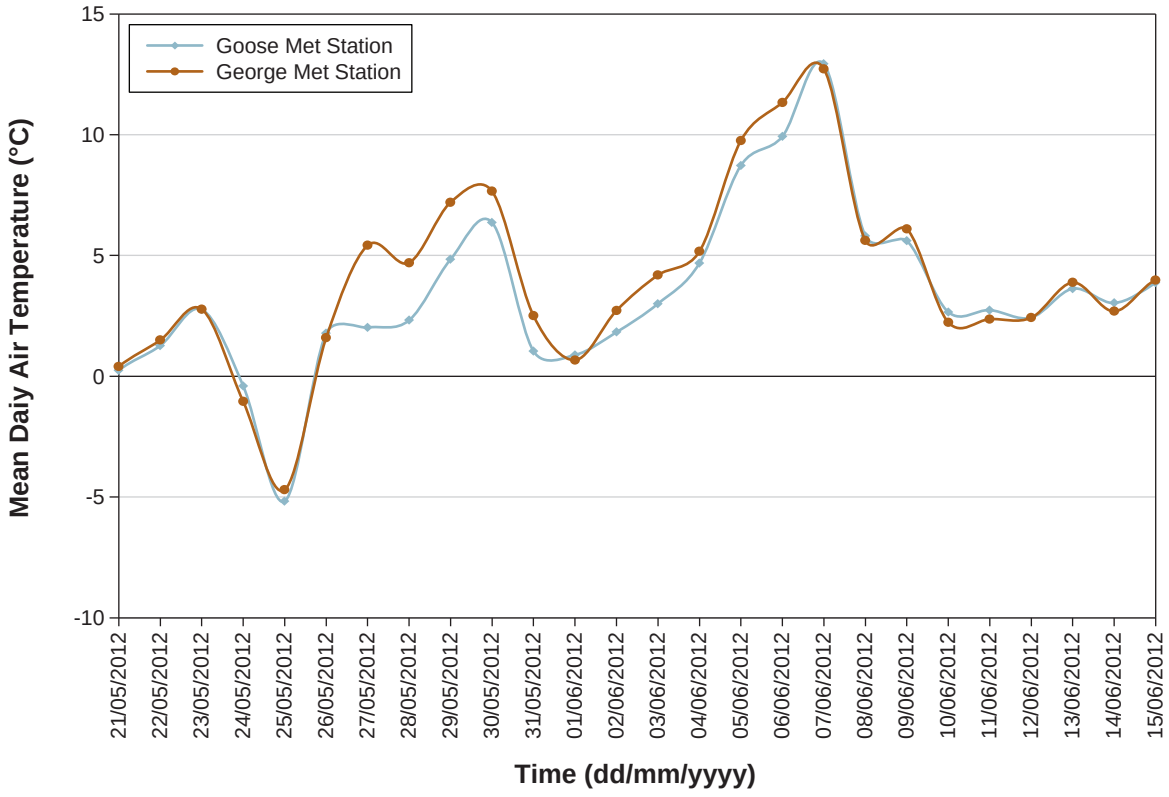

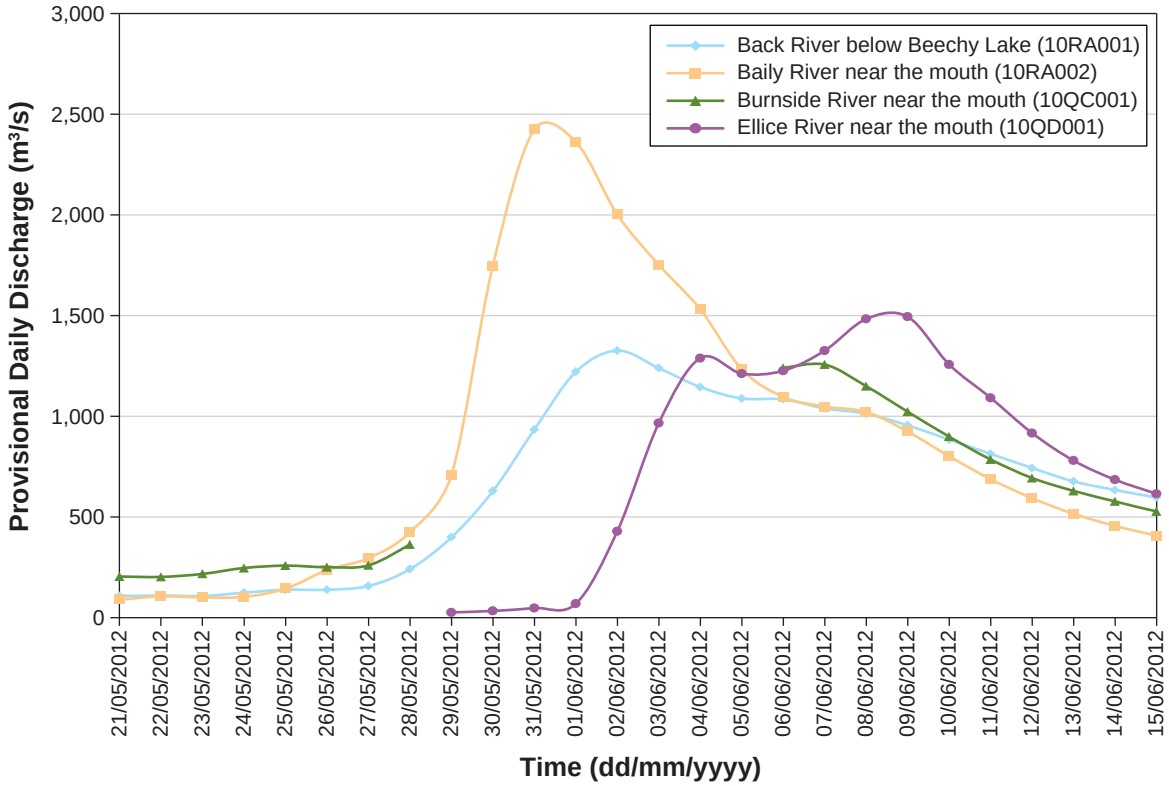

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Break-up Period Mean Daily Air Temperatures at Goose and George Meteorological Stations and Hydrographs of Related Water Survey of Canada Stations

Figure 4.4-9

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Table 4.4-1. 2012 Volumetric Water Yield in Millions of Cubic Meters (million m^3) for Hydrometric Stations in the Goose Property Area

Hydrometric Station	Jan-May	June	July	August	September	October	Nov-Dec	Total Annual
GL-H1	*0.01*	*1.31*	0.13	0.01	*0.00*	*0.00*	*0.00*	*1.45*
GL-H2	*0.00*	*0.31*	0.03	0.00	*0.00*	*0.00*	*0.00*	*0.34*
GL-H3	*0.00*	*0.36*	0.03	0.00	*0.00*	*0.00*	*0.00*	*0.39*
PL-H1	*0.00*	*23.10*	3.68	0.61	*0.00*	*0.00*	*0.00*	*27.39*
PL-H2	*0.00*	*6.09*	0.91	0.10	*0.20*	*0.00*	*0.00*	*7.31*
GI-H1	*0.00*	*2.96*	0.38	0.08	*0.05*	*0.00*	*0.00*	*3.48*
EL-H1	*0.00*	*0.06*	0.00	0.00	*0.01*	*0.00*	*0.00*	*0.08*
WL-H1	*0.01*	*2.52*	0.26	0.02	*0.06*	*0.00*	*0.00*	*2.87*
REFB-H1	*0.00*	*0.21*	0.00	0.00	*0.00*	*0.00*	*0.00*	*0.21*
BL-H1	*0.00*	*0.10*	0.01	0.01	*0.01*	*0.00*	*0.00*	*0.13*
BL-H2	*0.00*	*7.68*	2.40	0.64	*0.16*	*0.00*	*0.00*	*10.88*
BL-H3	*0.01*	*1.24*	0.06	0.08	*0.13*	*0.00*	*0.00*	*1.52*

Note: Estimated values are italicized

Table 4.4-2. 2012 Volumetric Water Yield in Millions of Cubic Meters (million m^3) for Hydrometric Stations in the George Property Area

Hydrometric Station	Jan-May	June	July	August	September	October	Nov-Dec	Total Annual
REFC-H1	*0.00*	*0.50*	0.08	0.00	*0.00*	*0.00*	*0.00*	*0.58*
KL-H1	*0.00*	*2.33*	0.50	0.12	*0.31*	*0.17*	*0.00*	*3.43*
KL-H2	*0.00*	*0.95*	0.32	0.06	*0.05*	*0.00*	*0.00*	*1.38*

Note: Estimated values are italicized

4.5 FLOW DURATION ANALYSIS

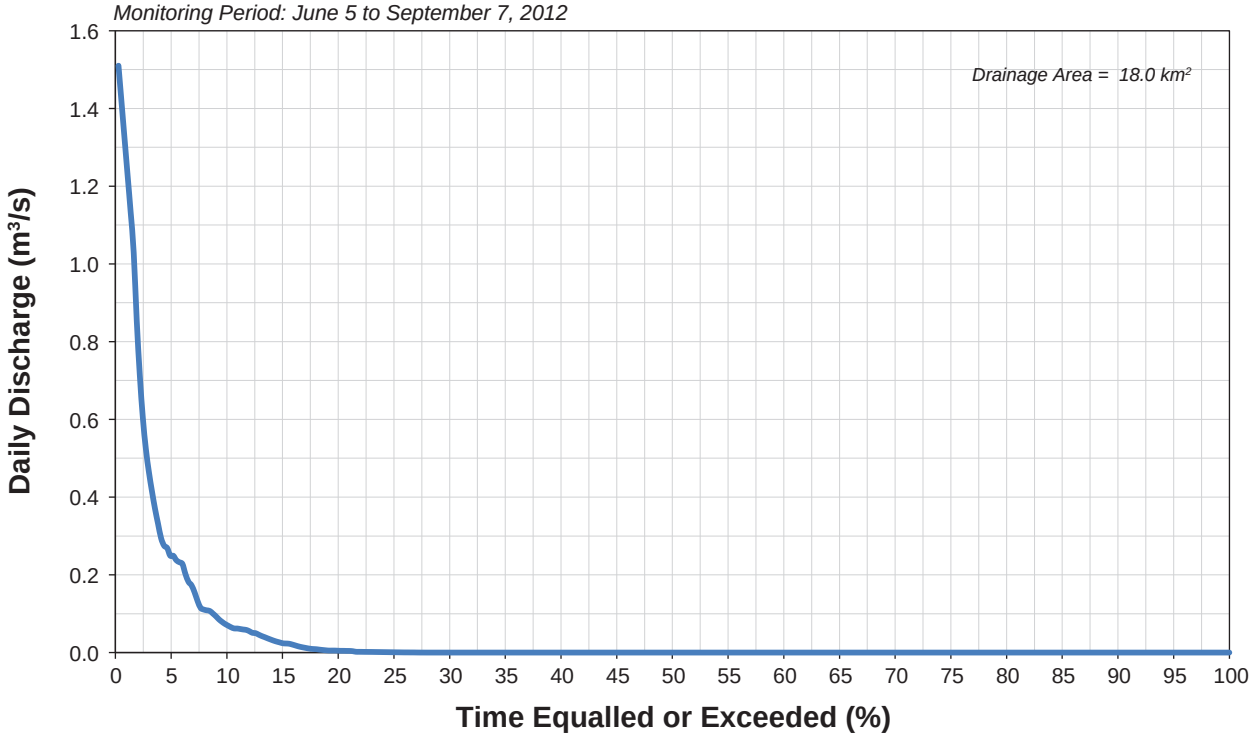
Annual flow duration curves (FDC) were produced for each of the monitored streams in 2012 (Figures 4.5-1 through 4.5-8). The trends in the FDC clearly demonstrate the seasonality of these small Arctic streams. A range of exceedance values and a percentage of time in the open water season during which streams were flowing are presented in Table 4.5-1 and 4.5-2. In the Goose Property area, the flow duration analysis reveals that on average there was streamflow during 27% of the year with a maximum of 33% observed at GI-H1 and a minimum of 10% at REFB-H1. In the Goose Property area, on average 31% of the year there was flow in streams, with a maximum of 42% observed at KL-H1 and a minimum of 20% at REFC-H1, which are longer than the stations in the Goose Property area.

The shape of the FDC describes the runoff response of each drainage basin to precipitation or snow melt events. The smaller (e.g., EL-H1) basins typically produced a steeper FDC as they responded quicker to hydrological inputs. Conversely, larger drainage basins showed a flatter FDC. This reflects a more attenuated response as water was routed through the system (e.g., station PL-H1).

The streamflow duration in 2012 was much shorter than in 2011 though the freshet in 2012 occurred earlier than in 2011. At the nine stations that were operated in 2011, the average of streamflow duration in 2012 was 26% of the year compared to 30% of the year in 2011.

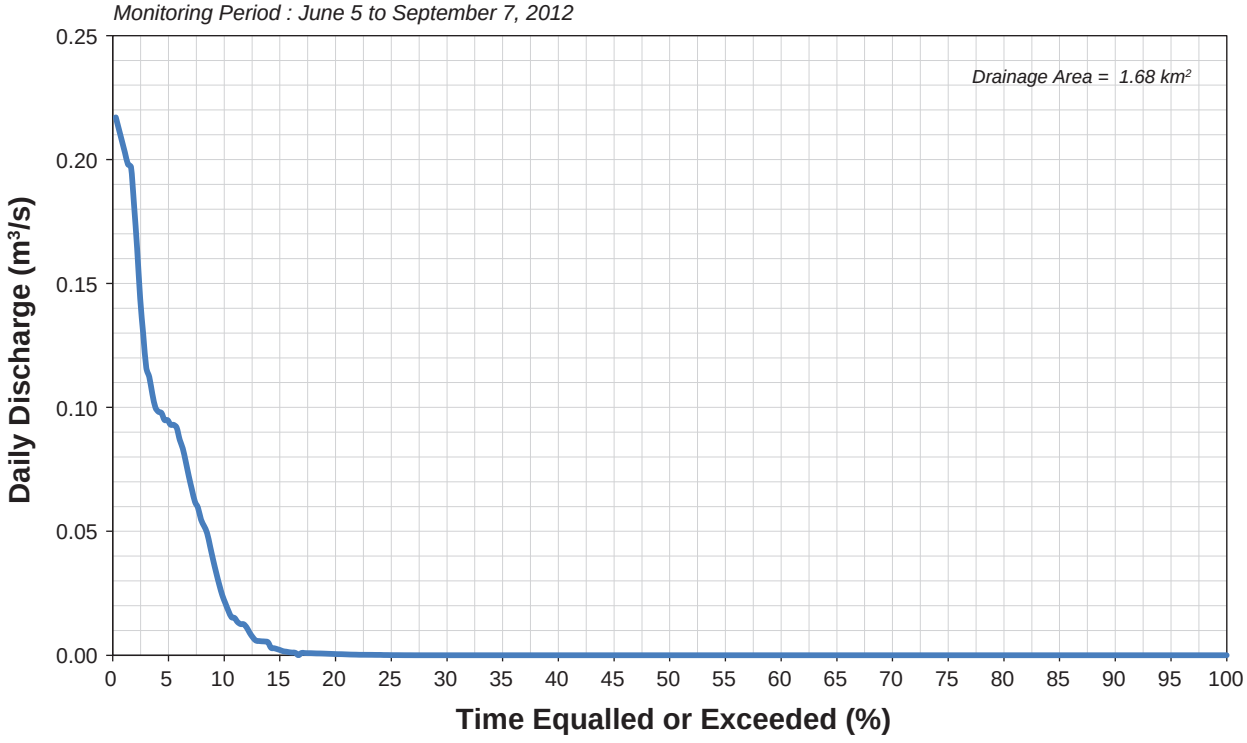
Station GL-H1

Monitoring Period: June 5 to September 7, 2012



Station GL-H2

Monitoring Period : June 5 to September 7, 2012



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2012 Flow Duration Curves for Hydrometric Monitoring Stations GL-H1 and GL-H2

Figure 4.5-1

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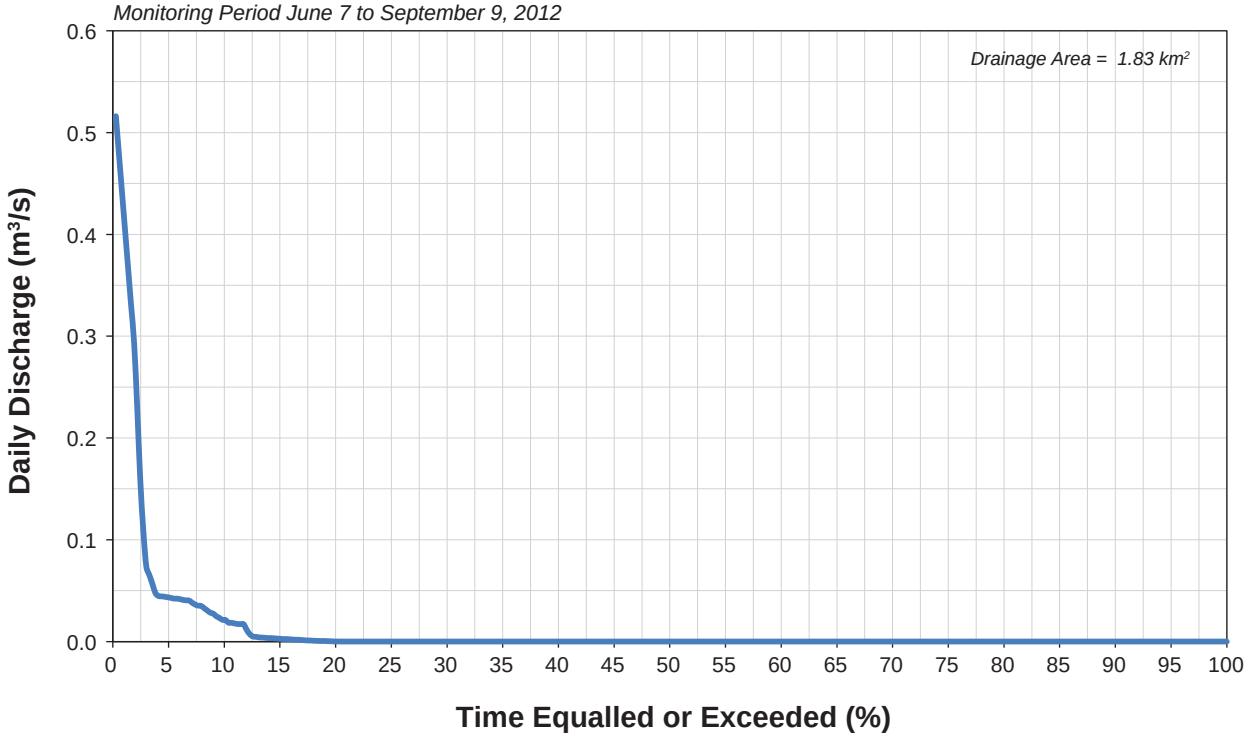
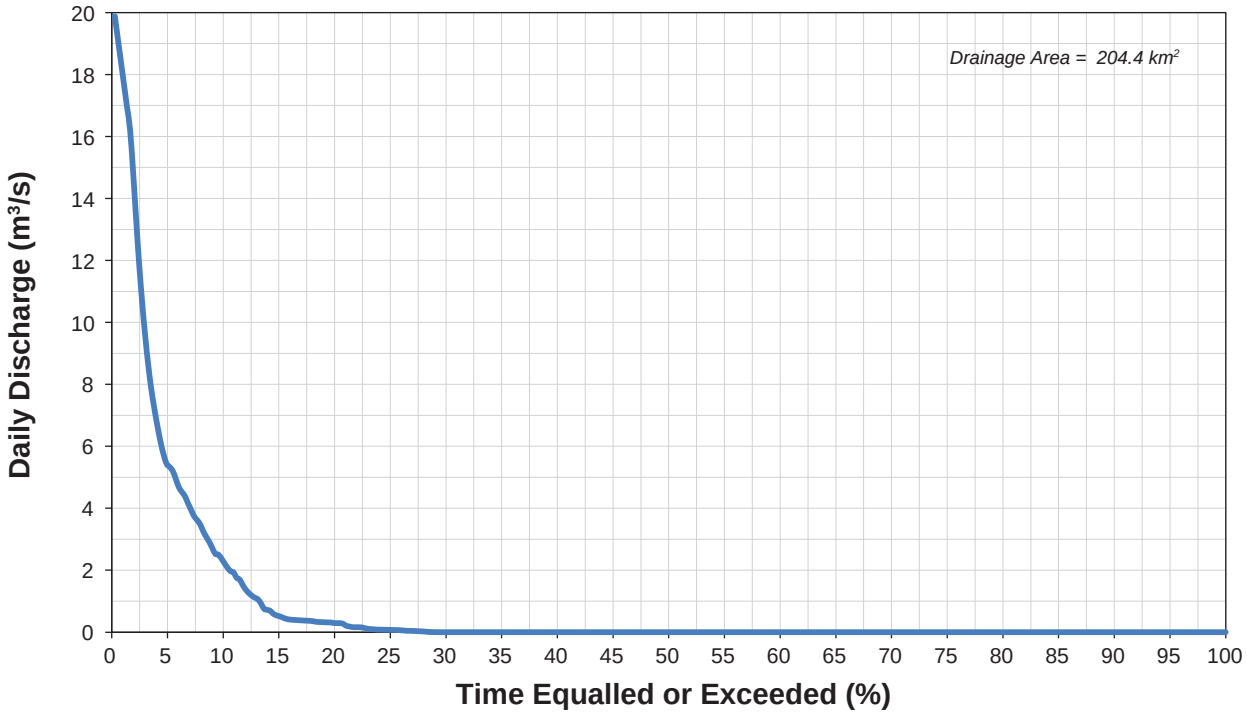
Station GL-H3

Monitoring Period June 7 to September 9, 2012



Station PL-H1

Monitoring Period June 6 to September 8, 2012



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2012 Flow Duration Curves for Hydrometric Monitoring Stations GL-H3 and PL-H1

Figure 4.5-2

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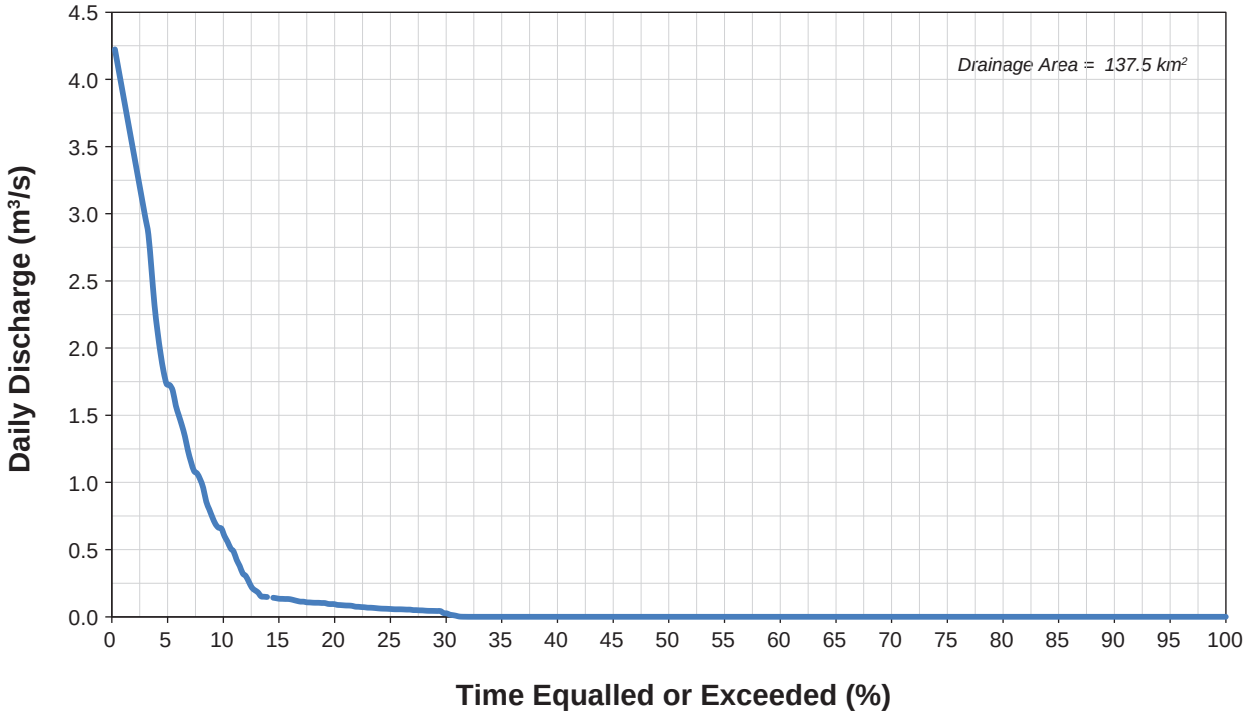
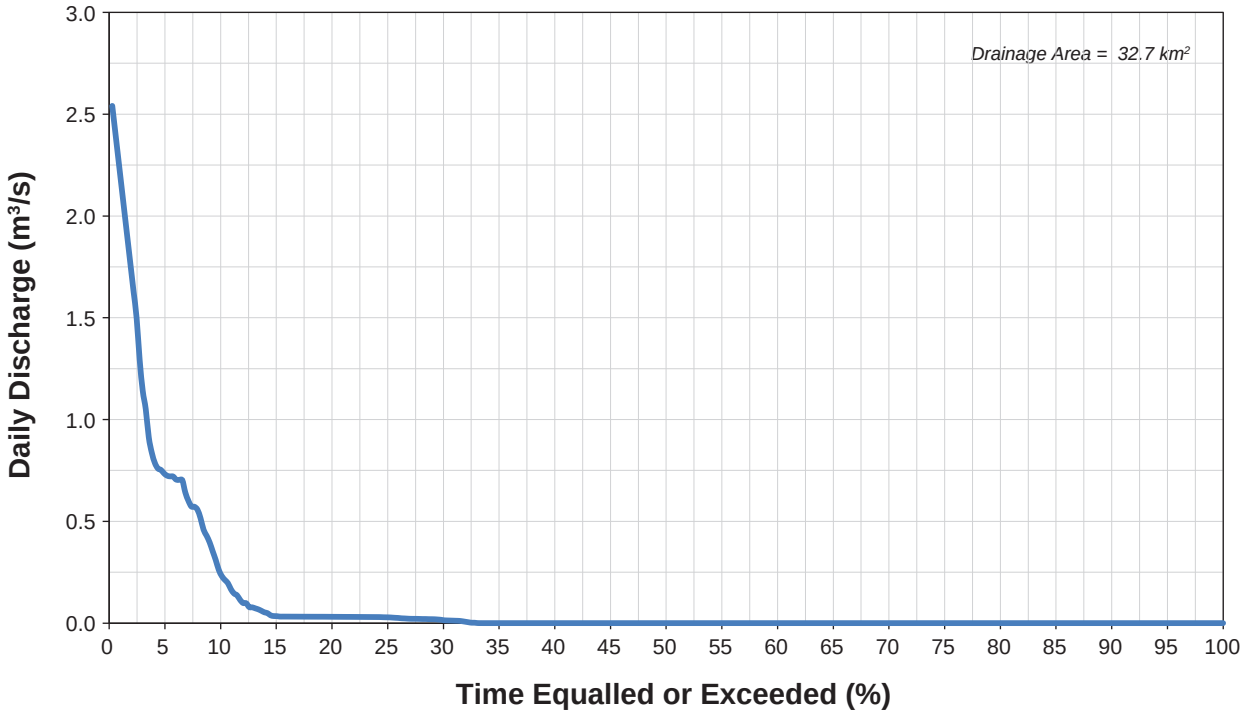
Station PL-H2



Station GI-H1

Monitoring Period: June 9 to September 14, 2012



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2012 Flow Duration Curves for Hydrometric Monitoring Stations PL-H2 and GI-H1

Figure 4.5-3

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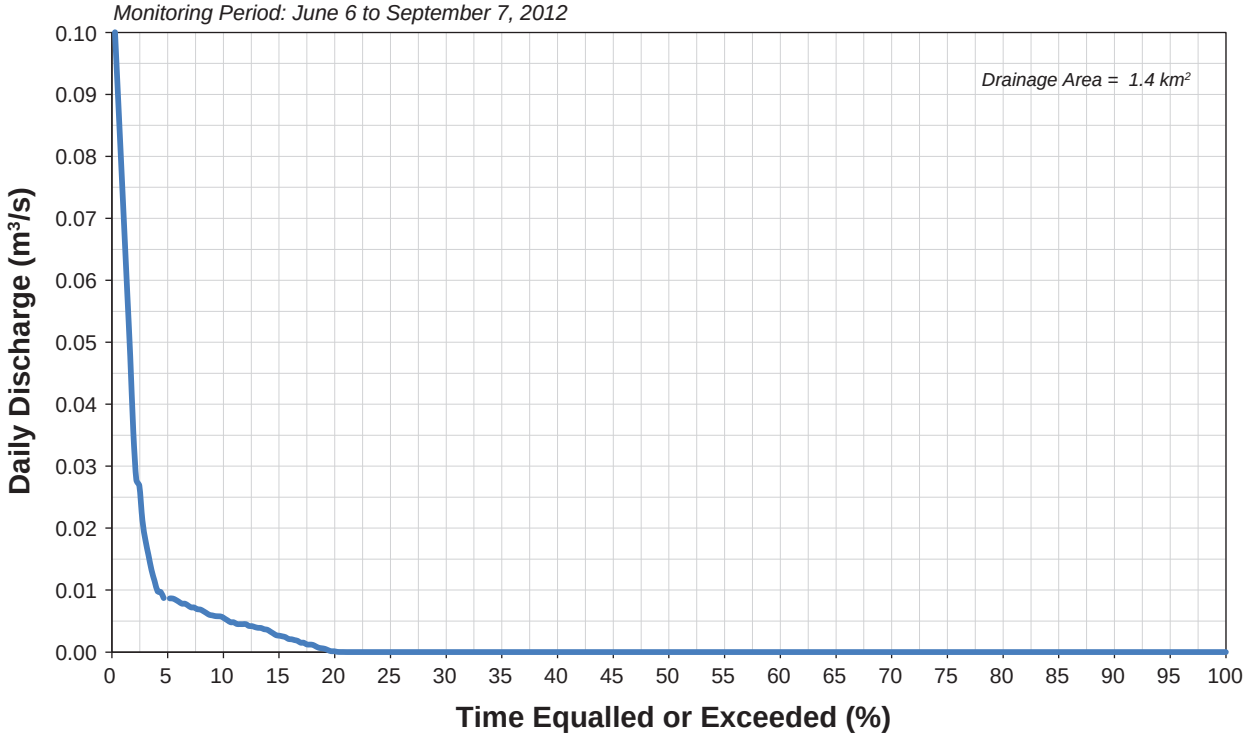
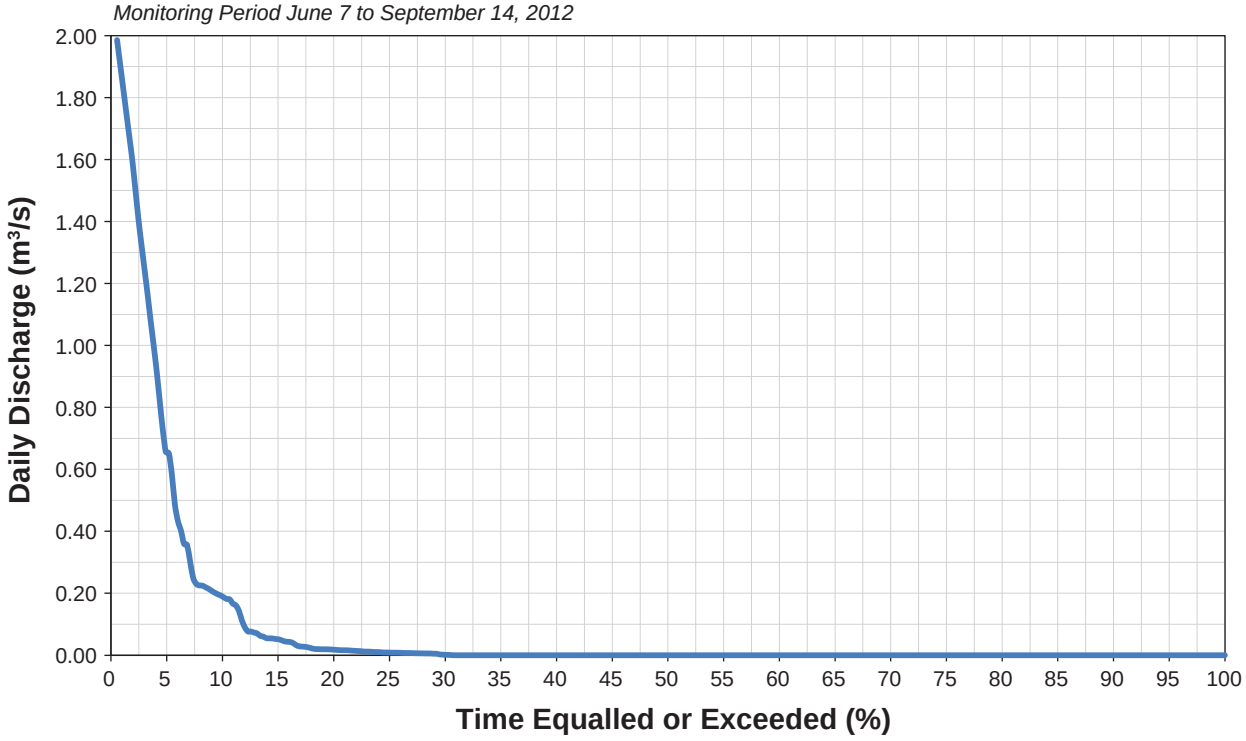
Station EL-H1

Monitoring Period: June 6 to September 7, 2012



Station WL-H1

Monitoring Period June 7 to September 14, 2012



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2012 Flow Duration Curves for Hydrometric Monitoring Stations EL-H1 and WL-H1

Figure 4.5-4

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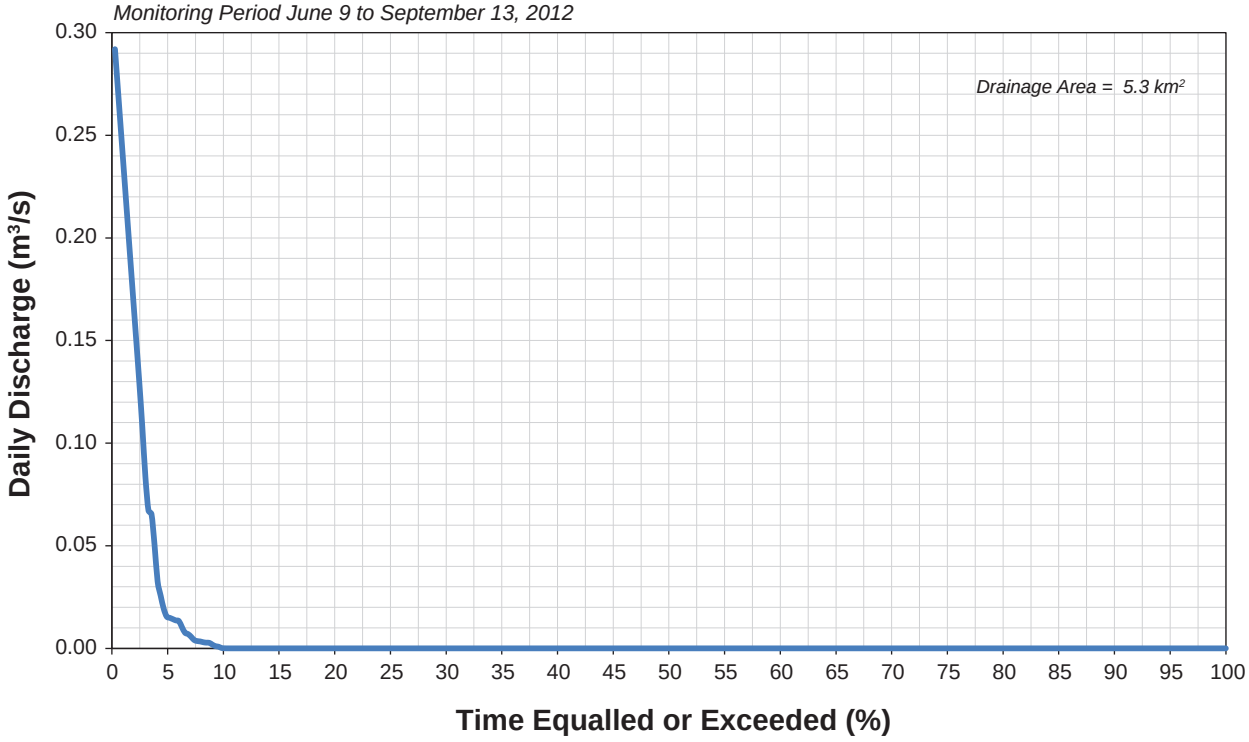
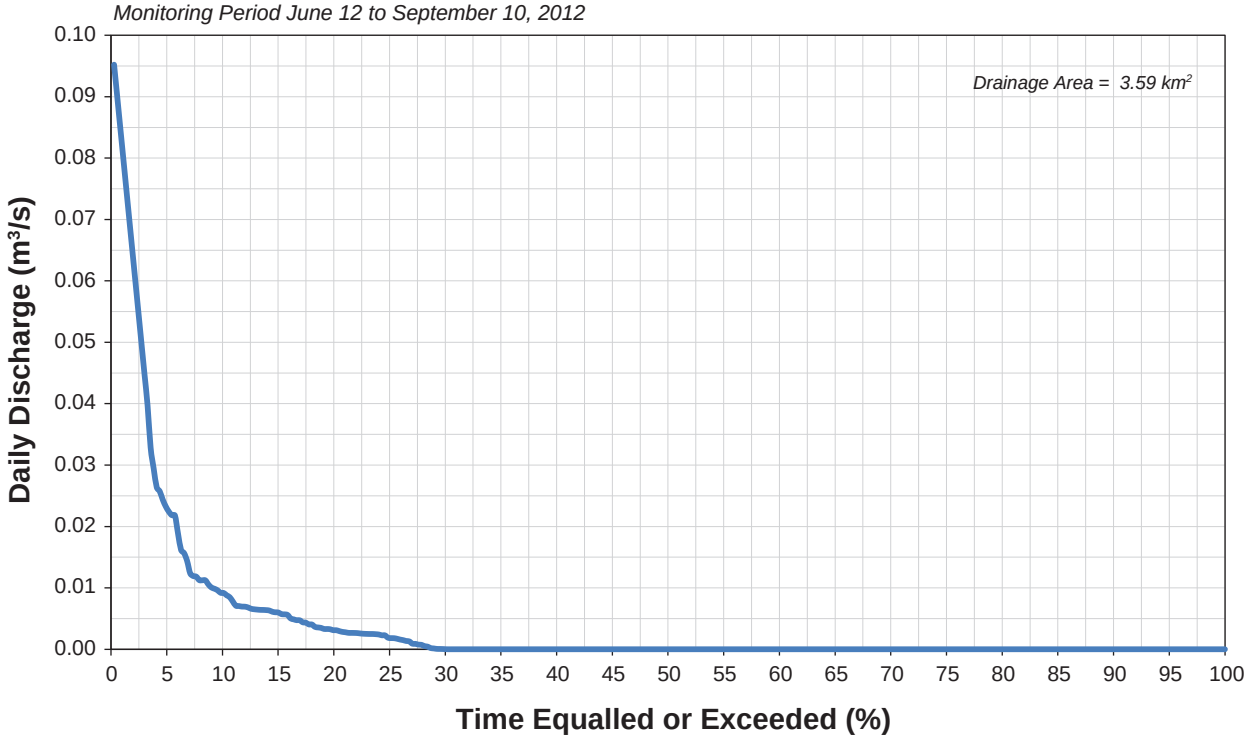
Station REFB-H1

Monitoring Period June 9 to September 13, 2012



Station BL-H1

Monitoring Period June 12 to September 10, 2012



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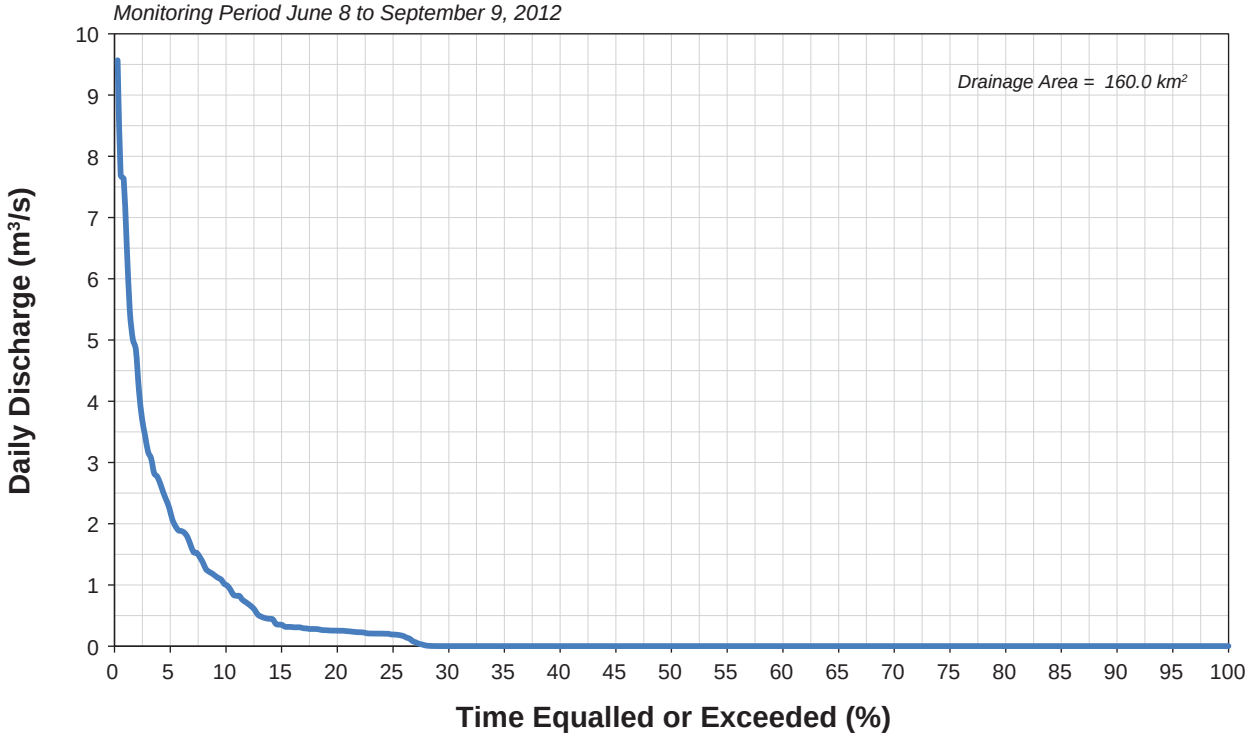
2012 Flow Duration Curves for Hydrometric Monitoring Stations REFB-H1 and BL-H1

Figure 4.5-5

Rescan™ Engineers & Scientists

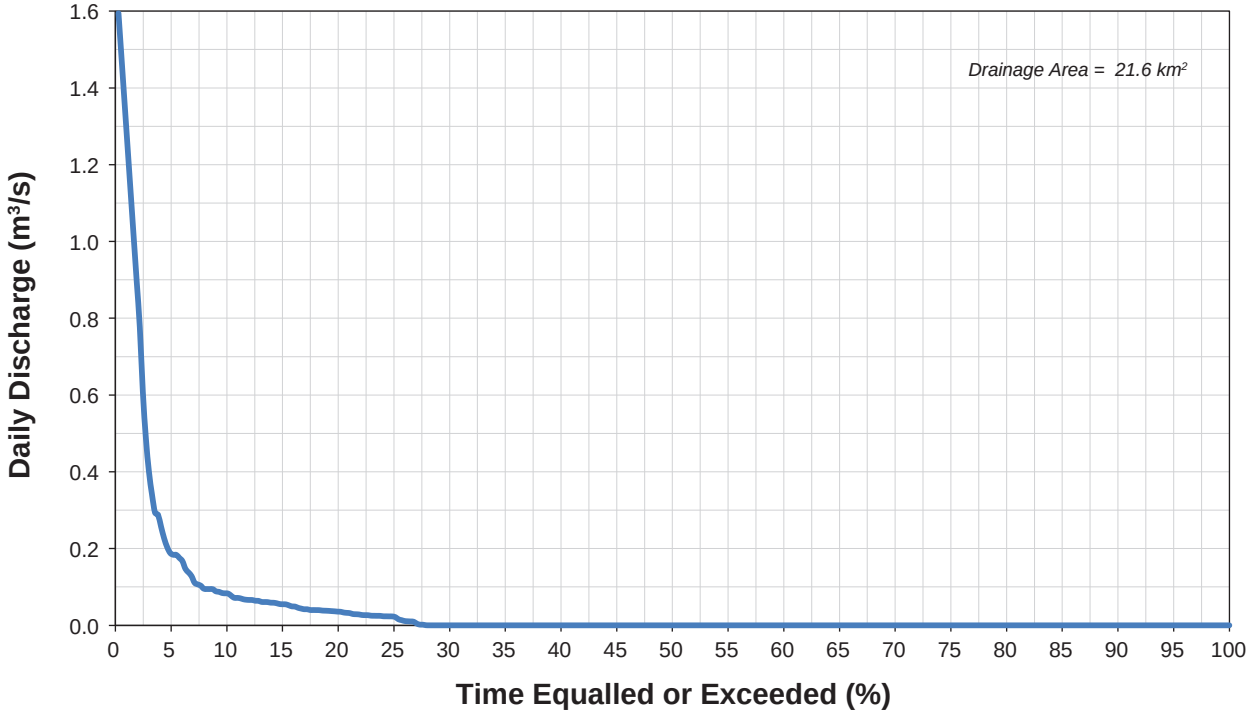
Station BL-H2

Monitoring Period June 8 to September 9, 2012



Station BL-H3

Monitoring Period June 8 to September 9, 2012



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2012 Flow Duration Curves for Hydrometric Monitoring Stations BL-H2 and BL-H3

Figure 4.5-6

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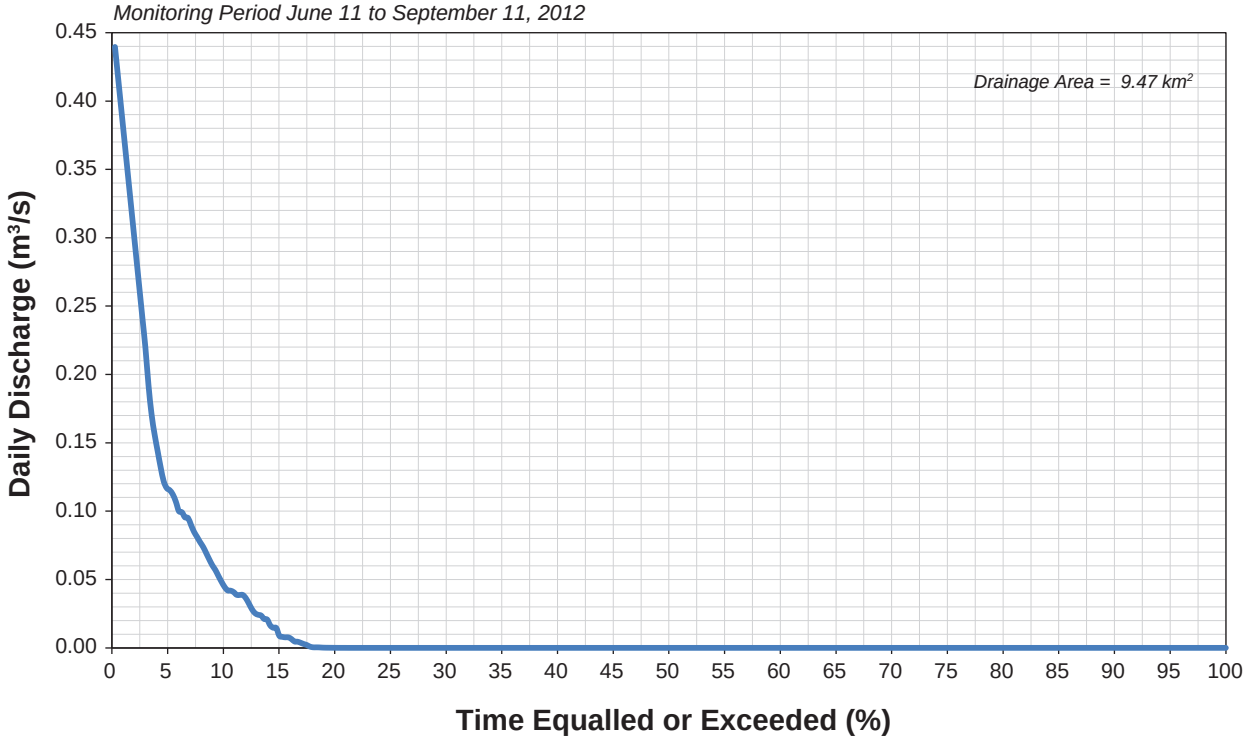
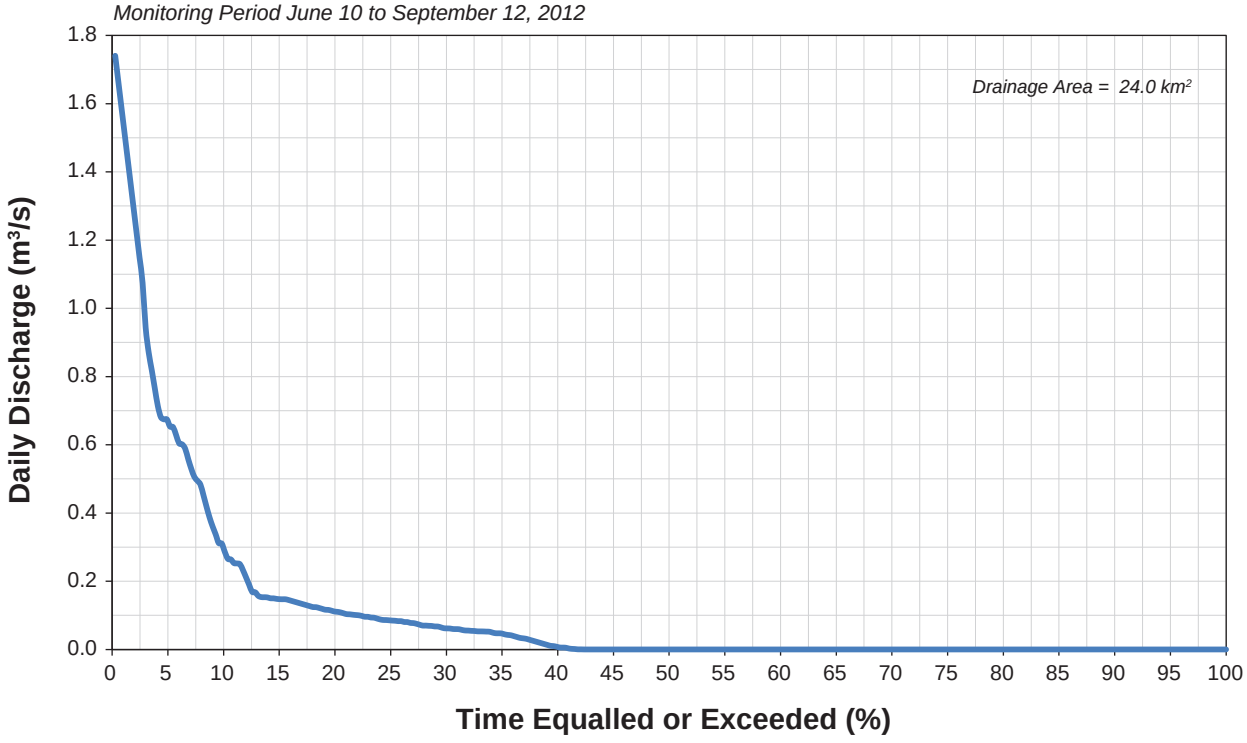
Station REFC-H1

Monitoring Period June 11 to September 11, 2012



Station KL-H1

Monitoring Period June 10 to September 12, 2012



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2012 Flow Duration Curves for Hydrometric Monitoring Stations REFC-H1 and KL-H1

Figure 4.5-7

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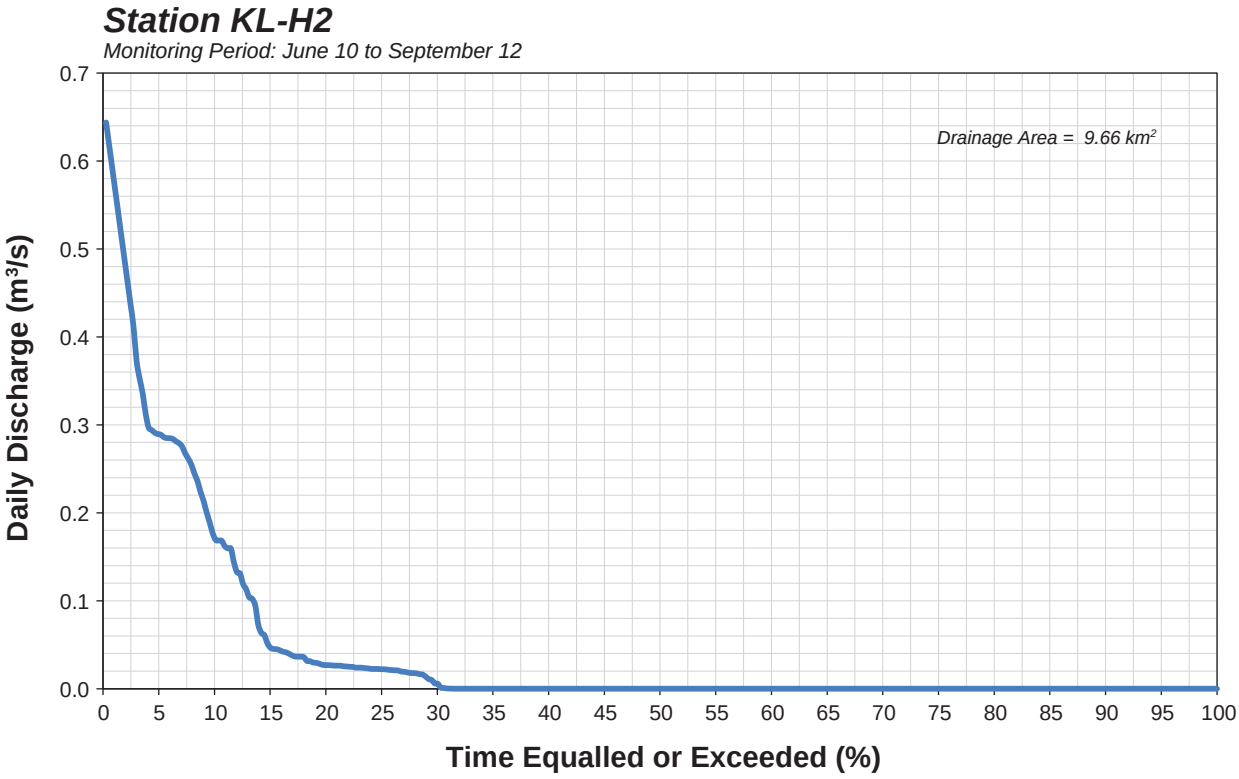

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2012 Flow Duration Curve for Hydrometric Monitoring Station KL-H2

Figure 4.5-8

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Table 4.5-1. Flow Duration Analysis Exceedance Values and Annual Flow Duration for Stations Located in the Goose Property Area

Hydrometric Station	Drainage Area (km^2)	Flow Equalled or Exceeded 5% of the Time (m^3/s)	Flow Equalled or Exceeded 10% of the Time (m^3/s)	Flow Equalled or Exceeded 20% of the Time (m^3/s)	Time of Year with Flow (%)
GL-H1	18.0	0.249	0.072	0.004	28
GL-H2	1.7	0.094	0.023	0.00048	27
GL-H3	1.8	0.043	0.021	0.00001	20
PL-H1	204.4	5.400	2.300	0.295	30
PL-H2	101.5	1.730	0.628	0.094	32
GI-H1	27.4	0.735	0.245	0.031	33
EL-H1	1.4	0.009	0.006	0.001	21
WL-H1	32.7	0.655	0.191	0.018	31
REFB-H1	5.3	0.015	0.0002	0	10
BL-H1	3.59	0.023	0.009	0.003	30
BL-H2	160.0	2.232	0.988	0.251	30
BL-H3	21.4	0.187	0.083	0.035	28

Table 4.5-2. Flow Duration Analysis Exceedance Values and Annual Flow Duration for Stations Located in the George Property Area

Hydrometric Station	Drainage Area (km^2)	Flow Equalled or Exceeded 5% of the Time (m^3/s)	Flow Equalled or Exceeded 10% of the Time (m^3/s)	Flow Equalled or Exceeded 20% of the Time (m^3/s)	Time of Year with Flow (%)
REFC-H1	9.47	0.116	0.046	0	20
KL-H1	24.0	0.674	0.300	0.111	42
KL-H2	9.66	0.289	0.176	0.027	32

4.6 HYDROLOGIC INDICIES

4.6.1 Annual Runoff

For the gauged drainages in the Goose Property area, the estimated 2012 average annual runoff was 99 mm, ranging from 36 mm at BL-H1 to 219 mm at GL-H3. The observed runoff ranged from 16 mm to 166 mm with an average of 64 mm (Table 4.6-1).The estimated annual runoff was significantly higher than the observed runoff at all the stations because most likely the largest peak flows were not recorded.

For the gauged drainages in the George Property area, the estimated 2012 average annual runoff was 116 mm, ranging from 61 mm at REFC-H1 to 143 mm at KL-H1 and KL-H2. The observed runoff ranged from 32 mm to 100 mm with an average of 72 mm (Table 4.6-2). The George Property has higher annual runoff than the Goose Property.

The low runoff at REFB-H1 is likely related to the percent of lake coverage in the basin (19.1%), which acts as a storage reservoir. The relative large storage in the watershed coupled to the low relief topography limit drainage and promotes local ponding of runoff. The potential for hydrological losses through evaporation from this drainage basin is great due to the inputs (snowmelt or rainfall) slowly moving through the system and collecting in lakes or other depressions of the flat topography.

Table 4.6-1. 2012 Annual Runoff and Mean Annual Discharge in the Goose Property Area

Hydrometric Station	Drainage Area (km^2)	Observed Runoff (mm)	Period of Record (observed)	Estimated Annual Runoff (mm)	MAD (m^3/s)		% Lake Coverage
					Open Water	Total	
GL-H1	18.0	59	June 5 to September 7	*81*	*0.859*	*0.046*	10.6
GL-H2	1.7	166	June 5 to September 7	*202*	*1.672*	*0.011*	23.1
GL-H3	1.8	105	June 7 to September 9	*219*	*1.815*	*0.013*	7.5
PL-H1	204.4	101	June 6 to September 8	*134*	*1.112*	*0.868*	18.9
PL-H2	101.5	40	June 12 to September 13	*72*	*0.598*	*0.232*	15.1
GI-H1	27.4	76	June 9 to September 14	*126*	*1.043*	*0.109*	13.3
EL-H1	1.4	23	June 7 to September 7	*54*	*0.443*	*0.002*	2.2
WL-H1	32.7	61	June 7 to September 14	*88*	*0.677*	*0.091*	16.6
REFB-H1	5.3	13	June 9 to September 13	*40*	*0.333*	*0.007*	19.1
BL-H1	3.59	16	June 12 to September 10	*36*	*0.249*	*0.004*	2.5
BL-H2	160.0	68	June 8 to September 6	*68*	*0.574*	*0.352*	18.9
BL-H3	21.4	35	June 8 to September 9	*71*	*0.581*	*0.048*	4.7

Note: Estimated values are italicized

Table 4.6-2. 2012 Annual Runoff and Mean Annual Discharge in the George Property Area

Hydrometric Station	Drainage Area (km^2)	Observed Runoff (mm)	Period of Record (observed)	Estimated Annual Runoff (mm)	MAD (m^3/s)		% Lake Coverage
					Open Water	Total	
REFC-H1	9.47	32	June 11 to September 11	*62*	*0.509*	*0.018*	17.0
KL-H1	24.0	84	June 10 to September 12	*143*	*1.124*	*0.109*	19.7
KL-H2	9.66	100	June 10 to September12	*143*	*1.159*	*0.044*	24.6

Note: Estimated values are italicized

The highest runoff values observed at GL-H3 may be a result of the observed snow depths (90 mm) and snow water equivalence (35.3 mm) at this site (see Section 4.7). In the Goose Property area, the average snow depth was 57 cm and the average snow water equivalence was 20.8 cm.

On average, the annual runoff in 2012 was lower than in 2011. At the nine stations that were operated in 2011, the average of the annual runoff was 113 mm in 2012, compared to 170 mm in 2011.

4.6.2 Mean Annual Discharge

Mean annual discharge (MAD) was calculated as an average of the daily discharges for the open water period from the beginning of June through September and for the total year (January to December). For the gauged drainages in the Goose Property area, MAD during the open water season was the lowest at BL-H1 (0.249 m^3/s) and the highest at GL-H3 (1.815 m^3/s), with an average of 0.830 m^3/s (Table 4.6-1). For the gauged drainages in the George Property area, MAD during the open water season was the lowest at REFC-H1 (0.509 m^3/s) and the highest at KL-H2 (1.159 m^3/s), with an average of 0.931 m^3/s (Table 4.6-2).

MAD calculated for the entire year was much lower due to the large portion of the year with zero flow conditions. In the Goose Property area, on average MAD for the full year was 0.148 m^3/s with a minimum of 0.002 m^3/s at EL-H1 and a maximum of 0.868 m^3/s at PL-H1 (Table 4.6-1). In the George

Property area, on average MAD for the full year was 0.148 m^3/s with a minimum of 0.018 m^3/s at REFC-H1 and a maximum of 0.109 m^3/s at KL-H1 (Table 4.6-2).

4.6.3 Seasonal Runoff Distribution

The seasonal runoff distribution was similar for all the gauged drainages in the Project area. In all drainages the maximum monthly runoff occurred in June. Within the Goose Property area, on average over 85% of annual runoff occurred in June, 9% in July, 6% in August and September, and negligible amounts through the remainder of the year (Table 4.6-3, Figure 4.6-1). Within the George Property area, on average over approximately 75% of annual runoff occurred in June, 17% in July, 7% in August and September, and negligible amounts through the remainder of the year (Table 4.6-4 and Figure 4.6-2).

Table 4.6-3. 2012 Monthly Runoff Distribution in the Goose Property Area

Hydrometric Station	Jan-May		June		July		August		September		October		Nov-Dec	
	(mm)	(%)*	(mm)	(%)	(mm)	(%)	(mm)	(%)	(mm)	(%)	(mm)	(%)	(mm)	(%)
GL-H1	0	0	*73*	*90*	8	9	0	0	*0*	*0*	*0*	*0*	*0*	*0*
GL-H2	1	0	*181*	*90*	19	9	0	0	*1*	*0*	*0*	*0*	*0*	*0*
GL-H3	1	0	*202*	*92*	14	6	0	0	*2*	*1*	*0*	*0*	*0*	*0*
PL-H1	0	0	*113*	*84*	18	13	3	2	*0*	*0*	*0*	*0*	*0*	*0*
PL-H2	0	0	*60*	*83*	9	13	1	1	*2*	*3*	*0*	*0*	*0*	*0*
GI-H1	0	0	*108*	*86*	14	11	3	2	*2*	*2*	*0*	*0*	*0*	*0*
EL-H1	1	2	*43*	*80*	0	0	0	0	*10*	*19*	*0*	*0*	*0*	*0*
WL-H1	0	0	*77*	*88*	8	9	1	1	*2*	*2*	*0*	*0*	*0*	*0*
REFB-H1	0	0	*40*	*100*	0	0	0	0	*0*	*0*	*0*	*0*	*0*	*0*
BL-H1	0	1	*28*	*78*	2	6	2	5	*4*	*11*	*0*	*0*	*0*	*0*
BL-H2	0	0	*48*	*71*	15	22	4	6	*1*	*1*	*0*	*0*	*0*	*0*
BL-H3	0	0	*58*	*82*	3	4	4	5	*6*	*8*	*0*	*0*	*0*	*0*

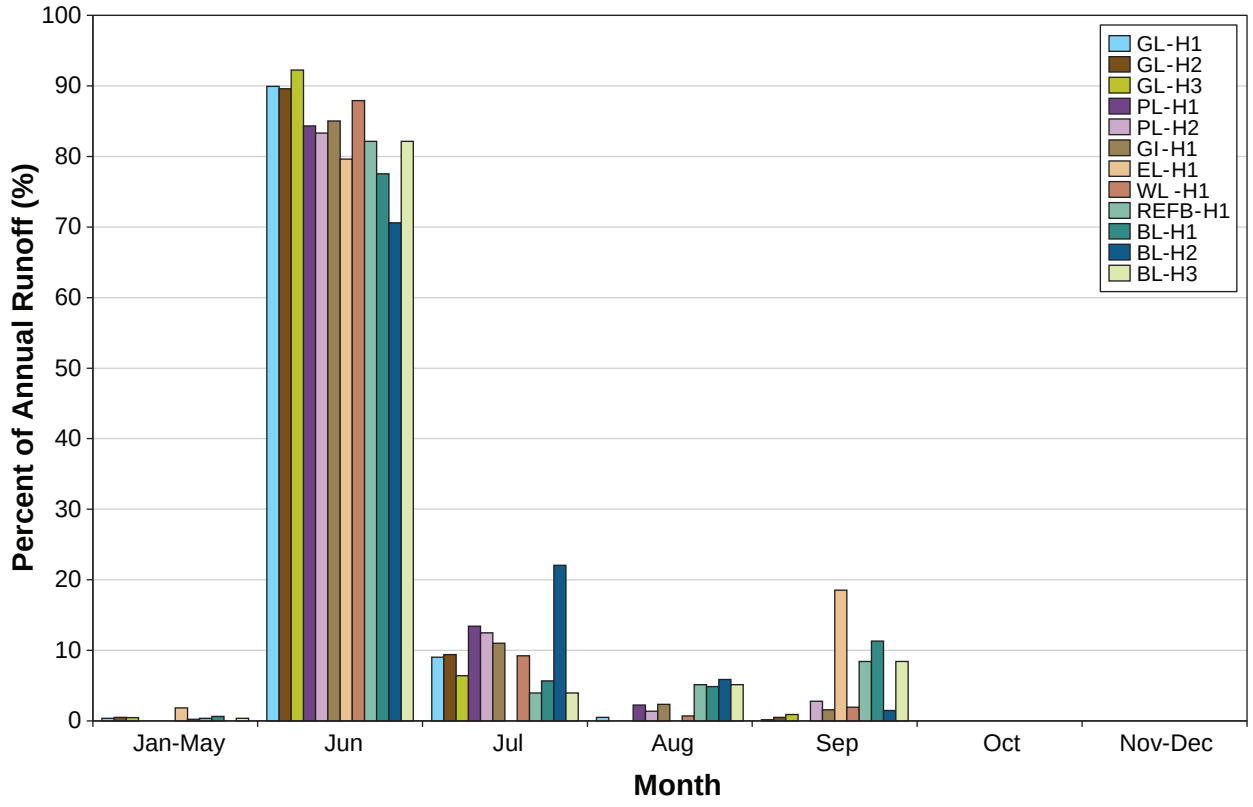
** Monthly or a certain period runoff represented as a percentage of annual runoff.*

Table 4.6-4. 2012 Monthly Runoff Distribution in the George Property Area

Hydrometric Station	Jan- May		June		July		August		September		October		Nov-Dec	
	(mm)	(%)*	(mm)	(%)	(mm)	(%)	(mm)	(%)	(mm)	(%)	(mm)	(%)	(mm)	(%)
REFC-H1	0	0	*53*	*85*	8	13	0	0	*0*	*0*	*0*	*0*	*0*	*0*
KL-H1	0	0	*97*	*68*	21	15	5	3	*13*	*9*	*7*	*5*	*0*	*0*
KL-H2	0	0	*98*	*69*	33	23	6	4	*5*	*4*	*0*	*0*	*0*	*0*

** Monthly or a certain period runoff represented as a percentage of annual runoff.*

Compared to last year, this year more annual runoff was concentrated in June. At the nine stations that were operated in 2011, 88% of annual runoff in 2012 occurred in June, while only 50% of annual runoff in 2011 occurred in June.



Sabina GOLD & SILVER CORP.

Monthly Runoff Distribution - Goose Property Area

Figure 4.6-1

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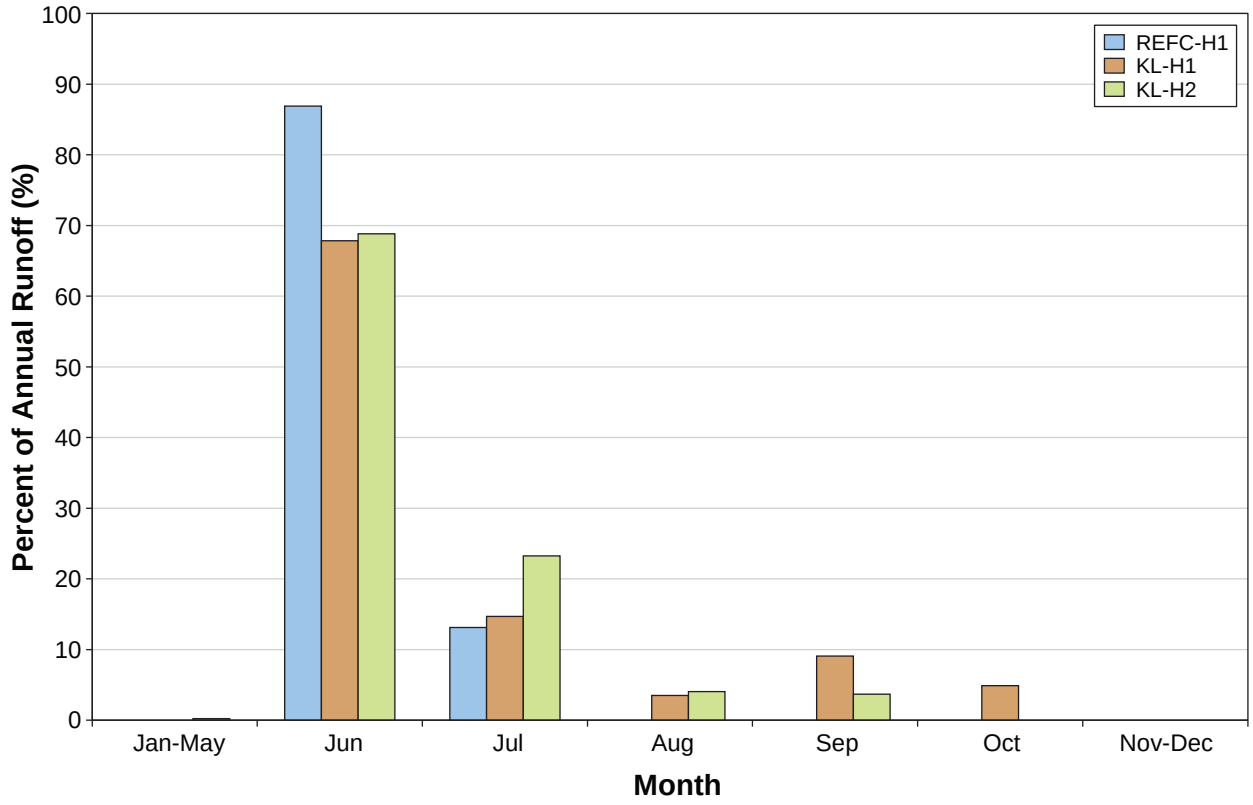

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Monthly Runoff Distribution - George Property Area

Figure 4.6-2

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4.6.4 Annual Peak and Low Flow

Peak flows for most basins in the Project area occurred in late May or early June. In the Goose Property area, instantaneous peak flows ranged from 0.130 m^3/s at BL-H1 to 21.9 m^3/s at PL-H1, while daily peak flows ranged from 0.0952 to 19.9 m^3/s (Table 4.6-5). In the George Property area, instantaneous peak flows ranged from 0.569 m^3/s at REFC-H1 to 9.82 m^3/s at KL-H2, while daily peak flows ranged from 0.440 m^3/s to 1.74 m^3/s (Table 4.6-6). Both instantaneous and daily peak flows of all stations except BL-H2 were assumed to occur on June 2.

Table 4.6-5. 2012 Peak Flows and Peak Unit Yields in the Goose Proper Area

Hydrometric Station	Drainage Area (km^2)	Peak Flow (m^3/s)			Peak Unit Yield ($L/s/km^2$)	
		Instantaneous	Daily	Date	Instantaneous	Daily
GL-H1	18.0	*1.56*	*1.51*	*June 2*	*86.7*	*83.9*
GL-H2	1.7	*0.221*	*0.217*	*June 2*	*130.0*	*127.7*
GL-H3	1.8	*0.633*	*0.516*	*June 2*	*351.7*	*286.7*
PL-H1	204.4	*21.9*	*19.9*	*June 2*	*107.4*	*97.3*
PL-H2	101.5	*5.25*	*4.22*	*June 2*	*51.7*	*41.6*
GI-H1	27.4	*2.94*	*2.54*	*June 2*	*107.1*	*92.7*
EL-H1	1.4	*0.148*	*0.100*	*June 2*	*105.9*	*71.5*
WL-H1	32.7	*2.29*	*2.06*	*June 2*	*70*	*63.0*
REFB-H1	5.3	*0.350*	*0.292*	*June 2*	*66.0*	*55.1*
BL-H1	3.59	*0.130*	*0.0952*	*June 2*	*36.2*	*26.5*
BL-H2	160.0	*11.1*	*9.57*	*June 9*	*69.4*	*59.8*
BL-H3	21.4	*2.08*	*1.59*	*June 2*	*97.2*	*74.3*

Note: Estimated values are italicized

Table 4.6-6. 2012 Peak Flows and Peak Unit Yields in the George Property Area

Hydrometric Station	Drainage Area (km^2)	Peak Flow (m^3/s)			Peak Unit Yield ($L/s/km^2$)	
		Instantaneous	Daily	Date	Instantaneous	Daily
REFC-H1	9.47	*0.569*	*0.440*	*June 2*	*60.1*	*46.6*
KL-H1	24.0	*2.16*	*1.74*	*June 2*	*89.9*	*72.5*
KL-H2	9.66	*0.728*	*0.644*	*June 2*	*75.4*	*66.7*

Note: Estimated values are italicized

In the Goose Property area, instantaneous peak unit yields were at a minimum of 36.2 $L/s/km^2$ at BL-H1 and at a maximum of 351.7 $L/s/km^2$ at GL-H3 (Table 4.6-5). In the George Property area, instantaneous peak unit yields were at a minimum of 60.1 $L/s/km^2$ at REFC-H1 and at a maximum of 89.9 $L/s/km^2$ at KH-H1 (Table 4.6-6). The largest peak unit yields were at the station GL-H3. This is likely due to deepest snow pack depth and snow water equivalence.

Annual low flows are expected to reach zero in all the basins once freeze-up occurs, and zero flow conditions will last throughout the winter months (approximately October to May). The observed low flows are those that occurred during the 2012 period of record from early June to mid-September (Table 4.6-7 and 8). Observed low flows for the majority of basins in the Project area occurred in early August. Most streams except the streams monitored by the hydrometric stations GI-H1, WL-H1, and BL-H2 experienced zero or extreme low flow conditions during the open water period. Zero flow

conditions on the streams monitored by stations GL-H1, GL-H3, PL-H1, REFB-H1 and REFC-H1 continued up until early September.

Table 4.6-7. 2012 Observed Daily Minimum Flows (June through September) in the Goose Property Area

Hydrometric Station	Drainage Area (km^2)	Daily minimum Flow (m^3/s)	Date
GL-H1	14.0	0	August 16 – September 6
GL-H2	1.7	<0.001	August 20 - 29
GL-H3	1.8	0*	July 19 – September 5
PL-H1	204.4	<0.0002	September 3 - 6
PL-H2	101.5	<0.001	August 6 - 7
GI-H1	27.4	0.011	August 8
EL-H1	1.4	0*	July 3 – August 31
WL-H1	35.1	0.001	August 6-9
REFB-H1	5.3	0*	July 23 – September 13
BL-H1	4.28	0	July 29 August 9
BL-H2	160.0	0.176	August 26
BL-H3	21.6	0	July 21 – August 9

** Dry channel conditions between the indicated dates.*

Table 4.6-8. 2012 Observed Daily Minimum Flows (June through September) in the George Property Area

Hydrometric Station	Drainage Area (km^2)	Daily minimum Flow (m^3/s)	Date
REFC-H1	9.47	0	August 22 – September 11
KL-H1	24.0	0	July 30 – August 9
KL-H2	9.82	0	August 2-4

** Dry channel conditions between the indicated dates.*

4.7 SNOW COURSE SURVEYS

Tables 4.7-1 and 4.7-2 summarize snow depth, snow water equivalent (SWE) and snow density on the twelve Back River Project snow courses. The snow course field data sheets are included in Appendix 6.

Table 4.7-1. 2012 Snow Course Survey Summary - Goose Property Area

Station ID	Station Location	Date	Snow Depth (cm)	SWE (cm)	Snow Density (%)
SC-01	PL-H1 drainage	April 25	36	12.1	34
SC-02	BL-H2 drainage	April 21	53	20.2	37
SC-03	BL-H3 drainage	April 24	46	15.5	34
SC-04	GL-H2 drainage	April 21	51	17.4	33
SC-05	PL-H2 drainage	April 24	48	15.7	33
SC-06	REFB-H1 drainage	April 23	56	19.2	34
SC-07	South of WL-H1 drainage	April 23	79	30.8	39
SC-08	GL-H3 drainage	April 25	90	35.3	38
Mean			**57**	**20.8**	**35**

Table 4.7-2. 2012 Snow Course Survey Summary - George Property Area

Station ID	Station Location	Date	Snow Depth (cm)	SWE (cm)	Snow Density (%)
SC-09	KL-H2 drainage (North of George Lake)	April 20	33	13.5	41
SC-10	KL-H2 drainage (South of George Lake)	April 20	85	24	28
SC-11	KL-H1 drainage	April 22	33	12.2	37
SC-12	Dragon Lake drainage	April 22	50	19.9	40
Mean			**50**	**17.4**	**36**

On the Goose Property, the highest recorded SWE value was 35.3 cm on snow course SC-08 near hydrometric station GL-H3 and the lowest recorded SWE was 12.1 cm on snow course SC-01 near hydrometric station PL-H1. On the George Property, the highest recorded SWE was 24 cm on snow course SC-10 near hydrometric station KL-H2 and the lowest recorded SWE value was 12.2 cm on snow course SC-11 near hydrometric station KL-H1.

Snow density is a measure of the compactness of the snowpack. The sampling that was performed in mid-April was intended to catch the peak snow pack. On the Goose Property, recorded snow densities varied between 33% and 37%. On the George Property, recorded snow densities varied between 28% and 41%.

5. Summary

5. Summary

The 2012 hydrology program included two networks that encompassed both the Goose and George Properties. The network in the Goose Property area was comprised of the nine stations from 2011 and three new stations to monitor a total drainage area of 391.3 km^2, including a reference drainage area of 5.3 km^2. The network in the George Property area was comprised of three new stations to monitor a total drainage area of 33.47 km^2, including a reference drainage area of 9.47 km^2.

The hydrometric network was operated through the open water season from June 5, 2012 to September 14, 2012. During this time period, continuous time series water level (stage) data were collected at each station and a total of 82 manual discharge measurements were completed. Based on the stage and discharge data collected, stage-discharge rating equations were determined and annual hydrographs produced.

The annual hydrographs show that basins within the Project area have an Arctic nival hydrologic regime characterized by snowmelt-driven high flows during the spring freshet and no flows during the winter. In 2012 one prominent snowmelt-driven high flow event was observed in late May to mid-June in most basins. After this high flow, discharge steadily decreased throughout the Project area until mid-August. Only one minor rainfall-driven flow occurred in early September.

Peak flows varied substantially between gauged streams. Instantaneous peak flows in the Goose Property area ranged from 0.130 m^3/s at the hydrometric station BL-H1 (Big Lake inflow) to 21.9 m^3/s at the station PL-H1 (Propellor Drainage outflow). Instantaneous peak flows in the George Property area ranged from 0.569 m^3/s at the hydrometric station REFC-H1 (Reference Lake inflow) to 2.16 m^3/s at the station KL-H1 (Komatic Lake outflow).

Volumetric outflows from each of the monitored drainages were generally found to be a function of drainage area. In the Goose Property area, the minimum volumetric outflows were observed at EL-H1 (Echo Drainage outflow; drainage area = 1.4 km^2) which had a total annual water output of 0.08 million m^3. The maximum annual volumetric output was 27.39 million m^3 at PL-H1 (Propellor Drainage outflow; drainage area = 204.4 km^2). In the George Property area, the minimum volumetric outflows were observed at REFC-H1 (drainage area = 9.47 km^2) which had a total annual water output of 0.59 million m^3. The maximum annual volumetric output was 3.43 million m^3 at KL-H1 (drainage area = 24.0 km^2).

The calculated peak unit yields varied among the monitored drainages, generally increasing as drainage area decreased. Daily peak unit yields in the Goose Property area were at a minimum of 26.5 $L/s/km^2$ at BL-H1 (Big Lake inflow) and at a maximum of 286.7 $L/s/km^2$ at GL-H3 (Goose Lake inflow). Daily peak unit yields in the George Property area were at a minimum of 44.6 $L/s/km^2$ at REFCL-H1 (Reference lake C outflow) and at a maximum of 72.5 $L/s/km^2$ at KL-H1 (Komatic Lake inflow).

Average annual runoff was 99 mm for the Goose Property area and 116 mm for the George Property area. Annual Runoff in the Goose Property area varied between drainages from a minimum of 36 mm at BL-H1 (Big Lake inflow) to a maximum of 219 mm at GL-H3 (Goose Lake inflow); annual Runoff in the George Property area varied between drainages from a minimum of 62 mm at REFC-H1 (Reference Lake C outflow) to a maximum of 143 mm at KL-H1 (Komatic Lake inflow).

In all drainages the maximum monthly runoff occurred in June. In the Goose Property area, approximately 85% of annual runoff occurred in June, 9% in July, 6% in August and September, and negligible amounts through the remainder of the year. In the George Property area, approximately 74% of runoff occurred in June, 17% in July, 7% in August and September, and negligible amounts through the remainder of the year.

All monitored streams can be considered either intermittent or ephemeral. The majority are considered intermittent (seasonal) with zero flow in the winter when they freeze to their bed. On average the monitored streams flowed for 27% of the year in the Goose Property area and for 31% of the year in the George Property area, and they were either frozen or dry for the remainder of the year.

Snow depth, snow water equivalent, and snow density were surveyed on twelve snow courses, nine on the Goose Property and four on the George Property. The recorded SWE values varied from 12.1 cm to 35.3 cm on the Goose Property and from 12.2 cm to 24 cm on the George Property. The recorded snow densities varied from 33% to 37% on the Goose Property area and from 28% to 41% on the George Property area.

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Appendix 1

Hydrometric Monitoring Station Information

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Appendix 1.1. Station Information Sheet for Hydrometric Station GL-H1

Site ID:	GL-H1	**Drainage Area (km^2):**	14.0
Site Location:	Near the mouth of the southwestern inflow to Goose Lake		
UTM:	NAD 83, Zone 13W	430,772 E	7,270,016 N

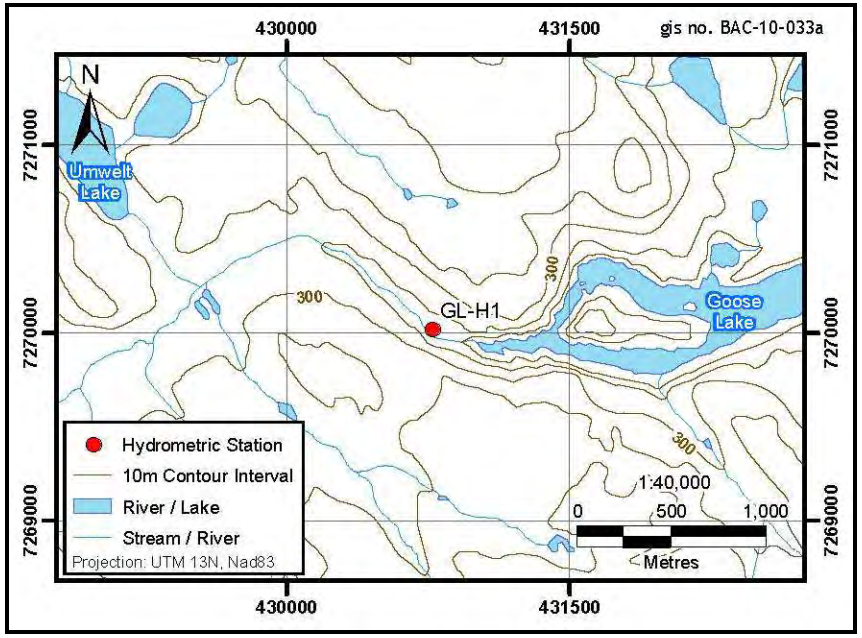
Benchmarks	**Elevation (m)**	**Description**
BM3	100.000	Bolt on left bank upstream of the station
BM4	100.217	Rebar on left bank downstream of the station
BM5	100.526	Rebar on left bank at the data logger box

Transducer:	PS-98i	**Logger:**	ELF-2

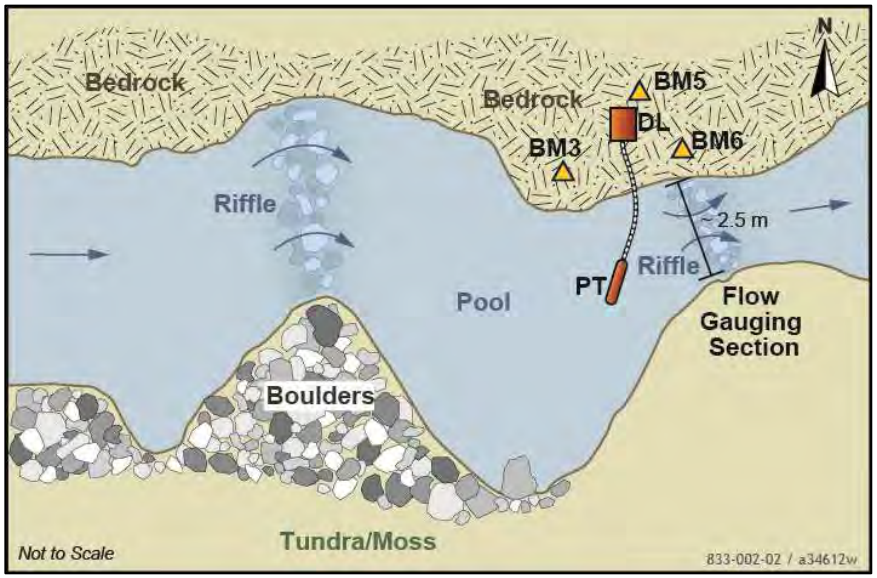
Operating Periods:		
2010	June 10- Sep 16	Established June 16, 2010
2011	June 10- Sep 16	
2012	June 5 – Sep 7	

General Comments:

- Location previously established and monitored from 2007 to 2009 as D32 by Gartner Lee.
- Relatively low flow
- Wadeable under all conditions
- Access by helicopter



Site Map



Plan View of Hydrometric Station GL-H1

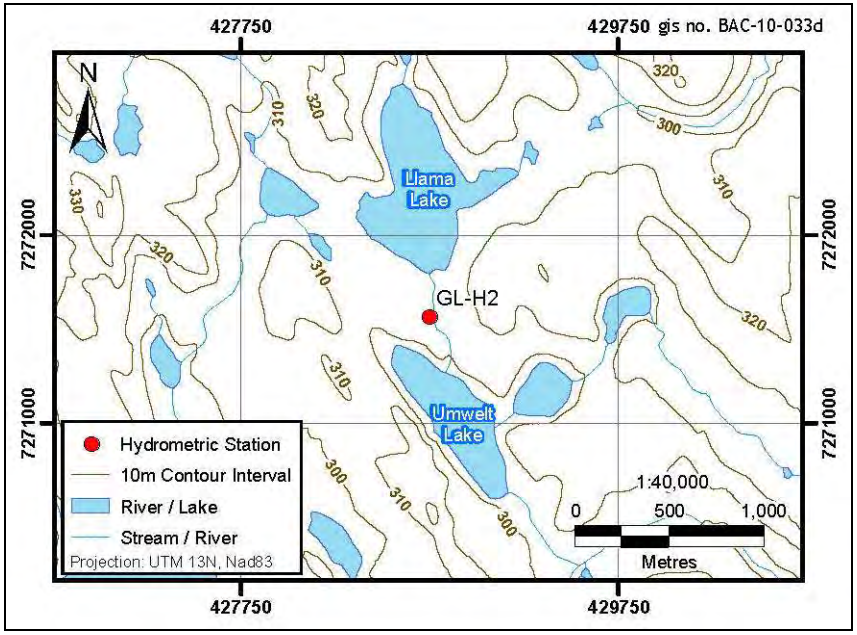
Low angle view looking across the channel and downstream. The enclosure for the data logger can be seen on the left bank. June 5, 2012.

Site Photo

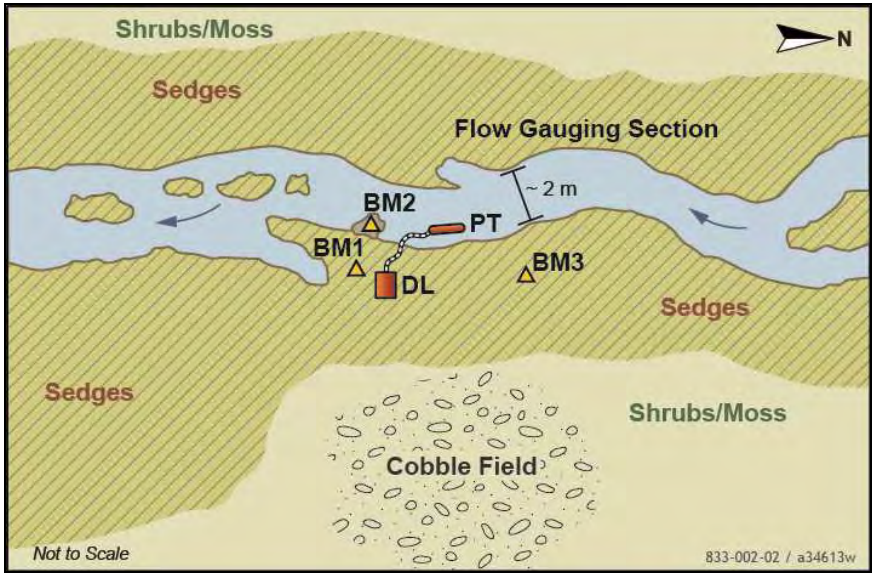
Appendix 1.2. Station Information Sheet for Hydrometric Station GL-H2

Site ID:	GL-H2	**Drainage Area (km^2):**	1.7
Site Location:	Llama Lake outflow		
UTM:	NAD 83, Zone 13W	428,746 E	7,271,567 N
Benchmarks	**Elevation (m)**	**Description**	
BM1	100.000	Bolt at base of DL enclosure box	
BM2	99.746	Bolt in boulder embedded in LB	
BM3	99.781	Bolt in buried boulder ~5m upstream of station	
Transducer:	PS-98i	**Logger:**	ELF-2
Operating Periods:			
2010	July 06- Sept 29	Established June 16, 2010	
2011	June 10 – Sept 16		
2012	June 5 – Sept 7		
General Comments:			

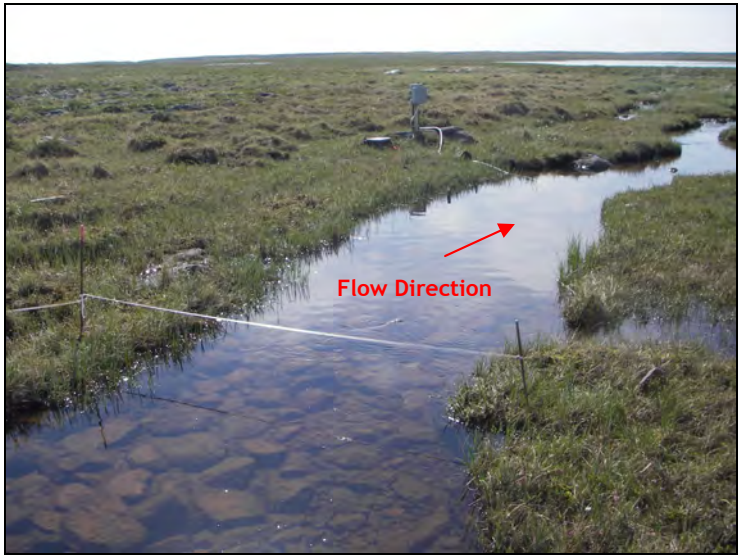
- Relatively low flow
- Wadeable under all conditions
- Access by helicopter



Site Map



Plan View of Hydrometric Station GL-H2



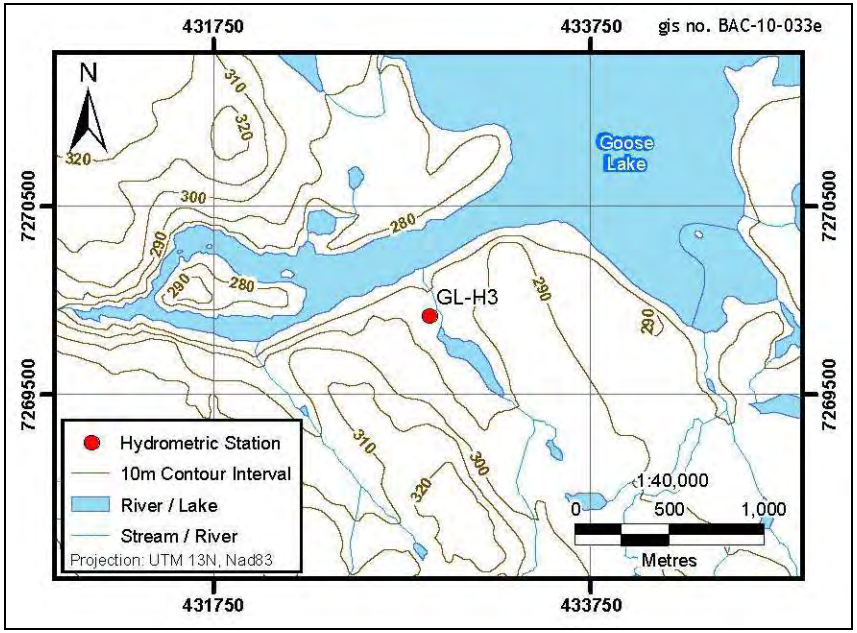
Low angle view looking downstream to the south along the monitored stream reach. July 6, 2012.

Site Photo

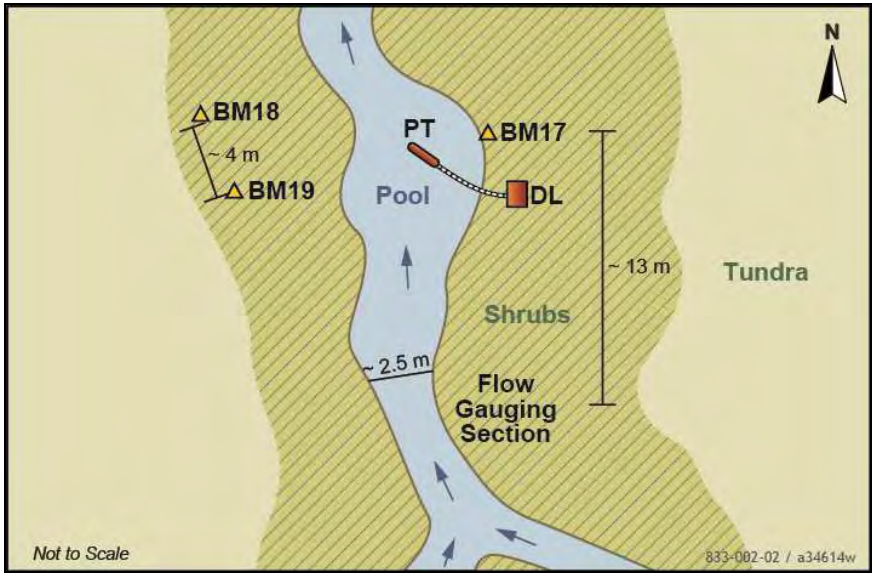
Appendix 1.3. Station Information Sheet for Hydrometric Station GL-H3

Site ID:	GL-H3	**Drainage Area (km^2):**	1.8
Site Location:	Near the mouth of a small inflow to the West arm of Goose Lake		
UTM:	NAD 83, Zone 13W	432,891 E	7,269,919 N
Benchmarks	**Elevation (m)**	**Description**	
BM17	100.00	Bolt on right bank downstream of the station	
BM18	100.153	Bolt on left bank downstream of the station	
BM19	100.053	Bolt on left bank even with the station	
Transducer:	PS-98i	**Logger:**	ELF-2
Operating Periods:			
2011	June 14 - Sep 16	Established June 16, 2011	
2012	June 7 - Sep 9		
General Comments:			

- Zero flow during summer low flow period
- Wadeable under all conditions
- Bench marks marked with rebar stakes for locating
- Access by helicopter or on foot from camp

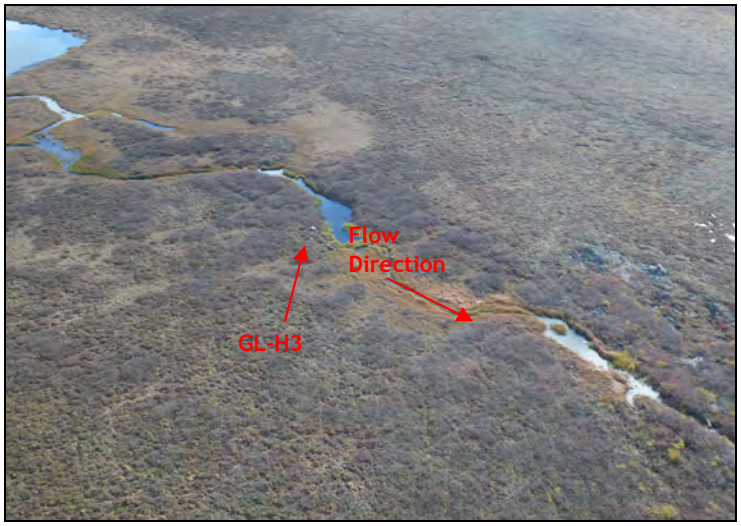


Site Map



Plan View of Hydrometric Station GL-H3

General Site Information



High Angle oblique view of the monitored stream reach. September 9, 2012.

Site Photo

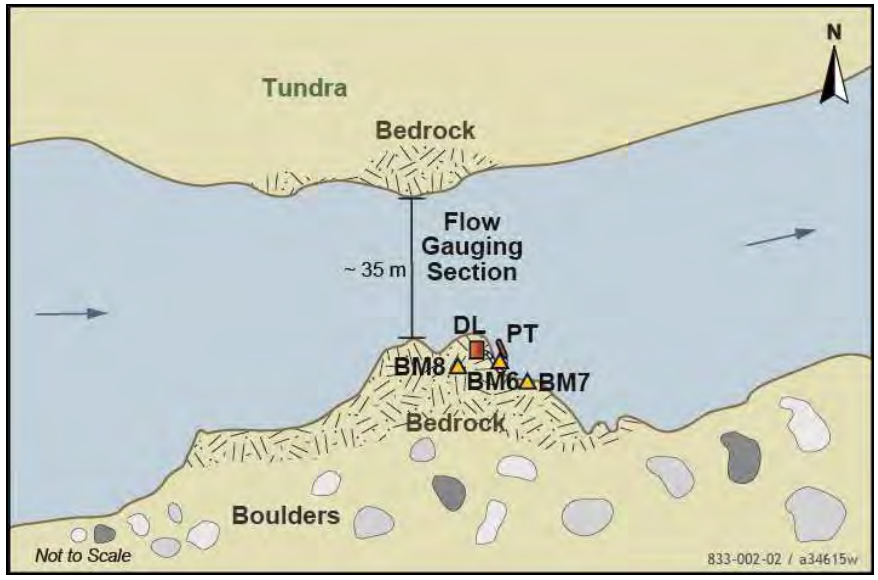
Appendix 1.4. Station Information Sheet for Hydrometric Station PL-H1

Site ID:	PL-H1	**Drainage Area (km^2):**	204.4
Site Location:	Downstream from Propellor Lake outflow		
UTM:	NAD 83, Zone 13W	436,094 E	7,279,939 N
Benchmarks	**Elevation (m)**	**Description**	
BM8	100.00	Bolt upstream from station	
BM7	99.538	Bolt downstream from station	
BM6	99.601	Bolt near station	
Transducer:	PS-98i	**Logger:**	ELF-2
Operating Periods:			
2011	June14 - Sep 17	Established June 14, 2011	
2012	June 6 - Sep 8		

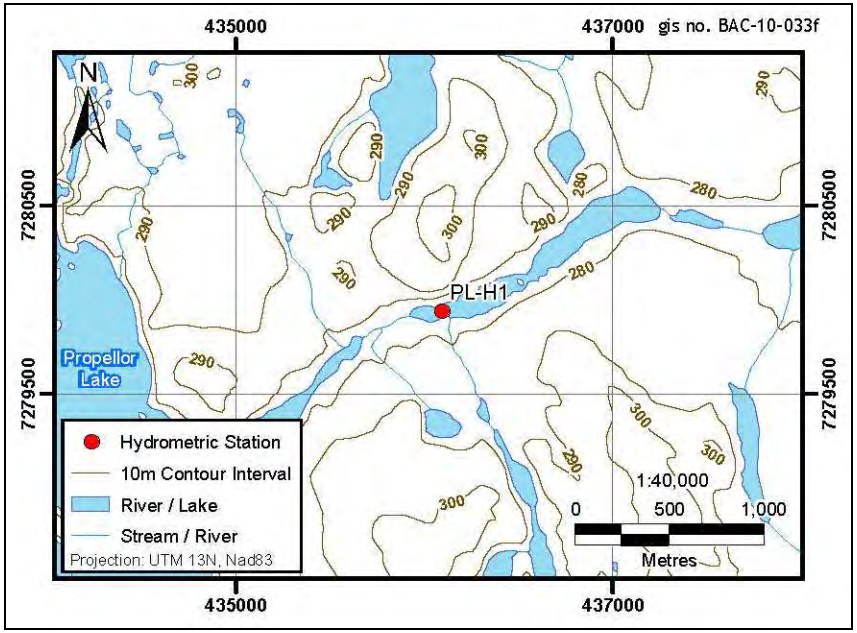
General Comments:

- Boat required to cross channel
- Deep but relatively low velocity reach
- Not wadeable under any conditions
- Access by helicopter
- Under 2012 August and September 2012 low flow conditions, manual flow measurement taken 400 m upstream of station.

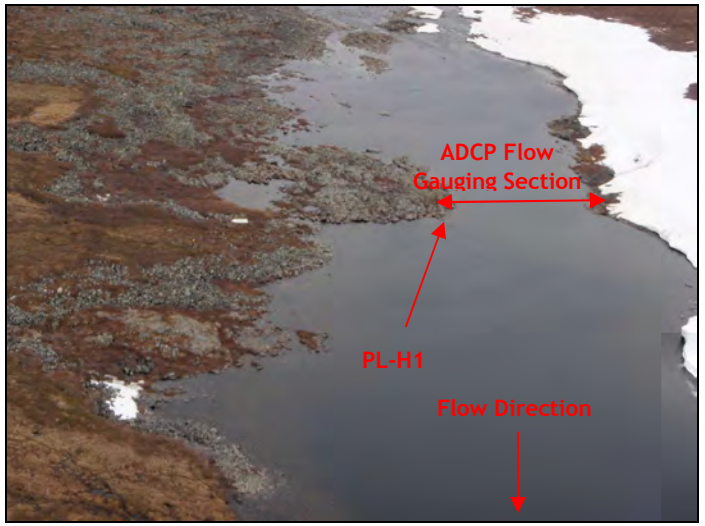
General Site Information



Plan View of Hydrometric Station PL-H1



Site Map



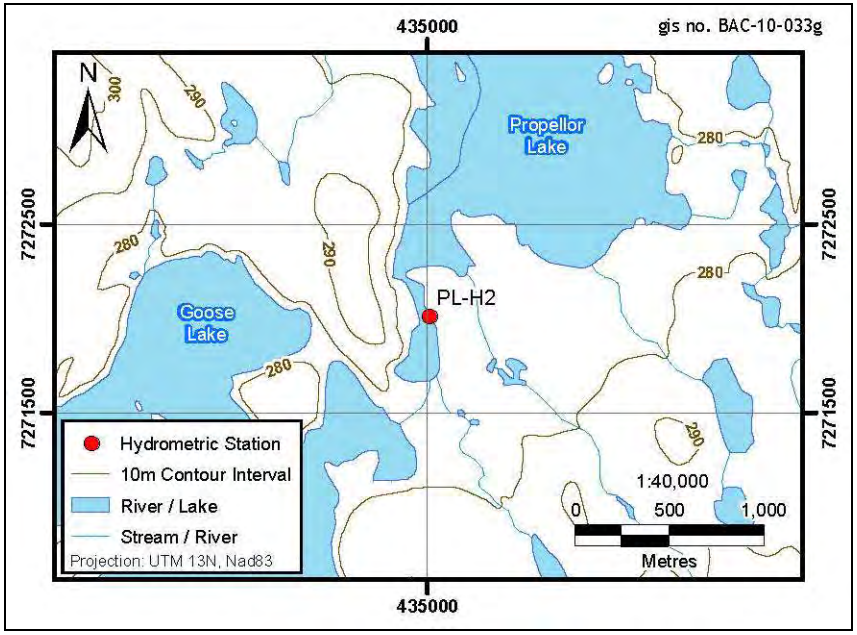
High angle view looking upstream towards station PL-H1 and the monitored reach. At low flow (Aug., Sep.) manual measurement was taken 400 m further upstream. June 14, 2012.

Site Photo

Appendix 1.5. Station Information Sheet for Hydrometric Station

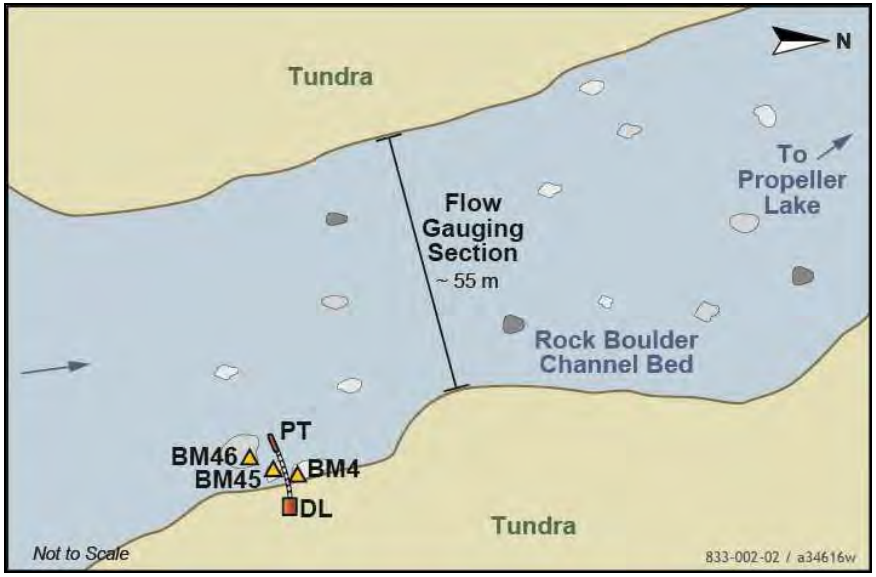
Site ID:	PL-H2	**Drainage Area (km^2):**	101.5
Site Location:	Between the outflow of Goose Lake and the inflow of Propellor Lake		
UTM:	NAD 83, Zone 13 W	435,007 E	7,272,014 N
Benchmarks	**Elevation (m)**	**Description**	
BM4	100.000	Bolt on in-stream boulder near the station	
BM45	99.856	Bolt on in-stream boulder near the station	
BM46	100.169	Bolt on in-stream boulder near the station	
Transducer:	PT-2X	**Logger:**	Self-Contained
Operating Periods:			
2011	June 11 – Sep 17	Established June 11, 2011	
2012	June 12 – Sep 13		
General Comments:			

- Wide boulder strewn channel
- Relatively low flow
- Wadeable under all conditions
- Access by helicopter



General Site Information

Site Map



Plan View of Hydrometric Station PL-H2

Low angle view looking downstream from the right bank along the monitored stream reach. June 16, 2012.

Site Photo

Appendix 1.6. Station Information Sheet for Hydrometric Station GI-H1

Site ID:	GI-H1	**Drainage Area (km²):**	27.4
Site Location:	Outflow of Giraffe Lake		
UTM:	NAD 83, Zone 13W	432,744 E	7,271,610 N

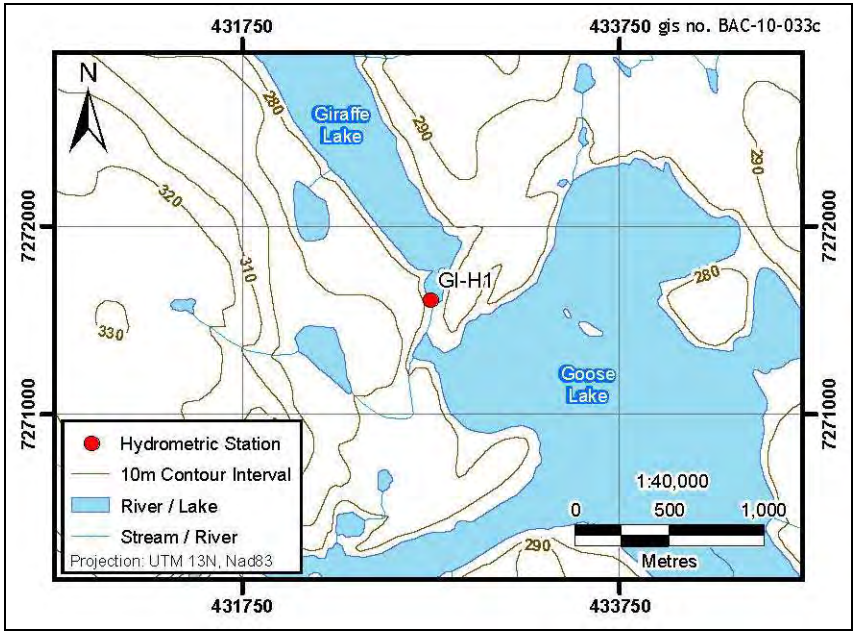
Benchmarks	**Elevation (m)**	**Description**
BM5	100.000	Bolt near station
BM47	99.922	Bolt downstream from station
Bm49	100.037	Bolt downstream from station

Transducer:	PS-98i	**Logger:**	ELF2

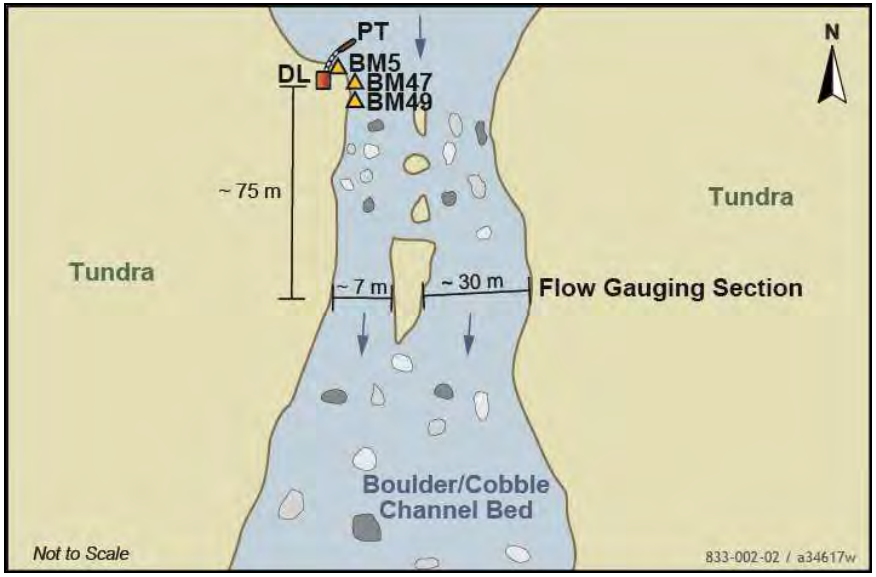
Operating Periods:		
2011	June 11 - Sep 16	Established June 16, 2011
2012	June 9 - Sep 14	

General Comments:

- Wide boulder strewn channel
- Relatively low flow
- Wadeable under all conditions
- Access by helicopter



Site Map



Plan View of Hydrometric Station GI-H1

General Site Information

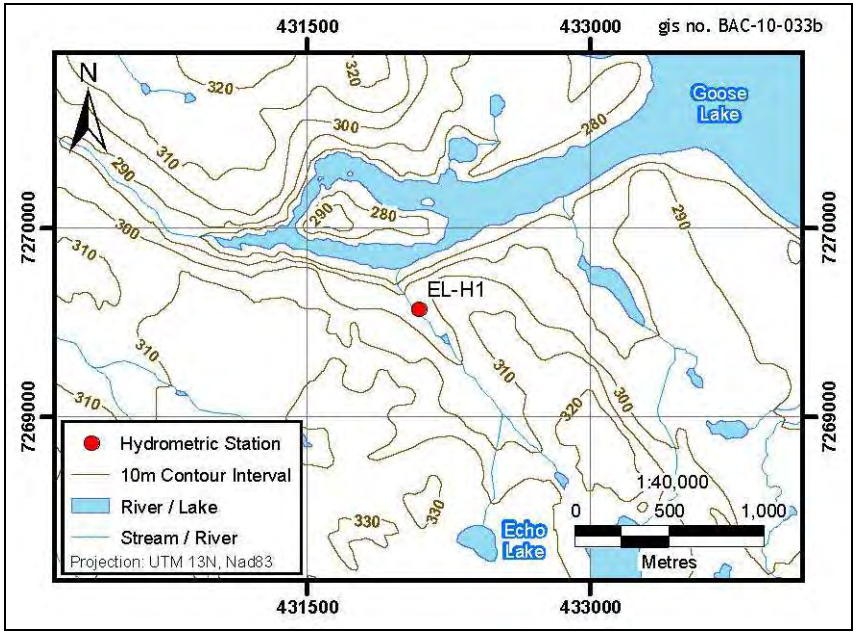
Upstream view of Giraffe Lake outflow. Photograph was taken during very low flow conditions and shows flow gauging section. August 10, 2012.

Site Photo

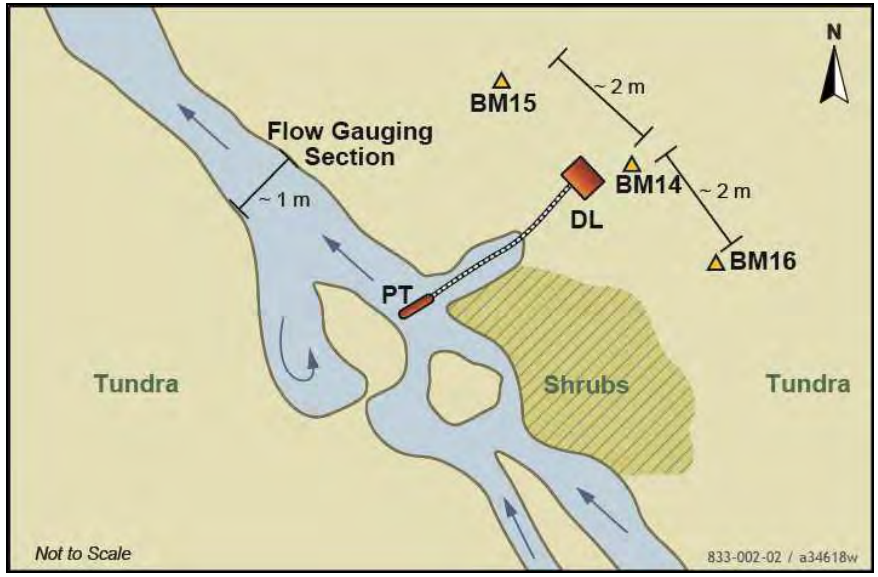
Appendix 1.7. Station Information Sheet for Hydrometric Station EL-H1

Site ID:	EL-H1	**Drainage Area (km²):**	1.4
Site Location:	Near the inflow to the West arm of Goose Lake		
UTM:	NAD 83, Zone 13W	432,091 E	7,269,573 N
Benchmarks	**Elevation (m)**	**Description**	
BM14	100.000	Bolt near the station	
BM15	99.924	Bolt downstream from the station	
BM16	99.991	Bolt upstream from the station	
Transducer:	PS-98i	**Logger:**	ELF-2
Operating Periods:			
2011	June 13 - Sep 16	Established June 13, 2011	
2012	June 6 - Sep 7		
General Comments:			

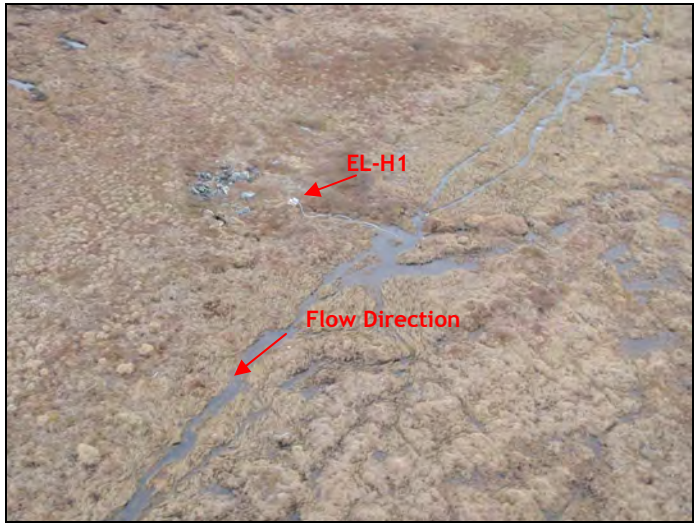
- Ephemeral channel prone to flooding
- Wadeable under all conditions
- Access by helicopter



Site Map



Plan View of Hydrometric Station EL-H1



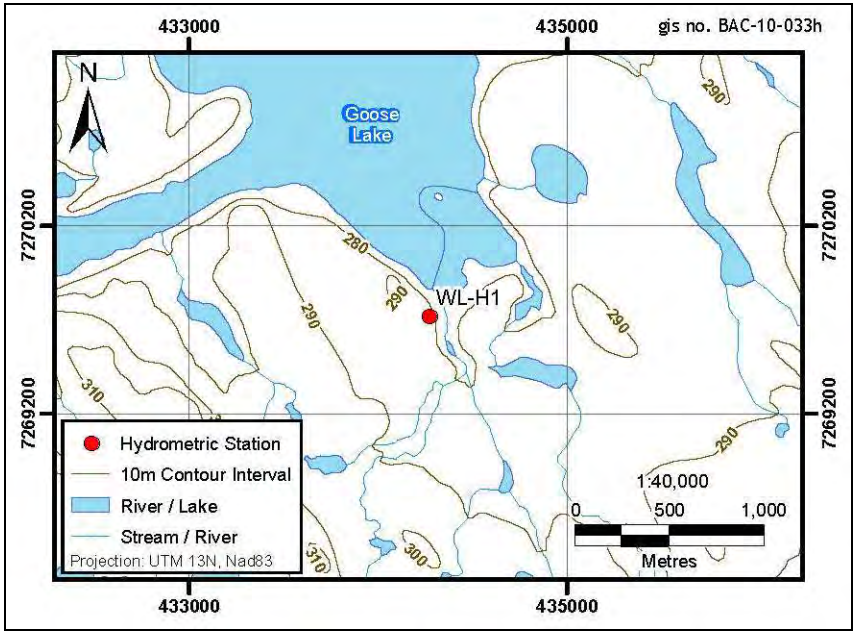
High angle oblique view of the monitored reach under high flow conditions. Due to the ephemeral nature of the channel, it is lined with grasses. June 13, 2012.

Site Photo

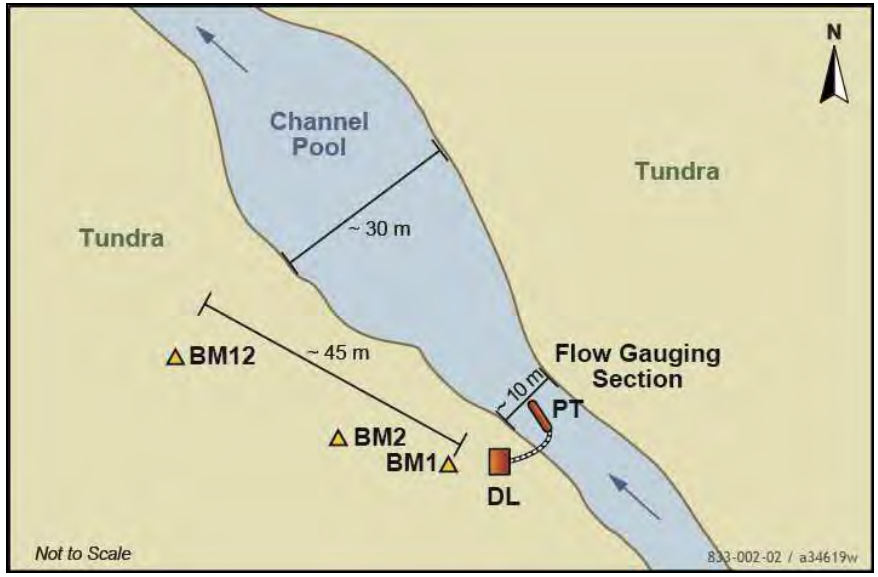
Appendix 1.8. Station Information Sheet for Hydrometric Station WL-H1

Site ID:	WL-H1	**Drainage Area (km²):**	35.1
Site Location:	Near the southern most inflow to Goose Lake		
UTM:	NAD 83, Zone 13W	434,269 E	7,269,719 N
Benchmarks	**Elevation (m)**	**Description**	
BM12	100.00	Bolt ~65m northwest of the station	
BM1	99.237	Tip of drill casing near station	
BM2	99.929	Tip of drill casing between station and BM12	
Transducer:	PS-98i	**Logger:**	ELF-2
Operating Periods:			
2011	June 10 - Sep 17	Established June 10, 2011	
2012	June 7 - Sep 14		
General Comments:			

- Relatively deep channel
- Relatively low velocity
- Wadeable under most conditions
- Access by helicopter



Site Map



General Site Information

Plan View of Hydrometric Station WL-H1

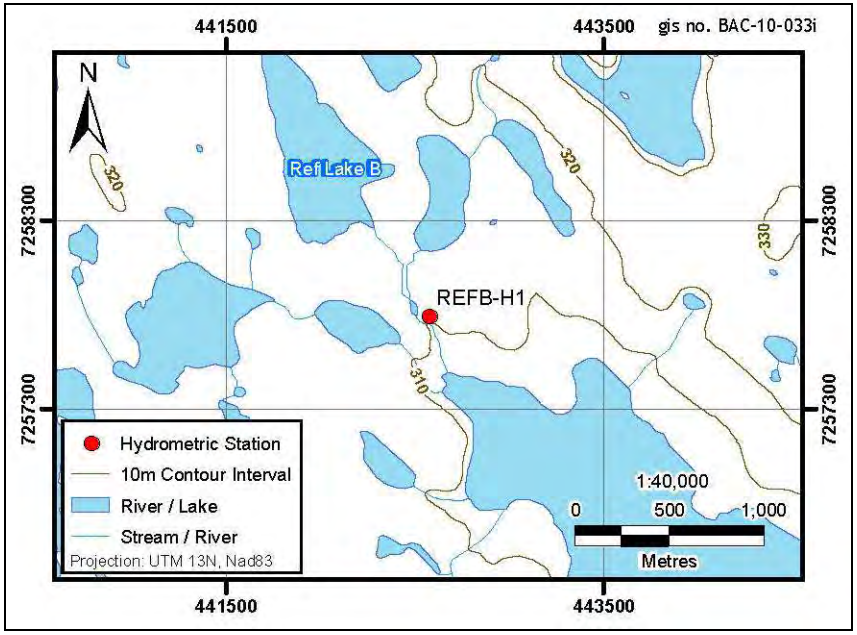
Downstream view of the monitored reach looking West towards Goose Camp under low flow conditions. Sep 14, 2012.

Site Photo

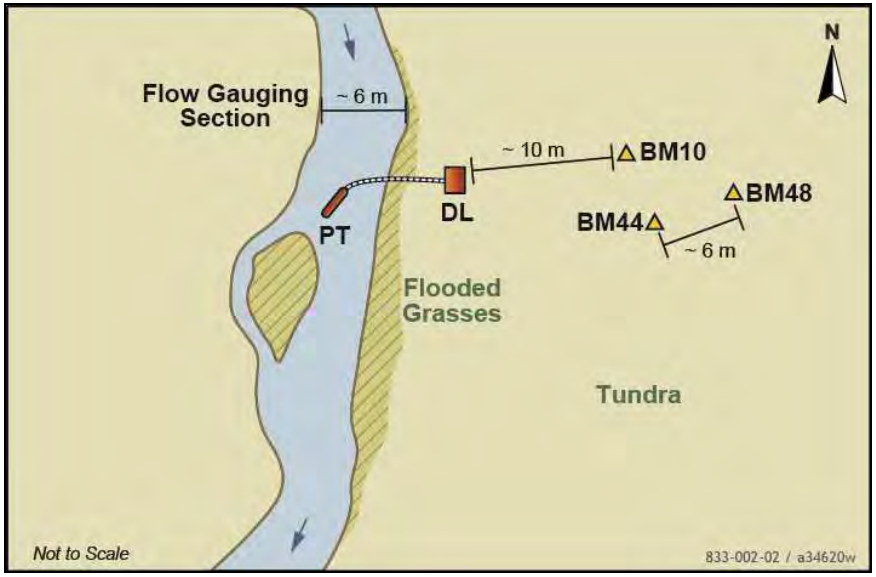
Appendix 1.9. Station Information Sheet for Hydrometric Station REFB-H1

Site ID:	REFB-H1	**Drainage Area (km²):**	5.3
Site Location:	Near the outflow of Reference Lake B		
UTM:	NAD 83, Zone 13W	442,573 E	7,257,794 N
Benchmarks	**Elevation (m)**	**Description**	
BM10	100.000	Bolt ~10m west of the data logger	
BM44	99.954	Bolt ~5m south of BM10	
BM48	100.104	Bolt ~ 6m west of BM44	
Transducer:	PS-98i	**Logger:**	ELF-2
Operating Periods:			
2011	June 13 - Sep 17	Established June 13, 2011	
2012	June 9 - Sep 13		
General Comments:			

- Ephemeral stream
- Soft bed (transducer sinks over the summer)
- Wadeable under all conditions
- Access by helicopter



General Site Information



Plan View of Hydrometric Station REFB-H1

Site Map

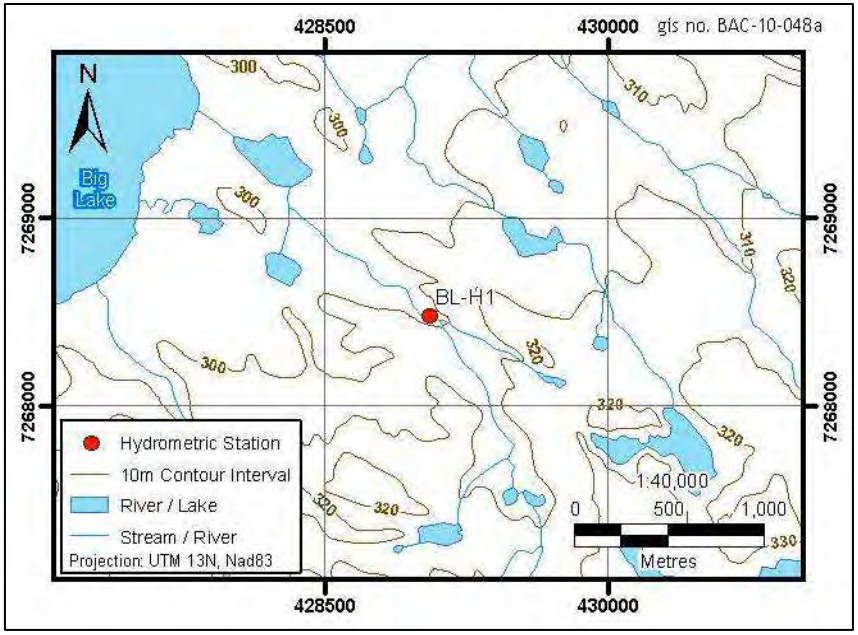
High angle oblique view looking West at the monitored reach. Photograph taken September 13, 2012.

Site Photo

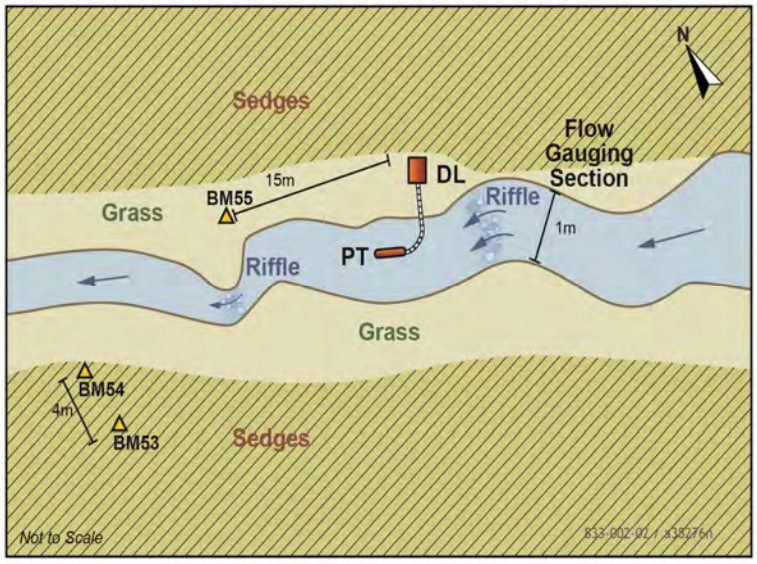
Appendix 1.10. Station Information Sheet for Hydrometric Station BL-H1

Site ID:	BL-H1	Drainage Area (km^2):	4.28
Site Location:	Near the north eastern inflow to Big Lake		
UTM:	NAD 83, Zone 13W	429,044 E	7,268,478 N
Benchmarks	**Elevation (m)**	**Description**	
BM 53	100.000	Bolt in rock left bank downstream of station	
BM 54	99.939	Bolt in rock left bank downstream of station	
BM 55	99.922	Bolt on right bank 15m downstream of station	
Transducer:	PS-98i	Logger:	ELF-2
Operating Period:			
2012	June 12 – Sep 10	Established on June 12, 2012	
General Comments:			

- Small channel with low flow
- Wadeable under all conditions
- Pool-riffle morphology with cobble bed (gradient = 2%)
- Access by helicopter



General Site Information



Plan View of Hydrometric Station BL-H1

Site Map

Low angle view looking upstream towards the station. The enclosure for the data logger can be seen on the right bank. June 16, 2012.

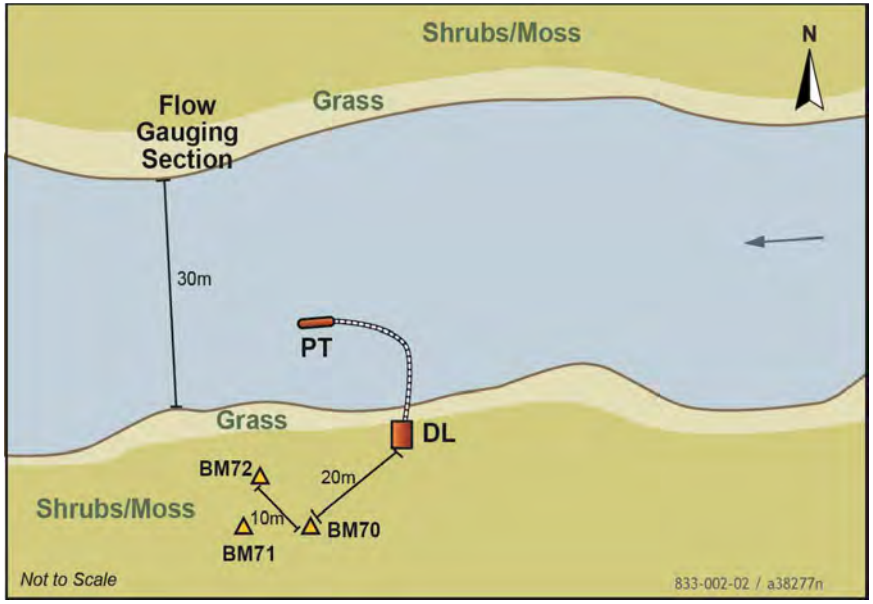
Site Photo

Appendix 1.11. Station Information Sheet for Hydrometric Station BL-H2

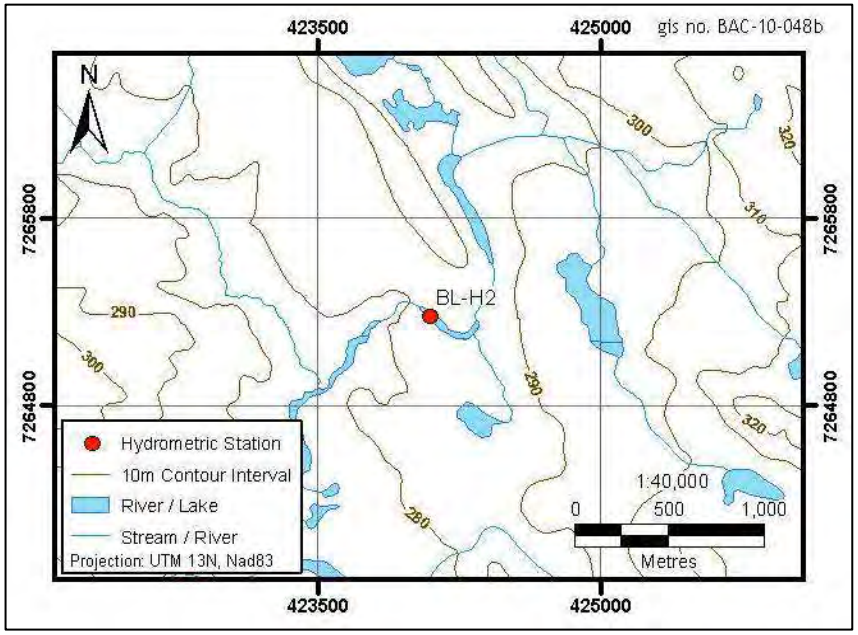
Site ID:	BL-H2	**Drainage Area (km²):**	160.0
Site Location:	On Swan Lake Outflow 1km upstream of Gander Lake		
UTM:	NAD 83, Zone 13W	424,087 E	7,265,274 N
Benchmarks	**Elevation (m)**	**Description**	
BM 70	100.000	Bolt on left bank downstream of station	
BM 71	99.942	Bolt on left bank downstream of BM 70	
BM 72	99.608	Bolt on left bank closer to stream than BM 71	
Transducer:	PT-2X	**Logger:**	Self-contained
Operating Period:			
2012	June 8 – Sep 9	Established on June 8, 2012	
General Comments:			

- Large, wide (30 m) channel with relatively high flow
- Wadeable under all conditions
- Pool-riffle morphology with silt/boulder bed (gradient = 1%)
- Access by helicopter

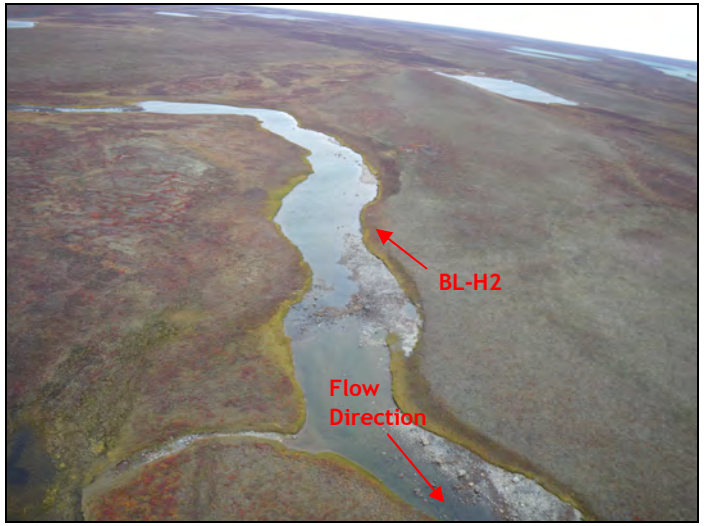
General Site Information



Plan View of Hydrometric Station BL-H2



Site Map



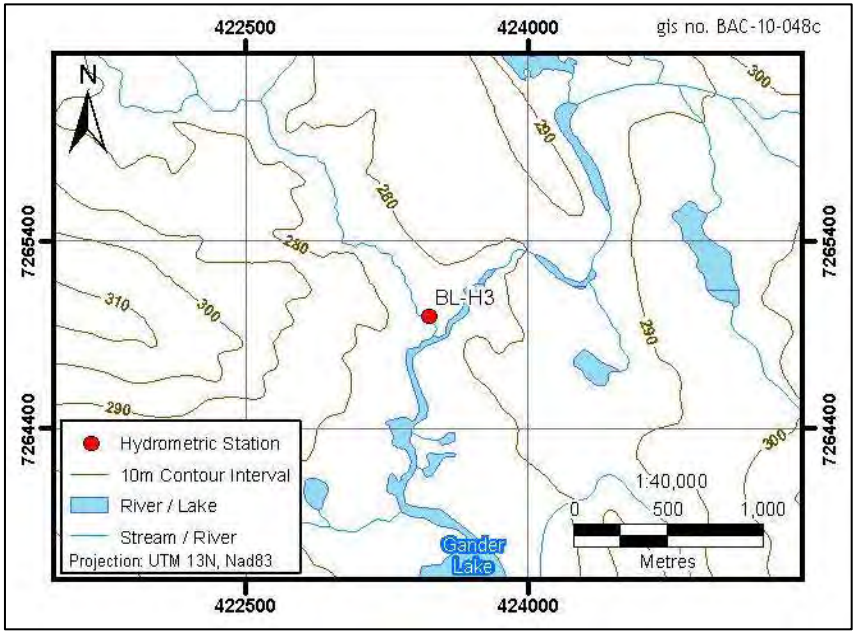
High angle oblique view looking upstream at the channel section under low flow conditions. The station is shown on the left bank. September 9, 2012.

Site Photo

Appendix 1.12. Station Information Sheet for Hydrometric Station BL-H3

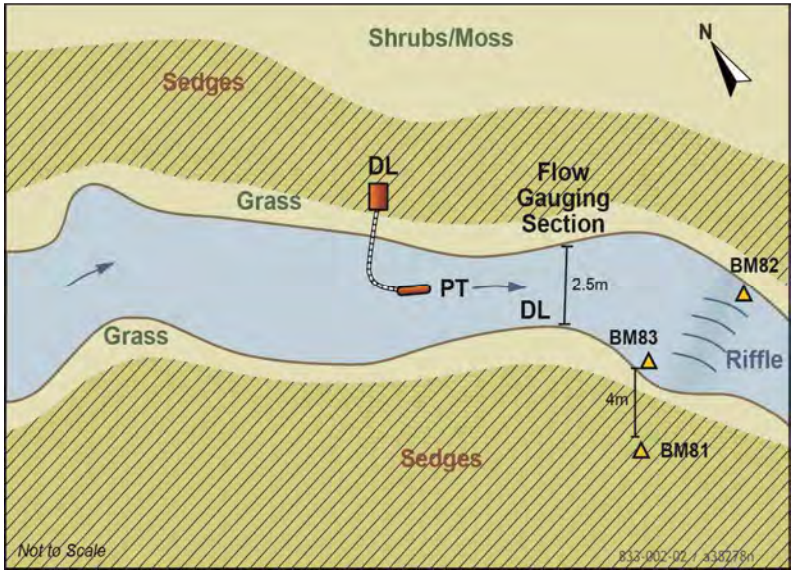
Site ID:	BL-H3	**Drainage Area (km²):**	21.6
Site Location:	Moby lake outflow		
UTM:	NAD 83, Zone 13W	423,467N	7,264,998E
Benchmarks	**Elevation (m)**	**Description**	
BM 81	100.000	Bolt in rock on Right Bank near downstream riffle	
BM 82	99.710	Bolt in rock on left side of downstream riffle	
BM 83	99.836	Bolt on right side of downstream riffle	
Transducer:	PT-2X	**Logger:**	Self-contained
Operating Period:			
2012	June 8 – Sep 9	Established on June 8, 2012	
General Comments:			

- Narrow, deep channel swift flows at high water
- Wadeable under all conditions
- Pool-riffle morphology with undercut banks near pressure transducer location
- Access by helicopter

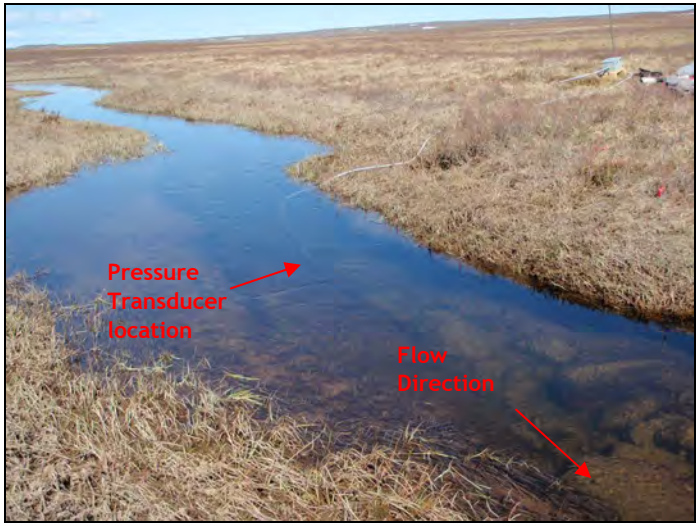


Site Map

General Site Information



Plan View of Hydrometric Station BL-H3



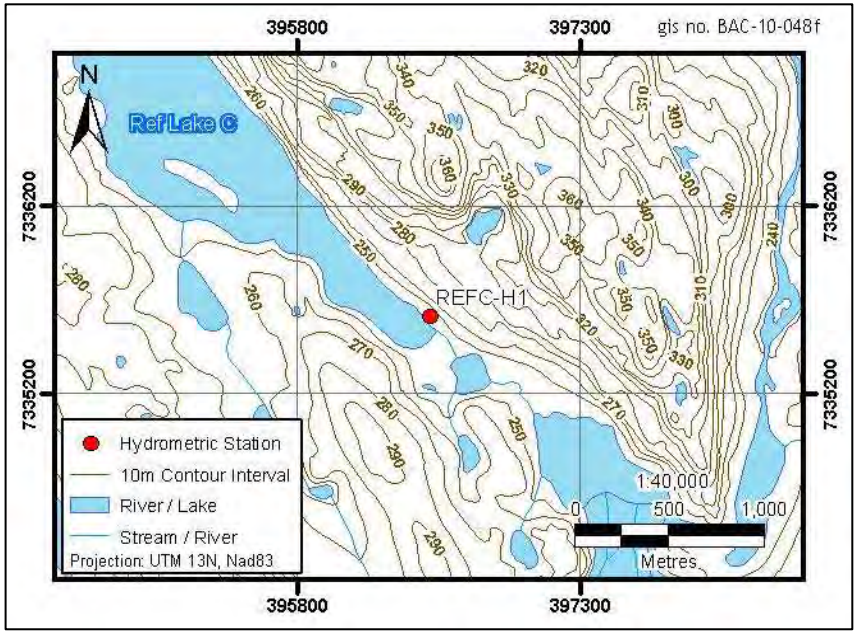
Low angle oblique view looking upstream at the channel section under high flow conditions. The station is shown on the left bank. June 8, 2012.

Site Photo

Appendix 1.13. Station Information Sheet for Hydrometric Station REFC-H1

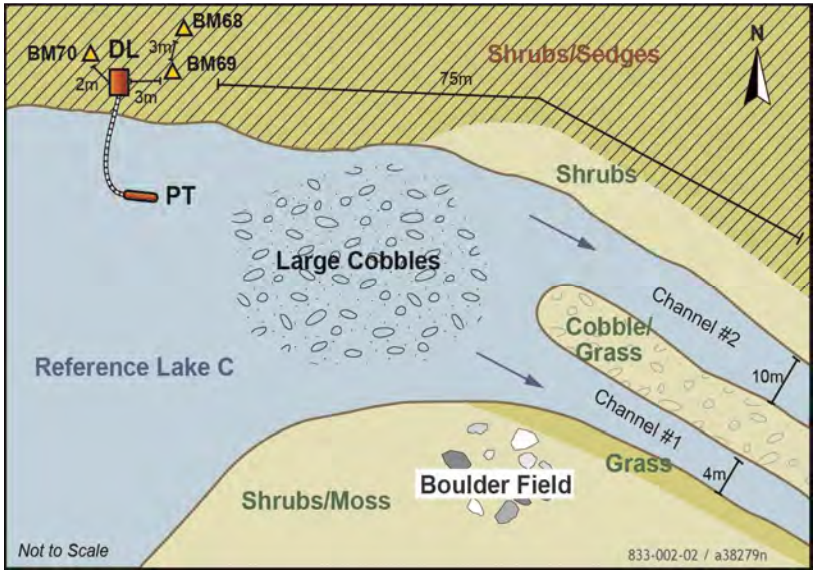
Site ID:	REFC-H1	**Drainage Area (km^2):**	9.47
Site Location:	Near Reference Lake C outflow		
UTM:	NAD 83, Zone 13W	396,495E	7,335,612N
Benchmarks	**Elevation (m)**	**Description**	
BM 68	100.000	Bolt in rock 3m up bank of BM 69	
BM 69	99.687	Bolt in rock 3m downstream of station	
BM 70	99.879	Bolt in rock 2m upstream of station	
Transducer:	PT-2X	**Logger:**	Self-contained
Operating Period:			
2012	June 11 – Sep 11	Established on June 11, 2012	
General Comments:			

- Braided channel with two braids at location of flow measurement (Right braid only at low water)
- Wadeable under all conditions
- Cobble bed with water flowing mainly deep in loose cobbles at low water
- Access by helicopter

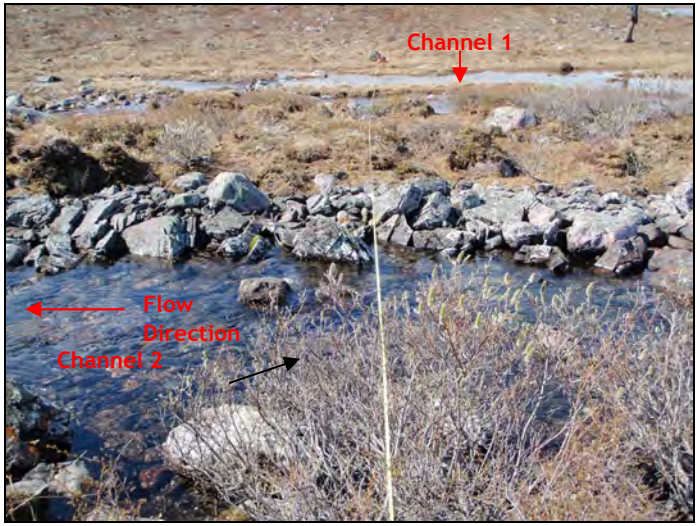


Site Map

General Site Information



Plan View of Hydrometric Station REFC-H1



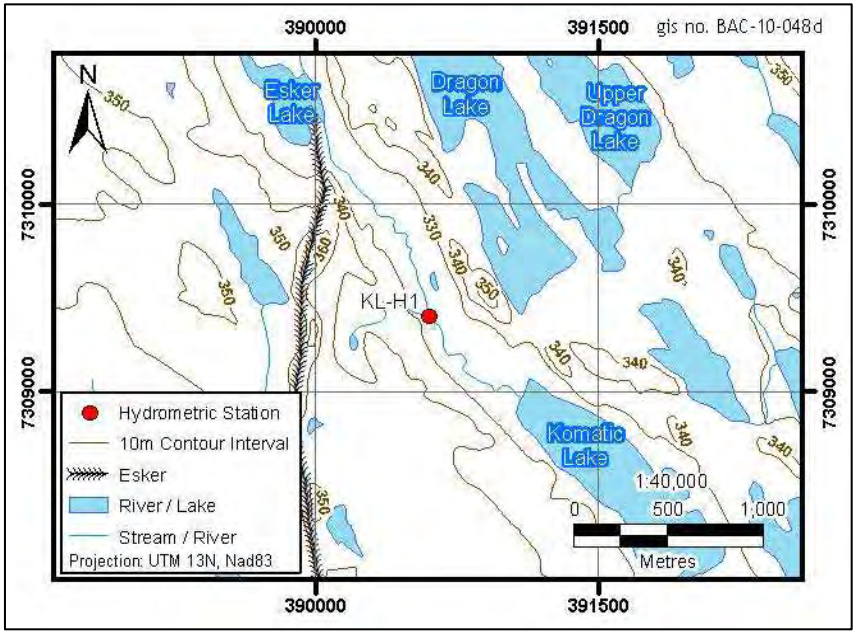
View from left bank at location of flow gauging section. The channel is split into two main braids along its length under high water conditions June 15, 2012.

Site Photo

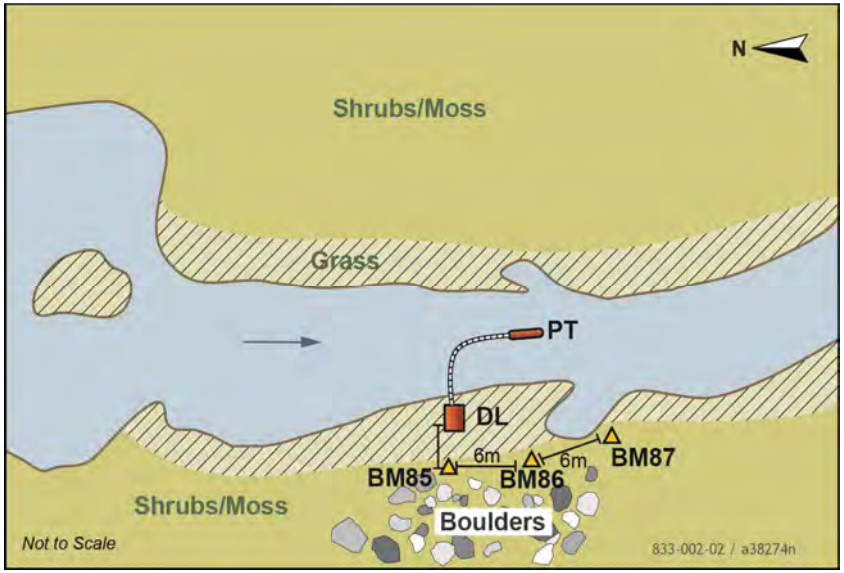
Appendix 1.14. Station Information Sheet for Hydrometric Station KL-H1

Site ID:	KL-H1	**Drainage Area (km²):**	24.0
Site Location:	On Channel between Esker Pond and Komatic Lake		
UTM:	NAD 83, Zone 13W	390,592E	7,309,400N
Benchmarks	**Elevation (m)**	**Description**	
BM 85	100.000	Bolt in rock 5m behind station	
BM 86	100.126	Bolt in rock 6m downstream of station	
BM 87	99.627	Bolt in rock 6m downstream of BM 86	
Transducer:	PT-2X	**Logger:**	Self-contained
Operating Period:			
2012	June 10 – Sep 12	Established on June 10, 2012	
General Comments:			

- Narrow, deep channel with swift flows at high water
- Wadeable under all conditions
- Pool-riffle morphology with large, deep pool downstream of station
- Access by helicopter



Site Map



Plan View of Hydrometric Station KL-H1

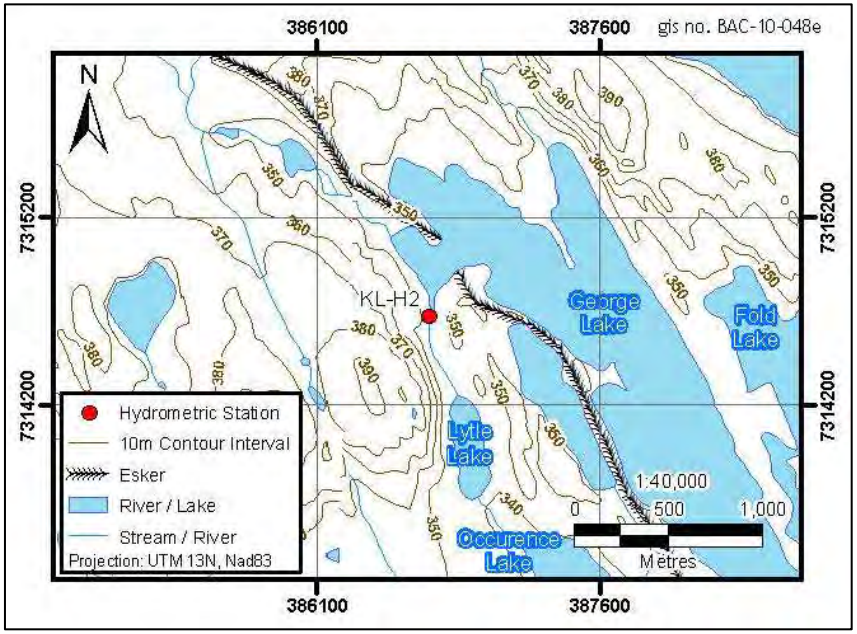
High angle oblique view looking upstream at the channel section under high flow conditions. The station is shown on the right bank. June 15, 2012.

Site Photo

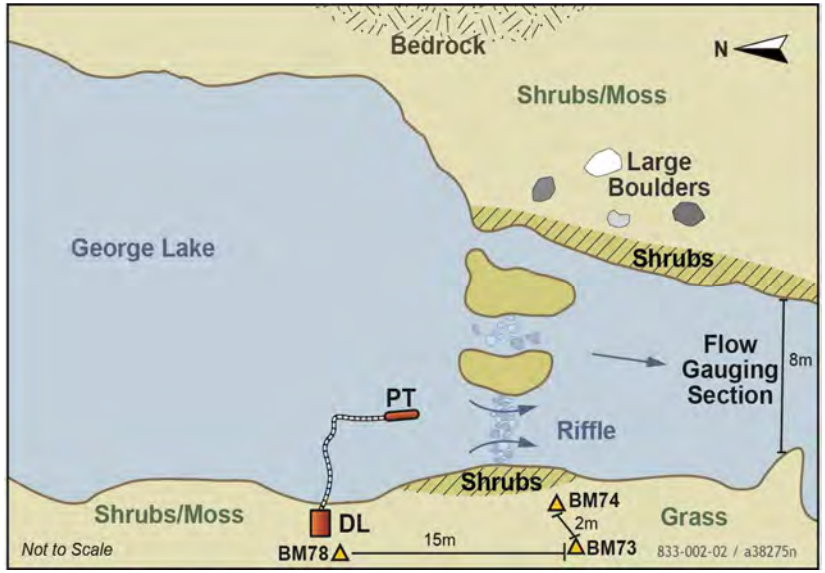
Appendix 1.15. Station Information Sheet for Hydrometric Station KL-H2

Site ID:	KL-H2	**Drainage Area (km²):**	9.82
Site Location:	George Lake outflow		
UTM:	NAD 83, Zone 13W	386,687E	7,314,673N
Benchmarks	**Elevation (m)**	**Description**	
BM 73	100.000	Bolt in rock 15m downstream of station	
BM 74	99.848	Bolt in rock 2m east of BM 73	
BM 78	100.733	Bolt in rock behind station	
Transducer:	PT-2X	**Logger:**	Self-contained
Operating Period:			
2012	June 10 – Sep 12	Established on June 10, 2012	
General Comments:			

- Wide, boulder
- Wadeable under all conditions
- Cobble bed with water flowing mainly deep in loose cobbles at low water
- Access by helicopter



Site Map



Plan View of Hydrometric Station KL-H2

Low angle downstream view of the outlet of George Lake and KL-H2. The station can be seen on the right bank upstream of the gauging section. June 10, 2012.

Site Photo

Appendix 2
Discharge Measurements

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Engineers and Scientists

Appendix 2-1. Manual Discharge Measurements and Levelling Surveys at GL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H1			
Stream Name	Goose Neck			
Date Monitored	5-Jun-12			
Time at Site (24 hr)	Start Time:	2:00:00 PM	End Time:	5:30:00 PM
Personnel	Eli, Coby			
Station Cordinates	Easting	Northing	Elevation	
	430,772E	7,279,016N	275m	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PS98i	Serial #	2818014
Gain	3.52168	Offset	0
Status	O.k.	Battery	100%
# of Records	0	Memory Free	32535 readings
Date Serviced	n/a	Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 3	1.142	101.142		100.000	
BM 4			0.926	100.216	
WL			1.464	**99.678**	
PT			2.487	98.655	
BM 5			0.617	100.525	
BM 5	0.529	101.054			
PT			2.420	98.634	
WL			1.375	**99.679**	
BM 4			0.838	100.216	
BM 3			1.054	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 4	100.218	100.216	-0.002	
BM 5	100.527	100.525	-0.002	
PT	98.584	98.578	-0.006	

Summary	
Stage (m)	99.679
Discharge (m^3/s)	No Measurement on this date
Pressure Transducer Reading (m)	1.101
Pressure Transducer Elevation (m)	98.578

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	15:30	End	16:15	Location	4m downstream of PT				
Method				Instrument Model						
Flow Meter Type				Instrument Serial #						
Stage (m)	Start	Reading		Time		Flo-Mate not functional				
	End	Reading		Time						

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	18.26	0.00	0.00	0.04					
	18.80	0.14	0.54	0.07					
	19.30	0.16	0.50	0.06					
	19.60	0.21	0.30	0.04					
	19.70	0.37	0.10	0.15					
	20.40	0.48	0.70	0.31					
	21.00	0.59	0.60	0.32					
	21.50	0.69	0.50	0.31					
	21.90	0.68	0.40	0.20					
	22.10	0.90	0.20	0.18					
	22.30	1.12	0.20	0.34					
	22.70	0.90	0.40	0.34					
	23.05	0.77	0.35	0.27					
	23.40	0.54	0.35	0.18					
	23.71	0.47	0.31	0.08					
RB	23.75	0.00	0.04	0.00					

General Notes
Higher energy arctic stream. Confined by Bedrock banks. Cascade pool morphology. Mixed bedrock and boulder bed. Gradient = -2%(pool with PT), -6% cascade downstream. Flowmate not functional June 5. Unable to survey same position on PT due to deep water.

Appendix 2-1. Manual Discharge Measurements and Levelling Surveys at GL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H1			
Stream Name	Goose Neck			
Date Monitored	13-Jun-12			
Time at Site (24 hr)	Start Time:	3:20:00 PM	End Time:	5:10:00 PM
Personnel	Eli, Coby			
Station Cordinates	Easting	Northing	Elevation	
	430,772E	7,279,016N	275m	
Weather Conditions	Above Zero	Partly Cloudy		

Transducer Information			
PT Model	PS98i	Serial #	2818014
Gain	3.52168	Offset	0
Status	O.k.	Battery	100%
# of Records	1151	Memory Free	31956 readings
Date Serviced	n/a	Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 3	0.934	100.934		100.000	
BM 4			0.718	100.216	
WL			1.533	**99.401**	
PT			2.332	98.602	
BM 5			0.409	100.525	
BM 5	0.444	100.969			
PT			2.369	98.600	
WL			1.567	**99.402**	
BM 4			0.753	100.216	
BM 3			0.970	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 4	100.218	100.216	-0.002	
BM 5	100.527	100.525	-0.002	
PT	98.584	98.582	-0.002	

Summary	
Stage (m)	99.402
Discharge (m^3/s)	0.384
Pressure Transducer Reading (m)	0.820
Pressure Transducer Elevation (m)	98.582

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	15:30	End	16:15	Location	1m downstream of PT			
Method	Velocity-area (Mid-section)			Instrument Model		Flomate			
Flow Meter Type	Flomate			Instrument Serial #		2004405			
Stage (m)	Start	Reading	0.819	Time	15:30				
	End	Reading	0.819	Time	16:15				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	19.15	0.00	0.00	0.01	0			0.000	0.0
	19.30	0.16	0.15	0.03	0.02			0.001	0.1
	19.50	0.18	0.20	0.04	0.1			0.004	0.9
	19.70	0.16	0.20	0.03	0.16			0.005	1.3
	19.90	0.18	0.20	0.04	0.2			0.007	1.9
	20.10	0.13	0.20	0.03	0.23			0.006	1.6
	20.30	0.08	0.20	0.02	0.22			0.004	0.9
	20.50	0.07	0.20	0.01	0.25			0.003	0.9
	20.70	0.12	0.20	0.02	0.3			0.007	1.9
	20.90	0.66	0.20	0.12	0.35			0.040	10.5
	21.05	0.64	0.15	0.10	0.34			0.033	8.5
	21.20	0.60	0.15	0.09	0.32			0.029	7.5
	21.35	0.60	0.15	0.09	0.32			0.029	7.5
	21.50	0.60	0.15	0.09	0.29			0.026	6.8
	21.65	0.54	0.15	0.08	0.23			0.019	4.9
	21.80	0.61	0.15	0.11	0.29			0.031	8.1
	22.00	0.48	0.20	0.10	0.26			0.025	6.5
	22.20	0.46	0.20	0.10	0.24			0.025	6.5
	22.45	0.46	0.25	0.12	0.25			0.029	7.5
	22.70	0.36	0.25	0.09	0.14			0.013	3.3
	22.95	0.33	0.25	0.08	0.24			0.020	5.2
	23.20	0.23	0.25	0.06	0.21			0.012	3.1
	23.45	0.16	0.25	0.04	0.2			0.008	2.1
	23.70	0.16	0.25	0.04	0.19			0.007	1.8
	23.90	0.16	0.20	0.02	0.14			0.003	0.7
LB	23.95	0.00	0.05	0.00	0			0.000	0.0
								0.384	**100.0**

General Notes
Gradiant from pool to below DS large riffle = 3.5%

Appendix 2-1. Manual Discharge Measurements and Levelling Surveys at GL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H1			
Stream Name	Goose Neck			
Date Monitored	6-Jul-12			
Time at Site (24 hr)	Start Time:	2:11:00 PM	End Time:	5:30:00 PM
Personnel	Eli H., Jacqueline			
Station Cordinates	Easting	Northing	Elevation	
	430772	7270016	275m	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PS98i	Serial #	281804
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	4456	Memory Free	30307
Date Serviced		Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 3	0.932	100.932		100.000	
BM 5			0.402	100.530	
BM 4			0.712	100.220	
PT			2.327	98.605	
WL			1.842	**99.090**	
TBM	2.418	100.830	2.520	98.412	
WL			1.743	**99.087**	
PT			2.227	98.603	
BM 4			0.613	100.217	
BM 5			0.303	100.527	
BM 3			0.830	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 4	100.218	100.219	0.001	
BM 5	100.527	100.529	0.002	
PT	98.584	98.595	0.011	

Summary	
Stage (m)	99.089
Discharge (m^3/s)	0.0842
Pressure Transducer Reading (m)	0.494
Pressure Transducer Elevation (m)	98.595

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	14:16	End	14:58	Location	1.5m Downstream of PT			
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			Instrument Serial #		2007612			
Stage (m)	Start	Reading	0.494	Time	14:16				
	End	Reading	0.494	Time	14:58				

	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
LB	0.70	0.00	0.00	0.00	0.00	0.00		0.000	0.0
	0.78	0.05	0.02	0.08	0.00	0.04		0.000	0.1
	0.85	0.10	0.03	0.07	0.00	0.10		0.000	0.3
	0.95	0.15	0.05	0.10	0.00	0.15		0.001	0.8
	1.05	0.15	0.05	0.10	0.00	0.20		0.001	1.1
	1.15	0.20	0.06	0.10	0.01	0.18		0.001	1.3
	1.25	0.27	0.08	0.10	0.01	0.15		0.001	1.5
	1.35	0.31	0.09	0.10	0.01	0.23		0.002	2.6
	1.45	0.40	0.12	0.10	0.01	0.30		0.004	4.3
on rock	1.55	0.15	0.05	0.10	0.00	0.22		0.001	1.2
on rock	1.65	0.15	0.05	0.10	0.00	0.18		0.001	1.0
	1.75	0.20	0.06	0.10	0.01	0.18		0.001	1.3
	1.85	0.35	0.11	0.10	0.01	0.24		0.003	3.0
	1.95	0.56	0.17	0.10	0.01	0.27		0.003	4.1
	2.00	0.75	0.23	0.05	0.02	0.23		0.004	4.7
	2.10	0.90	0.27	0.10	0.03	0.21		0.006	6.8
	2.20	1.00	0.30	0.10	0.02	0.20		0.005	5.4
	2.25	1.10	0.34	0.05	0.02	0.25		0.004	5.0
	2.30	1.15	0.35	0.05	0.02	0.25		0.004	5.2
	2.35	1.20	0.37	0.05	0.02	0.38		0.007	8.3
	2.40	1.29	0.39	0.05	0.02	0.45		0.009	10.5
	2.45	1.30	0.40	0.05	0.02	0.44		0.009	10.4
	2.50	1.35	0.41	0.05	0.02	0.36		0.007	8.8
	2.55	1.30	0.40	0.05	0.02	0.33		0.007	7.8
	2.60	1.30	0.40	0.05	0.02	0.13		0.002	2.4
Rrock overhang	2.63	1.40	0.43	0.03	0.01	0.12		0.002	2.1
RB	2.67	0.00	0.00	0.04	0.01	0.00		0.000	0.0
Total Q								**0.0842**	**100.0**

General Notes
Gradiant = 2%. Imperial Rod used. Depth values converted from ft. to m (1ft. = 0.3048m)

Appendix 2-1. Manual Discharge Measurements and Levelling Surveys at GL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H1			
Stream Name	Goose Neck			
Date Monitored	10-Aug-12			
Time at Site (24 hr)	Start Time:	11:41:00 AM	End Time:	1:00:00 PM
Personnel	Eli H., Cenling X.			
Station Cordinates	Easting	Northing	Elevation	
	430772	7270016	275m	
Weather Conditions	Cloudy, windy			

Transducer Information			
PT Model	PS98i	Serial #	281804
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	9490	Memory Free	27790
Date Serviced		Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 3	1.087	101.087		100.000	
BM 5			0.560	100.527	
BM 4			0.868	100.219	
PT			2.488	98.599	
WL			2.433	**98.654**	
TBM	2.577	101.163	2.501	98.586	
WL			2.511	**98.652**	
PT			2.565	98.598	
BM 4			0.945	100.218	
BM 5			0.635	100.528	
BM 3			1.162	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 4	100.218	100.219	0.001	
BM 5	100.527	100.528	0.001	
PT	98.584	98.587	0.003	

Summary	
Stage (m)	98.653
Discharge (m^3/s)	0.00452
Pressure Transducer Reading (m)	0.066
Pressure Transducer Elevation (m)	98.587

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	12:30	End	13:15	Location	10m Downstream of PT				
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2006042				
Stage (m)	Start	Reading	0.066	Time	12:30					
	End	Reading	0.066	Time	13:15					

	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
LB	0.91	0.00	0.00	0.00	0.00	0		0.000	0.0
	0.96	0.10	0.03	0.05	0.00	0.07		0.000	2.1
	1.00	0.31	0.09	0.04	0.00	0.19		0.001	17.9
	1.05	0.56	0.17	0.05	0.01	0.12		0.001	22.6
	1.10	0.50	0.15	0.05	0.01	0.16		0.001	21.6
	1.13	0.22	0.07	0.03	0.00	0.16		0.000	5.9
	1.15	0.21	0.06	0.02	0.00	0.14		0.000	6.9
	1.20	0.21	0.06	0.05	0.00	0.12		0.000	8.5
	1.25	0.43	0.13	0.05	0.01	0.07		0.000	10.1
	1.30	0.43	0.13	0.05	0.01	0.05		0.000	7.2
	1.35	0.42	0.13	0.05	0.01	0.04		0.000	5.7
	1.40	0.21	0.06	0.05	0.00	-0.02		0.000	-1.4
	1.45	0.20	0.06	0.05	0.00	-0.03		0.000	-2.0
	1.50	0.22	0.07	0.05	0.00	-0.03		0.000	-2.2
	1.55	0.29	0.09	0.05	0.00	-0.03		0.000	-2.9
RB	1.60	0.00	0.00	0.05	0.00	0		0.000	0.0
Total Q								**0.00452**	**100.0**

General Notes
Gradiant = 2%. Imperial Rod used. Depth values converted from ft. to m (1ft. = 0.3048m)

Appendix 2-1. Manual Discharge Measurements and Levelling Surveys at GL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H1			
Stream Name	Goose Neck			
Date Monitored	7-Sep-12			
Time at Site (24 hr)	Start Time:	10:53:00 AM	End Time:	12:00:00 PM
Personnel	Eli H., Scott C.			
Station Cordinates	Easting	Northing	Elevation	
	430772	7270016	275m	
Weather Conditions	Cloudy, cool			

Transducer Information			
PT Model	PS98i	Serial #	281804
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	13508	Memory Free	25780
Date Serviced		Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 3	2.581	102.581		100.000	
BM 5			2.365	100.216	
BM 4			2.057	100.524	
PT			3.985	98.596	
WL			3.917	**98.664**	
TBM	3.843	102.516	3.908	98.673	
WL			3.853	**98.663**	
PT			3.918	98.598	
BM 4			1.991	100.525	
BM 5			2.300	100.216	
BM 3			2.519	99.997	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 4	100.218	100.216	-0.002	
BM 5	100.527	100.525	-0.002	
PT	98.584	98.578	-0.006	

Summary	
Stage (m)	98.664
Discharge (m^3/s)	0.00652
Pressure Transducer Reading (m)	0.086
Pressure Transducer Elevation (m)	98.578

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	10:53	End	12:00	Location	20m Downstream of PT			
Method	Velocity-area (Mid-section)			Instrument Model		Swoffer 2100			
Flow Meter Type	Swoffer			Instrument Serial #					
Stage (m)	Start	Reading	0.085	Time	10:53				
	End	Reading	0.086	Time	12:00				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	0.62	0.00	0.00	0.00	0			0.000	0.0
	0.67	0.07	0.05	0.00	0			0.000	0.0
	0.73	0.07	0.06	0.00	0.01			0.000	0.7
	0.80	0.06	0.07	0.00	0.01			0.000	0.6
	0.85	0.08	0.05	0.00	0.01			0.000	0.6
	0.90	0.13	0.05	0.01	0.02			0.000	1.6
	0.93	0.12	0.03	0.00	0.12			0.001	7.7
	0.97	0.12	0.04	0.00	0.15			0.001	8.3
	0.99	0.15	0.02	0.00	0.15			0.001	8.6
	1.02	0.08	0.03	0.00	0.17			0.000	7.3
	1.06	0.06	0.04	0.00	0.19			0.001	7.9
	1.11	0.08	0.05	0.00	0.2			0.001	11.0
	1.15	0.19	0.04	0.01	0.12			0.001	14.0
	1.19	0.19	0.04	0.01	0.13			0.001	15.2
	1.23	0.17	0.04	0.01	0.1			0.001	9.1
	1.26	0.07	0.03	0.00	0.16			0.000	6.0
	1.30	0.02	0.04	0.00	0.13			0.000	1.4
	1.33	0.00	0.03	0.00	0			0.000	0.0
Total Q								**0.00652**	**100.0**

General Notes
Gradiant = 2%

Appendix 2-2. Manual Discharge Measurements and Levelling Surveys at GL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H2			
Stream Name	Llama Lake Outflow			
Date Monitored	5-Jun-12			
Time at Site (24 hr)	**Start Time:**	8:45:00 AM	**End Time:**	1:45:00 PM
Personnel	Eli, Coby			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	428,746E	7,271,567N	287m	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PS98i	**Serial #**	2818013
Gain	3.52168	**Offset**	0
Status	O.k.	**Battery**	100%
# of Records	0	**Memory Free**	32535 readings
Date Serviced	n/a	**Crest Gauges**	No

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM-01	1.351	101.351		100.000	
BM-02			1.612	99.739	
WL			1.614	**99.737**	
PT			1.924	99.427	Top of PVC
BM-03			1.576	99.775	
BM-03	1.544	101.319			
PT			1.892	99.427	
WL			1.583	**99.736**	
BM-02			1.580	99.739	
BM-01			1.318	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM-02	99.746	99.739	-0.007	
BM-03	99.792	99.775	-0.017	
PT	99.427	99.427	0.000	

Summary	
Stage (m)	99.737
Discharge (m^3/s)	No Discharge Measurement on this date
Pressure Transducer Reading (m)	0.339
Pressure Transducer Elevation (m)	99.398

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	10:25	**End**	12:36	**Location**	2m downstream of PT		
Method	Velocity-area (Mid-section)			**Instrument Model**				
Flow Meter Type				**Instrument Serial #**				
Stage (m)	**Start**	**Reading**		**Time**				
	End	**Reading**		**Time**				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	18.00	0.00	0.00	0.01					
Grass	18.25	0.07	0.25	0.04					
Grass	19.00	0.07	0.75	0.06					
Grass	20.00	0.11	1.00	0.12					
Grass	21.15	0.22	1.15	0.14					
	21.30	0.32	0.15	0.07					
	21.60	0.45	0.30	0.19					
	22.13	0.48	0.53	0.30					
	22.85	0.46	0.72	0.20					
	23.00	0.42	0.15	0.08					
Grass	23.21	0.32	0.21	0.06					
Grass	23.40	0.16	0.19	0.10					
Grass	24.50	0.20	1.10	0.21					
Grass	25.50	0.16	1.00	0.16					
Grass	26.50	0.18	1.00	0.18					
Grass	27.50	0.10	1.00	0.10					
Grass	28.50	0.04	1.00	0.04					
RB	29.35	0.00	0.85	0.02					
Total Q									

General Notes

Flow mate not operational on June 5, 2012.

Appendix 2-2. Manual Discharge Measurements and Levelling Surveys at GL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H2			
Stream Name	Llama Lake Outflow			
Date Monitored	12-Jun-12			
Time at Site (24 hr)	Start Time:	3:00:00 PM	End Time:	4:30:00 PM
Personnel	Eli, Coby			
Station Cordinates	Easting	Northing	Elevation	
	428,746E	7,271,567N	287m	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PS98i	Serial #	2818013
Gain	3.52168	Offset	0
Status	O.k.	Battery	100%
# of Records	1036	Memory Free	32014 readings
Date Serviced	n/a	Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM-01	1.236	101.236		100.000	
BM-02			1.502	99.734	
WL			1.557	**99.679**	
PT			1.805	99.431	error
BM-03			1.481	99.755	
BM-03	1.445	101.200			
PT			1.776	99.424	checked, ok
WL			1.523	**99.677**	
BM-02			1.466	99.734	
BM-01			1.202	99.998	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM-02	99.746	99.734	-0.012	
BM-03	99.792	99.755	-0.037	
PT	99.427	99.424	-0.003	

Summary	
Stage (m)	99.678
Discharge (m^3/s)	0.116
Pressure Transducer Reading (m)	0.281
Pressure Transducer Elevation (m)	99.397

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	15:15	End	16:05	Location	~40m upstream from PT				
Method	Velocity-area (Mid-section)			Instrument Model		Flomate				
Flow Meter Type	Flo-mate			Instrument Serial #		2004405				
Stage (m)	Start	Reading	0.28	Time	15:15					
	End	Reading	0.281	Time	16:05					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	0.35	0.00	0.00	0.01	0			0.000	0.0
	0.40	0.23	0.05	0.01	0.05			0.001	0.5
	0.45	0.22	0.05	0.01	0.32			0.004	3.0
	0.50	0.22	0.05	0.01	0.39			0.004	3.7
	0.55	0.22	0.05	0.01	0.4			0.004	3.8
	0.60	0.23	0.05	0.01	0.44			0.005	4.3
	0.65	0.23	0.05	0.01	0.48			0.006	4.7
	0.70	0.23	0.05	0.01	0.44			0.005	4.3
	0.75	0.24	0.05	0.01	0.42			0.005	4.3
	0.80	0.23	0.05	0.01	0.51			0.006	5.0
	0.85	0.25	0.05	0.01	0.52			0.007	5.6
	0.90	0.23	0.05	0.01	0.49			0.006	4.8
	0.95	0.23	0.05	0.01	0.51			0.006	5.0
	1.00	0.23	0.05	0.01	0.49			0.006	4.8
	1.05	0.22	0.05	0.01	0.51			0.006	4.8
	1.10	0.22	0.05	0.01	0.49			0.005	4.6
	1.15	0.24	0.05	0.01	0.48			0.006	4.9
	1.20	0.23	0.05	0.01	0.45			0.005	4.4
	1.25	0.22	0.05	0.01	0.45			0.005	4.2
	1.30	0.24	0.05	0.01	0.43			0.005	4.4
	1.35	0.24	0.05	0.01	0.42			0.005	4.3
	1.40	0.22	0.05	0.01	0.39			0.004	3.7
	1.45	0.22	0.05	0.01	0.37			0.004	3.5
	1.50	0.22	0.05	0.01	0.33			0.004	3.1
	1.55	0.21	0.05	0.01	0.29			0.003	2.6
	1.60	0.16	0.05	0.01	0.22			0.001	1.2
	1.63	0.00	0.03	0.00	0			0.000	0.0
Total Q								**0.116**	**100.0**

General Notes

Appendix 2-2. Manual Discharge Measurements and Levelling Surveys at GL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H2			
Stream Name	Llama Lake Outflow			
Date Monitored	6-Jul-12			
Time at Site (24 hr)	Start Time:	9:30:00 AM	End Time:	1:16:00 PM
Personnel	Eli H., Jacqueline			
Station Cordinates	Easting	Northing	Elevation	
	428746	7271567	287	
Weather Conditions	Mix of Sun and Cloud			

Transducer Information			
PT Model	PS98i	Serial #	2818013
Gain	3.52168	Offset	0
Status	OK	Battery	97%
# of Records	4460	Memory Free	30304
Date Serviced		Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 1	1.112	101.112		100.000	
BM 2			1.368	99.744	
BM 3			1.332	99.780	
PT			1.678	99.434	error
WL			1.511	**99.601**	
TBM	1.589	101.069	1.632	99.480	
WL			1.469	**99.600**	
PT			1.639	99.430	checked, correct
BM 3			1.290	99.779	
BM 2			1.326	99.743	
BM 1			1.070	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 2	99.746	99.744	-0.002	
BM 3	99.792	99.780	-0.013	
PT	99.427	99.430	0.003	

Summary	
Stage (m)	99.601
Discharge (m^3/s)	0.0270
Pressure Transducer Reading (m)	0.189
Pressure Transducer Elevation (m)	99.412

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	9:48	End	10:34	Location					
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2007612				
Stage (m)	Start	Reading	0.19	Time	9:48					
	End	Reading	0.189	Time	10:34					

	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
RB	0.80	0.00	0.00	0.00	0.00	0.00		0.000	0.0
Moss	0.90	0.15	0.05	0.10	0.00	0.12		0.000	1.7
	0.97	0.35	0.11	0.07	0.01	0.15		0.001	4.1
	1.04	0.40	0.12	0.07	0.01	0.18		0.002	5.7
	1.11	0.40	0.12	0.07	0.01	0.15		0.001	5.4
	1.20	0.40	0.12	0.09	0.01	0.16		0.001	5.4
	1.26	0.40	0.12	0.06	0.01	0.16		0.001	4.3
	1.32	0.55	0.17	0.06	0.01	0.17		0.002	6.3
	1.38	0.55	0.17	0.06	0.01	0.17		0.002	6.3
	1.44	0.50	0.15	0.06	0.01	0.16		0.002	5.9
On Rock	1.51	0.30	0.09	0.07	0.01	0.14		0.001	3.3
On Rock	1.58	0.30	0.09	0.07	0.01	0.12		0.001	2.8
	1.65	0.50	0.15	0.07	0.01	0.11		0.001	4.3
	1.72	0.40	0.12	0.07	0.01	0.12		0.001	3.8
	1.79	0.60	0.18	0.07	0.01	0.12		0.002	5.7
	1.86	0.70	0.21	0.07	0.01	0.12		0.002	6.6
	1.93	0.70	0.21	0.07	0.01	0.12		0.002	6.6
	2.00	0.50	0.15	0.07	0.01	0.12		0.001	4.7
	2.07	0.50	0.15	0.07	0.01	0.10		0.001	3.9
	2.14	0.50	0.15	0.07	0.01	0.12		0.001	4.7
	2.21	0.50	0.15	0.07	0.01	0.11		0.001	4.3
	2.28	0.45	0.14	0.07	0.01	0.07		0.001	2.1
Grass	2.33	0.45	0.14	0.05	0.01	0.03		0.000	0.9
Grass	2.40	0.40	0.12	0.07	0.01	0.01		0.000	0.4
	2.50	0.30	0.09	0.10	0.01	0.01		0.000	0.4
LB	2.65	0.00	0.00	0.15	0.01	0.00		0.000	0.0
Total Q								**0.0270**	**100.0**

General Notes
Imperial Rod used. Depth values converted from ft. to m (1ft. = 0.3048m)

Appendix 2-2. Manual Discharge Measurements and Levelling Surveys at GL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H2			
Stream Name	Llama Lake Outflow			
Date Monitored	10-Aug-12			
Time at Site (24 hr)	Start Time:	2:20:00 PM	End Time:	4:00:00 PM
Personnel	Eli H., Cenling X.			
Station Cordinates	Easting	Northing	Elevation	
	428746	7271567	287	
Weather Conditions	Cloudy, cool			

Transducer Information			
PT Model	PS98i	Serial #	2818013
Gain	3.52168	Offset	0
Status	OK	Battery	97%
# of Records	9528	Memory Free	27771
Date Serviced		Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 1	1.191	101.191		100.000	
BM 2			1.446	99.745	
BM 3			1.411	99.780	
PT			1.758	99.433	
WL			1.661	**99.530**	
TBM	1.624	101.134	1.681	99.510	
WL			1.603	**99.531**	
PT			1.701	99.433	
BM 3			1.353	99.781	
BM 2			1.388	99.746	
BM 1			1.133	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 2	99.746	99.746	-0.001	
BM 3	99.792	99.781	-0.011	
PT	99.427	99.433	0.006	

Summary	
Stage (m)	99.531
Discharge (m^3/s)	0.00127
Pressure Transducer Reading (m)	0.122
Pressure Transducer Elevation (m)	99.408

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	14:34	End	15:12	Location					
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2006042				
Stage (m)	Start	Reading	0.123	Time	14:34					
	End	Reading	0.122	Time	15:12					

	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
RB	0.40	0.00	0.00	0.00	0.00	0		0.000	0.0
	0.45	0.10	0.03	0.05	0.00	0.04		0.000	4.8
	0.50	0.12	0.04	0.05	0.00	0.07		0.000	10.1
	0.55	0.21	0.06	0.05	0.00	0.05		0.000	12.6
	0.60	0.21	0.06	0.05	0.00	0.07		0.000	17.7
	0.65	0.21	0.06	0.05	0.00	0.11		0.000	27.8
	0.70	0.15	0.05	0.05	0.00	0.06		0.000	10.8
	0.75	0.15	0.05	0.05	0.00	0.03		0.000	5.4
	0.80	0.12	0.04	0.05	0.00	0.03		0.000	10.8
LB	1.00	0.00	0.00	0.20	0.00	0		0.000	0.0
Total Q								0.00127	100.0

General Notes
Imperial Rod used. Depth values converted from ft. to m (1ft. = 0.3048m)

Appendix 2-2. Manual Discharge Measurements and Levelling Surveys at GL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H2			
Stream Name	Llama Lake Outflow			
Date Monitored	7-Sep-12			
Time at Site (24 hr)	Start Time:	8:45:00 AM	End Time:	10:45:00 AM
Personnel	Eli H., Scott C.			
Station Cordinates	Easting	Northing	Elevation	
	428746	7271567	287	
Weather Conditions	Cloudy, recent rain			

Transducer Information			
PT Model	PS98i	Serial #	2818013
Gain	3.52168	Offset	0
Status	OK	Battery	97%
# of Records	13526	Memory Free	25771
Date Serviced		Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 1	1.151	101.151		100.000	
BM 2			1.402	99.749	
BM 3			1.374	99.777	
PT			1.724	99.427	
WL			1.612	**99.539**	
TBM	1.551	101.082	1.620	99.531	
WL			1.546	**99.536**	
PT			1.658	99.424	
BM 3			1.307	99.775	
BM 2			1.336	99.746	
BM 1			1.085	99.997	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 2	99.746	99.748	0.002	
BM 3	99.792	99.776	-0.016	
PT	99.427	99.426	-0.002	

Summary	
Stage (m)	99.538
Discharge (m^3/s)	0.00151
Pressure Transducer Reading (m)	0.136
Pressure Transducer Elevation (m)	99.402

Discharge Measurement - Mid-Section Method											
Time (24 hr)	Start	8:50	End	9:20	Location						
Method	Velocity-area (Mid-section)			Instrument Model	Swoffer 2100						
Flow Meter Type	Swoffer			Instrument Serial #							
Stage (m)	Start	Reading	0.135	Time	8:50						
	End	Reading	0.136	Time	9:20						

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	1.32	0.00	0.00	0.00	0			0.000	0.0
	1.39	0.10	0.07	0.01	0.01			0.000	4.3
	1.45	0.10	0.06	0.00	0.04			0.000	12.0
	1.48	0.10	0.03	0.00	0.06			0.000	12.0
	1.51	0.07	0.03	0.00	0.04			0.000	6.5
	1.55	0.07	0.04	0.00	0.1			0.000	16.3
	1.58	0.06	0.03	0.00	0.2			0.000	23.9
	1.61	0.06	0.03	0.00	0.14			0.000	25.1
RB	1.67	0.00	0.06	0.00	0			0.000	0.0
Total Q								**0.00151**	**100.0**

General Notes

Appendix 2-3. Manual Discharge Measurements and Levelling Surveys at GL-H3 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H3			
Stream Name	Inflow to GL			
Date Monitored	7-Jun-12			
Time at Site (24 hr)	Start Time:	3:30:00 PM	End Time:	5:40:00 PM
Personnel	Eli, Coby			
Station Cordinates	Easting	Northing	Elevation	
	432,891	7,269,919		
Weather Conditions	Sunny			

Transducer Information			
PT Model	PS98i	Serial #	2818016
Gain	3.52168	Offset	0
Status	O.k.	Battery	100%
# of Records	1	Memory Free	32535 readings
Date Serviced	n/a	Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 17	1.506	101.506		100.000	
BM 18			1.367	100.139	
PT			2.603	98.903	
WL			1.671	**99.835**	
BM19			1.475	100.031	
BM19	1.394	101.425			
PT			2.523	98.902	
WL			1.586	**99.839**	
BM18			1.286	100.139	
BM17			1.425	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 18	100.137	100.139	0.002	
BM19	100.042	100.031	-0.011	
PT	98.902	99.369	0.467	

Summary	
Stage (m)	99.837
Discharge (m^3/s)	0.335
Pressure Transducer Reading (m)	0.981
Pressure Transducer Elevation (m)	98.856

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start		End		Location	10m upstream of PT				
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate 2000				
Flow Meter Type	Flo-mate			Instrument Serial #		2004405				
Stage (m)	Start	Reading	0.981	Time	16:00					
	End	Reading	0.981	Time	17:00					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	18.22	0.00	0.00	0.00	0			0.000	0.0
	18.30	0.06	0.08	0.01	0.05			0.000	0.1
	18.40	0.11	0.10	0.01	0.08			0.001	0.3
	18.50	0.18	0.10	0.02	0.11			0.002	0.6
	18.60	0.20	0.10	0.02	0.08			0.002	0.5
	18.70	0.20	0.10	0.02	0.21			0.004	1.3
	18.80	0.27	0.10	0.03	0.37			0.010	3.0
	18.90	0.28	0.10	0.03	0.43			0.012	3.6
	19.00	0.33	0.10	0.03	0.53			0.017	5.2
	19.10	0.36	0.10	0.04	0.49			0.018	5.3
	19.20	0.41	0.10	0.04	0.6			0.025	7.3
	19.30	0.43	0.10	0.04	0.59			0.025	7.6
	19.40	0.45	0.10	0.04	0.58			0.026	7.8
	19.50	0.42	0.10	0.04	0.6			0.025	7.5
	19.60	0.44	0.10	0.04	0.61			0.027	8.0
	19.70	0.46	0.10	0.05	0.65			0.030	8.9
	19.80	0.47	0.10	0.05	0.67			0.031	9.4
	19.90	0.46	0.10	0.05	0.74			0.034	10.2
	20.00	0.40	0.10	0.04	0.61			0.024	7.3
	20.10	0.36	0.10	0.04	0.39			0.014	4.2
	20.20	0.29	0.10	0.03	0.16			0.005	1.4
	20.30	0.24	0.10	0.02	0.09			0.002	0.6
	20.40	0.20	0.10	0.02	0.05			0.001	0.3
	20.50	0.19	0.10	0.02	0			0.000	0.0
	20.60	0.18	0.10	0.03	-0.03			-0.001	-0.2
LB	20.80	0.00	0.20	0.00	0			0.000	0.0
Total Q								**0.335**	**100.0**

General Notes
Plain grass bed with deep boulder pool. Small riffle 20m downstream.

Appendix 2-3. Manual Discharge Measurements and Levelling Surveys at GL-H3 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H3			
Stream Name	Inflow to GL			
Date Monitored	13-Jun-12			
Time at Site (24 hr)	Start Time:	10:25:00 AM	End Time:	11:50:00 AM
Personnel	Eli H., Coby H.			
Station Cordinates	Easting	Northing	Elevation	
	432,891	7,269,919		
Weather Conditions	Sunny			

Transducer Information			
PT Model	PS98i	Serial #	2818016
Gain	3.52168	Offset	0
Status	O.k.	Battery	100%
# of Records	830	Memory Free	32116 readings
Date Serviced	n/a	Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 17	1.622	101.622		100.000	
BM 18			1.482	100.140	
PT			2.709	98.913	error, on clamp
WL			1.876	**99.746**	
BM19			1.588	100.034	Az
BM19	1.561	101.595			175.000
PT			2.690	98.905	
WL			1.846	**99.749**	272.000
BM18			1.454	100.141	139.000
BM17			1.594	100.001	129.000

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 18	100.137	100.141	0.004	
BM19	100.042	100.034	-0.008	
PT	98.902	98.905	0.003	

Summary	
Stage (m)	99.748
Discharge (m^3/s)	0.0503
Pressure Transducer Reading (m)	0.889
Pressure Transducer Elevation (m)	98.859

Discharge Measurement - Mid-Section Method											
Time (24 hr)	Start	10:33	End	11:08	Location	15m upstream of PT					
Method	Velocity-area (Mid-section)				Instrument Model	Flowmate					
Flow Meter Type	Flo-mate				Instrument Serial #	2004405					
Stage (m)	Start	Reading	0.888		Time	10:33					
	End	Reading	0.889		Time	11:08					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.66	0.00	0.00	0.00	0			0.000	0.0
	0.75	0.07	0.09	0.01	-0.01			0.000	-0.1
	0.85	0.14	0.10	0.01	0			0.000	0.0
	0.90	0.18	0.05	0.01	0.01			0.000	0.3
	1.00	0.26	0.10	0.03	0.05			0.001	2.6
	1.10	0.25	0.10	0.03	0.1			0.003	5.0
	1.20	0.26	0.10	0.03	0.12			0.003	6.2
	1.30	0.26	0.10	0.03	0.12			0.003	6.2
	1.40	0.28	0.10	0.03	0.13			0.004	7.2
	1.50	0.28	0.10	0.03	0.15			0.004	8.3
	1.60	0.30	0.10	0.03	0.14			0.004	8.3
	1.70	0.34	0.10	0.03	0.15			0.005	10.1
	1.80	0.34	0.10	0.03	0.15			0.005	10.1
	1.90	0.34	0.10	0.03	0.17			0.006	11.5
	2.00	0.34	0.10	0.03	0.16			0.005	10.8
	2.10	0.30	0.10	0.03	0.15			0.005	8.9
	2.20	0.22	0.10	0.02	0.08			0.002	3.5
	2.30	0.14	0.10	0.01	0.04			0.001	1.1
	2.40	0.10	0.10	0.01	0			0.000	0.0
	2.50	0.06	0.10	0.01	-0.01			0.000	-0.1
LB	2.60	0.00	0.10	0.00	0			0.000	0.0
Total Q								**0.0503**	**100.0**

General Notes
Gradiant = 1.5%

Appendix 2-3. Manual Discharge Measurements and Levelling Surveys at GL-H3 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H3			
Stream Name	Inflow to GL			
Date Monitored	9-Jul-12			
Time at Site (24 hr)	Start Time:	1:50:00 PM	End Time:	5:45:00 PM
Personnel	Eli H., Yasser A.			
Station Cordinates	Easting	Northing	Elevation	
	432,891	7,269,919		
Weather Conditions	Sunny			

Transducer Information			
PT Model	PS98i	Serial #	2818016
Gain	3.52168	Offset	0
Status	O.k.	Battery	100%
# of Records	4595	Memory Free	30230
Date Serviced	n/a	Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 17	1.677	101.677		100.000	
BM 18			1.520	100.157	
BM 19			1.623	100.054	
PT			2.754	98.923	
WL			2.002	**99.675**	
TBM	1.687	101.622	1.742	99.935	
WL			1.942	**99.680**	
PT			2.698	98.924	
BM 19			1.568	100.054	
BM 18			1.462	100.160	
BM 17			1.619	100.003	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 18	100.137	100.159	0.022	
BM 19	100.042	100.054	0.012	
PT	98.902	98.924	0.022	

Summary	
Stage (m)	99.678
Discharge (m^3/s)	0.0167
Pressure Transducer Reading (m)	0.795
Pressure Transducer Elevation (m)	98.883

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	14:02	End	14:45	Location	15m upstream of PT				
Method	Velocity-area (Mid-section)			Instrument Model		Flomate				
Flow Meter Type	Flo-mate			Instrument Serial #		2007612				
Stage (m)	Start	Reading	0.796	Time	14:02					
	End	Reading	0.795	Time	14:45					

	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
RB	0.98	0.00	0.00	0.00	0.00	0.00		0.000	0.0
	1.05	0.32	0.10	0.07	0.01	0.00		0.000	0.0
	1.10	0.50	0.15	0.05	0.01	0.01		0.000	0.5
	1.17	0.68	0.21	0.07	0.01	0.01		0.000	0.9
	1.24	0.80	0.24	0.07	0.02	0.01		0.000	1.0
	1.31	0.90	0.27	0.07	0.02	0.03		0.001	3.4
	1.38	0.95	0.29	0.07	0.02	0.04		0.001	4.9
	1.45	0.96	0.29	0.07	0.02	0.04		0.001	4.9
	1.52	0.95	0.29	0.07	0.02	0.05		0.001	6.1
	1.59	0.90	0.27	0.07	0.02	0.06		0.001	6.9
	1.66	0.80	0.24	0.07	0.02	0.07		0.001	7.1
	1.73	0.81	0.25	0.07	0.02	0.07		0.001	7.2
	1.80	0.87	0.27	0.07	0.02	0.06		0.001	6.7
	1.87	0.90	0.27	0.07	0.02	0.07		0.001	8.0
	1.94	0.90	0.27	0.07	0.02	0.07		0.001	8.0
	2.01	0.92	0.28	0.07	0.02	0.05		0.001	5.9
	2.08	0.96	0.29	0.07	0.02	0.06		0.001	7.4
	2.15	0.93	0.28	0.07	0.02	0.05		0.001	5.9
	2.22	0.90	0.27	0.07	0.02	0.05		0.001	5.7
	2.29	0.67	0.20	0.07	0.01	0.06		0.001	5.1
	2.36	0.60	0.18	0.07	0.01	0.03		0.000	2.3
	2.43	0.54	0.16	0.07	0.01	0.03		0.000	1.9
	2.49	0.20	0.06	0.06	0.00	0.00		0.000	0.0
LB	2.53	0.00	0.00	0.04	0.00	0.00		0.000	0.0
Total Q								**0.0167**	**100.0**

General Notes
Gradiant = 1.5%. Imperial Rod used. Depth values converted from ft. to m (1ft. = 0.3048m).

Appendix 2-3. Manual Discharge Measurements and Levelling Surveys at GL-H3 in 2012

Site Information					
Project Name	Back River				
Station Identification	GL-H3				
Stream Name	Inflow to GL				
Date Monitored	15-Aug-12				
Time at Site (24 hr)	Start Time:	10:05:00 AM	End Time:	1:00:00 PM	
Personnel	Eli H., Cenling X				
Station Cordinates	Easting	Northing	Elevation		
	432,891	7,269,919			
Weather Conditions	Above Zero	Partly Cloudy			
Transducer Information					
PT Model	PS98i	Serial #		2818016	
Gain	3.52168	Offset		0	
Status	O.k.	Battery		100%	
# of Records	9900	Memory Free		55276	
Date Serviced	n/a	Crest Gauges		No	
Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 17	1.780	101.780		100.000	
BM 18			1.627	100.153	
BM 19			1.728	100.052	
PT			2.845	98.935	
WL			2.212	**99.568**	
TBM	2.779	101.714	2.845	98.935	
WL			2.148	**99.566**	
PT			2.779	98.935	
BM 19			1.661	100.053	
BM 18			1.562	100.152	
BM 17			1.713	100.001	
BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**		**Difference (m)**	**Notes**
BM 18	100.137	100.153		0.016	
BM 19	100.042	100.053		0.011	
PT	98.902	98.935		0.033	
Summary					
Stage (m)			99.567		
Discharge (m^3/s)			No Flow		
Pressure Transducer Reading (m)			0.680		
Pressure Transducer Elevation (m)			98.887		

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	N/A	End	N/A	Location	N/A			
Method	No Flow			Instrument Model					
Flow Meter Type				Instrument Serial #					
Stage (m)	Start	Reading	0.68	Time	N/A	No Flow on August 15th			
	End	Reading	0.68	Time	N/A				
	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
NO FLOW									
Total Q								**0.000**	**0.0**

General Notes

Gradiant = 0%

Appendix 2-3. Manual Discharge Measurements and Levelling Surveys at GL-H3 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H3			
Stream Name	Inflow to GL			
Date Monitored	9-Sep-12			
Time at Site (24 hr)	Start Time:	3:45:00 PM	End Time:	5:00:00 PM
Personnel	Eli H., Scott C.			
Station Cordinates	Easting	Northing	Elevation	
	432,891	7,269,919		
Weather Conditions	Above Zero	Partly Cloudy		

Transducer Information			
PT Model	PS98i	Serial #	2818016
Gain	3.52168	Offset	0
Status	O.k.	Battery	100%
# of Records	13535	Memory Free	25759
Date Serviced	n/a	Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 17	1.739	101.739		100.000	BM 17
BM 18			1.600	100.139	BM 18
BM 19			1.695	100.044	BM 19
PT			2.800	98.939	
WL			2.098	**99.641**	
TBM	1.661	101.641	1.759	99.980	
WL			2.001	**99.640**	
PT			2.701	98.940	
BM 19			1.597	100.044	BM 19
BM 18			1.502	100.139	BM 18
BM 17			1.641	100.000	BM 17

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 18	100.137	100.139	0.002	
BM 19	100.042	100.044	0.002	
PT	98.902	98.940	0.038	

Summary	
Stage (m)	99.641
Discharge (m^3/s)	0.00352
Pressure Transducer Reading (m)	0.748
Pressure Transducer Elevation (m)	98.893

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	15:58	End	16:30	Location	15m US of PT				
Method	Velocity-area (Mid-section)			Instrument Model		Swoffer				
Flow Meter Type	Swoffer			Instrument Serial #						
Stage (m)	Start	Reading	0.748	Time	15:58					
	End	Reading	0.748	Time	16:30					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.42	0.00	0.00	0.00	0			0.000	0.0
	0.45	0.03	0.03	0.00	0			0.000	0.0
	0.50	0.07	0.05	0.00	0.01			0.000	1.0
	0.55	0.01	0.05	0.00	0.01			0.000	0.2
	0.60	0.12	0.05	0.01	0.01			0.000	1.7
	0.65	0.14	0.05	0.01	0.06			0.000	11.9
	0.70	0.14	0.05	0.01	0.07			0.000	13.9
	0.75	0.12	0.05	0.01	0.06			0.000	10.2
	0.80	0.12	0.05	0.01	0.04			0.000	6.8
	0.85	0.10	0.05	0.01	0.07			0.000	10.0
	0.90	0.08	0.05	0.00	0.07			0.000	8.0
	0.95	0.07	0.05	0.00	0.08			0.000	8.0
	1.00	0.06	0.05	0.00	0.07			0.000	6.0
	1.05	0.07	0.05	0.00	0.05			0.000	5.0
	1.10	0.09	0.05	0.00	0.06			0.000	7.7
	1.15	0.10	0.05	0.01	0.05			0.000	7.1
	1.20	0.11	0.05	0.01	0.01			0.000	1.6
	1.25	0.07	0.05	0.00	0.01			0.000	1.0
	1.30	0.07	0.05	0.00	0			0.000	0.0
	1.35	0.04	0.05	0.00	0			0.000	0.0
LB	1.40	0.00	0.05	0.00	0			0.000	0.0
Total Q								**0.00352**	**100.0**

General Notes

Appendix 2-4a. ADCP Discharge Measurements and Levelling Surveys at PL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	PL-H1			
Stream Name	Propeller Outflow			
Date Monitored	6-Jun-12			
Time at Site (24 hr)	**Start Time:**	8:45	**End Time:**	15:00
Personnel	Eli H., Coby H.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	436094	7279939		
Weather Conditions				

Transducer Information			
PT Model	PS98i	**Serial #**	2718019
Gain	3.52168	**Offset**	0
Status	OK	**Battery**	100%
# of Records	1	**Memory Free**	32530
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 8	0.808	100.808		100.000	
BM 7			1.270	99.538	
PT			2.296	98.512	
WL			1.375	**99.433**	
BM 6	1.259	100.860	1.207	99.601	
WL			1.427	**99.433**	
PT			2.349	98.511	
BM 7			1.322	99.538	
BM 8			0.861	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 7	99.539	99.538	-0.001	BM 8
BM 6	99.603	99.601	-0.002	BM 7
PT	98.512	98.512	0.000	BM 6

Discharge Measurement ADCP								
Time (24 hr)		**Start**	10:17	**End**	13:51	**Location**	~15m Upstream of station	
Method		Velocity-area (ADCP)				**Water Temp (ADCP)(°C)**	4	
Flow Meter Type		ADCP				**Water Temp (Therm) (°C)**		
Instrument Model		SteamPro				**Mean Discharge Q (m^3/s)**	19.3	
Instrument Serial#						**Error (Std Dev in m^3/s)**	0.36	
Stage (m)	**Start**	**Reading**	0.955	**Time**	**10:17**	**Mean % of Q Measured**	71.5	
	End	**Reading**	0.952	**Time**	**13:51**			
File Location		N:\833 Sabina\833-002 Back River\833-002-02 WaterResources-Hydrology\Data and Documentation\Flow Measurements\						
		2012\ADCP\June\PL-H1_060612\PL-H1_060612						

Transect #	Discharge Q (m^3/s)						% Q Measured	% Bad	
	Top	**Mid**	**Bottom**	**Left**	**Right**	**Total Q**		**Ensembles**	**Bins**
2	1.931	13.733	3.609	0.058	0.085	19.415	70.7	30	0
3	1.865	13.246	3.494	0.086	0.075	18.766	70.6	27	0
4	1.750	14.191	3.216	0.069	0.069	19.296	73.5	32	0
5	1.915	13.930	3.578	0.090	0.077	19.591	71.1	29	0
Mean	**1.87**	**13.78**	**3.47**	**0.08**	**0.08**	**19.27**	71.5	**29.5**	**0.0**

General Notes

High percentage of bad ensembles is due to bouldery bottom of channel. Have selected transects based on lowest values for % bad bins and similar measured channel width.
Rejected Transect #1 due to larger width and missing data near left bank. Rejected transect 6 due to high number of %bad ensembles.

Summary

Stage (m)	99.433		
Discharge (m^3/s)	19.267		
Pressure Transducer Reading (m)	0.953		
Pressure Transducer Elevation (m)	98.480		

Appendix 2-4a. ADCP Discharge Measurements and Levelling Surveys at PL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	PL-H1			
Stream Name	Propeller Outflow			
Date Monitored	14-Jun-12			
Time at Site (24 hr)	**Start Time:**	8:45	**End Time:**	11:30
Personnel	Eli H., Coby H.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	436094	7279939		
Weather Conditions				

Transducer Information			
PT Model	PS98i	**Serial #**	2718019
Gain	3.52168	**Offset**	0
Status	OK	**Battery**	100%
# of Records	1143	**Memory Free**	31960
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 8	1.009	101.009		100.000	
BM 7			1.471	99.538	
PT			2.501	98.508	error
WL			1.855	**99.154**	
BM 6	1.345	100.947	1.407	99.602	
WL			1.793	**99.154**	
PT			2.435	98.512	checked, ok
BM 7			1.408	99.539	
BM 8			0.947	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 7	99.539	99.539	-0.001	
BM 6	99.603	99.602	-0.001	
PT	98.512	98.510	-0.002	

Discharge Measurement ADCP								
Time (24 hr)		**Start**	10:17	**End**	13:51	**Location**	~15m Upstream of station	
Method		Velocity-area (ADCP)				**Water Temp (ADCP)(°C)**	3.31	
Flow Meter Type		ADCP				**Water Temp (Therm) (°C)**		
Instrument Model		SteamPro				**Mean Discharge Q (m^3/s)**	6.9	
Instrument Serial#						**Error (Std Dev in m^3/s)**	0.23	
Stage (m)	**Start**	**Reading**	0.955	**Time**	**10:17**	**Mean % of Q Measured**	71.0	
	End	**Reading**	0.952	**Time**	**13:51**			
File Location		N:\833 Sabina\833-002 Back River\833-002-02 WaterResources-Hydrology\Data and Documentation\Flow Measurements\						
		2012\ADCP\June\PL-H1_140612\PL-H1_140612						

Transect #	Discharge Q (m^3/s)						% Q Measured	% Bad	
	Top	**Mid**	**Bottom**	**Left**	**Right**	**Total Q**		**Ensembles**	**Bins**
15	0.75	5.07	1.26	0.05	0.05	7.18	70.6	35	1
16	0.70	4.89	1.27	0.03	0.05	6.94	70.5	39	1
17	0.71	4.99	1.17	0.03	0.06	6.96	71.8	36	1
22	0.68	4.70	1.17	0.03	0.04	6.62	71.0	23	1
Mean	**0.7**	**4.9**	**1.2**	**0.0**	**0.0**	**6.9**	**71.0**	**33.3**	**1.0**

General Notes

High percentage of bad ensembles is due to bouldery nature of the channel bottom. Values chosen based on lowest number of bad ensembles

Summary			
Stage (m)	99.154		
Discharge (m^3/s)	6.922		
Pressure Transducer Reading (m)	0.674		
Pressure Transducer Elevation (m)	98.480		

Appendix 2-4a. ADCP Discharge Measurements and Levelling Surveys at PL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	PL-H1			
Stream Name	Propeller Outflow			
Date Monitored	14-Jul-12			
Time at Site (24 hr)	**Start Time:**	10:20	**End Time:**	16:30
Personnel	Eli H., Craig H., Kaitlin G.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	436094	7279939		
Weather Conditions				

Transducer Information			
PT Model	PS98i	**Serial #**	2718019
Gain	3.52168	**Offset**	0
Status	OK	**Battery**	100%
# of Records	5473	**Memory Free**	29799
Date Serviced		**Crest Gauges**	No

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 8	1.006	101.006		100.000	BM 8
BM 7			1.469	99.537	BM 7
BM 6			1.405	99.601	BM 6
PT			2.498	98.508	
WL			2.187	**98.819**	
TBM	2.145	101.049	2.102	98.904	
WL			2.231	**98.818**	
PT			2.541	98.508	
BM 6			1.447	99.602	BM 6
BM 7			1.511	99.538	BM 7
BM 8			1.048	100.001	BM 8

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**		**Difference (m)**	**Notes**
BM 7	99.539	99.538		-0.002	
BM 6	99.603	99.602		-0.002	
PT	98.512	98.508		-0.004	

Discharge Measurement ADCP								
Time (24 hr)		**Start**	10:17	**End**	13:51	**Location**	~15m Upstream of station	
Method		Velocity-area (ADCP)				**Water Temp (ADCP)(°C)**	14	
Flow Meter Type		ADCP				**Water Temp (Therm) (°C)**		
Instrument Model		SteamPro				**Mean Discharge Q (m^3/s)**	1.7	
Instrument Serial#						**Error (Std Dev in m^3/s)**	0.40	
Stage (m)	**Start**	**Reading**	0.326	**Time**	**10:45**	**Mean % of Q Measured**	0.0	
	End	**Reading**	0.325	**Time**	**14:15**			
File Location		N:\833 Sabina\833-002 Back River\833-002-02 WaterResources-Hydrology\Data and Documentation\Flow Measurements\						
		2012\ADCP\July\PL-H1_140712\PL-H1_140712						

Transect #	**Discharge Q (m^3/s)**						**% Q Measured**	**% Bad**	
	Top	**Mid**	**Bottom**	**Left**	**Right**	**Total Q**		**Ensembles**	**Bins**
13	0.342	0.874	0.426	0.161	0.187	1.990	43.920	2	8
15	0.510	0.581	0.399	0.033	-0.100	1.423	40.829	3	7
16	0.175	0.688	0.286	-0.047	0.008	1.110	61.982	3	6
18	0.334	0.980	0.526	-0.246	0.037	1.631	60.086	2	7
19	0.303	0.648	0.376	-0.297	0.180	1.210	53.554	1	8
Mean	**0.33**	**0.75**	**0.40**	**-0.08**	**0.06**	**1.47**	**52.07**	**2.20**	**7.20**

General Notes

Measured values varied significantly due to low flow conditions. Also used flow-mate on this date in order compare values further upstream.

Summary	
Stage (m)	98.819
Discharge (m^3/s)	1.473
Pressure Transducer Reading (m)	0.326
Pressure Transducer Elevation (m)	98.493

Appendix 2-4b. Manual Discharge Measurements and Levelling Surveys at PL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	PL-H1			
Stream Name	Propeller Outflow			
Date Monitored	15-Jul-12			
Time at Site (24 hr)	Start Time:	9:25:00 AM	End Time:	12:00:00 PM
Personnel				
Station Cordinates	Easting	Northing	Elevation	
	436094	7279939		
Weather Conditions				

Transducer Information			
PT Model	PS98i	Serial #	2718019
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	29730	Memory Free	5612
Date Serviced	N/A	Crest Gauges	no

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 8	0.994	100.994		100.000	
BM 7			1.456	99.538	
BM 6			1.393	99.601	
PT			2.486	98.508	
WL			2.185	**98.809**	
TBM	2.089	100.920	2.163	98.831	
WL			2.112	**98.808**	
PT			2.410	98.510	
BM 6			1.320	99.600	
BM 7			1.383	99.537	
BM 8			0.921	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 7	99.539	99.538	-0.002	
BM 6	99.603	99.601	-0.002	
PT	98.512	98.509	-0.003	

Summary	
Stage (m)	98.809
Discharge (m^3/s)	1.051
Pressure Transducer Reading (m)	0.316
Pressure Transducer Elevation (m)	98.493

Discharge Measurement - Mid-Section Method (continued on following page)												
Time (24 hr)	Start	9:30	End	11:15	Location	200m Upstream of PT						
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000						
Flow Meter Type	Flo-Mate			Instrument Serial #								
Stage (m)	Start	Reading	0.316	Time	9:30							
	End	Reading	0.316	Time	11:15							

	Station	Depth	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	2.40	0.00	0.00	0.00	0.02	0.00			0.000	0.0
	2.55	0.70	0.21	0.15	0.05	-0.01			-0.001	-0.1
	2.90	0.20	0.06	0.35	0.04	0.02			0.001	0.1
	4.00	1.32	0.40	1.10	0.42	0.10			0.042	4.0
	5.00	1.00	0.30	1.00	0.30	0.15			0.046	4.3
	6.00	0.91	0.28	1.00	0.28	0.04			0.011	1.1
	7.00	0.20	0.06	1.00	0.06	0.12			0.007	0.7
	8.00	0.46	0.14	1.00	0.14	0.18			0.025	2.4
	9.00	0.41	0.12	1.00	0.12	0.11			0.014	1.3
	10.00	0.76	0.23	1.00	0.23	0.16			0.037	3.5
	11.00	0.41	0.12	1.00	0.12	0.27			0.034	3.2
	12.00	0.66	0.20	1.00	0.20	0.17			0.034	3.3
	13.00	0.62	0.19	1.00	0.19	0.12			0.023	2.2
	14.00	0.78	0.24	1.00	0.18	0.06			0.011	1.0
	14.50	0.70	0.21	0.50	0.11	0.09			0.010	0.9
	15.00	0.00	0.00	0.50	0.00	0.00			0.000	0.0
	15.50	0.58	0.18	0.50	0.09	0.05			0.004	0.4
	16.00	0.22	0.07	0.50	0.05	0.14			0.007	0.7
	17.00	0.39	0.12	1.00	0.11	0.00			0.000	0.0
	17.90	1.50	0.46	0.90	0.46	0.02			0.009	0.9
	19.00	0.49	0.15	1.10	0.16	0.03			0.005	0.4
	20.00	0.51	0.16	1.00	0.16	0.02			0.003	0.3
	21.00	1.51	0.46	1.00	0.46	0.04			0.018	1.8
	22.00	2.32	0.71	1.00	0.71	0.06			0.042	4.0
	23.00	2.18	0.66	1.00	0.50	0.17			0.085	8.1
	23.50	1.19	0.36	0.50	0.18	0.28			0.051	4.8
	24.00	2.00	0.61	0.50	0.30	0.29			0.088	8.4
	24.50	2.03	0.62	0.50	0.31	0.33			0.102	9.7
cont'd								**0.709**	**0.7**	**67.4**

General Notes
ADCP Measurement taken previous day. At location of measurement may have missed some flow due to bouldery nature of channel.

Appendix 2-4b. Manual Discharge Measurements and Levelling Surveys at PL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	PL-H1			
Stream Name	Propeller Outflow			
Date Monitored	15-Jul-12			
Time at Site (24 hr)	Start Time:	9:25:00 AM	End Time:	12:00:00 PM
Personnel				
Station Cordinates	Easting	Northing	Elevation	
	436094	7279939		
Weather Conditions				

Transducer Information			
PT Model	PS98i	Serial #	2718019
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	29730	Memory Free	5612
Date Serviced	N/A	Crest Gauges	no

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM#	Established Elevation (m)	Mean Elevation (this date) (m)		Difference (m)	Notes

Summary	
Stage (m)	
Discharge (m^3/s)	
Pressure Transducer Reading (m)	
Pressure Transducer Elevation (m)	

Discharge Measurement - Mid-Section Method (completed)											
Time (24 hr)	Start	9:30	End	11:15	Location	200m Upstream of PT					
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000					
Flow Meter Type	Flo-Mate			Instrument Serial #							
Stage (m)	Start	Reading	0.316	Time	9:30						
	End	Reading	0.316	Time	11:15						
cont'd	Station	Depth	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q	
Notes	(m)	(ft)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%	
	25.00	2.30	0.70	0.0	0.35	0.22			0.077	7.3	
	25.50	1.71	0.52	0.5	0.26	0.16			0.042	4.0	
	26.00	2.20	0.67	0.5	0.50	0.12			0.060	5.7	
	27.00	2.17	0.66	1.0	0.66	0.13			0.086	8.2	
	28.00	1.57	0.48	1.0	0.48	0.06			0.029	2.7	
	29.00	0.61	0.19	1.0	0.19	0.05			0.009	0.9	
	30.00	1.06	0.32	1.0	0.24	0.11			0.027	2.5	
	30.50	0.66	0.20	0.5	0.10	0.10			0.010	1.0	
	31.00	0.30	0.09	0.5	0.05	0.05			0.002	0.2	
LB	31.50	0.00	0.00	0.5	0.02	0.00			0.000	0.0	
Total Q									1.051	32.6	

General notes

Appendix 2-4b. Manual Discharge Measurements and Levelling Surveys at PL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	PL-H1			
Stream Name	Propeller Outflow			
Date Monitored	13-Aug-12			
Time at Site (24 hr)	**Start Time:**	10:15:00 AM	**End Time:**	4:00:00 PM
Personnel	Eli H., Cenling X.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	436094	7279939		
Weather Conditions	cloudy, cool			

Transducer Information			
PT Model	PS98i	**Serial #**	2718019
Gain	3.52168	**Offset**	0
Status	OK	**Battery**	100%
# of Records	9793	**Memory Free**	27639
Date Serviced	N/A	**Crest Gauges**	no

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 8	0.932	100.932		100.000	
BM 7			1.395	99.537	
BM 6			1.331	99.601	
PT			2.427	98.505	
WL			2.308	**98.624**	
TBM	2.160	100.878	2.214	98.718	
WL			2.255	**98.623**	
PT			2.372	98.506	
BM 6			1.277	99.601	
BM 7			1.340	99.538	
BM 8			0.877	100.001	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 7	99.539	99.538	-0.002	
BM 6	99.603	99.601	-0.002	
PT	98.512	98.506	-0.007	

Summary	
Stage (m)	98.624
Discharge (m^3/s)	0.316
Pressure Transducer Reading (m)	0.132
Pressure Transducer Elevation (m)	98.492

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	10:30	**End**	14:00	**Location**	400m Upstream of PT			
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2006042			
Stage (m)	**Start**	**Reading**	0.133	**Time**	10:30				
	End	**Reading**	0.132	**Time**	14:00				

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	2.00	0.00	0.00	0.03	0			0.000	0.0
	2.20	0.27	0.20	0.07	0.16			0.011	3.5
	2.50	0.50	0.30	0.15	0.15			0.023	7.2
	2.80	0.56	0.30	0.14	0.13			0.018	5.7
	3.00	0.50	0.20	0.10	0.13			0.013	4.1
	3.20	0.61	0.20	0.12	0.14			0.017	5.4
	3.40	0.65	0.20	0.13	0.12			0.016	4.9
	3.60	0.64	0.20	0.13	0.14			0.018	5.7
	3.80	0.62	0.20	0.12	0.2			0.025	7.9
	4.00	0.58	0.20	0.12	0.24			0.028	8.8
	4.20	0.49	0.20	0.10	0.28			0.027	8.6
	4.40	0.40	0.20	0.08	0.28			0.022	7.0
	4.60	0.40	0.20	0.08	0.24			0.019	6.0
	4.80	0.32	0.20	0.06	0.34			0.022	6.9
	5.00	0.38	0.20	0.08	0.19			0.014	4.6
Behind Rock	5.20	0.40	0.20	0.08	0.09			0.007	2.3
Behind Rock	5.40	0.32	0.20	0.06	0			0.000	0.0
Behind Rock	5.60	0.23	0.20	0.05	0.02			0.001	0.3
Behind Rock	5.80	0.24	0.20	0.05	0.01			0.000	0.2
	6.00	0.18	0.20	0.04	0.13			0.005	1.5
	6.20	0.18	0.20	0.04	0.26			0.010	3.0
	6.40	0.14	0.20	0.03	0.28			0.008	2.4
	6.60	0.20	0.20	0.04	0.2			0.008	2.5
	6.80	0.15	0.20	0.03	0.13			0.004	1.3
	7.00	0.12	0.20	0.02	0.01			0.000	0.1
	7.20	0.03	0.20	0.00	0.18			0.001	0.2
LB	7.25	0.00	0.05	0.00	0			0.000	0.0
Total Q								**0.316**	100.0

General Notes
Prefered location for manual flow measurement under low flow conditions (further upstream than July). Still likely to be significant underground flow due to large boulders in the channel.

Appendix 2-4b. Manual Discharge Measurements and Levelling Surveys at PL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	PL-H1			
Stream Name	Propeller Outflow			
Date Monitored	8-Sep-12			
Time at Site (24 hr)	Start Time:	9:00:00 AM	End Time:	4:00:00 PM
Personnel	Eli H., Scott C.			
Station Cordinates	Easting	Northing	Elevation	
	436094	7279939		
Weather Conditions	cloudy			

Transducer Information			
PT Model	PS98i	Serial #	2718019
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	13555	Memory Free	25757
Date Serviced	N/A	Crest Gauges	no

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 8	1.508	101.508		100.000	
BM 7			1.971	99.537	
BM 6			1.908	99.600	
PT			3.016	98.492	
WL			2.944	**98.564**	
TBM	2.843	101.436	2.915	98.593	
WL			2.874	**98.562**	
PT			2.945	98.491	
BM 6			1.836	99.600	
BM 7			1.900	99.536	
BM 8			1.437	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 7	99.539	99.537	-0.003	
BM 6	99.603	99.600	-0.003	
PT	98.512	98.492	-0.020	

Summary	
Stage (m)	98.563
Discharge (m^3/s)	0.116
Pressure Transducer Reading (m)	0.0703
Pressure Transducer Elevation (m)	98.493

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	15:00	End	16:00	Location	400m Upstream of PT				
Method	Velocity-area (Mid-section)			Instrument Model		Swoffer 2100				
Flow Meter Type	Swoffer			Instrument Serial #						
Stage (m)	Start	Reading	0.070	Time	15:00					
	End	Reading	0.070	Time	16:00					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	1.24	0.00	0.00	0.00	0			0.000	0.0
	1.30	0.10	0.06	0.01	0.02			0.000	0.1
	1.40	0.10	0.10	0.02	0.06			0.001	0.9
	1.65	0.16	0.25	0.04	0.01			0.000	0.3
	1.90	0.07	0.25	0.02	0.02			0.000	0.3
	2.15	0.10	0.25	0.03	0.01			0.000	0.2
	2.40	0.20	0.25	0.05	0.01			0.001	0.4
	2.65	0.15	0.25	0.03	0.06			0.002	1.6
	2.80	0.11	0.15	0.02	0.02			0.000	0.3
	3.00	0.34	0.20	0.05	0.07			0.004	3.1
	3.10	0.48	0.10	0.06	0.18			0.011	9.3
	3.25	0.50	0.15	0.08	0.21			0.016	13.6
	3.40	0.51	0.15	0.08	0.24			0.018	15.8
	3.55	0.62	0.15	0.09	0.11			0.010	8.8
	3.70	0.62	0.15	0.09	0.18			0.017	14.4
	3.85	0.63	0.15	0.09	0.09			0.009	7.3
	4.00	0.62	0.15	0.11	0.06			0.007	5.6
	4.20	0.55	0.20	0.11	0.05			0.006	4.7
	4.40	0.42	0.20	0.08	0.05			0.004	3.6
	4.60	0.40	0.20	0.08	0.06			0.005	4.1
	4.80	0.41	0.20	0.08	0.05			0.004	3.5
	5.00	0.43	0.20	0.08	0.01			0.001	0.6
	5.15	0.40	0.15	0.04	0.01			0.000	0.3
	5.20	0.19	0.05	0.01	0.06			0.001	0.7
LB	5.30	0.00	0.10	0.01	0			0.000	0.0
Total Q								**0.116**	100.0

General Notes

Appendix 2-5. Manual Discharge Measurements and Levelling Surveys at PL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	PL-H2			
Stream Name	Goose Lake Outflow			
Date Monitored	12-Jun-12			
Time at Site (24 hr)	**Start Time:**	11:45:00 AM	**End Time:**	3:00:00 PM
Personnel	Eli H., Coby H.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	435007	7272014	266	
Weather Conditions				

Transducer Information			
PT Model	PT2X	**Serial #**	21221023
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	1	**Memory Free**	524139 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 04	1.366	101.366		100.000	
BM 45			1.519	99.847	
PT			2.026	99.340	
WL			1.597	**99.769**	
BM 46	1.189	101.343	1.212	100.154	
WL			1.573	**99.770**	
PT			2.000	99.343	
BM 45			1.495	99.848	
BM 04			1.342	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 45	99.869	99.848	-0.022	est. from 2011
BM 46	100.177	100.154	-0.023	est. from 2011
PT	99.342	99.342	-0.001	From install date

Summary	
Stage (m)	99.770
Discharge (m^3/s)	3.456
Pressure Transducer Reading (m)	0.445
Pressure Transducer Elevation (m)	99.325

Discharge Measurement - Mid-Section Method											
Time (24 hr)	**Start**	12:31	**End**	14:00	**Location**	~20m Dowstream of station					
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000					
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2004405					
Stage (m)	**Start**	**Reading**	0.446	**Time**	12:31						
	End	**Reading**	0.445	**Time**	14:00						

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	17.90	0.00	0.00	0.06	0			0.000	0.0
	18.25	0.32	0.35	0.34	0.06			0.020	0.6
	20.00	0.25	1.75	0.41	0.19			0.078	2.3
	21.55	0.10	1.55	0.10	0.05			0.005	0.1
Rocks	22.00	0.00	0.45	0.00	0			0.000	0.0
	23.00	0.16	1.00	0.24	0.07			0.017	0.5
	25.00	0.17	2.00	0.34	0.14			0.048	1.4
	27.00	0.16	2.00	0.32	0.29			0.093	2.7
	29.00	0.21	2.00	0.42	0.3			0.126	3.6
	31.00	0.18	2.00	0.36	0.13			0.047	1.4
	33.00	0.20	2.00	0.40	0.4			0.160	4.6
	35.00	0.29	2.00	0.58	0.32			0.186	5.4
	37.00	0.28	2.00	0.56	0.33			0.185	5.3
	39.00	0.34	2.00	0.68	0.31			0.211	6.1
	41.00	0.39	2.00	0.78	0.37			0.289	8.4
	43.00	0.34	2.00	0.68	0.36			0.245	7.1
	45.00	0.30	2.00	0.60	0.29			0.174	5.0
DS of Rocks	47.00	0.44	2.00	0.88	0.15			0.132	3.8
	49.00	0.32	2.00	0.64	0.29			0.186	5.4
	51.00	0.34	2.00	0.68	0.33			0.224	6.5
	53.00	0.30	2.00	0.60	0.37			0.222	6.4
	55.00	0.22	2.00	0.44	0.34			0.150	4.3
	57.00	0.30	2.00	0.60	0.33			0.198	5.7
	59.00	0.24	2.00	0.48	0.32			0.154	4.4
	61.00	0.16	2.00	0.32	0.3			0.096	2.8
	63.00	0.22	2.00	0.44	0.13			0.057	1.7
	65.00	0.22	2.00	0.44	0.16			0.070	2.0
	67.00	0.12	2.00	0.24	0.11			0.026	0.8
	69.00	0.20	2.00	0.37	0.15			0.056	1.6
	70.70	0.17	1.70	0.15	0.02			0.003	0.1
LB	70.78	0.00	0.08	0.01	0			0.000	0.0
Total Q								**3.456**	**100.0**

General Notes

Appendix 2-5. Manual Discharge Measurements and Levelling Surveys at PL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	PL-H2			
Stream Name	Goose Lake Outflow			
Date Monitored	16-Jun-12			
Time at Site (24 hr)	**Start Time:**	2:15:00 PM	**End Time:**	4:30:00 PM
Personnel	Eli H., Coby H.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	435007	7272014	266	
Weather Conditions				

Transducer Information			
PT Model	PT2X	**Serial #**	21221023
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	588	**Memory Free**	523551 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 04	1.407	101.407		100.000	
BM 45			1.555	99.852	
PT			2.066	99.341	
WL			1.700	**99.707**	
BM 46	1.213	101.370	1.250	100.157	
WL			1.662	**99.708**	
PT			2.031	99.339	
BM 45			1.520	99.850	
BM 04			1.371	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 45	99.869	99.851	-0.018	est. from 2011
BM 46	100.177	100.157	-0.020	est. from 2011
PT	99.342	99.340	-0.002	From install date

Summary	
Stage (m)	99.708
Discharge (m^3/s)	1.731
Pressure Transducer Reading (m)	0.394
Pressure Transducer Elevation (m)	99.314

Discharge Measurement - Mid-Section Method											
Time (24 hr)	**Start**	14:38	**End**	15:30	**Location**	~20m Dowstream of station					
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000					
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2004405					
Stage (m)	**Start**	**Reading**	0.395	**Time**	14:38						
	End	**Reading**	0.395	**Time**	15:30						

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	18.80	0.00	0.00	0.03	0			0.000	0.0
	19.15	0.16	0.35	0.04	0			0.000	0.0
	19.30	0.18	0.15	0.12	0.04			0.005	0.3
	20.50	0.15	1.20	0.19	0.04			0.008	0.4
	21.80	0.13	1.30	0.12	0.04			0.005	0.3
Rock Island	22.40	0.00	0.60	0.00	0			0.000	0.0
Rock Island	23.40	0.00	0.00	0.00	0.00			0.000	0.0
	23.87	0.10	1.47	0.13	0.04			0.005	0.3
	26.00	0.08	2.13	0.17	0.03			0.005	0.3
	28.00	0.10	2.00	0.20	0.12			0.024	1.4
	30.00	0.18	2.00	0.36	0.15			0.054	3.1
	32.00	0.15	2.00	0.30	0.1			0.030	1.7
	34.00	0.14	2.00	0.28	0.30			0.084	4.9
	36.00	0.27	2.00	0.54	0.24			0.130	7.5
	38.00	0.26	2.00	0.52	0.15			0.078	4.5
	40.00	0.30	2.00	0.60	0.27			0.162	9.4
	42.00	0.25	2.00	0.50	0.26			0.130	7.5
	44.00	0.24	2.00	0.48	0.32			0.154	8.9
	46.00	0.41	2.00	0.82	0.17			0.139	8.1
	48.00	0.33	2.00	0.66	0.09			0.059	3.4
	50.00	0.28	2.00	0.56	0.17			0.095	5.5
	52.00	0.26	2.00	0.52	0.26			0.135	7.8
	54.00	0.27	2.00	0.54	0.19			0.103	5.9
	56.00	0.17	2.00	0.34	0.21			0.071	4.1
	58.00	0.24	2.00	0.48	0.19			0.091	5.3
	60.00	0.25	2.00	0.50	0.14			0.070	4.0
	62.00	0.16	2.00	0.32	0.11			0.035	2.0
	64.00	0.19	2.00	0.38	0.06			0.023	1.3
	66.00	0.10	2.00	0.20	0.1			0.020	1.2
	68.00	0.05	2.00	0.10	0.04			0.004	0.2
	70.00	0.18	2.00	0.29	0.02			0.006	0.3
	71.20	0.26	1.20	0.21	0.03			0.006	0.4
LB	71.60	0.00	0.40	0.05	0			0.000	0.0
Total Q								**1.731**	**100.0**

Appendix 2-5. Manual Discharge Measurements and Levelling Surveys at PL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	PL-H2			
Stream Name	Goose Lake Outflow			
Date Monitored	7-Jul-12			
Time at Site (24 hr)	**Start Time:**	8:30:00 AM	**End Time:**	2:00:00 PM
Personnel	Eli H., Rebecca K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	435007	7272014	266m	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PT2X	**Serial #**	21221023
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	3.0V
# of Records	3578	**Memory Free**	520561
Date Serviced		**Crest Gauges**	No

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 4	1.453	101.453		100.000	
BM 45			1.598	99.855	
BM 46			1.282	100.171	
PT			2.109	99.344	
WL			1.857	**99.596**	
TBM	1.807	101.403	1.857	99.596	
WL			1.807	**99.596**	
PT			2.060	99.343	
BM 46			1.233	100.170	
BM 45			1.548	99.855	
BM 4			1.403	100.000	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 45	99.869	99.855	-0.014	est. from 2011
BM 46	100.177	100.171	-0.007	est. from 2011
PT	99.342	99.344	0.002	From install date

Summary	
Stage (m)	99.596
Discharge (m^3/s)	0.668
Pressure Transducer Reading (m)	0.275
Pressure Transducer Elevation (m)	99.321

Discharge Measurement - Mid-Section Method (continued on following page)

Time (24 hr)	**Start**	9:00	**End**	10:03	**Location**	15m Downstream of PT		
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000		
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2007612		
Stage (m)	**Start**	**Reading**	0.275	**Time**	9:00	Reading values converted from psi to mH20		
	End	**Reading**	0.274	**Time**	10:03	(mH20=psi/1.422)		

	Station	**Depth**		**Distance**	**Area**	**Velocity @60%**	**Cal. Velocity**	**Q**	**% of Total Q**
Notes	**(m)**	**(ft)**	**(m)**	**(m)**	**(m^2)**	**(m/s)**	**(m/s)**	**(m^3/s)**	**%**
RB	1.50	0.00	0.00	0.00	0.01	0		0.000	0.0
	1.70	0.30	0.09	0.20	0.03	0.01		0.000	0.0
	2.15	0.31	0.09	0.45	0.04	0.05		0.002	0.3
	2.60	0.10	0.03	0.45	0.02	0.01		0.000	0.0
	3.15	0.31	0.09	0.55	0.05	0.02		0.001	0.1
	3.65	0.60	0.18	0.50	0.08	0.01		0.001	0.1
	4.00	0.25	0.08	0.35	0.02	0.01		0.000	0.0
Island RB	4.30	0.00	0.00	0.30	0.00	0		0.000	0.0
Island LB	7.90	0.00	0.00	3.60	0.00	0		0.000	0.0
	8.00	0.37	0.11	0.10	0.02	0.09		0.002	0.2
Rocks	8.20	0.19	0.06	0.20	0.01	0.02		0.000	0.0
Rocks	8.30	0.00	0.00	0.10	0.00	0		0.000	0.0
	9.25	0.00	0.00	0.95	0.00	0		0.000	0.0
	9.35	0.25	0.08	0.10	0.03	0.11		0.003	0.5
	10.00	0.20	0.06	0.65	0.08	0.1		0.008	1.2
	12.00	0.22	0.07	2.00	0.09	0.03		0.003	0.4
	12.70	0.40	0.12	0.70	0.12	0.14		0.017	2.6
DS of Boulder	14.00	0.60	0.18	1.30	0.30	0.1		0.030	4.5
	16.00	0.15	0.05	2.00	0.09	0.15		0.014	2.1
	18.00	0.32	0.10	2.00	0.20	0.18		0.035	5.3
	20.00	0.61	0.19	2.00	0.37	0.18		0.067	10.0
	22.00	0.77	0.23	2.00	0.47	0.06		0.028	4.2
	24.00	0.48	0.15	2.00	0.29	0.24		0.070	10.5
	26.00	0.70	0.21	2.00	0.43	0.2		0.085	12.8
	28.00	0.45	0.14	2.00	0.27	0.15		0.041	6.2
	30.00	0.55	0.17	2.00	0.34	0.09		0.030	4.5
	32.00	0.70	0.21	2.00	0.43	0.11		0.047	7.0
	34.00	0.45	0.14	2.00	0.27	0.16		0.044	6.6
								0.529	**79.2**

General Notes

Gradiant = 1%. Depth values converted from ft. to m (1ft. = 0.3048m).

Appendix 2-5. Manual Discharge Measurements and Levelling Surveys at PL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	PL-H2			
Stream Name	Goose Lake Outflow			
Date Monitored	7-Jul-12			
Time at Site (24 hr)	Start Time:	8:30:00 AM	End Time:	2:00:00 PM
Personnel	Eli H., Rebecca K.			
Station Cordinates	Easting	Northing	Elevation	
	435007	7272014	266m	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PT2X	Serial #	21221023
Gain	N/A	Offset	N/A
Status	Active	Battery	3.0V
# of Records	3578	Memory Free	520561
Date Serviced		Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes	

Summary	
Stage (m)	
Discharge (m^3/s)	
Pressure Transducer Reading (m)	
Pressure Transducer Elevation (m)	

Discharge Measurement - Mid-Section Method (completed)										
Time (24 hr)	Start	9:00	End	10:03	Location	15m Downstream of PT				
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2007612				
Stage (m)	Start	Reading	0.275	Time	9:00	Reading values converted from psi to mH20				
	End	Reading	0.274	Time	10:03	(mH20=psi/1.422)				

cont'd	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
	36.00	0.60	0.18	2.00	0.37	0.1		0.037	5.5
	38.00	0.29	0.09	2.00	0.18	0.17		0.030	4.5
	40.00	0.53	0.16	2.00	0.32	0.07		0.023	3.4
	42.00	0.45	0.14	2.00	0.27	0.04		0.011	1.6
Behind Rock	44.00	0.33	0.10	2.00	0.17	0.05		0.008	1.2
	45.30	0.20	0.06	1.30	0.05	0.1		0.005	0.7
Rocks	45.50	0.00	0.00	0.20	0.00	0		0.000	0.0
Rocks	46.80	0.00	0.00	1.30	0.00	0		0.000	0.0
	46.90	0.20	0.06	0.10	0.01	0.11		0.001	0.2
	47.10	0.22	0.07	0.20	0.01	0.09		0.001	0.1
Rocks	47.20	0.00	0.00	0.10	0.00	0		0.000	0.0
Rocks	48.10	0.00	0.00	0.90	0.00	0		0.000	0.0
	48.30	0.26	0.08	0.20	0.03	0.07		0.002	0.3
	48.75	0.19	0.06	0.45	0.02	0.09		0.002	0.2
	48.90	0.00	0.00	0.15	0.00	0		0.000	0.0
	50.50	0.00	0.00	1.60	0.00	0		0.000	0.0
	50.80	0.41	0.12	0.30	0.11	0.07		0.008	1.2
	52.30	0.41	0.12	1.50	0.16	0.02		0.003	0.5
	53.30	0.30	0.09	1.00	0.07	0.14		0.010	1.4
LB	53.80	0.00	0.00	0.50	0.02	0		0.000	0.0
Total Q								0.668	100.0

General Notes

Appendix 2-5. Manual Discharge Measurements and Levelling Surveys at PL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	PL-H2			
Stream Name	Goose Lake Outflow			
Date Monitored	11-Aug-12			
Time at Site (24 hr)	**Start Time:**	8:30:00 AM	**End Time:**	11:00:00 AM
Personnel	Eli H., Cenling X.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	435007	7272014	266m	
Weather Conditions	Cloudy, Cool			

Transducer Information			
PT Model	PT2X	**Serial #**	21221023
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	3.0V
# of Records	8616	**Memory Free**	515523
Date Serviced		**Crest Gauges**	No

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 4	1.449	101.449		100.000	
BM 45			1.592	99.857	
BM 46			1.280	100.169	
PT			2.107	99.342	
WL			1.968	**99.481**	
TBM	1.859	101.382	1.926	99.523	
WL			1.902	**99.480**	
PT			2.040	99.342	
BM 46			1.213	100.169	
BM 45			1.527	99.855	
BM 4			1.382	100.000	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 45	99.869	99.856	-0.013	est. from 2011
BM 46	100.177	100.169	-0.008	est. from 2011
PT	99.342	99.342	0.000	From install date

Summary	
Stage (m)	99.481
Discharge (m^3/s)	0.042
Pressure Transducer Reading (m)	0.160
Pressure Transducer Elevation (m)	99.321

Discharge Measurement - Mid-Section Method										
Time (24 hr)	**Start**	8:44	**End**	9:46	**Location**	80m Downstream of PT				
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2006042				
Stage (m)	**Start**	**Reading**	0.159	**Time**	8:44	Channel very bouldery.				
	End	**Reading**	0.16	**Time**	9:46	Low flow near edges could not be measured				

	Station	**Depth**		**Distance**	**Area**	**Velocity @60%**	**Cal. Velocity**	**Q**	**% of Total Q**
Notes	**(m)**	**(ft)**	**(m)**	**(m)**	**(m^2)**	**(m/s)**	**(m/s)**	**(m^3/s)**	**%**
LB	8.00	0.00	0.00	0.00	0.01	0		0.000	0.0
	8.15	0.42	0.13	0.15	0.04	0.04		0.001	3.3
	8.55	0.23	0.07	0.40	0.03	0.08		0.002	5.3
	8.95	0.21	0.06	0.40	0.03	0.02		0.001	1.2
Behind Rock	9.35	0.31	0.09	0.40	0.03	0.05		0.001	3.4
	9.55	0.48	0.15	0.20	0.02	0.05		0.001	2.2
Rock	9.60	0.00	0.00	0.05	0.00	0		0.000	0.0
Rock	10.00	0.00	0.00	0.40	0.00	0		0.000	0.0
	10.10	0.66	0.20	0.10	0.05	0.06		0.003	7.2
	10.50	0.20	0.06	0.40	0.02	0.05		0.001	2.9
	10.90	0.70	0.21	0.40	0.09	0.09		0.008	18.3
	11.30	0.45	0.14	0.40	0.04	0.1		0.004	9.8
	11.50	0.30	0.09	0.20	0.02	0.12		0.002	5.2
	11.70	0.60	0.18	0.20	0.04	0.09		0.003	7.8
	11.90	0.51	0.16	0.20	0.03	0.04		0.001	3.0
	12.10	0.42	0.13	0.20	0.04	0.03		0.001	2.7
	12.50	0.41	0.12	0.40	0.05	0.03		0.001	3.6
	12.90	0.22	0.07	0.40	0.03	0.02		0.001	1.3
	13.30	0.13	0.04	0.40	0.02	0.05		0.001	1.9
	13.70	0.20	0.06	0.40	0.02	0.05		0.001	2.9
	14.10	0.10	0.03	0.40	0.01	0.3		0.003	6.5
Rock	14.30	0.00	0.00	0.20	0.00	0		0.000	0.0
behind rock	14.50	0.10	0.03	0.20	0.00	0		0.000	0.0
Rocks	14.60	0.00	0.00	0.10	0.00	0		0.000	0.0
Rocks	15.30	0.00	0.00	0.70	0.00	0		0.000	0.0
	15.55	0.10	0.03	0.25	0.00	0.27		0.001	2.9
Rocks	15.60	0.00	0.00	0.05	0.00	0		0.000	0.0
Rocks	16.20	0.00	0.00	0.60	0.00	0		0.000	0.0
	16.50	0.20	0.06	0.30	0.02	0.17		0.004	8.6
RB	16.90	0.00	0.00	0.40	0.01	0		0.000	0.0
								0.042	**100.0**

General Notes
Gradiant = 1%. Depth values converted from ft. to m (1ft. = 0.3048m).

Appendix 2-5. Manual Discharge Measurements and Levelling Surveys at PL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	PL-H2			
Stream Name	Goose Lake Outflow			
Date Monitored	13-Sep-12			
Time at Site (24 hr)	**Start Time:**	12:35:00 PM	**End Time:**	4:30:00 PM
Personnel	Eli H., Scott C.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	435007	7272014	266m	
Weather Conditions	Cloudy, Cool			

Transducer Information			
PT Model	PT2X	**Serial #**	21221023
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	3.0V
# of Records	13392	**Memory Free**	510747
Date Serviced		**Crest Gauges**	No

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 4	1.221	101.221		100.000	
BM 45			1.379	99.842	
BM 46			1.058	100.163	
PT			1.900	99.321	
WL			1.690	**99.531**	
TBM	1.679	101.139	1.761	99.460	
WL			1.610	**99.529**	
PT			1.817	99.322	
BM 46			0.975	100.164	
BM 45			1.297	99.842	
BM 4			1.139	100.000	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 45	99.869	99.842	-0.027	est. from 2011
BM 46	100.177	100.164	-0.014	est. from 2011
PT	99.342	99.322	-0.020	From install date

Summary	
Stage (m)	99.530
Discharge (m^3/s)	0.172
Pressure Transducer Reading (m)	0.224
Pressure Transducer Elevation (m)	99.306

Discharge Measurement - Mid-Section Method										
Time (24 hr)	**Start**	12:41	**End**	13:20	**Location**	15m Downstream of PT				
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2007529				
Stage (m)	**Start**	**Reading**	0.222	**Time**	12:41	Channel very bouldery.				
	End	**Reading**	0.223	**Time**	13:20	Low flow near edges could not be measured				

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	0.00	0.00	0.00	0.02	0			0.000	0.0
	1.00	0.04	1.00	0.05	0.01			0.001	0.3
	2.50	0.08	1.50	0.12	0.02			0.002	1.4
	4.00	0.04	1.50	0.06	0.02			0.001	0.7
	5.50	0.04	1.50	0.06	0.03			0.002	1.0
	7.00	0.12	1.50	0.18	0.07			0.013	7.3
	8.50	0.16	1.50	0.24	0.07			0.017	9.8
	10.00	0.07	1.50	0.11	0.04			0.004	2.4
	11.50	0.18	1.50	0.27	0.06			0.016	9.4
	13.00	0.11	1.50	0.17	0.11			0.018	10.5
	14.50	0.12	1.50	0.18	0.08			0.014	8.4
	16.00	0.16	1.50	0.24	0.09			0.022	12.5
	17.50	0.03	1.50	0.05	0.02			0.001	0.5
	19.00	0.14	1.50	0.21	0.04			0.008	4.9
	20.50	0.16	1.50	0.24	0.03			0.007	4.2
	22.00	0.14	1.50	0.21	0.04			0.008	4.9
	23.50	0.07	1.50	0.11	0.06			0.006	3.7
	25.00	0.16	1.50	0.24	0.02			0.005	2.8
	26.50	0.10	1.50	0.15	0.04			0.006	3.5
	28.00	0.06	1.50	0.09	0.03			0.003	1.6
	29.50	0.12	1.50	0.18	0.06			0.011	6.3
	31.00	0.10	1.50	0.14	0.01			0.001	0.8
	32.30	0.14	1.30	0.11	0.05			0.005	3.0
	32.50	0.00	0.20	0.00	0			0.000	0.0
	32.90	0.00	0.40	0.00	0			0.000	0.0
	33.00	0.10	0.10	0.02	0			0.000	0.0
	33.30	0.02	0.30	0.01	0.02			0.000	0.1
	34.00	0.00	0.70	0.01	0			0.000	0.0
Total Q								**0.172**	100.0

General Notes
Distance from middle of PT to top of conduit = 1.9cm

Appendix 2-6. Manual Discharge Measurements and Levelling Surveys at GI-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	9-Jun-12			
Time at Site (24 hr)	Start Time:	1:20:00 PM	End Time:	
Personnel	Eli H, Coby H.			
Station Cordinates	Easting	Northing	Elevation	
	432744	7271610	267	
Weather Conditions	Cloudy			

Transducer Information			
PT Model	P598i	Serial #	2718023
Gain	3.52168	Offset	0
Status	ok	Battery	100%
# of Records	0	Memory Free	32535
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 5	1.256	101.256		100.000	
BM 47			1.332	99.924	
PT			1.944	99.312	
WL			1.475	**99.781**	
BM 49	1.277	101.300	1.233	100.023	
WL			1.520	**99.780**	
PT			1.993	99.307	
BM 47			1.377	99.923	
BM 5			1.301	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 47	99.925	99.924	-0.001	
BM 49	100.038	100.023	-0.015	
PT	99.312	99.310	-0.002	

Summary	
Stage (m)	99.781
Discharge (m^3/s)	1.827
Pressure Transducer Reading (m)	0.484
Pressure Transducer Elevation (m)	99.297

Discharge Measurement - Mid-Section Method (continued on following page)										
Time (24 hr)	Start		End		Location	Braid 1, 60m downstream of station				
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate 2000				
Flow Meter Type				Instrument Serial #		2004405				
Stage (m)	Start	Reading	0.48	Time	13:54	Braid 1				
	End	Reading		Time						

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	22.95	0.00	0.00	0.02	0			0.000	0.0
	23.10	0.21	0.15	0.06	0.15			0.009	0.5
	23.50	0.16	0.40	0.06	0.31			0.020	1.1
	23.90	0.13	0.40	0.05	0.42			0.022	1.2
	24.30	0.21	0.40	0.08	0.34			0.029	1.6
	24.70	0.08	0.40	0.03	0.15			0.005	0.3
	25.10	0.13	0.40	0.05	0.09			0.005	0.3
	25.50	0.15	0.40	0.06	0.32			0.019	1.1
	25.90	0.20	0.40	0.08	0.29			0.023	1.3
	26.30	0.36	0.40	0.14	0.21			0.030	1.7
	26.70	0.13	0.40	0.05	0.26			0.012	0.6
	27.00	0.19	0.30	0.06	0.3			0.017	0.9
	27.30	0.35	0.30	0.11	0.25			0.026	1.4
	27.60	0.30	0.30	0.09	0.38			0.034	1.9
	27.90	0.28	0.30	0.08	0.41			0.034	1.9
	28.20	0.33	0.30	0.10	0.37			0.037	2.0
	28.50	0.33	0.30	0.10	0.41			0.041	2.2
	28.80	0.38	0.30	0.11	0.41			0.047	2.6
	29.10	0.28	0.30	0.08	0.39			0.033	1.8
	29.40	0.28	0.30	0.08	0.49			0.041	2.3
	29.70	0.30	0.30	0.09	0.5			0.045	2.5
	30.00	0.37	0.30	0.11	0.41			0.046	2.5
	30.30	0.25	0.30	0.08	0.51			0.038	2.1
	30.60	0.20	0.30	0.06	0.25			0.015	0.8
	30.90	0.16	0.30	0.03	0.09			0.003	0.1
LB	30.95	0.00	0.05	0.08	0			0.000	0.0
Total Q (braid 1)								**0.629**	**34.4**

General Notes
Channel was braided, both braids were measured. Sum of total Qs is the total discharge
Meter would not zero, values were offset by -.03

Appendix 2-6. Manual Discharge Measurements and Levelling Surveys at GI-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	9-Jun-12			
Time at Site (24 hr)	Start Time:	1:20:00 PM	End Time:	
Personnel	Eli H, Coby H.			
Station Cordinates	Easting	Northing	Elevation	
	432744	7271610	267	
Weather Conditions	Cloudy			

Transducer Information			
PT Model	P598i	Serial #	2718023
Gain	3.52168	Offset	0
Status	ok	Battery	100%
# of Records	0	Memory Free	32535
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes

Summary	
Stage (m)	
Discharge (m^3/s)	
Pressure Transducer Reading (m)	
Pressure Transducer Elevation (m)	

Discharge Measurement - Mid-Section Method (completed)						
Time (24 hr)	Start		End		Location	Braid 2, 60m downstream of station
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate 2000
Flow Meter Type				Instrument Serial #		2004405
Stage (m)	Start	Reading		Time		
	End	Reading	0.484	Time	15:30	

Notes	Station (m)	Depth (m)	Distance (m)	Area (m^2)	Velocity (m/s) 60%	Velocity (m/s) 20%	Velocity (m/s) 80%	Q (m^3/s)	% of Total Q (%)
RB	20.10	0.00	0.00	0.00	0			0.000	0.0
	20.15	0.08	0.05	0.02	0.17			0.004	0.2
	20.70	0.32	0.55	0.30	0.18			0.053	2.9
	22.00	0.27	1.30	0.35	0.12			0.042	2.3
	23.30	0.11	1.30	0.14	0.04			0.006	0.3
	24.60	0.38	1.30	0.49	0.02			0.010	0.5
Rocks+Eddies	25.90	0.13	1.30	0.17	-0.01			-0.002	-0.1
	27.20	0.18	1.30	0.23	0.05			0.012	0.6
	28.50	0.33	1.30	0.43	0.11			0.047	2.6
	29.80	0.30	1.30	0.39	0.18			0.070	3.8
	31.10	0.18	1.30	0.23	0.23			0.054	2.9
	32.40	0.38	1.30	0.49	0.23			0.114	6.2
	33.70	0.36	1.30	0.47	0.25			0.117	6.4
	35.00	0.31	1.30	0.40	0.24			0.097	5.3
	36.30	0.21	1.30	0.27	0.31			0.085	4.6
	37.60	0.32	1.30	0.42	0.26			0.108	5.9
	38.90	0.24	1.30	0.31	0.27			0.084	4.6
	40.20	0.20	1.30	0.26	0.26			0.068	3.7
	41.50	0.29	1.30	0.38	0.26			0.098	5.4
	42.80	0.30	1.30	0.39	0.12			0.047	2.6
	44.10	0.24	1.30	0.31	0.15			0.047	2.6
	45.40	0.10	1.30	0.13	0.17			0.022	1.2
	46.70	0.20	1.30	0.16	0.09			0.014	0.8
	46.95	0.07	0.25	0.02	0.1			0.002	0.1
LB	47.20	0.00	0.25	0.01	0			0.000	0.0
Total Q (braid 2)								**1.198**	**62.4**

General Notes

Appendix 2-6. Manual Discharge Measurements and Levelling Surveys at GI-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	14-Jun-12			
Time at Site (24 hr)	Start Time:	2:45:00 PM	End Time:	5:15:00 PM
Personnel	Eli H, Coby H.			
Station Cordinates	Easting	Northing	Elevation	
	432744E	7271610N	267	
Weather Conditions	Cloudy, windy, cold			

Transducer Information			
PT Model	P598i	Serial #	2718023
Gain	3.52168	Offset	0
Status	ok	Battery	100%
# of Records	727	Memory Free	32168
Date Serviced		Crest Gauges	no

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 5	1.344	101.344		100.000	
BM 47			1.407	99.937	
PT			2.025	99.319	
WL			1.624	**99.720**	Wavey conditions
BM 49	1.270	101.313	1.301	100.043	
WL			1.592	**99.721**	Wavey conditions
PT			1.992	99.321	
BM 47			1.375	99.938	
BM 5			1.312	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 47	99.925	99.938	0.013	
BM 49	100.038	100.043	0.005	
PT	99.312	99.320	0.008	

Summary	
Stage (m)	99.721
Discharge (m^3/s)	0.841
Pressure Transducer Reading (m)	0.438
Pressure Transducer Elevation (m)	99.283

Discharge Measurement - Mid-Section Method (continued on following page)

Time (24 hr)	Start	13:54	End	15:30	Location	Braid 1, 60m downstream of station	
Method	Velocity-area (Mid-section)			Instrument Model		Flomate	
Flow Meter Type				Instrument Serial #			
Stage (m)	Start	Reading	0.48	Time	13:54	Braid 1	
	End	Reading		Time			

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	19.70	0.00	0.00	0.00	0			0.000	0.0
	19.76	0.08	0.06	0.02	0.23			0.004	0.4
	20.10	0.14	0.34	0.05	0.03			0.001	0.2
	20.45	0.11	0.35	0.04	0.23			0.009	1.1
	20.80	0.10	0.35	0.04	0.11			0.004	0.5
	21.15	0.22	0.35	0.08	0.12			0.009	1.1
	21.50	0.14	0.35	0.05	0.07			0.003	0.4
	21.85	0.10	0.35	0.04	0.14			0.005	0.6
	22.20	0.20	0.35	0.07	0.15			0.011	1.2
	22.55	0.24	0.35	0.08	0.19			0.016	1.9
	22.90	0.35	0.35	0.12	0.06			0.007	0.9
	23.25	0.24	0.35	0.08	0.1			0.008	1.0
	23.60	0.23	0.35	0.08	0.26			0.021	2.5
	23.95	0.38	0.35	0.13	0.25			0.033	4.0
	24.30	0.46	0.35	0.16	0.08			0.013	1.5
	24.65	0.34	0.35	0.12	0.27			0.032	3.8
	25.00	0.18	0.35	0.06	0.31			0.020	2.3
	25.35	0.25	0.35	0.09	0.17			0.015	1.8
	25.70	0.26	0.35	0.09	0.35			0.032	3.8
	26.05	0.26	0.35	0.09	0.27			0.025	2.9
	26.40	0.17	0.35	0.06	0.29			0.017	2.1
	26.75	0.18	0.35	0.06	0.24			0.015	1.8
	27.10	0.10	0.35	0.02	0.12			0.002	0.3
LB	27.15	0.00	0.05	0.00	0			0.000	0.0
Total Q (braid 1)								**0.302**	**35.9**

General Notes

Channel was braided, both braids were measured. Sum of total Qs is the total discharge
Gradiant = 2%

Appendix 2-6. Manual Discharge Measurements and Levelling Surveys at GI-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	14-Jun-12			
Time at Site (24 hr)	Start Time:	2:45:00 PM	End Time:	5:15:00 PM
Personnel	Eli H, Coby H.			
Station Cordinates	Easting	Northing	Elevation	
	432744E	7271610N	267	
Weather Conditions	Cloudy, windy, cold			

Transducer Information			
PT Model	P598i	Serial #	2718023
Gain	3.52168	Offset	0
Status	ok	Battery	100%
# of Records	727	Memory Free	32168
Date Serviced		Crest Gauges	no

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes

Summary	
Stage (m)	
Discharge (m^3/s)	
Pressure Transducer Reading (m)	
Pressure Transducer Elevation (m)	

Discharge Measurement - Mid-Section Method (complete)										
Time (24 hr)	Start	13:54	End	15:30	Location	Braid 2, 60m downstream of station				
Method	Velocity-area (Mid-section)			Instrument Model		Flomate 2000				
Flow Meter Type				Instrument Serial #		2004405				
Stage (m)	Start	Reading		Time						
	End	Reading	0.484	Time	15:30					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.10	0.05	0.00	0.24	0.11			0.026	3.1
	1.60	0.32	1.50	0.48	0.01			0.005	0.6
	3.10	0.07	1.50	0.11	0.14			0.015	1.7
	4.60	0.12	1.50	0.12	0.03			0.004	0.4
	5.10	0.22	0.50	0.22	0.02			0.004	0.5
	6.60	0.05	1.50	0.06	0.02			0.001	0.1
	7.60	0.40	1.00	0.40	0.14			0.056	6.7
	8.60	0.26	1.00	0.26	0.11			0.029	3.4
	9.60	0.26	1.00	0.26	0.1			0.026	3.1
	10.60	0.26	1.00	0.26	0.16			0.042	4.9
	11.60	0.23	1.00	0.23	0.22			0.051	6.0
	12.60	0.23	1.00	0.23	0.2			0.046	5.5
	13.60	0.24	1.00	0.24	0.16			0.038	4.6
	14.60	0.21	1.00	0.21	0.19			0.040	4.7
	15.60	0.16	1.00	0.16	0.17			0.027	3.2
	16.60	0.21	1.00	0.21	0.19			0.040	4.7
	17.60	0.17	1.00	0.17	0.14			0.024	2.8
	18.60	0.17	1.00	0.17	0.12			0.020	2.4
	19.60	0.20	1.00	0.25	0.14			0.035	4.2
	21.10	0.06	1.50	0.10	0.03			0.003	0.3
	22.80	0.05	1.70	0.08	0.05			0.004	0.4
	24.10	0.06	1.30	0.05	0.07			0.004	0.4
	24.60	0.00	0.50	0.02	0			0.000	0.0
LB									
Total Q (braid 2)								0.539	64.1

Genreral Notes

Appendix 2-6. Manual Discharge Measurements and Levelling Surveys at GI-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	13-Jul-12			
Time at Site (24 hr)	Start Time:	8:40:00 AM	End Time:	1:15:00 PM
Personnel	Eli H, Fraser T.			
Station Cordinates	Easting	Northing	Elevation	
	432744	7271610	267	
Weather Conditions	Cloudy, cool			

Transducer Information			
PT Model	P598i	Serial #	2718023
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	4864	Memory Free	30104
Date Serviced		Crest Gauges	no

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 5	1.609	101.609		100.000	
BM 47			1.686	99.923	
BM 49			1.561	100.048	
PT			2.282	99.327	
WL			1.962	**99.647**	
TBM	1.765	101.555	1.819	99.790	
WL			1.907	**99.648**	
PT			2.227	99.328	
BM 49			1.505	100.050	
BM 47			1.630	99.925	
BM 5			1.552	100.003	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 47	99.925	99.924	-0.001	
BM 49	100.038	100.049	0.011	
PT	99.312	99.328	0.015	

Summary	
Stage (m)	99.648
Discharge (m^3/s)	0.131
Pressure Transducer Reading (m)	0.340
Pressure Transducer Elevation (m)	99.307

Discharge Measurement - Mid-Section Method (continued on following page)							
Time (24 hr)	Start	8:43	End	10:15	Location	Braid 1, 60m downstream of station	
Method	Velocity-area (Mid-section)			Instrument Model		Flomate 2000	
Flow Meter Type	Flo-Mate			Instrument Serial #		2007612	
Stage (m)	Start	Reading	0.339	Time	8:43	Braid 1	
	End	Reading		Time			

	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
RB	3.50	0.00	0.00	0.00	0.00	0		0.000	0.0
	3.60	0.10	0.03	0.10	0.00	0.03		0.000	0.1
Hole	3.80	0.68	0.21	0.20	0.04	0.07		0.003	2.2
behind rock	4.00	0.26	0.08	0.20	0.02	0.01		0.000	0.1
	4.20	0.20	0.06	0.20	0.01	0.07		0.001	0.7
	4.40	0.30	0.09	0.20	0.02	0.06		0.001	0.8
	4.60	0.15	0.05	0.20	0.01	0.12		0.001	0.8
	4.80	0.48	0.15	0.20	0.03	0.1		0.003	2.2
	5.00	0.41	0.12	0.20	0.02	0.13		0.003	2.5
	5.20	0.40	0.12	0.20	0.02	0.12		0.003	2.2
	5.40	0.33	0.10	0.20	0.02	0.12		0.002	1.8
	5.60	0.52	0.16	0.20	0.03	0.2		0.006	4.8
	5.80	0.92	0.28	0.20	0.06	0.03		0.002	1.4
	6.05	0.56	0.17	0.25	0.04	0.14		0.006	4.6
	6.30	0.27	0.08	0.25	0.02	0.22		0.005	3.5
	6.55	0.64	0.20	0.25	0.05	0.12		0.006	4.5
	6.80	0.61	0.19	0.25	0.05	0.14		0.007	5.0
rock	7.05	0.00	0.00	0.25	0.00	0		0.000	0.0
	7.30	0.33	0.10	0.25	0.03	0.27		0.007	5.2
	7.55	0.33	0.10	0.25	0.03	0.02		0.001	0.4
	7.80	0.23	0.07	0.25	0.02	0.07		0.001	0.9
	8.05	0.32	0.10	0.25	0.02	0.29		0.007	5.4
	8.30	0.30	0.09	0.25	0.02	0.05		0.001	0.9
	8.55	0.24	0.07	0.25	0.01	0.02		0.000	0.2
eddy	8.65	0.25	0.08	0.10	0.01	-0.02		0.000	-0.1
LB	8.72	0.00	0.00	0.07	0.00	0		0.000	0.0
Total Q (braid 1)								**0.0657**	**50.2**

General Notes
Channel was braided, both braids were measured. Sum of total Qs is the total discharge
Gradiant = 1%. Imperial Rod was used. Depths converted from ft to m (1ft = 0.3048m)

Appendix 2-6. Manual Discharge Measurements and Levelling Surveys at GI-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	13-Jul-12			
Time at Site (24 hr)	Start Time:	8:40:00 AM	End Time:	1:15:00 PM
Personnel	Eli H, Fraser T.			
Station Cordinates	Easting	Northing	Elevation	
	432744	7271610	267	
Weather Conditions	Cloudy, cool			

Transducer Information			
PT Model	P598i	Serial #	2718023
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	4864	Memory Free	30104
Date Serviced		Crest Gauges	no

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes	

Summary	
Stage (m)	
Discharge (m^3/s)	
Pressure Transducer Reading (m)	
Pressure Transducer Elevation (m)	

Discharge Measurement - Mid-Section Method (complete)										
Time (24 hr)	Start	8:43	End	10:15	Location	Braid 2, 60m downstream of station				
Method	Velocity-area (Mid-section)				Instrument Model	Flomate 2000				
Flow Meter Type	Flo-Mate				Instrument Serial #	2007612				
Stage (m)	Start	Reading			Time		Braid 2			
	End	Reading	0.34		Time	10:15				

	Station	Depth		Distance	Area	Velocity @60%	Cal. velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
RB	1.70	0.00	0.00	0.00	0.00	0		0.000	0.0
	1.80	0.15	0.05	0.10	0.01	0.07		0.000	0.4
	2.00	0.15	0.05	0.20	0.01	0.05		0.000	0.2
rock	2.05	0.00	0.00	0.05	0.00	0		0.000	0.0
rock	2.50	0.00	0.00	0.45	0.00	0		0.000	0.0
	2.62	0.60	0.18	0.12	0.03	0		0.000	0.0
	2.85	0.36	0.11	0.23	0.03	0.01		0.000	0.2
	3.10	0.35	0.11	0.25	0.03	0.25		0.007	5.1
	3.35	0.22	0.07	0.25	0.01	0.03		0.000	0.3
rocks	3.45	0.00	0.00	0.10	0.00	0		0.000	0.0
rocks	5.10	0.00	0.00	1.65	0.00	0		0.000	0.0
	9.25	0.20	0.06	4.15	0.14	0		0.000	0.0
	9.60	0.32	0.10	0.35	0.07	0.02		0.001	1.0
	10.60	0.35	0.11	1.00	0.11	0.05		0.005	4.1
rock	11.60	0.00	0.00	1.00	0.00	0		0.000	0.0
	12.10	0.41	0.12	0.50	0.09	0.02		0.002	1.4
	13.10	0.41	0.12	1.00	0.12	0.03		0.004	2.9
	14.10	0.50	0.15	1.00	0.15	0.06		0.009	7.0
	15.10	0.32	0.10	1.00	0.10	0.07		0.007	5.2
	16.10	0.40	0.12	1.00	0.12	0.04		0.005	3.7
	17.10	0.48	0.15	1.00	0.15	0.07		0.010	7.8
	18.10	0.70	0.21	1.00	0.21	0.01		0.002	1.6
	19.10	0.25	0.08	1.00	0.08	0.02		0.002	1.2
	20.10	0.56	0.17	1.00	0.17	0.05		0.009	6.5
	21.10	0.20	0.06	1.00	0.06	0.01		0.001	0.5
	22.10	0.23	0.07	1.00	0.07	0		0.000	0.0
	23.10	0.50	0.15	1.00	0.10	0.01		0.001	0.8
	23.40	0.10	0.03	0.30	0.01	0.01		0.000	0.0
LB	23.50	0.00	0.00	0.10	0.00	0		0.000	0.0
Total Q (braid 2)								**0.0653**	**49.8**

General Notes

Appendix 2-6. Manual Discharge Measurements and Levelling Surveys at GI-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	14-Aug-12			
Time at Site (24 hr)	**Start Time:**	10:00:00 AM	**End Time:**	2:20:00 PM
Personnel	Eli H, Cenling X.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	432744E	7271610N	267	
Weather Conditions	Mix of Sun + Cloud			

Transducer Information			
PT Model	P598i	**Serial #**	2718023
Gain	3.52168	**Offset**	0
Status	OK	**Battery**	100%
# of Records	9484	**Memory Free**	55650
Date Serviced		**Crest Gauges**	no

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 5	1.596	101.596		100.000	
BM 47			1.674	99.922	
BM 49			1.560	100.036	
PT			2.270	99.326	
WL			2.036	**99.560**	
TBM	1.978	101.626	1.948	99.648	
WL			2.065	**99.561**	
PT			2.302	99.324	
BM 49			1.589	100.037	
BM 47			1.705	99.921	
BM 5			1.626	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 47	99.925	99.922	-0.003	
BM 49	100.038	100.037	-0.001	
PT	99.312	99.325	0.013	

Summary	
Stage (m)	99.561
Discharge (m^3/s)	0.034
Pressure Transducer Reading (m)	0.264
Pressure Transducer Elevation (m)	99.297

Discharge Measurement - Mid-Section Method (continued on following page)

Time (24 hr)	**Start**	10:45	**End**	11:40	**Location**	Braid 1, 20m downstream of station	
Method	Velocity-area (Mid-section)			**Instrument Model**		Flomate 2000	
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2006042	
Stage (m)	**Start**	**Reading**	0.257	**Time**	10:45	Braid 1	
	End	**Reading**		**Time**			

					Velocity (m/s)				
	Station	**Depth**	**Distance**	**Area**				**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	2.50	0.00	0.00	0.00	0			0.000	0.0
	2.60	0.03	0.10	0.00	0.01			0.000	0.1
	2.70	0.03	0.10	0.00	0.03			0.000	0.3
Rock	2.80	0.00	0.10	0.00	0			0.000	0.0
Rock	3.10	0.00	0.30	0.00	0			0.000	0.0
	3.30	0.06	0.20	0.01	0.07			0.001	2.6
	3.50	0.08	0.20	0.02	0			0.000	0.0
	3.70	0.06	0.20	0.01	0.03			0.000	1.1
	3.90	0.14	0.20	0.03	0.01			0.000	0.8
	4.10	0.19	0.20	0.04	0.09			0.003	9.8
	4.30	0.37	0.20	0.07	0.06			0.004	12.8
	4.50	0.20	0.20	0.04	0.13			0.005	15.1
	4.70	0.40	0.20	0.08	0.05			0.004	11.6
	4.90	0.31	0.20	0.06	0.03			0.002	5.4
	5.10	0.34	0.20	0.05	0.05			0.003	7.5
	5.20	0.05	0.10	0.01	0.04			0.000	0.8
	5.40	0.06	0.20	0.01	-0.01			0.000	-0.4
	5.60	0.03	0.20	0.01	0.01			0.000	0.2
	5.80	0.03	0.20	0.01	-0.01			0.000	-0.2
	6.00	0.09	0.20	0.01	0			0.000	0.0
LB (1st channel)	6.10	0.00	0.10	0.00	0			0.000	0.0
Q (this table)								**0.0231**	**67.4**

General Notes

Channel was braided, both braids were measured. Sum of total Qs is the total discharge
Gradiant = 1%. Imperial Rod was used. Depths converted from ft to m (1ft = 0.3048m)

Appendix 2-6. Manual Discharge Measurements and Levelling Surveys at GI-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	14-Aug-12			
Time at Site (24 hr)	Start Time:	10:00:00 AM	End Time:	2:20:00 PM
Personnel	Eli H, Cenling X.			
Station Cordinates	Easting	Northing	Elevation	
	432744E	7271610N	267	
Weather Conditions	Mix of Sun + Cloud			

Transducer Information			
PT Model	P598i	Serial #	2718023
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	9484	Memory Free	55650
Date Serviced		Crest Gauges	no

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes

Summary	
Stage (m)	
Discharge (m^3/s)	
Pressure Transducer Reading (m)	
Pressure Transducer Elevation (m)	

Discharge Measurement - Mid-Section Method (complete)										
Time (24 hr)	Start	8:43	End	10:15	Location	Braid 2, 60m downstream of station				
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2007612				
Stage (m)	Start	Reading		Time		Braid 2				
	End	Reading	0.34	Time	10:15					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	12.00	0.00	0.00	0.00	0			0.000	0.0
	12.05	0.03	0.05	0.00	0.07			0.000	0.6
	12.20	0.06	0.15	0.01	0.08			0.001	2.5
	12.40	0.05	0.20	0.01	0.02			0.000	0.4
	12.50	0.00	0.10	0.00	0			0.000	0.0
	14.30	0.00	1.80	0.00	0			0.000	0.0
	14.40	0.03	0.10	0.00	0.05			0.000	0.7
	14.60	0.08	0.20	0.02	0.03			0.001	1.7
	14.90	0.12	0.30	0.02	0.08			0.002	5.6
	15.00	0.00	0.10	0.00	0			0.000	0.0
	15.35	0.09	0.35	0.02	0.12			0.002	6.2
	15.40	0.18	0.05	0.02	0.06			0.001	3.2
	15.55	0.00	0.15	0.00	0			0.000	0.0
	16.00	0.00	0.45	0.00	0			0.000	0.0
	16.10	0.11	0.10	0.02	0.07			0.001	3.3
	16.30	0.00	0.20	0.00	0			0.000	0.0
	16.50	0.06	0.20	0.01	0.11			0.001	3.1
	16.60	0.07	0.10	0.01	0.12			0.001	3.5
	16.80	0.00	0.20	0.00	0			0.000	0.0
	17.10	0.03	0.30	0.01	0			0.000	0.0
	17.30	0.05	0.20	0.01	0.03			0.000	0.8
	17.50	0.05	0.20	0.01	0.04			0.000	1.1
	17.70	0.00	0.20	0.00	0			0.000	0.0
	17.90	0.03	0.20	0.01	0			0.000	0.0
LB	18.20	0.00	0.30	0.00	0			0.000	0.0
Q (this table)								0.0111	32.6

General Notes

Appendix 2-6. Manual Discharge Measurements and Levelling Surveys at GI-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	10-Sep-12			
Time at Site (24 hr)	Start Time:	2:00:00 PM	End Time:	4:30:00 PM
Personnel	Eli H, Scott C.			
Station Cordinates	Easting	Northing	Elevation	
	432744E	7271610N	267	
Weather Conditions	Cloud, cool			

Transducer Information			
PT Model	P598i	Serial #	2718023
Gain	3.52168	Offset	0
Status	OK/ Stopped	Battery	100%
# of Records	65534	Memory Free	0
Date Serviced		Crest Gauges	no

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 5	1.407	101.407		100.000	
BM 47			1.485	99.922	
BM 49			1.369	100.038	
PT			2.087	99.320	
WL			1.855	**99.552**	
TBM	1.918	101.323	2.002	99.405	
WL			1.772	**99.551**	
PT			2.003	99.320	
BM 49			1.283	100.040	
BM 47			1.399	99.924	
BM 5			1.322	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 47	99.925	99.923	-0.002	
BM 49	100.038	100.039	0.001	
PT	99.312	99.320	0.008	

Summary	
Stage (m)	99.552
Discharge (m^3/s)	0.0295
Pressure Transducer Reading (m)	0.249
Pressure Transducer Elevation (m)	99.303

Discharge Measurement - Mid-Section Method (continued on following page)									
Time (24 hr)	Start	14:25	End	15:37	Location	Braid 1, 20m downstream of station			
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate 2000			
Flow Meter Type	Flo-Mate			Instrument Serial #		2007529			
Stage (m)	Start	Reading	0.249	Time	14:25				
	End	Reading		Time					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	4.10	0.00	0.00	0.01	0			0.000	0.0
	4.25	0.12	0.15	0.02	0.03			0.001	1.8
	4.40	0.13	0.15	0.03	0.02			0.001	2.0
	4.70	0.14	0.30	0.03	0.06			0.002	5.7
Rock	4.80	0.00	0.10	0.00	0			0.000	0.0
Rock	5.20	0.00	0.40	0.00	0			0.000	0.0
	5.35	0.14	0.15	0.02	0.09			0.002	6.4
	5.50	0.26	0.15	0.03	0.13			0.004	14.3
	5.60	0.24	0.10	0.02	0.12			0.003	9.7
	5.70	0.19	0.10	0.02	0.12			0.002	7.7
	5.80	0.20	0.10	0.03	0.12			0.004	12.2
	6.00	0.16	0.20	0.04	0.06			0.002	8.1
	6.30	0.06	0.30	0.02	0.06			0.001	3.7
	6.60	0.10	0.30	0.03	0			0.000	0.0
Rock	6.85	0.00	0.25	0.00	0			0.000	0.0
Rock	8.35	0.00	1.50	0.00	0			0.000	0.0
	8.40	0.01	0.05	0.00	0.05			0.000	0.2
	8.55	0.02	0.15	0.00	0.03			0.000	0.2
Rocks	8.60	0.00	0.05	0.00	0			0.000	0.0
Rocks	13.00	0.00	4.40	0.00	0			0.000	0.0
	13.05	0.04	0.05	0.00	0.17			0.001	2.3
	13.20	0.02	0.15	0.00	0			0.000	0.0
Rock	13.40	0.00	0.20	0.00	0			0.000	0.0
Rock	15.70	0.00	2.30	0.00	0			0.000	0.0
	15.75	0.04	0.05	0.00	0.04			0.000	0.5
	15.90	0.11	0.15	0.02	0.04			0.001	2.6
	16.10	0.06	0.20	0.01	0.07			0.001	2.8
	16.30	0.05	0.20	0.01	0.02			0.000	0.7
Q (this table)								**0.0239**	**81.0**

General Notes

Appendix 2-6. Manual Discharge Measurements and Levelling Surveys at GI-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	10-Sep-12			
Time at Site (24 hr)	Start Time:	2:00:00 PM	End Time:	4:30:00 PM
Personnel	Eli H, Scott C.			
Station Cordinates	Easting	Northing	Elevation	
	432744E	7271610N	267	
Weather Conditions	Cloud, cool			

Transducer Information			
PT Model	P598i	Serial #	2718023
Gain	3.52168	Offset	0
Status	OK/ Stopped	Battery	100%
# of Records	65534	Memory Free	0
Date Serviced		Crest Gauges	no

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes	

Summary	
Stage (m)	
Discharge (m^3/s)	
Pressure Transducer Reading (m)	
Pressure Transducer Elevation (m)	

Discharge Measurement - Mid-Section Method (complete)										
Time (24 hr)	Start	8:43	End	10:15	Location	Braid 2, 60m downstream of station				
Method	Velocity-area (Mid-section)			Instrument Model		Flomate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2007529				
Stage (m)	Start	Reading		Time						
	End	Reading	0.249	Time	15:37					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
	16.50	0.18	0.20	0.03	0.08			0.002	7.3
Rock	16.60	0.00	0.10	0.00	0			0.000	0.0
Rock	17.10	0.00	0.50	0.00	0			0.000	0.0
	17.20	0.09	0.10	0.01	0.11			0.001	3.4
Rock	17.30	0.00	0.10	0.00	0			0.000	0.0
	17.55	0.05	0.25	0.01	0.01			0.000	0.3
	17.65	0.05	0.10	0.01	0.03			0.000	0.9
	17.90	0.12	0.25	0.03	0.02			0.001	1.8
Rock	18.10	0.00	0.20	0.00	0			0.000	0.0
	18.30	0.03	0.20	0.01	0			0.000	0.0
	18.45	0.06	0.15	0.01	0.08			0.001	2.0
	18.55	0.14	0.10	0.02	0.04			0.001	2.4
	18.70	0.07	0.15	0.01	0.01			0.000	0.4
	18.85	0.06	0.15	0.01	0.02			0.000	0.6
	19.00	0.05	0.15	0.01	0			0.000	0.0
LB	19.20	0.00	0.20	0.00	0			0.000	0.0
Q (this table)								0.00563	19.0

General Notes

Appendix 2-6. Manual Discharge Measurements and Levelling Surveys at GI-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	14-Sep-12			
Time at Site (24 hr)	**Start Time:**	8:40:00 AM	**End Time:**	10:20:00 AM
Personnel	Eli H, Chris H.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	432744E	7271610N	267	
Weather Conditions	Sunny, cool			

Transducer Information			
PT Model	P598i	**Serial #**	2718023
Gain	3.52168	**Offset**	0
Status	OK/ Stopped	**Battery**	100%
# of Records	542	**Memory Free**	32258
Date Serviced		**Crest Gauges**	no

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 5	1.415	101.415		100.000	
BM 47			1.492	99.923	
BM 49			1.378	100.037	
PT			2.098	99.317	
WL			1.869	**99.546**	
TBM	2.057	101.353	2.119	99.296	
WL			1.807	**99.546**	
PT			2.037	99.316	
BM 49			1.316	100.037	
BM 47			1.432	99.921	
BM 5			1.353	100.000	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 47	99.925	99.922	-0.003	
BM 49	100.038	100.037	-0.001	
PT	99.312	99.317	0.005	

Summary	
Stage (m)	99.546
Discharge (m^3/s)	0.0456
Pressure Transducer Reading (m)	0.246
Pressure Transducer Elevation (m)	99.300

Discharge Measurement - Mid-Section Method (continued on following page)

Time (24 hr)	**Start**	8:42	**End**	9:52	**Location**	Braid 1, 20m downstream of station	
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-mate 2000	
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2007529	
Stage (m)	**Start**	**Reading**	0.243	**Time**	8:42		
	End	**Reading**		**Time**			

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	1.50	0.00	0.00	0.00	0			0.000	0.0
	1.60	0.06	0.10	0.01	0.05			0.000	0.8
	1.75	0.06	0.15	0.01	0.04			0.000	0.8
Rock above water	1.90	0.00	0.15	0.00	0			0.000	0.0
	2.20	0.04	0.30	0.01	0.02			0.000	0.4
	2.35	0.22	0.15	0.03	0.03			0.001	2.2
	2.50	0.18	0.15	0.03	0.07			0.002	4.1
	2.65	0.33	0.15	0.05	0.1			0.005	10.8
	2.80	0.41	0.15	0.06	0.07			0.004	9.4
	2.95	0.42	0.15	0.06	0.06			0.004	8.3
	3.10	0.31	0.15	0.05	0.08			0.004	8.2
	3.25	0.32	0.15	0.05	0.04			0.002	4.2
	3.40	0.42	0.15	0.06	0.03			0.002	4.1
	3.55	0.26	0.15	0.04	0.05			0.002	4.3
	3.70	0.07	0.15	0.01	0.03			0.000	0.6
Right Channel LB	3.80	0.00	0.10	0.00	0			0.000	0.0
Left Channel RB	10.40	0.00	6.60	0.00	0			0.000	0.0
	10.45	0.08	0.05	0.01	0.02			0.000	0.4
	10.65	0.12	0.20	0.02	0.05			0.001	2.0
Rock above water	10.75	0.00	0.10	0.00	0			0.000	0.0
Rock above water	10.80	0.00	0.05	0.00	0			0.000	0.0
	11.90	0.06	1.10	0.04	0.04			0.002	3.8
	12.25	0.03	0.35	0.01	0.02			0.000	0.5
	12.60	0.12	0.35	0.04	0.07			0.003	6.0
	12.90	0.17	0.30	0.05	0.03			0.002	3.4
	13.20	0.08	0.30	0.02	0.01			0.000	0.5
	13.50	0.12	0.30	0.04	0.02			0.001	1.8
	13.90	0.14	0.40	0.05	0.05			0.002	5.4
Q (this table)								**0.0374**	**82.0**

General Notes

Distance from middle of PT to top of pipe = 1.6cm

Appendix 2-6. Manual Discharge Measurements and Levelling Surveys at GI-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	14-Sep-12			
Time at Site (24 hr)	Start Time:	8:40:00 AM	End Time:	10:20:00 AM
Personnel	Eli H, Chris H.			
Station Cordinates	Easting	Northing	Elevation	
	432744E	7271610N	267	
Weather Conditions	Sunny, cool			

Transducer Information			
PT Model	P598i	Serial #	2718023
Gain	3.52168	Offset	0
Status	OK/ Stopped	Battery	100%
# of Records	542	Memory Free	32258
Date Serviced		Crest Gauges	no

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes

Summary	
Stage (m)	
Discharge (m^3/s)	
Pressure Transducer Reading (m)	
Pressure Transducer Elevation (m)	

Discharge Measurement - Mid-Section Method(Complete)										
Time (24 hr)	Start	8:42	End	9:52	Location	Braid 2, 20m downstream of station				
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2007529				
Stage (m)	Start	Reading		Time						
	End	Reading	0.246	Time	9:52					

continued	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
	14.20	0.20	0.30	0.06	0.02			0.001	2.6
	14.50	0.20	0.30	0.06	0.01			0.001	1.3
	14.80	0.08	0.30	0.02	0.07			0.002	3.7
	15.10	0.11	0.30	0.03	0.06			0.002	4.3
	15.40	0.06	0.30	0.02	0.04			0.001	1.6
	15.70	0.05	0.30	0.02	0.04			0.001	1.3
	16.00	0.09	0.30	0.02	0.04			0.001	2.2
	16.25	0.10	0.25	0.02	0.03			0.000	1.0
LB	16.30	0.00	0.05	0.00	0			0.000	0.0
Q (this table)								0.00822	18.0

General Notes

Appendix 2-7. Manual Discharge Measurements and Levelling Surveys at EL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	EL-H1			
Stream Name	South of Goose			
Date Monitored	6-Jun-12			
Time at Site (24 hr)	Start Time:	3:10:00 PM	End Time:	5:30:00 PM
Personnel	Eli, Coby			
Station Cordinates	Easting	Northing	Elevation	
	432,091	7,269,573	293m	
Weather Conditions	Above 20C	Sunny		

Transducer Information			
PT Model	PS98i	Serial #	2714003
Gain	3.52168	Offset	0
Status	O.k.	Battery	100%
# of Records	1	Memory Free	32530 readings
Date Serviced	n/a	Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 14	1.108	101.108		100.000	
BM 15			1.182	99.926	
PT			2.141	98.967	
WL			1.729	**99.379**	
BM 16			1.116	99.992	
BM 16	1.066	101.058			
WL			1.679	99.379	
PT			2.090	**98.968**	
BM 15			1.132	99.926	
BM 14			1.057	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 15	99.915	99.926	0.011	
BM 16	99.984	99.992	0.008	
PT	98.968	98.968	-0.001	

Summary	
Stage (m)	99.379
Discharge (m^3/s)	Not Measured
Pressure Transducer Reading (m)	0.440
Pressure Transducer Elevation (m)	98.939

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	15:55	End	16:40	Location	10m downstream of PT				
Method	No Discharge measurement			Instrument Model						
Flow Meter Type				Instrument Serial #						
Stage (m)	Start	Reading	0.437	Time	15:55					
	End	Reading	0.439	Time	16:40					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	18.43	0.00	0.00	0.01					
	18.55	0.09	0.12	0.01					
	18.70	0.15	0.15	0.03					
	18.90	0.14	0.20	0.02					
	19.00	0.17	0.10	0.02					
	19.15	0.13	0.15	0.02					
	19.30	0.17	0.15	0.03					
	19.45	0.17	0.15	0.03					
	19.60	0.15	0.15	0.02					
	19.75	0.12	0.15	0.02					
	19.90	0.07	0.15	0.01					
LB	19.95	0.00	0.05	0.00					
Total Q									

General Notes
Small low energy ephemeral stream. Bed of grass covering boulders, muddy. Vegetated tundra banks. Gradient looking from above riffle above PT =2%. Flow meter not operational.

Appendix 2-7. Manual Discharge Measurements and Levelling Surveys at EL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	EL-H1			
Stream Name	South of Goose			
Date Monitored	13-Jun-12			
Time at Site (24 hr)	**Start Time:**	0-Jan-00	**End Time:**	0-Jan-00
Personnel	Eli, Coby			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	432,091	7,269,573	293m	
Weather Conditions	Above Zero	Partly Cloudy		

Transducer Information			
PT Model	PS98i	**Serial #**	7-Sep-30
Gain	3-Jan-00	**Offset**	0-Jan-00
Status	O.k.	**Battery**	100%
# of Records	22-Aug-02	**Memory Free**	32048 readings
Date Serviced	n/a	**Crest Gauges**	No

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 14	1.158	101.158		100.000	
BM 15			1.234	99.924	
PT			2.190	98.968	
WL			1.850	**99.308**	
BM 16			1.167	99.991	**Az**
BM 16	1.131	101.122			335.000
WL			1.815	99.307	
PT			2.155	**98.967**	132.000
BM 15			1.198	99.924	217.000
BM 14			1.123	99.999	247.000

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 15	99.915	99.924	0.009	
BM 16	99.984	99.991	0.007	
PT	98.968	98.968	-0.001	

Summary	
Stage (m)	99.308
Discharge (m^3/s)	0.00675
Pressure Transducer Reading (m)	0.361
Pressure Transducer Elevation (m)	98.946

Discharge Measurement - Mid-Section Method										
Time (24 hr)	**Start**		**End**		**Location**	10m downstream of PT				
Method	Velocity-area (Mid-section)			**Instrument Model**	Flo-mate 2000					
Flow Meter Type	Flo-mate			**Instrument Serial #**	14-Nov-87					
Stage (m)	**Start**	**Reading**	0-Jan-00	**Time**	15:55					
	End	**Reading**	0-Jan-00	**Time**	16:40					

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	0.56	0.00	0.00	0.00	0			0.0000	0.0
Grass/eddy	0.64	0.08	0.08	0.00	0.07			0.0003	5.0
Grass/Eddy	0.68	0.10	0.04	0.01	0			0.0000	0.0
Eddy	0.74	0.19	0.06	0.01	-0.01			-0.0001	-1.7
Eddy	0.80	0.18	0.06	0.01	-0.01			-0.0001	-1.5
Eddy	0.85	0.18	0.05	0.01	-0.01			-0.0001	-1.3
Eddy	0.90	0.19	0.05	0.01	-0.01			-0.0001	-1.4
	0.95	0.18	0.05	0.01	0.01			0.0001	1.3
	1.00	0.18	0.05	0.01	0.02			0.0002	2.7
	1.05	0.19	0.05	0.01	0.02			0.0002	2.8
Grass	1.10	0.14	0.05	0.01	0.06			0.0004	6.2
Grass	1.15	0.13	0.05	0.01	0.07			0.0005	6.7
Grass	1.20	0.12	0.05	0.01	0.13			0.0008	11.6
Grass	1.25	0.13	0.05	0.01	0.06			0.0004	5.8
Grass	1.30	0.14	0.05	0.01	0.17			0.0012	17.6
Grass	1.35	0.12	0.05	0.01	0.16			0.0010	14.2
Grass	1.40	0.11	0.05	0.01	0.2			0.0011	16.3
Grass	1.45	0.10	0.05	0.01	0.12			0.0006	8.9
Grass	1.50	0.09	0.05	0.00	0.08			0.0004	5.3
Grass	1.55	0.08	0.05	0.00	0.02			0.0001	1.4
LB	1.62	0.00	0.07	0.00	0			0.0000	0.0
Total Q								**0.00675**	**100.0**

General Notes
Gradiant = 1.5%

Appendix 2-7. Manual Discharge Measurements and Levelling Surveys at EL-H1 in 2012

Site Information					
Project Name	Back River				
Station Identification	EL-H1				
Stream Name	South of Goose				
Date Monitored	17-Jun-12				
Time at Site (24 hr)	Start Time:	12:44:00 PM	End Time:	1:30:00 PM	
Personnel	E. Heyman, C. Hall				
Station Cordinates	Easting	Northing	Elevation		
	432,091	7,269,573	293m		
Weather Conditions	Sunny				

Transducer Information					
PT Model		PS98i	Serial #		2714003
Gain		3.52168	Offset		0
Status		Active	Battery		100%
# of Records		1565	Memory Free		31749
Date Serviced			Crest Gauges		N/A

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 14	1.154	101.154		100.000	
BM 15			1.234	99.920	error
PT			2.186	98.968	
WL			1.875	**99.279**	
BM 16	1.148	101.139	1.163	99.991	
WL			1.860	**99.279**	
PT			2.171	98.968	
BM 15			1.214	99.925	checked, correct
BM 14			1.139	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 15	99.915	99.925	0.010	
BM 16	99.984	99.991	0.007	
PT	98.968	98.968	0.000	

Summary	
Stage (m)	99.279
Discharge (m^3/s)	0.00263
Pressure Transducer Reading (m)	0.336
Pressure Transducer Elevation (m)	98.943

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	10:11	End	11:03	Location	10m downstream of pressure transducer			
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate 2000			
Flow Meter Type	Flo-mate			Instrument Serial #		2004405			
Stage (m)	Start	Reading	0.336	Time	16:13				
	End	Reading	0.336	Time	17:32				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.37	0.00	0.00	0.00	0			0.0000	0.0
	0.43	0.08	0.06	0.00	0.19			0.0006	23.1
	0.45	0.09	0.02	0.00	0.31			0.0007	26.6
	0.48	0.07	0.03	0.00	0.41			0.0009	32.8
	0.51	0.04	0.03	0.00	0.23			0.0005	17.5
LB	0.58	0.00	0.07	0.00	0			0.0000	0.0
Total Q								**0.00263**	**100.0**

General Notes

Gradiant = 2%

Appendix 2-7. Manual Discharge Measurements and Levelling Surveys at EL-H1 in 2012

Site Information

Project Name	Back River			
Station Identification	EL-H1			
Stream Name	Echo Lake Outflow			
Date Monitored	9-Jul-12			
Time at Site (24 hr)	**Start Time:**	11:00:00 AM	**End Time:**	1:30:00 PM
Personnel	E. Heyman, Yasser A.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	432,091	7,269,573	293m	
Weather Conditions	Sunny			

Transducer Information

PT Model	PS98i	**Serial #**	2714003
Gain	3.52168	**Offset**	0
Status	OK	**Battery**	100%
# of Records	4723	**Memory Free**	30173
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 14	0.906	100.906		100.000	
BM 15			0.988	99.918	
BM 16			0.908	99.998	
PT			1.917	98.989	
WL			1.700	**99.206**	
TBM	1.527	100.862	1.571	99.335	
WL			1.654	**99.208**	
PT			1.875	98.987	
BM 16			0.863	99.999	
BM15			0.946	99.916	
BM 14			0.862	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 15	99.915	99.917	0.002	
BM 16	99.984	99.999	0.015	
PT	98.968	98.988	0.020	

Summary

Stage (m)	99.207
Discharge (m^3/s)	No Flow
Pressure Transducer Reading (m)	0.239
Pressure Transducer Elevation (m)	98.968

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	11:11	**End**	11:11	**Location**	N/A
Method				**Instrument Model**		N/A
Flow Meter Type	N/A			**Instrument Serial #**		N/A
Stage (m)	**Start**	**Reading**	0.239	**Time**	11:11	No Flow on this date
	End	**Reading**	0.239	**Time**	11:11	

Notes	Station (m)	Depth (m)	Distance (m)	Area (m^2)	Velocity (m/s) 60%	20%	80%	Q (m^3/s)	% of Total Q %
No Flow									
Total Q								**0.000**	**0.0**

General Notes

Gradiant = 1.5%

Appendix 2-7. Manual Discharge Measurements and Levelling Surveys at EL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	EL-H1			
Stream Name	Echo Lake Outflow			
Date Monitored	14-Aug-12			
Time at Site (24 hr)	**Start Time:**	2:38:00 PM	**End Time:**	4:00:00 PM
Personnel	E. Heyman, Cenling X.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	432,091	7,269,573	293m	
Weather Conditions	Mix of Sun and Cloud, cool			

Transducer Information			
PT Model	PS98i	**Serial #**	2714003
Gain	3.52168	**Offset**	0
Status	OK	**Battery**	100%
# of Records	9928	**Memory Free**	27571
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 14	1.087	101.087		100.000	
BM 15			1.157	99.930	
BM 16			1.086	100.001	
PT			2.077	99.010	
WL			1.915	**99.172**	
TBM	1.717	101.003	1.801	99.286	
WL			1.831	**99.172**	
PT			1.994	99.009	
BM 16			1.002	100.001	
BM15			1.071	99.932	
BM 14			1.003	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 15	99.915	99.931	0.016	
BM 16	99.984	100.001	0.017	
PT	98.968	99.010	0.041	

Summary	
Stage (m)	99.172
Discharge (m^3/s)	No Flow
Pressure Transducer Reading (m)	0.182
Pressure Transducer Elevation (m)	98.990

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	N/A	**End**	N/A	**Location**	N/A
Method				**Instrument Model**		N/A
Flow Meter Type	N/A			**Instrument Serial #**		N/A
Stage (m)	**Start**	**Reading**	0.182	**Time**	14:45	No Flow on August 14th
	End	**Reading**	0.182	**Time**	14:45	

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
No Flow									
Total Q								**0.000**	**0.0**

General Notes

No Flow on this date

Appendix 2-7. Manual Discharge Measurements and Levelling Surveys at EL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	EL-H1			
Stream Name	Echo Lake Outflow			
Date Monitored	7-Sep-12			
Time at Site (24 hr)	Start Time:	2:25:00 PM	End Time:	4:30:00 PM
Personnel	E. Heyman, Scott C.			
Station Cordinates	Easting	Northing	Elevation	
	432,091	7,269,573	293m	
Weather Conditions	Mix of Sun and Cloud			

Transducer Information			
PT Model	PS98i	Serial #	2714003
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	13384	Memory Free	25833
Date Serviced		Crest Gauges	N/A

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 14	1.253	101.253		100.000	
BM 15			1.324	99.929	
BM 16			1.276	99.977	
PT			2.248	99.005	
WL			1.924	**99.329**	
TBM	1.885	101.192	1.946	99.307	
WL			1.863	**99.329**	
PT			2.189	99.003	
BM 16			1.215	99.977	
BM15			1.263	99.929	
BM 14			1.194	99.998	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 15	99.915	99.929	0.014	
BM 16	99.984	99.977	-0.007	
PT	98.968	99.004	0.036	

Summary	
Stage (m)	99.329
Discharge (m^3/s)	0.00818
Pressure Transducer Reading (m)	0.335
Pressure Transducer Elevation (m)	98.994

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	14:30	End	14:04	Location	10m DS of station			
Method	Velocity-area (Mid-section)			Instrument Model		Swoffer			
Flow Meter Type	Swoffer			Instrument Serial #					
Stage (m)	Start	Reading	0.336	Time	14:30				
	End	Reading	0.335	Time	15:04				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.65	0.00	0.00	0.00	0			0.0000	0.0
	0.70	0.04	0.05	0.00	0.01			0.0000	0.3
	0.77	0.16	0.07	0.01	0.06			0.0007	8.2
	0.84	0.17	0.07	0.01	0.08			0.0007	9.1
	0.88	0.18	0.04	0.01	0.09			0.0006	7.9
	0.92	0.18	0.04	0.01	0.11			0.0008	9.7
	0.96	0.12	0.04	0.00	0.12			0.0006	7.0
	1.00	0.11	0.04	0.00	0.18			0.0008	9.7
	1.04	0.10	0.04	0.00	0.13			0.0005	6.4
	1.08	0.10	0.04	0.00	0.12			0.0005	5.9
	1.12	0.09	0.04	0.00	0.17			0.0006	7.5
	1.16	0.08	0.04	0.00	0.16			0.0005	6.3
	1.20	0.09	0.04	0.00	0.18			0.0006	7.9
	1.24	0.07	0.04	0.00	0.18			0.0005	6.2
	1.28	0.06	0.04	0.00	0.17			0.0004	5.0
	1.32	0.06	0.04	0.00	0.09			0.0002	3.0
LB	1.37	0.00	0.05	0.00	0			0.0000	0.0
Total Q								**0.00818**	**100.0**

General Notes
No Flow on this date

Appendix 2-8. Manual Discharge Measurements and Levelling Surveys at REFB-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFB-H1			
Stream Name	Reference Lake B Outflow			
Date Monitored	9-Jun-12			
Time at Site (24 hr)	Start Time:	8:30:00 AM	End Time:	
Personnel	Eli H, Coby H			
Station Cordinates	Easting	Northing	Elevation	
	442573E	7257794N		
Weather Conditions	Cloudy, light snow			

Transducer Information			
PT Model	PS98i	Serial #	2809011
Gain	3.52168	Offset	0
Status	logging	Battery	100%
# of Records	0	Memory Free	32535
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 10	1.219	101.219		100.000	
BM 44			1.248	99.971	
				101.219	
PT			1.965	99.254	
WL			1.585	**99.634**	
BM 48	1.040	101.161	1.098	100.121	
WL			1.524	**99.637**	
PT			1.910	99.251	
				101.161	
BM 44			1.189	99.972	
BM 10			1.160	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 44	99.962	99.972	0.009	
BM 48	100.118	100.121	0.003	
PT	99.253	99.253	-0.001	

Summary	
Stage (m)	99.636
Discharge (m^3/s)	Not Measured
Pressure Transducer Reading (m)	0.405
Pressure Transducer Elevation (m)	99.231

Discharge Measurement - Mid-Section Method											
Time (24 hr)	Start	9:25	End	10:58	Location	~2m upstream from PT					
Method				Instrument Model		N/A					
Flow Meter Type	N/A			Instrument Serial #		N/A					
Stage (m)	Start	Reading	0.402	Time	9:25	Velocity not measured on this date					
	End	Reading	0.405	Time	10:58						

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	17.90	0.00	0.00	0.04					
Grass	18.50	0.13	0.60	0.07					
Grass	19.00	0.14	0.50	0.07					
Grass	19.50	0.17	0.50	0.09					
Grass	20.00	0.15	0.50	0.06					
Grass	20.30	0.21	0.30	0.08					
	20.75	0.27	0.45	0.13					
	21.25	0.33	0.50	0.17					
	21.75	0.39	0.50	0.20					
	22.25	0.34	0.50	0.17					
	22.75	0.37	0.50	0.14					
Grass	23.00	0.29	0.25	0.11					
Grass	23.50	0.20	0.50	0.10					
Grass	24.00	0.17	0.50	0.09					
Grass	24.50	0.20	0.50	0.10					
Grass	25.00	0.22	0.50	0.11					
Grass	25.50	0.16	0.50	0.08					
Grass	26.00	0.15	0.50	0.08					
Grass	26.50	0.13	0.50	0.07					
Grass	27.00	0.12	0.50	0.06					
Grass	27.50	0.10	0.50	0.05					
Grass	28.00	0.07	0.50	0.04					
Grass	28.50	0.07	0.50	0.04					
RB	29.20	0.00	0.70	0.02					
Total Q									

General Notes
Flomate not operational

Appendix 2-8. Manual Discharge Measurements and Levelling Surveys at REFB-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFB-H1			
Stream Name	Reference Lake B Outflow			
Date Monitored	14-Jun-12			
Time at Site (24 hr)	Start Time:	8:30:00 AM	End Time:	
Personnel	Eli H, Coby H			
Station Cordinates	Easting	Northing	Elevation	
	442573E	7257794N		
Weather Conditions	Cloudy, cool			

Transducer Information			
PT Model	PS98i	Serial #	2809011
Gain	3.52168	Offset	0
Status	logging	Battery	100%
# of Records	741	Memory Free	32161
Date Serviced		Crest Gauges	no

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 10	1.194	101.194		100.000	
BM 44			1.230	99.964	
PT			1.965	99.229	
WL			1.635	**99.559**	
BM 48	1.050	101.162	1.082	100.112	
WL			1.605	**99.557**	
PT			1.936	99.226	
BM 44			1.198	99.964	
BM 10			1.159	100.003	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 44	99.962	99.964	0.002	
BM 48	100.118	100.112	-0.006	
PT	99.253	99.228	-0.026	

Summary	
Stage (m)	99.558
Discharge (m^3/s)	0.113
Pressure Transducer Reading (m)	0.356
Pressure Transducer Elevation (m)	99.202

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	9:25	End	10:58	Location	~2m upstream from PT				
Method	Surface Velocity Estimation			Instrument Model		Flo-Mate 200				
Flow Meter Type	Flo-Mate			Instrument Serial #		2004405				
Stage (m)	Start	Reading	0.402	Time	9:25					
	End	Reading	0.405	Time	10:58					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	19.40	0.00	0.00	0.00	0			0.000	0.0
Grass, no flow	19.50	0.06	0.10	0.02	0			0.000	0.0
Grass, no flow	20.00	0.06	0.50	0.03	0			0.000	0.0
Grass	20.40	0.12	0.40	0.04	0.02			0.001	0.6
Grass	20.60	0.12	0.20	0.03	0.16			0.004	4.0
Grass	20.80	0.14	0.20	0.03	0.14			0.004	3.7
	21.00	0.15	0.20	0.04	0.13			0.005	4.4
	21.20	0.19	0.20	0.04	0.17			0.006	5.4
	21.40	0.18	0.20	0.03	0.14			0.005	4.2
	21.60	0.17	0.20	0.04	0.14			0.005	4.7
	21.80	0.19	0.20	0.04	0.07			0.003	2.2
	22.00	0.18	0.20	0.04	0.1			0.004	3.2
	22.20	0.18	0.20	0.04	0.23			0.008	7.4
	22.40	0.16	0.20	0.03	0.13			0.004	3.7
	22.60	0.18	0.20	0.04	0.17			0.006	5.4
	22.80	0.18	0.20	0.04	0.11			0.004	3.5
	23.00	0.20	0.20	0.04	0.19			0.008	6.8
	23.20	0.22	0.20	0.04	0.16			0.007	6.3
	23.40	0.22	0.20	0.04	0.17			0.007	6.6
	23.60	0.24	0.20	0.04	0.17			0.006	5.4
	23.70	0.22	0.10	0.03	0.1			0.003	2.9
Grass	23.90	0.16	0.20	0.06	0.09			0.006	5.1
Grass	24.50	0.11	0.60	0.08	0.1			0.008	6.8
Grass	25.30	0.08	0.80	0.06	0.07			0.004	3.7
Grass	26.00	0.08	0.70	0.06	0.03			0.002	1.5
Grass	26.70	0.06	0.70	0.06	0.04			0.003	2.2
RB	28.10	0.00	1.40	0.04	0			0.000	0.0
Total Q								**0.113**	**100.0**

General Notes
Flomate not operational

Appendix 2-8. Manual Discharge Measurements and Levelling Surveys at REFB-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFB-H1			
Stream Name	Reference Lake B Outflow			
Date Monitored	17-Jun-12			
Time at Site (24 hr)	Start Time:	8:30:00 AM	End Time:	12:15:00 PM
Personnel	Eli H, Coby H			
Station Cordinates	Easting	Northing	Elevation	
	442573E	7257794N		
Weather Conditions	Cloudy, cool			

Transducer Information			
PT Model	PS98i	Serial #	2809011
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	1147	Memory Free	31958
Date Serviced		Crest Gauges	no

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 10	1.276	101.276		100.000	
BM 44			1.320	99.956	error
PT			2.058	99.218	
WL			1.764	**99.512**	
BM 48	1.132	101.237	1.171	100.105	
WL			1.725	**99.512**	
PT			2.020	99.217	
BM 44			1.251	99.986	checked, correct
BM 10			1.236	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 44	99.962	99.986	0.024	
BM 48	100.118	100.105	-0.013	
PT	99.253	99.218	-0.035	

Summary	
Stage (m)	99.512
Discharge (m^3/s)	0.0127
Pressure Transducer Reading (m)	0.318
Pressure Transducer Elevation (m)	99.194

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	9:25	End	10:58	Location	~2m upstream from PT				
Method	Surface Velocity Estimation			Instrument Model		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2004405				
Stage (m)	Start	Reading	0.402	Time	9:25					
	End	Reading	0.405	Time	10:58					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	20.90	0.00	0.00	0.01	0			0.000	0.0
Grass	21.10	0.10	0.20	0.03	-0.04			-0.001	-8.7
	21.45	0.13	0.35	0.03	-0.01			0.000	-2.3
	21.55	0.16	0.10	0.02	0.04			0.001	6.3
	21.70	0.15	0.15	0.03	0.02			0.001	4.2
	21.85	0.18	0.15	0.02	0.03			0.001	5.3
	21.95	0.18	0.10	0.02	0.05			0.001	7.9
	22.05	0.20	0.10	0.02	0.04			0.001	6.0
	22.15	0.19	0.10	0.02	0.02			0.000	3.1
	22.25	0.20	0.10	0.02	0.01			0.000	1.5
	22.35	0.19	0.10	0.02	0.02			0.000	2.8
Grass	22.45	0.18	0.10	0.02	-0.02			0.000	-2.8
	22.55	0.20	0.10	0.02	0.01			0.000	1.6
	22.65	0.20	0.10	0.02	0.02			0.000	3.1
	22.75	0.20	0.10	0.02	0.02			0.000	3.1
	22.85	0.20	0.10	0.02	0.06			0.001	9.4
	22.95	0.20	0.10	0.02	0.06			0.001	9.4
	23.05	0.18	0.10	0.02	0.11			0.002	15.6
	23.15	0.19	0.10	0.02	0.08			0.002	12.0
	23.25	0.20	0.10	0.02	0.05			0.001	7.9
	23.35	0.20	0.10	0.02	0.08			0.002	12.6
	23.45	0.20	0.10	0.02	0.04			0.001	7.9
	23.60	0.19	0.15	0.04	-0.02			-0.001	-6.0
RB	23.85	0.00	0.25	0.02	0			0.000	0.0
Total Q								**0.0127**	**100.0**

General Notes

Appendix 2-8. Manual Discharge Measurements and Levelling Surveys at REFB-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFB-H1			
Stream Name	Reference Lake B outflow			
Date Monitored	7-Jul-12			
Time at Site (24 hr)	**Start Time:**	3:45:00 PM	**End Time:**	5:40:00 PM
Personnel	Eli H., Rebecca K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	442573	7257796	275m	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PS98i	**Serial #**	2809011
Gain	3.52168	**Offset**	0
Status	OK	**Battery**	100%
# of Records	4070	**Memory Free**	30495
Date Serviced		**Crest Gauges**	No

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 10	1.274	101.274		100.000	
BM 44			1.320	99.954	
BM 48			1.172	100.102	
PT			2.058	99.216	
WL			1.831	**99.443**	
TBM	0.491	101.187	0.578	100.696	
WL			1.743	**99.444**	
PT			1.969	99.218	
BM 48			1.082	100.105	
BM 44			1.233	99.954	
BM 10			1.186	100.001	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 44	99.962	99.954	-0.008	
BM 48	100.118	100.104	-0.014	
PT	99.253	99.217	-0.036	

Summary	
Stage (m)	99.444
Discharge (m^3/s)	0.0099
Pressure Transducer Reading (m)	0.245
Pressure Transducer Elevation (m)	99.199

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	15:48	**End**	16:19	**Location**	Above PT			
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2007612			
Stage (m)	**Start**	**Reading**	0.244	**Time**	15:48				
	End	**Reading**	0.245	**Time**	16:19				

	Station	**Depth**		**Distance**	**Area**	**Velocity @60%**	**Cal. Velocity**	**Q**	**% of Total Q**
Notes	**(m)**	**(ft)**	**(m)**	**(m)**	**(m^2)**	**(m/s)**	**(m/s)**	**(m^3/s)**	**%**
LB	0.62	0.00	0.00	0.00	0.00	0		0.0000	0.0
eddy/swamp	0.70	0.15	0.05	0.08	0.01	0.01		0.0001	0.5
	0.85	0.25	0.08	0.15	0.01	0		0.0000	0.0
	1.00	0.30	0.09	0.15	0.02	0		0.0000	0.0
	1.30	0.40	0.12	0.30	0.04	0		0.0000	0.0
	1.60	0.60	0.18	0.30	0.05	0		0.0000	0.0
	1.90	0.85	0.26	0.30	0.05	0.01		0.0005	5.2
	2.00	0.76	0.23	0.10	0.02	0.05		0.0009	8.8
	2.05	0.72	0.22	0.05	0.01	0.05		0.0005	5.6
	2.10	0.70	0.21	0.05	0.01	0.06		0.0006	6.5
	2.15	0.70	0.21	0.05	0.01	0.01		0.0001	1.1
	2.20	0.70	0.21	0.05	0.01	0.06		0.0006	6.5
	2.25	0.75	0.23	0.05	0.01	0.05		0.0006	5.8
	2.30	0.70	0.21	0.05	0.01	0.04		0.0004	4.3
	2.35	0.70	0.21	0.05	0.01	0.06		0.0006	6.5
	2.40	0.60	0.18	0.05	0.01	0.07		0.0006	6.5
	2.45	0.60	0.18	0.05	0.01	0.08		0.0007	7.4
	2.50	0.51	0.16	0.05	0.01	0.07		0.0005	5.5
	2.55	0.51	0.16	0.05	0.01	0.07		0.0005	5.5
	2.60	0.50	0.15	0.05	0.01	0.07		0.0005	5.4
	2.65	0.47	0.14	0.05	0.01	0.05		0.0004	3.6
	2.70	0.45	0.14	0.05	0.01	0.07		0.0007	7.3
	2.80	0.41	0.12	0.10	0.01	0.06		0.0007	7.6
	2.90	0.30	0.09	0.10	0.01	0.02		0.0002	1.9
	3.00	0.25	0.08	0.10	0.01	-0.01		-0.0001	-1.3
RB	3.25	0.00	0.00	0.25	0.01	0		0.0000	0.0
Total Q								**0.0099**	**100.0**

General Notes
Gradiant = <1%. radiant= 2%. Depth values converted from ft. to m (1ft. = 0.3048m).

Appendix 2-8. Manual Discharge Measurements and Levelling Surveys at REFB-H1 in 2012

Site Information					
Project Name	Back River				
Station Identification	REFB-H1				
Stream Name	Reference Lake B outflow				
Date Monitored	8-Nov-12				
Time at Site (24 hr)	Start Time:	11:10:00 AM	End Time:	12:45:00 PM	
Personnel	Eli H., Cenling X				
Station Cordinates	Easting	Northing	Elevation		
	442573	7257796	275m		
Weather Conditions	Rain				

Transducer Information			
PT Model	PS98i	Serial #	2809011
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	9086	Memory Free	56095
Date Serviced		Crest Gauges	No

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 10	1.198	101.198		100.000	
BM 44			1.235	99.963	
BM 48			1.083	100.115	
PT			2.006	99.192	Difficult to find due to mud
WL			1.845	**99.353**	
TBM	0.630	101.264	0.564	100.634	
WL			1.912	**99.352**	
PT			2.080	99.184	use average
BM 48			1.151	100.113	
BM 44			1.302	99.962	
BM 10			1.265	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 44	99.962	99.963	0.000	
BM 48	100.118	100.114	-0.004	
PT	99.253	99.188	-0.065	

Summary	
Stage (m)	99.353
Discharge (m^3/s)	No Flow
Pressure Transducer Reading (m)	0.167
Pressure Transducer Elevation (m)	99.186

Discharge Measurement - Mid-Section Method

Time (24 hr)	Start	N/A	End	N/A	Location	NO FLOW
Method	NO FLOW			Instrument Model		
Flow Meter Type				Instrument Serial #		
Stage (m)	Start	Reading	N/A	Time	N/A	NO FLOW on August 11th 2012
	End	Reading	N/A	Time	N/A	

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
NO FLOW									
Total Q								**0.000**	**0.0**

General Notes

Gradiant = <1%

Appendix 2-8. Manual Discharge Measurements and Levelling Surveys at REFB-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFB-H1			
Stream Name	Reference Lake B outflow			
Date Monitored	13-Sep-12			
Time at Site (24 hr)	Start Time:	9:20:00 AM	End Time:	12:20:00 PM
Personnel	Eli H., Chris H.			
Station Cordinates	Easting	Northing	Elevation	
	442573	7257796	275m	
Weather Conditions	Cloudy, windy, cool			

Transducer Information			
PT Model	PS98i	Serial #	2809011
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	13828	Memory Free	25371
Date Serviced		Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 10	1.467	101.467		100.000	
BM 44			1.497	99.970	
BM 48			1.367	100.100	
PT			2.320	99.147	error
WL			2.071	**99.396**	
TBM	2.078	101.553	1.992	99.475	
WL			2.161	**99.392**	
PT			2.401	99.152	checked, ok
BM 48			1.453	100.100	
BM 44			1.586	99.967	
BM 10			1.553	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 44	99.962	99.969	0.007	
BM 48	100.118	100.100	-0.018	
PT	99.253	99.152	-0.101	

Summary	
Stage (m)	99.394
Discharge (m^3/s)	0.00202
Pressure Transducer Reading (m)	0.237
Pressure Transducer Elevation (m)	99.157

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	9:38	End	9:57	Location	Above PT			
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			Instrument Serial #		2007529			
Stage (m)	Start	Reading	0.238	Time	9:38				
	End	Reading	0.238	Time	9:52				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	0.88	0.00	0.00	0.00	0			0.0000	0.0
	0.90	0.06	0.02	0.00	0.01			0.0000	1.8
	1.00	0.12	0.10	0.01	0			0.0000	0.0
	1.10	0.16	0.10	0.02	0.01			0.0002	7.9
	1.20	0.16	0.10	0.02	0.01			0.0002	7.9
	1.30	0.16	0.10	0.02	0.01			0.0002	7.9
	1.40	0.16	0.10	0.02	0.01			0.0002	7.9
	1.50	0.17	0.10	0.02	0.01			0.0002	8.4
	1.60	0.17	0.10	0.02	0.01			0.0002	8.4
	1.70	0.16	0.10	0.02	0.01			0.0002	7.9
	1.80	0.16	0.10	0.02	0			0.0000	0.0
	1.90	0.16	0.10	0.02	0.01			0.0002	7.9
	2.00	0.16	0.10	0.02	0.01			0.0002	7.9
	2.10	0.16	0.10	0.02	0			0.0000	0.0
	2.20	0.16	0.10	0.02	0			0.0000	0.0
	2.30	0.10	0.10	0.01	0.02			0.0002	9.9
	2.40	0.10	0.10	0.01	0.01			0.0001	5.0
	2.50	0.09	0.10	0.01	0.01			0.0001	4.5
	2.60	0.07	0.10	0.01	0.01			0.0001	3.5
	2.70	0.06	0.10	0.01	0.01			0.0001	3.0
	2.80	0.05	0.10	0.01	0			0.0000	0.0
	2.90	0.03	0.10	0.00	0			0.0000	0.0
RB	3.00	0.00	0.10	0.00	0			0.0000	0.0
Total Q								**0.00202**	**100.0**

General Notes
Gradiant = <1%. Distance from middle of PT to survey point on conduit = 1.5cm. PT Bumped at 9:40 --> dropped 0.010m

Appendix 2-9. Manual Discharge Measurements and Levelling Surveys at WL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	WL-H1			
Stream Name	Wolf Outflow			
Date Monitored	7-Jun-12			
Time at Site (24 hr)	Start Time:	8:20:00 AM	End Time:	2:30:00 PM
Personnel	Eli H, Coby H			
Station Cordinates	Easting	Northing	Elevation	
	434269	7269719		
Weather Conditions	Cloudy, cool			

Transducer Information			
PT Model	PS98i	Serial #	2809027
Gain	3.52168	Offset	0
Status	logging	Battery	100%
# of Records	0	Memory Free	32535
Date Serviced	N/A	Crest Gauges	N/A

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 12	0.322	100.322		100.000	
BM 1			1.085	99.237	
PT			2.513	97.809	
WL			1.556	**98.766**	
BM 2	0.332	100.261	0.393	99.929	
WL			1.496	**98.765**	
PT			2.454	97.807	
BM 1			1.024	99.237	
BM 12			0.260	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 1	99.207	99.237	0.030	
BM 2	99.917	99.929	0.012	
PT	97.808	97.808	0.000	

Summary	
Stage (m)	98.766
Discharge (m^3/s)	1.743
Pressure Transducer Reading (m)	0.991
Pressure Transducer Elevation (m)	97.775

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	13:15	End	14:30	Location	5m upstream of PT				
Method	Velocity-area (Mid-section)			Instrument Model		Flomate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2004405				
Stage (m)	Start	Reading	0.989	Time	13:15					
	End	Reading	0.989	Time	14:30					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	17.84	0.00	0.00	0.01	0.00			0.000	0.0
Grass	17.98	0.12	0.14	0.01	-0.06			-0.001	0.0
eddy	18.05	0.18	0.07	0.01	0.00			0.000	0.0
eddy	18.13	0.42	0.08	0.04	-0.05			-0.002	-0.1
	18.26	0.52	0.13	0.10	0.01			0.001	0.1
	18.50	0.66	0.24	0.24	0.07			0.017	1.0
	19.00	0.90	0.50	0.45		0.13	0.07	0.045	2.6
	19.50	0.99	0.50	0.50		0.18	0.10	0.069	4.0
	20.00	1.10	0.50	0.55		0.22	0.11	0.091	5.2
	20.50	1.18	0.50	0.59		0.19	0.11	0.089	5.1
	21.00	1.24	0.50	0.62		0.25	0.14	0.121	6.9
faster @ depth	21.50	1.22	0.50	0.61		0.22	0.25	0.143	8.2
	22.00	1.22	0.50	0.61		0.26	0.19	0.137	7.9
	22.50	1.21	0.50	0.61		0.29	0.20	0.148	8.5
	23.00	1.19	0.50	0.60		0.29	0.28	0.170	9.7
	23.50	1.16	0.50	0.58		0.31	0.24	0.160	9.2
	24.00	1.10	0.50	0.55		0.33	0.27	0.165	9.5
	24.50	1.05	0.50	0.53		0.27	0.29	0.147	8.4
	25.00	0.88	0.50	0.44		0.27	0.23	0.110	6.3
	25.50	0.78	0.50	0.39		0.20	0.18	0.074	4.3
	26.00	0.63	0.50	0.32	0.16			0.050	2.9
	26.50	0.62	0.50	0.29	0.02			0.006	0.3
	26.95	0.55	0.45	0.18	0.01			0.002	0.1
	27.14	0.44	0.19	0.11	0.01			0.001	0.1
RB	27.45	0.00	0.31	0.07	0.00			0.000	0.0
Total Q								1.743	100.0

General Notes
Gradiant = <1%

Appendix 2-9. Manual Discharge Measurements and Levelling Surveys at WL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	WL-H1			
Stream Name	Wolf Outflow			
Date Monitored	13-Jun-12			
Time at Site (24 hr)	Start Time:	12:40:00 PM	End Time:	2:30:00 PM
Personnel	Eli H, Coby H			
Station Cordinates	Easting	Northing	Elevation	
	434269	7269719		
Weather Conditions	Cloudy, cool			

Transducer Information			
PT Model	PS98i	Serial #	2809027
Gain	3.52168	Offset	0
Status	O.k.	Battery	100%
# of Records	884	Memory Free	32089
Date Serviced	N/A	Crest Gauges	no

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 12	0.275	100.275		100.000	
BM 1			1.034	99.241	
PT			2.477	97.798	
WL			1.603	**98.672**	error
BM 2	0.390	100.321	0.344	99.931	
WL			1.642	**98.679**	checked, correct
PT			2.521	97.800	
BM 1			1.079	99.242	
BM 12			0.321	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 1	99.207	99.242	0.035	
BM 2	99.917	99.931	0.014	
PT	97.808	97.799	-0.009	

Summary	
Stage (m)	98.679
Discharge (m^3/s)	1.069
Pressure Transducer Reading (m)	0.912
Pressure Transducer Elevation (m)	97.767

Discharge Measurement - Mid-Section Method							
Time (24 hr)	Start	12:48	End	14:00	Location		
Method	Velocity-area (Mid-section)			Instrument Model		Flomate 2000	
Flow Meter Type	Flo-Mate			Instrument Serial #		2004405	
Stage (m)	Start	Reading	0.913	Time	12:48		
	End	Reading	0.912	Time	14:00		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	19.30	0.00	0.00	0.00	0			0.000	0.0
Grass	19.40	0.08	0.10	0.01	-0.01			0.000	0.0
Grass	19.55	0.13	0.15	0.02	0.07			0.002	0.1
	19.75	0.48	0.20	0.11	0.11			0.012	1.1
	20.00	0.64	0.25	0.21	0.13			0.027	2.5
	20.40	0.68	0.40	0.27	0.13			0.035	3.3
	20.80	0.76	0.40	0.30		0.16	0.10	0.040	3.7
	21.20	0.83	0.40	0.33		0.14	0.09	0.038	3.6
	21.60	0.89	0.40	0.36		0.14	0.16	0.053	5.0
	22.00	1.00	0.40	0.40		0.15	0.10	0.050	4.7
	22.40	1.08	0.40	0.43		0.16	0.17	0.071	6.7
	22.80	1.12	0.40	0.45		0.18	0.13	0.069	6.5
	23.20	1.14	0.40	0.46		0.18	0.13	0.071	6.6
	23.60	1.14	0.40	0.46		0.22	0.14	0.082	7.7
	24.00	1.10	0.40	0.44		0.17	0.15	0.070	6.6
	24.40	1.07	0.40	0.43		0.19	0.14	0.071	6.6
	24.80	1.02	0.40	0.41		0.18	0.17	0.071	6.7
	25.20	1.04	0.40	0.42		0.16	0.17	0.069	6.4
	25.60	0.99	0.40	0.40		0.12	0.15	0.053	5.0
	26.00	0.95	0.40	0.38		0.14	0.15	0.055	5.2
	26.40	0.92	0.40	0.37		0.14	0.17	0.057	5.3
	26.80	0.85	0.40	0.26		0.12	0.13	0.032	3.0
	27.00	0.88	0.20	0.20		0.12	0.11	0.023	2.1
	27.25	0.54	0.25	0.14	0.11			0.015	1.4
	27.50	0.16	0.25	0.03	0.1			0.003	0.3
RB	27.60	0.00	0.10	0.01	0			0.000	
Total Q								**1.069**	**100.0**

General Notes
Gradiant = <1%

Appendix 2-9. Manual Discharge Measurements and Levelling Surveys at WL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	WL-H1			
Stream Name	Wolf Outflow			
Date Monitored	5-Jul-12			
Time at Site (24 hr)	Start Time:	3:23:00 PM	End Time:	5:50:00 PM
Personnel	Eli H., Merle K.			
Station Cordinates	Easting	Northing	Elevation	
	434269	7269719		
Weather Conditions				

Transducer Information			
PT Model	PS98i	Serial #	2809027
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	4069	Memory Free	30500
Date Serviced		Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 12	0.049	100.049		100.000	
BM 1			0.821	99.228	
BM 2			0.110	99.939	
PT			2.249	97.800	
WL			1.679	**98.370**	
TBM	1.301	100.098	1.252	98.797	
WL			1.728	**98.370**	
PT			2.298	97.800	
BM 2			0.161	99.937	
BM 1			0.870	99.228	
BM 12			0.100	99.998	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 1	99.207	99.228	0.021	
BM 2	99.917	99.938	0.021	
PT	97.808	97.800	-0.008	

Summary	
Stage (m)	98.370
Discharge (m^3/s)	0.1894
Pressure Transducer Reading (m)	0.601
Pressure Transducer Elevation (m)	97.769

Discharge Measurement - Mid-Section Method												
Time (24 hr)	Start	15:34	End	16:43	Location	1 m Downstream of Station						
Method	Velocity-area (Mid-section)				Instrument Model	Flo-Mate 2000						
Flow Meter Type	Flo-Mate				Instrument Serial #	2007612						
Stage (m)	Start	Reading	0.602	Time	15:34							
	End	Reading	0.601	Time	16:43							

	Station	Depth	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	1.10	0.00	0.00	0.00	0.01	0			0.000	0.0
	1.20	0.35	0.11	0.10	0.02	0			0.000	0.0
	1.50	0.90	0.27	0.30	0.08	-0.01			-0.001	-0.4
	1.80	1.25	0.38	0.30	0.11	0.01			0.001	0.6
	2.10	1.45	0.44	0.30	0.13	0.02			0.003	1.4
	2.40	1.65	0.50	0.30	0.15	0.03			0.005	2.4
	2.70	1.70	0.52	0.30	0.16	0.03			0.005	2.5
	3.00	1.95	0.59	0.30	0.18	0.03			0.005	2.8
	3.30	2.10	0.64	0.30	0.19	0.03			0.006	3.0
	3.60	2.25	0.69	0.30	0.21	0.04			0.008	4.3
	3.90	2.55	0.78	0.30	0.23		0.03	0.04	0.008	4.3
	4.20	2.60	0.79	0.30	0.24		0.04	0.04	0.010	5.0
	4.50	2.60	0.79	0.30	0.24		0.04	0.04	0.010	5.0
	4.80	2.55	0.78	0.30	0.23		0.04	0.04	0.009	4.9
	5.10	2.50	0.76	0.30	0.23		0.03	0.04	0.008	4.2
	5.40	2.40	0.73	0.30	0.22	0.05			0.011	5.8
	5.70	2.40	0.73	0.30	0.22	0.05			0.011	5.8
	6.00	2.30	0.70	0.30	0.21	0.05			0.011	5.6
	6.30	2.25	0.69	0.30	0.21	0.05			0.010	5.4
	6.60	2.30	0.70	0.30	0.21	0.05			0.011	5.6
	6.90	2.35	0.72	0.30	0.21	0.05			0.011	5.7
	7.20	2.30	0.70	0.30	0.21	0.05			0.011	5.6
	7.50	2.15	0.66	0.30	0.20	0.05			0.010	5.2
	7.80	2.10	0.64	0.30	0.19	0.04			0.008	4.1
	8.10	2.00	0.61	0.30	0.18	0.05			0.009	4.8
	8.40	2.05	0.62	0.30	0.19	0.05			0.009	4.9
	8.70	1.05	0.32	0.30	0.07	0.04			0.003	1.5
	8.85	0.30	0.09	0.15	0.01	0			0.000	0.0
RB	9.00	0.00	0.00	0.15	0.01	0			0.000	0.0
Total Q									**0.189**	**100.0**

General Notes
Gradiant = 1%. Depth values measured in ft and converted to m (1ft = 0.3048m)

Appendix 2-9. Manual Discharge Measurements and Levelling Surveys at WL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	WL-H1			
Stream Name	Wolf Outflow			
Date Monitored	11-Aug-12			
Time at Site (24 hr)	Start Time:	3:10:00 PM	End Time:	5:00:00 PM
Personnel	Eli H., Cenling X.			
Station Cordinates	Easting	Northing	Elevation	
	434269	7269719		
Weather Conditions				

Transducer Information			
PT Model	PS98i	Serial #	2809027
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	9395	Memory Free	27838
Date Serviced		Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 12	0.210	100.210		100.000	
BM 1			0.968	99.242	
BM 2			0.255	99.955	
PT			2.396	97.814	
WL			1.947	**98.263**	
TBM	1.955	100.176	1.989	98.221	
WL			1.916	**98.260**	
PT			2.365	97.811	
BM 2		0.936	0.220	99.956	
BM 1			0.936	99.240	
BM 12			0.174	100.002	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 1	99.207	99.241	0.034	
BM 2	99.917	99.956	0.038	
PT	97.808	97.813	0.004	

Summary	
Stage (m)	98.262
Discharge (m^3/s)	0.0494
Pressure Transducer Reading (m)	0.477
Pressure Transducer Elevation (m)	97.785

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	15:22	End	15:56	Location	5m Downstream of Station				
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2006042				
Stage (m)	Start	Reading	0.477	Time	15:22					
	End	Reading	0.477	Time	15:56					

	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
LB	1.70	0.00	0.00	0.00	0.07	0		0.000	0.0
	2.00	1.45	0.44	0.30	0.15	0		0.000	0.0
	2.40	1.90	0.58	0.40	0.23	-0.01		-0.002	-4.7
	2.80	1.99	0.61	0.40	0.24	0.01		0.002	4.9
	3.20	2.10	0.64	0.40	0.26	0		0.000	0.0
	3.60	2.12	0.65	0.40	0.26	0.01		0.003	5.2
	4.00	2.17	0.66	0.40	0.26	0.02		0.005	10.7
	4.40	2.14	0.65	0.40	0.26	0.01		0.003	5.3
	4.80	2.11	0.64	0.40	0.26	0.02		0.005	10.4
	5.20	2.15	0.66	0.40	0.26	0.01		0.003	5.3
	5.60	2.20	0.67	0.40	0.27	0.01		0.003	5.4
	6.00	2.22	0.68	0.40	0.27	0.02		0.005	11.0
	6.40	2.12	0.65	0.40	0.26	0.02		0.005	10.5
	6.80	2.10	0.64	0.40	0.26	0.02		0.005	10.4
	7.20	2.05	0.62	0.40	0.25	0.01		0.002	5.1
	7.60	2.00	0.61	0.40	0.24	0.02		0.005	9.9
	8.00	1.85	0.56	0.40	0.23	0.01		0.002	4.6
	8.40	1.70	0.52	0.40	0.21	0.01		0.002	4.2
	8.80	1.62	0.49	0.40	0.20	0		0.000	0.0
	9.20	1.10	0.34	0.40	0.12	0.01		0.001	2.4
	9.50	0.31	0.09	0.30	0.02	-0.01		0.000	-0.5
RB	9.70	0.00	0.00	0.20	0.01	0		0.000	0.0
RB									
Total Q								0.0494	100.0

General Notes
Gradiant = 1%. Depth values converted from ft. to m (1ft. = 0.3048m).

Appendix 2-9. Manual Discharge Measurements and Levelling Surveys at WL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	WL-H1			
Stream Name	Wolf Outflow			
Date Monitored	14-Sep-12			
Time at Site (24 hr)	Start Time:	10:40:00 AM	End Time:	5:00:00 PM
Personnel	Eli H., Chris H.			
Station Cordinates	Easting	Northing	Elevation	
	434269	7269719		
Weather Conditions				

Transducer Information			
PT Model	PS98i	Serial #	2809027
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	14271	Memory Free	25401
Date Serviced		Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 12	0.104	100.104		100.000	
BM 1			0.871	99.233	
BM 2			0.143	99.961	
PT			2.300	97.804	
WL			1.807	**98.297**	
TBM	2.410	100.159	2.355	97.749	
WL			1.862	**98.297**	
PT			2.352	97.807	
BM 2		0.924	0.199	99.960	
BM 1			0.924	99.235	
BM 12			0.161	99.998	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 1	99.207	99.234	0.027	
BM 2	99.917	99.961	0.043	
PT	97.808	97.806	-0.003	

Summary	
Stage (m)	98.297
Discharge (m^3/s)	0.0508
Pressure Transducer Reading (m)	0.515
Pressure Transducer Elevation (m)	97.782

Discharge Measurement - Mid-Section Method											
Time (24 hr)	Start	10:P45	End	12:00	Location	5m Downstream of Station					
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000					
Flow Meter Type	Flo-Mate			Instrument Serial #		2007529					
Stage (m)	Start	Reading	0.514	Time	10:45						
	End	Reading	0.514	Time	12:00						

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	1.85	0.00	0.00	0.00	0			0.000	0.0
	1.90	0.07	0.05	0.01	0			0.000	0.0
	2.15	0.19	0.25	0.05	0.01			0.000	0.9
	2.40	0.22	0.25	0.06	0.02			0.001	2.2
	2.65	0.29	0.25	0.07	0.02			0.001	2.9
	2.90	0.32	0.25	0.08	0.02			0.002	3.2
	3.15	0.34	0.25	0.09	0.02			0.002	3.3
	3.40	0.36	0.25	0.09	0.03			0.003	5.3
	3.65	0.40	0.25	0.10	0.03			0.003	5.9
	3.90	0.44	0.25	0.11	0.03			0.003	6.5
	4.15	0.48	0.25	0.12	0.03			0.004	7.1
	4.40	0.52	0.25	0.13	0.04			0.005	10.2
	4.65	0.52	0.25	0.13	0.04			0.005	10.2
	4.90	0.53	0.25	0.13	0.04			0.005	10.4
	5.15	0.40	0.25	0.10	0.03			0.003	5.9
	5.40	0.38	0.25	0.10	0.03			0.003	5.6
	5.65	0.42	0.25	0.11	0.02			0.002	4.1
	5.90	0.40	0.25	0.10	0.03			0.003	5.9
	6.15	0.36	0.25	0.08	0.02			0.002	3.2
	6.35	0.35	0.20	0.09	0.02			0.002	3.4
	6.65	0.32	0.30	0.09	0.02			0.002	3.5
	6.90	0.34	0.25	0.06	0			0.000	0.0
	7.00	0.08	0.10	0.01	0.01			0.000	0.2
RB	7.10	0.00	0.10	0.00	0			0.000	0.0
RB									
Total Q								0.0508	100.0

General Notes
Gradiant = 1%. Distance from middle of PT to survey point on conduit = 1.65cm

Appendix 2-10. Manual Discharge Measurements and Levelling Surveys at BL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H1			
Stream Name	Northeast inflow to Big Lake			
Date Monitored	12-Jun-12			
Time at Site (24 hr)	Start Time:	8:30:00 AM	End Time:	11:00:00 AM
Personnel	Eli H., Coby H.			
Station Cordinates	Easting	Northing	Elevation	
	429044	7268478	301	
Weather Conditions				

Transducer Information			
PT Model	PS98i	Serial #	2714017
Gain	N/A	Offset	N/A
Status	OK, logging	Battery	100%
# of Records	1	Memory Free	32530 readings
Date Serviced		Crest Gauges	N/A

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 52	1.197	101.197		100.000	
BM 53			1.253	99.944	
PT			1.747	99.450	
WL			1.442	**99.755**	
BM 54	1.199	101.119	1.277	99.920	
WL			1.365	**99.754**	
PT			1.670	99.449	
BM 53			1.174	99.945	
BM 52			1.117	100.002	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 53	99.945	99.945		
BM 54	99.920	99.920		
PT	99.450	99.450		

Summary	
Stage (m)	99.755
Discharge (m^3/s)	0.0569
Pressure Transducer Reading (m)	0.338
Pressure Transducer Elevation (m)	99.417

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	9:30	End	10:18	Location	~10m Upstream of PT				
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2004405				
Stage (m)	Start	Reading	0.339	Time	9:30					
	End	Reading	0.339	Time	10:18					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.12	0.00	0.00	0.00	0			0.000	0.0
	0.14	0.06	0.02	0.00	0.04			0.000	0.1
	0.19	0.11	0.05	0.01	0.19			0.001	2.0
	0.25	0.14	0.06	0.01	0.28			0.002	3.8
	0.30	0.15	0.05	0.01	0.31			0.002	4.1
	0.35	0.17	0.05	0.01	0.31			0.003	4.6
	0.40	0.18	0.05	0.01	0.32			0.003	5.1
	0.45	0.18	0.05	0.01	0.32			0.003	5.1
	0.50	0.18	0.05	0.01	0.35			0.003	5.5
	0.55	0.20	0.05	0.01	0.37			0.004	6.5
	0.60	0.20	0.05	0.01	0.43			0.004	7.6
	0.65	0.19	0.05	0.01	0.49			0.005	8.2
	0.70	0.19	0.05	0.01	0.49			0.005	8.2
	0.75	0.21	0.05	0.01	0.48			0.005	8.9
	0.80	0.22	0.05	0.01	0.44			0.005	8.5
	0.85	0.23	0.05	0.01	0.43			0.005	8.7
	0.90	0.23	0.05	0.01	0.38			0.004	7.7
	0.95	0.23	0.05	0.01	0.33			0.003	6.0
	0.99	0.22	0.04	0.01	-0.03			0.000	-0.5
LB	1.04	0.10	0.05	0.01	0			0.000	0.0
Total Q								**0.0569**	**100.0**

General Notes

Appendix 2-10. Manual Discharge Measurements and Levelling Surveys at BL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H1			
Stream Name	Northeast inflow to Big Lake			
Date Monitored	16-Jun-12			
Time at Site (24 hr)	**Start Time:**	12:15:00 PM	**End Time:**	2:00:00 PM
Personnel	Eli H., Coby H.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	429044	7268478	301	
Weather Conditions				

Transducer Information			
PT Model	PS98i	**Serial #**	2714017
Gain	N/A	**Offset**	N/A
Status	OK, logging	**Battery**	100%
# of Records	594	**Memory Free**	32234 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 52	1.180	101.180		100.000	BM 52
BM 53			1.237	99.943	BM 53
PT			1.740	99.440	
WL			1.478	**99.702**	
BM 54	1.246	101.164	1.262	99.918	BM 54
WL			1.464	**99.700**	
PT			1.724	99.440	
BM 53			1.222	99.942	BM 53
BM 52			1.164	100.000	BM 52

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 53	99.945	99.943	-0.002	
BM 54	99.920	99.918	-0.002	
PT	99.450	99.440	-0.010	

Summary	
Stage (m)	99.701
Discharge (m^3/s)	0.0213
Pressure Transducer Reading (m)	0.293
Pressure Transducer Elevation (m)	99.408

Discharge Measurement - Mid-Section Method										
Time (24 hr)	**Start**	12:28	**End**	13:15	**Location**	~10m Upstream of PT				
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2004405				
Stage (m)	**Start**	**Reading**	0.292	**Time**	12:28					
	End	**Reading**	0.293	**Time**	13:15					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.47	0.00	0.00	0.00	0			0.000	0.0
eddy	0.52	0.12	0.05	0.01	-0.02			0.000	-0.5
	0.56	0.12	0.04	0.01	0.02			0.000	0.6
	0.62	0.13	0.06	0.01	0.03			0.000	1.1
	0.68	0.16	0.06	0.01	0.04			0.000	1.8
	0.74	0.16	0.06	0.01	0.07			0.001	3.2
	0.80	0.14	0.06	0.01	0.10			0.001	4.0
	0.86	0.14	0.06	0.01	0.10			0.001	4.0
	0.92	0.15	0.06	0.01	0.12			0.001	5.1
	0.98	0.16	0.06	0.01	0.14			0.001	6.3
	1.04	0.18	0.06	0.01	0.14			0.002	7.1
	1.10	0.16	0.06	0.01	0.13			0.001	5.9
	1.16	0.16	0.06	0.01	0.13			0.001	5.9
	1.22	0.17	0.06	0.01	0.09			0.001	4.3
	1.28	0.18	0.06	0.01	0.11			0.001	5.6
	1.34	0.20	0.06	0.01	0.11			0.001	6.2
	1.40	0.20	0.06	0.01	0.13			0.002	7.3
	1.46	0.22	0.06	0.01	0.14			0.002	8.7
	1.52	0.21	0.06	0.01	0.16			0.002	9.5
	1.58	0.24	0.06	0.01	0.15			0.002	10.2
	1.64	0.24	0.06	0.02	0.05			0.001	4.0
LB	1.72	0.00	0.08	0.01	0			0.000	0.0
Total Q								**0.0213**	**100.0**

General Notes

Appendix 2-10. Manual Discharge Measurements and Levelling Surveys at BL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H1			
Stream Name	Northeast inflow to Big Lake			
Date Monitored	13-Jul-12			
Time at Site (24 hr)	**Start Time:**	1:57:00 PM	**End Time:**	5:30:00 PM
Personnel	Eli H., Fraser T.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	429044	7268478	301	
Weather Conditions	Mix of Sun and Cloud			

Transducer Information			
PT Model	PS98i	**Serial #**	2714017
Gain	N/A	**Offset**	N/A
Status	OK, logging	**Battery**	100%
# of Records	4492	**Memory Free**	30288 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 52	1.215	101.215		100.000	
BM 53			1.282	99.933	
BM 54			1.317	99.898	
PT			1.762	99.453	
WL			1.604	**99.611**	
TBM	1.568	101.255	1.528	99.687	
WL			1.644	**99.611**	
PT			1.800	99.455	
BM 54			1.358	99.897	
BM 53			1.321	99.934	
BM 52			1.252	100.003	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 53	99.945	99.934	-0.011	
BM 54	99.920	99.898	-0.022	
PT	99.450	99.454	0.005	

Summary	
Stage (m)	99.611
Discharge (m^3/s)	0.00840
Pressure Transducer Reading (m)	0.195
Pressure Transducer Elevation (m)	99.416

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	14:08	**End**	14:52	**Location**	~10m Upstream of PT			
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2007612			
Stage (m)	**Start**	**Reading**	0.196	**Time**	14:08				
	End	**Reading**	0.195	**Time**	14:52				

	Station	Depth		Distance	Area	Velocity @ 60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
RB	0.57	0.00	0.00	0.00	0.00	0.00		0.000	0.0
	0.61	0.34	0.10	0.04	0.00	-0.01		0.000	-0.6
	0.66	0.36	0.11	0.05	0.01	0.00		0.000	0.0
	0.71	0.38	0.12	0.05	0.01	0.01		0.000	0.7
	0.76	0.40	0.12	0.05	0.01	0.01		0.000	0.7
	0.81	0.46	0.14	0.05	0.01	0.01		0.000	0.8
	0.86	0.48	0.15	0.05	0.01	0.01		0.000	0.9
	0.91	0.44	0.13	0.05	0.01	0.02		0.000	1.6
	0.96	0.44	0.13	0.05	0.01	0.04		0.000	3.2
	1.01	0.49	0.15	0.05	0.01	0.05		0.000	4.4
	1.06	0.50	0.15	0.05	0.01	0.07		0.001	6.4
	1.11	0.48	0.15	0.05	0.01	0.07		0.001	6.1
	1.16	0.49	0.15	0.05	0.01	0.07		0.001	6.2
	1.21	0.51	0.16	0.05	0.01	0.08		0.001	7.4
	1.26	0.52	0.16	0.05	0.01	0.08		0.001	7.5
	1.31	0.52	0.16	0.05	0.01	0.07		0.001	6.6
	1.36	0.52	0.16	0.05	0.01	0.07		0.001	6.6
	1.41	0.50	0.15	0.05	0.01	0.07		0.001	6.4
	1.46	0.51	0.16	0.05	0.01	0.06		0.000	5.6
	1.51	0.52	0.16	0.05	0.01	0.06		0.000	5.7
	1.56	0.54	0.16	0.05	0.01	0.05		0.000	4.9
	1.61	0.51	0.16	0.05	0.01	0.06		0.000	5.6
	1.66	0.51	0.16	0.05	0.01	0.06		0.000	5.6
	1.71	0.53	0.16	0.05	0.01	0.06		0.000	5.2
	1.75	0.53	0.16	0.04	0.01	0.03		0.000	2.6
LB	1.80	0.00	0.00	0.05	0.00	0.00		0.000	0.0
Total Q								**0.00840**	**100.000**

General Notes
Imperial Rod used. Depth values converted from ft. to m. (1ft = 0.3048)

Appendix 2-10. Manual Discharge Measurements and Levelling Surveys at BL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H1			
Stream Name	Northeast inflow to Big Lake			
Date Monitored	10-Aug-12			
Time at Site (24 hr)	**Start Time:**	8:30:00 AM	**End Time:**	10:30:00 AM
Personnel	Eli H., Cenling X.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	429044	7268478	301	
Weather Conditions	Rainy and Cool			

Transducer Information			
PT Model	PS98i	**Serial #**	2714017
Gain	N/A	**Offset**	N/A
Status	OK, logging	**Battery**	100%
# of Records	8493	**Memory Free**	28287 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 52	1.093	101.093		100.000	
BM 53			1.113	99.980	error
BM 54			1.192	99.901	
PT			1.628	99.465	
WL			1.506	**99.587**	
TBM	1.500	101.022	1.571	99.522	
WL			1.436	**99.586**	
PT			1.556	99.466	
BM 54			1.119	99.903	
BM 53			1.083	99.939	checked, ok
BM 52			1.022	100.000	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 53	99.945	99.939	-0.005	
BM 54	99.920	99.902	-0.018	
PT	99.450	99.466	0.016	

Summary	
Stage (m)	99.587
Discharge (m^3/s)	0.00106
Pressure Transducer Reading (m)	0.149
Pressure Transducer Elevation (m)	99.438

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	8:56	**End**	9:55	**Location**	~15m Upstream of PT			
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2006042			
Stage (m)	**Start**	**Reading**	0.149	**Time**	8:56	Stream very low flow and narrow,			
	End	**Reading**	0.149	**Time**	9:55	unable to record 20 measurements			

	Station	**Depth**		**Distance**	**Area**	**Velocity @60%**	**Cal. Velocity**	**Q**	**% of Total Q**
Notes	**(m)**	**(ft)**	**(m)**	**(m)**	**(m^2)**	**(m/s)**	**(m/s)**	**(m^3/s)**	**%**
LB	1.12	0.00	0.00	0.00	0.00	0		0.000	0.0
	1.16	0.10	0.03	0.04	0.00	-0.03		0.000	-3.4
	1.20	0.41	0.12	0.04	0.00	0		0.000	0.0
	1.24	0.41	0.12	0.04	0.00	0.02		0.000	9.4
	1.28	0.40	0.12	0.04	0.01	0.03		0.000	15.5
	1.33	0.33	0.10	0.05	0.01	0.06		0.000	28.4
	1.38	0.35	0.11	0.05	0.00	0.07		0.000	31.6
	1.42	0.37	0.11	0.04	0.00	0.05		0.000	18.6
	1.45	0.39	0.12	0.03	0.00	0		0.000	0.0
RB	1.46	0.00	0.00	0.01	0.00	0		0.000	0.0
Total Q								**0.00106**	**100.0**

General Notes
Used 2nd measurement because flow was too low at first location (lots of 0.00s). Imperial Rod was used, depth values converted from ft. to m (1ft = 0.3048m).

Appendix 2-10. Manual Discharge Measurements and Levelling Surveys at BL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H1			
Stream Name	Northeast inflow to Big Lake			
Date Monitored	15-Aug-12			
Time at Site (24 hr)	Start Time:	12:00:00 PM	End Time:	3:00:00 PM
Personnel	Eli H., Cenling X.			
Station Cordinates	Easting	Northing	Elevation	
	429044	7268478	301	
Weather Conditions	Cloudy, coldl			

Transducer Information			
PT Model	PS98i	Serial #	2714017
Gain	N/A	Offset	N/A
Status	OK	Battery	100%
# of Records	9236	Memory Free	27916 readings
Date Serviced		Crest Gauges	N/A

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 52	1.288	101.288		100.000	
BM 53			1.348	99.940	
BM 54			1.383	99.905	
PT			1.820	99.468	
WL			1.668	**99.620**	
TBM	1.733	101.417	1.604	99.684	
WL			1.800	**99.617**	
PT			1.948	99.469	
BM 54			1.513	99.904	
BM 53			1.478	99.939	
BM 52			1.417	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 53	99.945	99.940	-0.005	
BM 54	99.920	99.905	-0.016	
PT	99.450	99.469	0.019	

Summary	
Stage (m)	99.619
Discharge (m^3/s)	0.00308
Pressure Transducer Reading (m)	0.178
Pressure Transducer Elevation (m)	99.441

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	12:45	End	13:15	Location	~7m Upstream of PT			
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			Instrument Serial #		2006042			
Stage (m)	Start	Reading	0.178	Time	12:45				
	End	Reading	0.178	Time	13:15				

	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
LB	0.85	0.00	0.00	0.00	0.00	0		0.000	0.0
	0.90	0.19	0.06	0.05	0.00	0		0.000	0.0
	0.95	0.30	0.09	0.05	0.00	0.02		0.000	2.7
	0.99	0.30	0.09	0.04	0.00	0.04		0.000	4.8
	1.03	0.30	0.09	0.04	0.00	0.06		0.000	7.1
	1.07	0.30	0.09	0.04	0.00	0.06		0.000	6.2
	1.10	0.25	0.08	0.03	0.00	0.09		0.000	7.8
	1.14	0.25	0.08	0.04	0.00	0.1		0.000	11.1
	1.19	0.25	0.08	0.05	0.00	0.12		0.000	13.4
	1.23	0.25	0.08	0.04	0.00	0.1		0.000	9.9
	1.27	0.25	0.08	0.04	0.00	0.07		0.000	6.9
	1.31	0.25	0.08	0.04	0.00	0.06		0.000	5.9
	1.35	0.24	0.07	0.04	0.00	0.05		0.000	4.8
	1.39	0.24	0.07	0.04	0.00	0.06		0.000	5.7
	1.43	0.22	0.07	0.04	0.00	0.05		0.000	4.4
	1.47	0.22	0.07	0.04	0.00	0.04		0.000	3.5
	1.51	0.22	0.07	0.04	0.00	0.04		0.000	3.5
	1.55	0.21	0.06	0.04	0.00	0.03		0.000	2.5
	1.59	0.20	0.06	0.04	0.00	0.01		0.000	0.8
	1.63	0.20	0.06	0.04	0.00	0		0.000	0.0
	1.67	0.15	0.05	0.04	0.00	-0.01		0.000	-1.0
RB	1.76	0.00	0.00	0.09	0.00	0		0.000	0.0
Total Q								**0.00308**	**100.0**

General Notes
Imperial Rod used. Depth values converted from ft. to m. (1ft = 0.3048)

Appendix 2-10. Manual Discharge Measurements and Levelling Surveys at BL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H1			
Stream Name	Big Lake inflow			
Date Monitored	10-Sep-12			
Time at Site (24 hr)	Start Time:	9:00:00 AM	End Time:	11:00:00 AM
Personnel	Eli H., Scott C.			
Station Cordinates	Easting	Northing	Elevation	
	429044	7268478	301	
Weather Conditions	Cloudy, coldl			

Transducer Information			
PT Model	PS98i	Serial #	2714017
Gain	N/A	Offset	N/A
Status	OK	Battery	100%
# of Records	12958	Memory Free	26054
Date Serviced		Crest Gauges	N/A

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 52	1.472	101.472		100.000	
BM 53			1.532	99.940	
BM 54			1.562	99.910	
PT			2.001	99.471	
WL			1.788	**99.684**	
TBM	1.853	101.407	1.918	99.554	
WL			1.723	**99.684**	
PT			1.933	99.474	
BM 54			1.497	99.910	
BM 53			1.469	99.938	
BM 52			1.409	99.998	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 53	99.945	99.939	-0.006	
BM 54	99.920	99.910	-0.010	
PT	99.450	99.473	0.023	

Summary	
Stage (m)	99.684
Discharge (m^3/s)	0.00871
Pressure Transducer Reading (m)	0.242
Pressure Transducer Elevation (m)	99.442

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	9:12	End	9:52	Location	~7m Upstream of PT				
Method	Velocity-area (Mid-section)			Instrument Model		Swoffer 2100				
Flow Meter Type	Swoffer			Instrument Serial #						
Stage (m)	Start	Reading	0.242	Time	9:12					
	End	Reading	0.242	Time	9:52					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	0.40	0.00	0.00	0.00	0			0.000	0.0
	0.45	0.11	0.05	0.01	0.01			0.000	0.6
	0.50	0.20	0.05	0.01	0.01			0.000	1.1
	0.55	0.20	0.05	0.01	0.02			0.000	2.3
	0.60	0.20	0.05	0.01	0.06			0.001	6.9
	0.65	0.20	0.05	0.01	0.07			0.001	8.0
	0.70	0.19	0.05	0.01	0.05			0.000	5.5
	0.75	0.20	0.05	0.01	0.05			0.001	5.7
	0.80	0.18	0.05	0.01	0.05			0.000	5.2
	0.85	0.18	0.05	0.01	0.05			0.000	5.2
	0.90	0.20	0.05	0.01	0.08			0.001	7.4
	0.93	0.20	0.03	0.01	0.1			0.001	5.7
	0.95	0.18	0.02	0.00	0.07			0.000	2.9
	0.97	0.18	0.02	0.00	0.11			0.000	5.7
	1.00	0.19	0.03	0.01	0.08			0.000	5.2
	1.03	0.20	0.03	0.01	0.1			0.001	5.7
	1.05	0.19	0.02	0.00	0.07			0.000	3.1
	1.07	0.20	0.02	0.01	0.1			0.001	5.7
	1.10	0.19	0.03	0.01	0.07			0.000	4.6
	1.13	0.20	0.03	0.01	0.07			0.000	4.0
	1.15	0.18	0.02	0.01	0.07			0.000	5.1
	1.20	0.19	0.05	0.01	0.02			0.000	2.2
	1.25	0.18	0.05	0.01	0.01			0.000	1.0
	1.30	0.18	0.05	0.01	0.01			0.000	1.0
	1.35	0.17	0.05	0.01	0.01			0.000	1.5
	1.45	0.17	0.10	0.02	0			0.000	0.0
	1.55	0.16	0.10	0.01	-0.01			0.000	-1.4
	1.60	0.17	0.05	0.01	0			0.000	0.0
RB	1.62	0.00	0.02	0.00	0			0.000	0.0
Total Q								**0.00871**	**100.0**

General Notes

Appendix 2-11. Manual Discharge Measurements and Levelling Surveys at BL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H2			
Stream Name	Swan Drainage Outflow			
Date Monitored	8-Jun-12			
Time at Site (24 hr)	**Start Time:**	9:00:00 AM	**End Time:**	3:30:00 PM
Personnel	Eli, Coby			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	424087	7265274	276m	
Weather Conditions	Sunny, cool			

Transducer Information			
PT Model	PT2X	**Serial #**	21221025
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	1	**Memory Free**	524138 readings
Date Serviced	N/A	**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 70	1.113	101.113		100.000	
BM 71			1.172	99.941	
PT			2.935	98.178	
WL			1.889	**99.224**	
BM 72	1.431	101.039	1.505	99.608	
WL			1.817	**99.222**	
PT			2.861	98.178	
BM 71			1.099	99.940	
BM 70			1.039	100.000	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 71	99.941	99.941		Established June 8 2012
BM 72	99.608	99.608		Established June 8 2012
PT	98.178	98.178		Installed June 8 2

Summary	
Stage (m)	99.223
Discharge (m^3/s)	10.167
Pressure Transducer Reading (m)	1.067
Pressure Transducer Elevation (m)	98.156

Discharge Measurement - Mid-Section Method										
Time (24 hr)	**Start**	11:34	**End**	13:29	**Location**	~30m DS of station				
Method	Velocity-area (Mid-section)			**Instrument Model**	Flo-Mate 2000					
Flow Meter Type	Flo-Mate			**Instrument Serial #**	2004405					
Stage (m)	**Start**	**Reading**	1.094	**Time**	11:34					
	End	**Reading**	1.067	**Time**	13:29					

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	21.25	0.00	0.00	0.01	0			0.000	0.0
	21.50	0.08	0.25	0.05	0.04			0.002	0.0
	22.50	0.15	1.00	0.19	0.38			0.071	0.7
	24.00	0.36	1.50	0.34	0.43			0.147	1.4
	24.40	0.67	0.40	0.67	0.34			0.228	2.2
	26.00	0.40	1.60	0.62	0.5			0.310	3.0
	27.50	0.35	1.50	0.53	0.4			0.210	2.1
	29.00	0.37	1.50	0.56	0.49			0.272	2.7
	30.50	0.51	1.50	0.77	0.45			0.344	3.4
	32.00	0.54	1.50	0.81	0.54			0.437	4.3
	33.50	0.69	1.50	1.04	0.56			0.580	5.7
	35.00	0.70	1.50	1.05	0.71			0.746	7.3
	36.50	0.73	1.50	1.10	0.62			0.679	6.7
	38.00	0.71	1.50	0.89	0.65			0.577	5.7
	39.00	0.81	1.00	0.81		0.63	0.59	0.494	4.9
	40.00	0.88	1.00	0.88		0.59	0.52	0.488	4.8
	41.00	1.02	1.00	1.02		0.59	0.56	0.587	5.8
	42.00	1.06	1.00	1.06		0.58	0.42	0.530	5.2
	43.00	1.06	1.00	1.06		0.60	0.66	0.668	6.6
	44.00	1.18	1.00	0.86		0.62	0.54	0.496	4.9
	44.45	1.16	0.45	0.58		0.62	0.25	0.252	2.5
	45.00	0.82	0.55	0.84		0.64	0.63	0.534	5.2
	46.50	0.93	1.50	1.40		0.55	0.58	0.788	7.8
	48.00	0.81	1.50	1.22		0.53	0.46	0.601	5.9
	49.50	0.38	1.50	0.40	0.3			0.120	1.2
	50.11	0.14	0.61	0.06	0.09			0.005	0.1
	50.35	0.00	0.24	0.02	0			0.000	0.0
Total Q								**10.167**	**100.0**

General Notes
Gradiant = 1%

Appendix 2-11. Manual Discharge Measurements and Levelling Surveys at BL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H2			
Stream Name	Swan Drainage Outflow			
Date Monitored	16-Jun-12			
Time at Site (24 hr)	**Start Time:**	8:20:00 AM	**End Time:**	9:55:00 AM
Personnel	Eli, Coby			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	424087	7265274	276m	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PT2X	**Serial #**	21221025
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	1133	**Memory Free**	523006 readings
Date Serviced	N/A	**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 70	0.988	100.988		100.000	
BM 71			1.045	99.943	
PT			2.821	98.167	
WL			1.985	**99.003**	
BM 72	1.325	100.933	1.380	99.608	
WL			1.931	**99.002**	
PT			2.763	98.170	
BM 71			0.992	99.941	
BM 70			0.932	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 71	99.9405	99.942	-0.002	
BM 72	99.608	99.608	0.000	
PT	98.169	98.169	0.001	

Summary	
Stage (m)	99.003
Discharge (m^3/s)	3.983
Pressure Transducer Reading (m)	0.855
Pressure Transducer Elevation (m)	98.147

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	11:34	**End**	13:29	**Location**	~100m DS of station			
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2004405			
Stage (m)	**Start**	**Reading**	0.857	**Time**	8:25				
	End	**Reading**	0.856	**Time**	9:26				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	18.90	0.00	0.00	0.01	0			0.000	0.0
	18.95	0.34	0.05	0.03	0.03			0.001	0.0
	19.05	0.33	0.10	0.16	0.1			0.016	0.4
	19.90	0.35	0.85	0.31	0.38			0.116	2.9
	20.80	0.35	0.90	0.32	0.25			0.079	2.0
	21.70	0.36	0.90	0.32	0.35			0.113	2.8
	22.60	0.38	0.90	0.34	0.32			0.109	2.7
	23.50	0.39	0.90	0.35	0.31			0.109	2.7
	24.40	0.40	0.90	0.36	0.43			0.155	3.9
	25.30	0.46	0.90	0.41	0.36			0.149	3.7
	26.20	0.41	0.90	0.37	0.38			0.140	3.5
	27.10	0.47	0.90	0.42	0.4			0.169	4.2
	28.00	0.52	0.90	0.47	0.46			0.215	5.4
	28.90	0.50	0.90	0.45	0.5			0.225	5.6
	29.80	0.52	0.90	0.47	0.12			0.056	1.4
	30.70	0.58	0.90	0.52	0.45			0.235	5.9
	31.60	0.70	0.90	0.63	0.56			0.353	8.9
	32.50	0.79	0.90	0.71		0.57	0.39	0.341	8.6
	33.40	0.78	0.90	0.70		0.60	0.53	0.397	10.0
	34.30	0.80	0.90	0.72		0.61	0.57	0.425	10.7
	35.20	0.68	0.90	0.46	0.62			0.285	7.1
	35.65	0.64	0.45	0.26	0.57			0.146	3.7
	36.00	0.36	0.35	0.24	0.59			0.143	3.6
	37.00	0.10	1.00	0.07	0.08			0.006	0.1
	37.45	0.00	0.45	0.00	0			0.000	0.0
Total Q								**3.983**	**100.0**

General Notes
Gradiant = 1%

Appendix 2-11. Manual Discharge Measurements and Levelling Surveys at BL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H2			
Stream Name	Big Lake Outflow			
Date Monitored	8-Jul-12			
Time at Site (24 hr)	**Start Time:**	8:50:00 AM	**End Time:**	1:00:00 PM
Personnel	Eli H., Ian K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	424087	7265274	276m	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PT2X	**Serial #**	21221025
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	3.0V%
# of Records	4304	**Memory Free**	519835
Date Serviced		**Crest Gauges**	No

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 70	1.118	101.118		100.000	
BM 71			1.172	99.946	
BM 72			1.489	99.629	
PT			2.980	98.138	
WL			2.299	**98.819**	
TBM	2.694	101.068	2.744	98.374	
WL			2.249	**98.819**	
PT			2.928	98.140	
BM 72			1.436	99.632	
BM 71			1.119	99.949	
BM 70			1.066	100.002	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 71	99.9405	99.948	0.007	
BM 72	99.608	99.631	0.022	
PT	98.169	98.139	-0.030	

Summary	
Stage (m)	98.819
Discharge (m^3/s)	1.666
Pressure Transducer Reading (m)	0.667
Pressure Transducer Elevation (m)	98.152

Discharge Measurement - Mid-Section Method							
Time (24 hr)	**Start**	9:35	**End**	10:50	**Location**	~50m Downstream of station	
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000	
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2007612	
Stage (m)	**Start**	**Reading**	0.667	**Time**	9:35	Reading values converted from psi to mH20	
	End	**Reading**	0.669	**Time**	10:50	(mH20=psi/1.422)	

	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	**(m)**	**(ft)**	**(m)**	**(m)**	**(m^2)**	**(m/s)**	**(m/s)**	**(m^3/s)**	**%**
LB	1.05	0.00	0.00	0.00	0.01	0.00		0.000	0.0
	1.25	0.25	0.08	0.20	0.04	0.05		0.002	0.1
	2.00	0.44	0.13	0.75	0.10	0.11		0.011	0.6
	2.70	0.50	0.15	0.70	0.11	0.20		0.021	1.3
	3.40	0.56	0.17	0.70	0.12	0.16		0.019	1.1
	4.10	0.59	0.18	0.70	0.13	0.19		0.024	1.4
On rock	4.80	0.32	0.10	0.70	0.07	0.20		0.014	0.8
	5.50	0.70	0.21	0.70	0.15	0.15		0.022	1.3
	6.20	0.76	0.23	0.70	0.16	0.19		0.031	1.8
	6.90	0.72	0.22	0.70	0.15	0.25		0.038	2.3
	7.60	0.80	0.24	0.70	0.17	0.21		0.036	2.2
	8.30	0.65	0.20	0.70	0.14	0.26		0.036	2.2
	9.00	0.95	0.29	0.70	0.20	0.25		0.051	3.0
	9.70	1.12	0.34	0.70	0.24	0.21		0.050	3.0
	10.40	1.05	0.32	0.70	0.22	0.25		0.056	3.4
	11.10	1.05	0.32	0.70	0.22	0.30		0.067	4.0
	11.80	1.44	0.44	0.70	0.31	0.21		0.065	3.9
	12.50	1.50	0.46	0.70	0.32	0.32		0.102	6.1
	13.20	1.33	0.41	0.70	0.28	0.31		0.088	5.3
On rock	13.90	0.29	0.09	0.70	0.06	0.37		0.023	1.4
	14.60	1.82	0.55	0.70	0.39	0.40		0.155	9.3
	15.30	2.15	0.66	0.70	0.29	0.42		0.124	7.4
	15.50	1.81	0.55	0.20	0.14	0.43		0.059	3.6
	15.80	1.62	0.49	0.30	0.15	0.42		0.062	3.7
	16.10	2.20	0.67	0.30	0.20	0.41		0.082	5.0
	16.40	1.95	0.59	0.30	0.30	0.42		0.125	7.5
	17.10	1.69	0.52	0.70	0.36	0.44		0.159	9.5
	17.80	1.48	0.45	0.70	0.20	0.40		0.081	4.9
	18.00	1.36	0.41	0.20	0.15	0.41		0.059	3.6
	18.50	0.30	0.09	0.50	0.04	0.07		0.003	0.2
RB	18.90	0.00	0.00	0.40	0.02	0.00		0.000	0.0
Total Q								**1.666**	**100.0**

General Notes
Gradiant = 2%. Imperial rod was used. Depths have been converted from ft to m (1ft=0.3048m)

Appendix 2-11. Manual Discharge Measurements and Levelling Surveys at BL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H2			
Stream Name	Big Lake Outflow			
Date Monitored	14-Aug-12			
Time at Site (24 hr)	Start Time:	7:40:00 AM	End Time:	9:45:00 AM
Personnel	Eli H., Cenling X.			
Station Cordinates	Easting	Northing	Elevation	
	424087	7265274	276m	
Weather Conditions	Cloudy, cold			

Transducer Information			
PT Model	PT2X	Serial #	21221025
Gain	N/A	Offset	N/A
Status	Active	Battery	3.0V%
# of Records	9625	Memory Free	514514
Date Serviced		Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 70	1.093	101.093		100.000	
BM 71			1.147	99.946	
BM 72			1.497	99.596	
PT			2.945	98.148	
WL			2.420	**98.673**	
TBM	2.470	101.103	2.460	98.633	
WL			2.430	**98.673**	
PT			2.955	98.148	
BM 72			1.500	99.603	
BM 71			1.158	99.945	
BM 70			1.104	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 71	99.9405	99.946	0.005	
BM 72	99.608	99.600	-0.008	
PT	98.169	98.148	-0.021	

Summary	
Stage (m)	98.673
Discharge (m^3/s)	0.339
Pressure Transducer Reading (m)	0.545
Pressure Transducer Elevation (m)	98.128

Discharge Measurement - Mid-Section Method												
Time (24 hr)	Start	7:48	End	8:50	Location	~50m Downstream of station						
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000						
Flow Meter Type	Flo-Mate			Instrument Serial #		2006042						
Stage (m)	Start	Reading	0.54	Time	7:48							
	End	Reading	0.545	Time	8:50							

	Station	Depth		Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	1.30	0.00	0.00	0.00	0.01	0			0.000	0.0
	1.60	0.25	0.08	0.30	0.03	-0.01			0.000	-0.1
	2.00	0.50	0.15	0.40	0.11	0.01			0.001	0.3
	3.00	0.70	0.21	1.00	0.21	0.01			0.002	0.6
	4.00	0.90	0.27	1.00	0.27	0.04			0.011	3.2
	5.00	0.93	0.28	1.00	0.28	0.04			0.011	3.3
	6.00	1.05	0.32	1.00	0.32	0.05			0.016	4.7
	7.00	1.10	0.34	1.00	0.34	0.08			0.027	7.9
	8.00	1.05	0.32	1.00	0.32	0.07			0.022	6.6
	9.00	0.80	0.24	1.00	0.24	0.08			0.020	5.8
	10.00	1.60	0.49	1.00	0.49	0.07			0.034	10.1
	11.00	1.65	0.50	1.00	0.50	0.06			0.030	8.9
	12.00	1.05	0.32	1.00	0.32	0.08			0.026	7.6
	13.00	1.45	0.44	1.00	0.44	0.01			0.004	1.3
	14.00	1.50	0.46	1.00	0.46	0.05			0.023	6.7
	15.00	1.40	0.43	1.00	0.43	0.06			0.026	7.6
	16.00	1.22	0.37	1.00	0.37	0.02			0.007	2.2
	17.00	1.00	0.30	1.00	0.24	0.04			0.010	2.9
	17.60	1.60	0.49	0.60	0.29	0.01			0.003	0.9
	18.20	2.00	0.61	0.60	0.37	0.03			0.011	3.2
	18.80	2.35	0.72	0.60	0.43	0.02			0.009	2.5
	19.40	2.30	0.70	0.60	0.42	0.03			0.013	3.7
	20.00	2.68	0.82	0.60	0.49		0.04	0.01	0.012	3.6
	20.60	2.70	0.82	0.60	0.41		0.03	0.03	0.012	3.6
	21.00	1.64	0.50	0.40	0.20	0.01			0.002	0.6
	21.40	1.20	0.37	0.40	0.18	0.04			0.007	2.2
RB	22.00	0.00	0.00	0.60	0.11	0			0.000	0.0
Total Q									**0.339**	**100**

General Notes
Gradiant = 1.5%. Imperial rod was used. Depths have been converted from ft to m (1ft=0.3048m)

Appendix 2-11. Manual Discharge Measurements and Levelling Surveys at BL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H2			
Stream Name	Big Lake Outflow			
Date Monitored	6-Sep-12			
Time at Site (24 hr)	**Start Time:**	3:00:00 PM	**End Time:**	4:30:00 PM
Personnel	Eli H., Scott C.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	424087	7265274	276m	
Weather Conditions	Cloudy, windy			

Transducer Information			
PT Model	PT2X	**Serial #**	21221025
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	2.9V
# of Records	12980	**Memory Free**	511159
Date Serviced		**Crest Gauges**	No

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 70	1.247	101.247		100.000	
BM 71			1.303	99.944	
BM 72			1.628	99.619	
PT			3.090	98.157	
WL			2.617	**98.630**	
TBM	2.562	101.162	2.647	98.600	
WL			2.529	**98.633**	
PT			3.003	98.159	
BM 72			1.543	99.619	
BM 71			1.219	99.943	
BM 70			1.162	100.000	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 71	99.9405	99.944	0.003	
BM 72	99.608	99.619	0.011	
PT	98.169	98.158	-0.011	

Summary	
Stage (m)	98.632
Discharge (m^3/s)	0.125
Pressure Transducer Reading (m)	0.486
Pressure Transducer Elevation (m)	98.145

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	14:58	**End**	15:56	**Location**	~50m Downstream of station			
Method	Velocity-area (Mid-section)			**Instrument Model**		Swoffer			
Flow Meter Type	Swoffer			**Instrument Serial #**					
Stage (m)	**Start**	**Reading**	0.49	**Time**	14:58				
	End	**Reading**	0.487	**Time**	15:56				

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	3.50	0.00	0.00	0.00	0			0.000	0.0
	3.70	0.02	0.20	0.01	0			0.000	0.0
	4.10	0.11	0.40	0.04	0.16			0.007	5.3
	4.45	0.07	0.35	0.02	0.01			0.000	0.2
	4.80	0.07	0.35	0.02	0.13			0.003	2.6
	5.15	0.08	0.35	0.03	0.33			0.009	7.4
	5.50	0.12	0.35	0.04	0.23			0.010	7.7
	5.85	0.13	0.35	0.04	0.08			0.003	2.7
	6.15	0.12	0.30	0.04	0.17			0.007	5.3
	6.50	0.12	0.35	0.04	0.22			0.009	7.4
	6.85	0.08	0.35	0.03	0.19			0.005	4.3
	7.20	0.15	0.35	0.06	0.23			0.013	10.4
	7.60	0.10	0.40	0.04	0.09			0.003	2.7
	7.95	0.16	0.35	0.04	0.17			0.007	5.4
	8.10	0.12	0.15	0.02	0.17			0.004	2.9
	8.30	0.17	0.20	0.05	0.17			0.008	6.4
	8.65	0.10	0.35	0.04	0.19			0.007	5.3
	9.00	0.13	0.35	0.04	0.28			0.010	8.0
	9.20	0.11	0.20	0.03	0.17			0.005	4.1
	9.55	0.09	0.35	0.03	0.02			0.001	0.5
	9.90	0.07	0.35	0.03	0.28			0.007	5.9
	10.30	0.06	0.40	0.02	0.2			0.004	3.1
	10.55	0.10	0.25	0.03	0.12			0.003	2.4
RB	10.80	0.00	0.25	0.01	0			0.000	0.0
Total Q								**0.125**	**100.0**

General Notes
Gradiant = 1.5%

Appendix 2-11. Manual Discharge Measurements and Levelling Surveys at BL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H2			
Stream Name	Big Lake Outflow			
Date Monitored	9-Sep-12			
Time at Site (24 hr)	**Start Time:**	1:45:00 PM	**End Time:**	3:30:00 PM
Personnel	Eli H., Scott C.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	424087	7265274	276m	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PT2X	**Serial #**	21221025
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	2.9V
# of Records	13405	**Memory Free**	510734
Date Serviced		**Crest Gauges**	No

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 70	1.052	101.052		100.000	
BM 71			1.110	99.942	
BM 72			1.435	99.617	
PT			2.898	98.154	
WL			2.373	**98.679**	
TBM	2.589	101.167	2.474	98.578	
WL			2.488	**98.679**	
PT			3.012	98.155	
BM 72			1.550	99.617	
BM 71			1.227	99.940	
BM 70			1.169	99.998	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 71	99.9405	99.941	0.001	
BM 72	99.608	99.617	0.009	
PT	98.169	98.155	-0.014	

Summary	
Stage (m)	98.679
Discharge (m^3/s)	0.260
Pressure Transducer Reading (m)	0.541
Pressure Transducer Elevation (m)	98.138

Discharge Measurement - Mid-Section Method										
Time (24 hr)	**Start**	13:44	**End**	14:32	**Location**	~50m Downstream of station				
Method	Velocity-area (Mid-section)			**Instrument Model**		Swoffer				
Flow Meter Type	Swoffer			**Instrument Serial #**						
Stage (m)	**Start**	**Reading**	0.542	**Time**	13:44					
	End	**Reading**	0.541	**Time**	14:32					

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	1.50	0.00	0.00	0.01	0			0.000	0.0
	1.60	0.12	0.10	0.03	0.12			0.004	1.4
	2.00	0.20	0.40	0.08	0.18			0.014	5.5
	2.40	0.27	0.40	0.09	0.18			0.017	6.5
	2.70	0.25	0.30	0.08	0.27			0.020	7.8
	3.00	0.30	0.30	0.09	0.19			0.017	6.6
	3.30	0.22	0.30	0.07	0.17			0.011	4.3
	3.60	0.22	0.30	0.07	0.17			0.011	4.3
	3.90	0.15	0.30	0.05	0.26			0.012	4.5
	4.20	0.24	0.30	0.07	0.28			0.020	7.8
	4.50	0.20	0.30	0.06	0.28			0.017	6.5
	4.80	0.21	0.30	0.07	0.2			0.015	5.7
	5.20	0.19	0.40	0.08	0.19			0.014	5.6
	5.60	0.17	0.40	0.05	0.2			0.010	3.9
	5.80	0.21	0.20	0.04	0.24			0.010	3.9
On Rock	6.00	0.04	0.20	0.01	0.34			0.004	1.6
Behind Rock	6.40	0.16	0.40	0.05	0			0.000	0.0
	6.65	0.18	0.25	0.05	0.21			0.011	4.4
	7.00	0.16	0.35	0.06	0.01			0.001	0.2
	7.40	0.19	0.40	0.08	0.25			0.019	7.3
	7.80	0.17	0.40	0.07	0.22			0.015	5.8
	8.20	0.17	0.40	0.07	0.18			0.012	4.7
	8.60	0.07	0.40	0.03	0.16			0.004	1.7
	9.00	0.04	0.40	0.02	0.01			0.000	0.1
	9.40	0.02	0.40	0.00	0			0.000	0.0
LB	9.45	0.00	0.05	0.00	0			0.000	0.0
Total Q								**0.260**	**100.0**

General Notes
Gradiant = 1.5%

Appendix 2-12. Manual Discharge Measurements and Levelling Surveys at BL-H3 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H3			
Stream Name	Swan OF			
Date Monitored	8-Jun-12			
Time at Site (24 hr)	**Start Time:**	4:30:00 PM	**End Time:**	6:30:00 PM
Personnel	E. Heyman, C. Hall			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	423,467E	7,264,998N	258m	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PT2X	**Serial #**	21221020
Gain		**Offset**	
Status	Active, Logging	**Battery**	100%
# of Records	1	**Memory Free**	524.138
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 81	1.653	101.653		100.000	
WL			1.486	**100.167**	**Error**
TBM	1.119	101.708	1.064	100.589	Station Rebar
WL			1.535	**100.173**	**Checked and Correct**
BM 81			1.709	99.999	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 81	100.000	100.000		
TBM		100.589		Station Rebar
PT		Not Surveyed		

Summary	
Stage (m)	100.173
Discharge (m^3/s)	0.969
Pressure Transducer Reading (m)	1.300
Pressure Transducer Elevation (m)	98.873

Discharge Measurement - Mid-Section Method											
Time (24 hr)	**Start**		**End**		**Location**	10m downstream of pressure transducer					
Method	Velocity-area (Mid-section)			**Instrument Model**	Flomate 2000						
Flow Meter Type	Flo-mate			**Instrument Serial #**	2004405						
Stage (m)	**Start**	**Reading**	1.299	**Time**	16:13						
	End	**Reading**	1.300	**Time**	17:32						

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	1.29	0.00	0.00	0.00	0			0.000	0.0
	1.35	0.07	0.06	0.01	0.06			0.000	0.0
	1.44	0.12	0.09	0.01	0.07			0.001	0.1
	1.47	0.63	0.03	0.03	0.3			0.010	1.1
	1.55	0.65	0.08	0.06	0.46			0.027	2.8
	1.65	0.62	0.10	0.06	0.46			0.029	2.9
	1.75	0.60	0.10	0.06	0.63			0.038	3.9
	1.85	0.58	0.10	0.06	0.78			0.045	4.7
	1.95	0.55	0.10	0.05	0.94			0.052	5.3
	2.05	0.60	0.10	0.07	1.06			0.073	7.5
	2.18	0.60	0.13	0.06	1.1			0.066	6.8
	2.25	0.59	0.07	0.06	1.08			0.061	6.2
	2.37	0.53	0.12	0.05	1			0.053	5.5
	2.45	0.55	0.08	0.05	1.12			0.055	5.7
	2.55	0.57	0.10	0.06	1.12			0.064	6.6
	2.65	0.52	0.10	0.05	1.12			0.058	6.0
	2.75	0.51	0.10	0.05	1.09			0.056	5.7
	2.85	0.50	0.10	0.05	1.05			0.053	5.4
	2.95	0.58	0.10	0.06	0.93			0.054	5.6
	3.05	0.57	0.10	0.06	0.88			0.050	5.2
	3.15	0.53	0.10	0.05	0.78			0.041	4.3
	3.25	0.59	0.10	0.06	0.69			0.041	4.2
	3.35	0.59	0.10	0.05	0.45			0.023	2.3
	3.42	0.58	0.07	0.04	0.43			0.017	1.8
	3.49	0.16	0.07	0.01	0.15			0.002	0.2
	3.55	0.08	0.06	0.00	0.32			0.001	0.1
	3.59	0.06	0.04	0.00	0.08			0.000	0.0
RB	3.68	0.00	0.09	0.00	0			0.000	0.0
Total Q								**0.969**	**100.0**

General Notes

Appendix 2-12. Manual Discharge Measurements and Levelling Surveys at BL-H3 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H3			
Stream Name	Swan OF			
Date Monitored	16-Jun-12			
Time at Site (24 hr)	**Start Time:**	10:10:00 AM	**End Time:**	11:50:00 AM
Personnel	E. Heyman, C. Hall			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	423,467E	7,264,998N	258m	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PT2X	**Serial #**	21221020
Gain		**Offset**	
Status	Active	**Battery**	100%
# of Records	1121	**Memory Free**	523018
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 81	1.608	101.608		100.000	
BM 82			1.910	99.698	
PT			2.701	98.907	
WL			1.694	**99.914**	
BM 83	1.835	101.645	1.798	99.810	
WL			1.734	**99.911**	
PT			2.740	98.905	
BM 82			1.948	99.697	
BM 81			1.645	100.000	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 82	99.698	99.698		Established June 16 2012
BM 83	99.810	99.810		Established June 16 2012
PT	98.906	98.906		Installed June 16 2012

Summary	
Stage (m)	99.913
Discharge (m^3/s)	0.232
Pressure Transducer Reading (m)	1.033
Pressure Transducer Elevation (m)	98.880

Discharge Measurement - Mid-Section Method											
Time (24 hr)	**Start**	10:11	**End**	11:03	**Location**	10m downstream of pressure transducer					
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-mate 2000					
Flow Meter Type	Flo-mate			**Instrument Serial #**		2004405					
Stage (m)	**Start**	**Reading**	1.032	**Time**	16:13						
	End	**Reading**	1.033	**Time**	17:32						

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	0.55	0.00	0.00	0.01	0.28			0.002	0.7
undercut	0.58	0.37	0.03	0.02	0.38			0.008	3.3
	0.66	0.42	0.08	0.03	0.39			0.013	5.6
	0.74	0.40	0.08	0.03	0.44			0.014	6.1
	0.82	0.40	0.08	0.03	0.46			0.015	6.3
	0.90	0.44	0.08	0.04	0.44			0.015	6.7
	0.98	0.42	0.08	0.03	0.45			0.015	6.5
	1.06	0.42	0.08	0.03	0.44			0.015	6.4
	1.14	0.43	0.08	0.03	0.47			0.016	7.0
	1.22	0.43	0.08	0.03	0.47			0.016	7.0
	1.30	0.30	0.08	0.02	0.48			0.012	5.0
	1.38	0.30	0.08	0.02	0.47			0.011	4.9
	1.46	0.29	0.08	0.02	0.49			0.011	4.9
	1.54	0.30	0.08	0.02	0.45			0.011	4.7
	1.62	0.30	0.08	0.02	0.43			0.010	4.4
	1.70	0.31	0.08	0.02	0.29			0.007	3.1
	1.78	0.38	0.08	0.03	0.34			0.010	4.5
	1.86	0.34	0.08	0.03	0.37			0.010	4.3
	1.94	0.30	0.08	0.02	0.32			0.008	3.3
	2.02	0.30	0.08	0.02	0.32			0.008	3.3
undercut	2.10	0.36	0.08	0.02	0.2			0.005	2.0
grass	2.15	0.05	0.05	0.00	0.08			0.000	0.1
RB	2.20	0.00	0.05	0.00	0			0.000	0.0
Total Q								**0.232**	**100.0**

General Notes
Gradiant = 2%

Appendix 2-12. Manual Discharge Measurements and Levelling Surveys at BL-H3 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H3			
Stream Name	Swan OF			
Date Monitored	8-Jul-12			
Time at Site (24 hr)	**Start Time:**	1:15:00 PM	**End Time:**	5:20:00 PM
Personnel	E. Heyman, Ian K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	423,467E	7,264,998N	258m	
Weather Conditions	Mix of sun and cloud			

Transducer Information			
PT Model	PT2X	**Serial #**	21221020
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	4303	**Memory Free**	519836
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 81	1.822	101.822		100.000	
BM 82			2.119	99.703	
BM 83			1.988	99.834	
PT			2.882	98.940	
WL			2.042	**99.780**	
TBM	2.459	101.761	2.520	99.302	
WL			1.982	**99.779**	
PT			2.823	98.938	
BM 83			1.928	99.833	
BM 82			2.060	99.701	
BM 81			1.762	99.999	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 82	99.698	99.702	0.004	
BM 83	99.810	99.834	0.024	
PT	98.906	98.939	0.033	

Summary	
Stage (m)	99.780
Discharge (m^3/s)	0.06044
Pressure Transducer Reading (m)	0.867
Pressure Transducer Elevation (m)	98.913

Discharge Measurement - Mid-Section Method										
Time (24 hr)	**Start**	14:05	**End**	14:38	**Location**	15m Dowstream of Station				
Method	Velocity-area (Mid-section)			**Instrument Model**		Flomate 2000				
Flow Meter Type	Flomate			**Instrument Serial #**		2007612				
Stage (m)	**Start**	**Reading**	0.866	**Time**	14:05	Reading values converted from psi to mH20				
	End	**Reading**	0.867	**Time**	14:38	(mH20=psi/1.422)				

	Station	**Depth**		**Distance**	**Area**	**Velocity @60%**	**Cal. Velocity**	**Q**	**% of Total Q**
Notes	**(m)**	**(ft)**	**(m)**	**(m)**	**(m^2)**	**(m/s)**	**(m/s)**	**(m^3/s)**	**%**
RB	0.60	0.00	0.00	0.00	0.00	0.00		0.000	0.0
	0.66	0.43	0.13	0.06	0.01	0.15		0.001	2.0
	0.72	0.43	0.13	0.06	0.01	0.20		0.002	2.6
	0.78	0.48	0.15	0.06	0.01	0.21		0.002	3.1
	0.84	0.48	0.15	0.06	0.01	0.22		0.002	3.2
	0.90	0.43	0.13	0.06	0.01	0.14		0.001	1.8
	0.96	0.41	0.12	0.06	0.01	0.13		0.001	1.6
	1.02	0.41	0.12	0.06	0.01	0.16		0.001	2.0
	1.08	0.32	0.10	0.06	0.01	0.16		0.001	1.5
On Rock	1.14	0.30	0.09	0.06	0.01	0.19		0.001	1.7
On Rock	1.20	0.23	0.07	0.06	0.00	0.19		0.001	1.3
	1.26	0.33	0.10	0.06	0.01	0.21		0.001	2.1
	1.32	0.38	0.12	0.06	0.01	0.23		0.002	2.6
On Rock	1.38	0.25	0.08	0.06	0.00	0.23		0.001	1.7
On Rock	1.44	0.24	0.07	0.06	0.00	0.23		0.001	1.7
	1.50	0.41	0.12	0.06	0.01	0.22		0.002	2.7
	1.56	0.65	0.20	0.06	0.01	0.19		0.002	3.7
	1.62	0.60	0.18	0.06	0.01	0.24		0.003	4.4
	1.68	0.51	0.16	0.06	0.01	0.21		0.002	3.2
	1.74	0.63	0.19	0.06	0.01	0.37		0.004	7.1
	1.80	0.65	0.20	0.06	0.01	0.40		0.005	7.9
	1.86	0.65	0.20	0.06	0.01	0.42		0.005	8.3
	1.92	0.70	0.21	0.06	0.01	0.41		0.005	8.7
	1.98	0.77	0.23	0.06	0.01	0.40		0.006	9.3
	2.04	0.91	0.28	0.06	0.01	0.38		0.005	7.8
	2.07	0.92	0.28	0.03	0.01	0.38		0.005	7.9
LB	2.13	0.00	0.00	0.06	0.01	0.00		0.000	0.0
Total Q								**0.0604**	**100.0**

General Notes
Gradiant = 2%. Imperial Rod was used. Depths converted from ft to m (1ft = 0.3048m)

Appendix 2-12. Manual Discharge Measurements and Levelling Surveys at BL-H3 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H3			
Stream Name	Swan OF			
Date Monitored	11-Aug-12			
Time at Site (24 hr)	**Start Time:**	1:00:00 PM	**End Time:**	2:30:00 PM
Personnel	E. Heyman, Cenling X.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	423,467E	7,264,998N	258m	
Weather Conditions	Mix of sun and cloud			

Transducer Information			
PT Model	PT2X	**Serial #**	21221020
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	9197	**Memory Free**	514942
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 81	1.745	101.745		100.000	
BM 82			2.035	99.710	
BM 83			1.909	99.836	
PT			2.748	98.997	error
WL			1.959	**99.786**	
TBM	1.978	101.792	1.931	99.814	
WL			2.009	**99.783**	
PT			2.857	98.935	
BM 83			1.957	99.835	
BM 82			2.083	99.709	
BM 81			1.792	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 82	99.698	99.710	0.012	
BM 83	99.810	99.836	0.025	
PT	98.906	98.935	0.029	

Summary	
Stage (m)	99.785
Discharge (m^3/s)	0.0304
Pressure Transducer Reading (m)	0.873
Pressure Transducer Elevation (m)	98.912

Discharge Measurement - Mid-Section Method										
Time (24 hr)	**Start**	13:14	**End**	13:42	**Location**	15m Dowstream of Station				
Method	Velocity-area (Mid-section)			**Instrument Model**		Flomate 2000				
Flow Meter Type	Flomate			**Instrument Serial #**		2006042				
Stage (m)	**Start**	**Reading**	0.872	**Time**	13:14					
	End	**Reading**	0.873	**Time**	13:42					

	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
LB	0.90	0.00	0.00	0.00	0.00	0		0.000	0.0
	0.94	0.10	0.03	0.04	0.00	0.01		0.000	0.1
	1.02	0.67	0.20	0.08	0.02	0.1		0.002	5.4
	1.10	0.63	0.19	0.08	0.02	0.13		0.002	6.6
	1.18	0.63	0.19	0.08	0.02	0.2		0.003	10.1
	1.26	0.71	0.22	0.08	0.02	0.19		0.003	10.8
	1.34	0.62	0.19	0.08	0.02	0.15		0.002	7.5
	1.42	0.51	0.16	0.08	0.01	0.14		0.002	5.7
	1.50	0.51	0.16	0.08	0.01	0.07		0.001	2.9
	1.58	0.60	0.18	0.08	0.01	0.04		0.001	1.9
	1.66	0.58	0.18	0.08	0.01	0.15		0.002	7.0
	1.74	0.54	0.16	0.08	0.01	0.17		0.002	7.4
	1.82	0.58	0.18	0.08	0.01	0.13		0.002	6.0
	1.90	0.55	0.17	0.08	0.01	0.12		0.002	5.3
	1.98	0.45	0.14	0.08	0.01	0.13		0.001	4.7
	2.06	0.43	0.13	0.08	0.01	0.05		0.001	1.7
	2.14	0.51	0.16	0.08	0.01	0.07		0.001	2.9
	2.22	0.52	0.16	0.08	0.01	0.14		0.002	5.8
	2.30	0.51	0.16	0.08	0.01	0.13		0.002	5.3
	2.38	0.50	0.15	0.08	0.01	0.03		0.000	1.2
	2.46	0.50	0.15	0.08	0.01	0.03		0.000	0.9
	2.50	0.49	0.15	0.04	0.00	0.06		0.000	0.9
RB	2.52	0.00	0.00	0.02	0.00	0		0.000	0.0
Total Q								**0.0304**	**100.0**

General Notes
Gradiant = 2%. Gradiant = 2%. Imperial Rod was used. Depths converted from ft to m (1ft = 0.3048m)

Appendix 2-12. Manual Discharge Measurements and Levelling Surveys at BL-H3 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H3			
Stream Name	Swan OF			
Date Monitored	9-Sep-12			
Time at Site (24 hr)	**Start Time:**	9:40:00 AM	**End Time:**	1:00:00 PM
Personnel	E. Heyman, Scott C.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	423,467E	7,264,998N	258m	
Weather Conditions	Sunny, fog			

Transducer Information			
PT Model	PT2X	**Serial #**	21221020
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	13351	**Memory Free**	510788
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 81	1.841	101.841		100.000	
BM 82			2.158	99.683	
BM 83			2.014	99.827	
PT			2.892	98.949	
WL			1.980	**99.861**	
TBM	2.062	101.755	2.148	99.693	
WL			1.893	**99.862**	
PT			2.806	98.949	
BM 83			1.930	99.825	
BM 82			2.072	99.683	
BM 81			1.755	100.000	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 82	99.698	99.683	-0.015	
BM 83	99.810	99.826	0.016	
PT	98.906	98.949	0.043	

Summary	
Stage (m)	99.862
Discharge (m^3/s)	0.0862
Pressure Transducer Reading (m)	0.940
Pressure Transducer Elevation (m)	98.922

Discharge Measurement - Mid-Section Method							
Time (24 hr)	**Start**	9:23	**End**	10:28	**Location**	15m Dowstream of Station	
Method	Velocity-area (Mid-section)			**Instrument Model**		Swoffer 2100	
Flow Meter Type	Swoffer			**Instrument Serial #**			
Stage (m)	**Start**	**Reading**	0.940	**Time**	9:23	Under cut 0.05-0.15 (d=0.27m, v=0.01m/s)	
	End	**Reading**	0.940	**Time**	10:28		

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	0.17	0.00	0.00	0.00	0			0.000	0.0
	0.20	0.27	0.03	0.01	0			0.000	0.0
	0.25	0.27	0.05	0.02	0.2			0.003	3.8
	0.32	0.26	0.07	0.02	0.2			0.003	3.9
	0.38	0.26	0.06	0.02	0.17			0.003	3.6
	0.46	0.26	0.08	0.02	0.27			0.005	6.1
	0.53	0.12	0.07	0.01	0.31			0.003	3.0
	0.60	0.07	0.07	0.00	0.32			0.002	1.8
	0.67	0.05	0.07	0.00	0.33			0.001	1.3
	0.74	0.06	0.07	0.00	0.4			0.002	1.9
	0.81	0.08	0.07	0.01	0.41			0.002	2.7
	0.88	0.10	0.07	0.01	0.4			0.003	3.2
	0.95	0.15	0.07	0.01	0.4			0.003	3.8
	0.99	0.23	0.04	0.01	0.31			0.004	4.5
	1.06	0.21	0.07	0.02	0.29			0.005	5.3
	1.14	0.17	0.08	0.01	0.29			0.004	4.6
	1.22	0.19	0.08	0.02	0.32			0.005	5.6
	1.30	0.25	0.08	0.02	0.36			0.008	8.9
	1.39	0.25	0.09	0.02	0.33			0.007	7.7
	1.46	0.23	0.07	0.01	0.25			0.004	4.3
	1.52	0.25	0.06	0.02	0.25			0.004	5.1
	1.60	0.25	0.08	0.02	0.17			0.003	3.9
RB	1.68	0.25	0.08	0.02	0.24			0.005	5.6
	1.76	0.15	0.08	0.01	0.23			0.003	3.2
	1.84	0.11	0.08	0.01	0.2			0.002	2.0
	1.92	0.11	0.08	0.01	0.18			0.002	1.8
	2.00	0.11	0.08	0.01	0.17			0.002	2.2
	2.12	0.00	0.12	0.01	0			0.000	0.0
Total Q								**0.0862**	**100.0**

General Notes
Gradiant = 2%

Appendix 2-13. Manual Discharge Measurements and Levelling Surveys at REFC-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFC-H1			
Stream Name	Reference Lake C outflow			
Date Monitored	11-Jun-12			
Time at Site (24 hr)	**Start Time:**	10:00:00 AM	**End Time:**	4:30:00 PM
Personnel	Eli H., Coby H.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	396495	7335612	237	
Weather Conditions				

Transducer Information			
PT Model	PT2X	**Serial #**	21221024
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	1	**Memory Free**	524139 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 68	1.172	101.172		100.000	
BM 69			1.486	99.686	
PT			2.544	98.628	
WL			1.829	**99.343**	
BM 70	1.222	101.102	1.292	99.880	
WL			1.755	**99.347**	
PT			2.470	98.632	
BM 69			1.415	99.687	
BM 68			1.102	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 69	99.687	99.687		Established June 11 2012
BM 70	99.880	99.880		Established June 11 2012
PT	98.630	98.630		Installed June 11 2012

Summary	
Stage (m)	99.345
Discharge (m^3/s)	0.249
Pressure Transducer Reading (m)	0.750
Pressure Transducer Elevation (m)	98.595

Discharge Measurement - Mid-Section Method (continued on following page)

Time (24 hr)	**Start**	12:17	**End**	15:02	**Location**	~75m Dowstream of station	
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000	
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2004405	
Stage (m)	**Start**	**Reading**	0.75	**Time**	12:17		
	End	**Reading**	0.748	**Time**	15:02		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	20.32	0.00	0.00	0.00	0			0.000	0.0
Grass	20.40	0.04	0.08	0.00	0.2			0.001	0.2
Grass	20.45	0.04	0.05	0.00	0.28			0.001	0.2
Grass	20.50	0.08	0.05	0.01	0.18			0.001	0.4
Grass	20.60	0.08	0.10	0.01	0.1			0.001	0.3
Grass	20.70	0.08	0.10	0.01	0.08			0.001	0.3
Grass	20.80	0.06	0.10	0.00	-0.01			0.000	0.0
Island RB	20.85	0.00	0.05	0.00	0			0.000	0.0
Island LB	22.60	0.00	1.75	0.00	0			0.000	0.0
	22.67	0.04	0.07	0.00	0.19			0.001	0.2
	22.75	0.04	0.08	0.00	0.32			0.001	0.5
	22.85	0.10	0.10	0.01	0.15			0.001	0.6
	22.95	0.07	0.10	0.01	0.38			0.003	1.1
	23.05	0.08	0.10	0.01	0.56			0.004	1.8
	23.15	0.15	0.10	0.02	0.29			0.004	1.7
	23.25	0.16	0.10	0.02	0.54			0.009	3.5
	23.35	0.15	0.10	0.02	0.45			0.007	2.7
On rock	23.45	0.08	0.10	0.01	0.78			0.006	2.5
On rock	23.55	0.05	0.10	0.01	0.45			0.002	0.9
	23.65	0.05	0.10	0.01	0.19			0.001	0.4
	23.75	0.06	0.10	0.01	0			0.000	0.0
Island RB	23.92	0.00	0.17	0.01	0			0.000	0.0
Island LB	25.15	0.00	1.23	0.00	0			0.000	0.0
	25.24	0.03	0.09	0.00	0.13			0.000	0.1
	25.30	0.05	0.06	0.00	0.13			0.001	0.2
	25.40	0.04	0.10	0.00	0.12			0.000	0.2
	25.50	0.04	0.10	0.00	0.19			0.001	0.3
	25.60	0.06	0.10	0.00	0.29			0.000	0.0
continued									

General Notes

WL location of rod may have changed slightly. PT difficult to get exact location on conduit, use average.

Appendix 2-13. Manual Discharge Measurements and Levelling Surveys at REFC-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFC-H1			
Stream Name	Reference Lake C outflow			
Date Monitored	11-Jun-12			
Time at Site (24 hr)	Start Time:	10:00:00 AM	End Time:	4:30:00 PM
Personnel	Eli H., Coby H.			
Station Cordinates	Easting	Northing	Elevation	
	396495	7335612	237	
Weather Conditions				

Transducer Information			
PT Model	PT2X	Serial #	21221024
Gain	N/A	Offset	N/A
Status	Active	Battery	100%
# of Records	1	Memory Free	524139 readings
Date Serviced		Crest Gauges	N/A

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes	

Summary	
Stage (m)	
Discharge (m^3/s)	
Pressure Transducer Reading (m)	
Pressure Transducer Elevation (m)	

Discharge Measurement - Mid-Section Method (Continued)							
Time (24 hr)	Start	12:17	End	15:02	Location	~75m Dowstream of station	
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000	
Flow Meter Type	Flo-Mate			Instrument Serial #		2004405	
Stage (m)	Start	Reading	0.75	Time	12:17		
	End	Reading	0.748	Time	15:02		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
	25.70	0.07	0.10	0.01	0.33			0.002	0.9
	25.80	0.07	0.10	0.01	0.17			0.001	0.5
	25.90	0.10	0.10	0.01	0.04			0.000	0.2
Island RB	26.00	0.00	0.10	0.01	0			0.000	0.0
Island LB	27.30	0.00	1.30	0.00	0			0.000	0.0
Grass	27.40	0.03	0.10	0.01	0.14			0.001	0.3
	27.65	0.04	0.25	0.01	0.02			0.000	0.1
	27.75	0.24	0.10	0.03	0.09			0.003	1.1
	27.90	0.21	0.15	0.03	0.2			0.006	2.5
	28.05	0.23	0.15	0.03	0.1			0.003	1.4
	28.20	0.32	0.15	0.05	0.09			0.004	1.7
	28.35	0.35	0.15	0.05	0.34			0.018	7.2
	28.50	0.23	0.15	0.03	0.33			0.011	4.6
	28.65	0.17	0.15	0.03	0.24			0.006	2.5
	28.80	0.32	0.15	0.05	0.16			0.008	3.1
	28.95	0.23	0.15	0.03	0.1			0.003	1.4
	29.10	0.09	0.15	0.01	0.29			0.003	1.3
	29.20	0.04	0.10	0.00	0.2			0.001	0.2
Rock RE	29.24	0.00	0.04	0.00	0			0.000	0.0
Rock LE	29.65	0.00	0.41	0.00	0			0.000	0.0
	29.70	0.08	0.05	0.01	0.06			0.000	0.1
	29.80	0.08	0.10	0.01	0.03			0.000	0.1
Island RB	29.95	0.00	0.15	0.01	0			0.000	0.0
Island LB	31.50	0.00	1.55	0.00	0			0.000	0.0
	31.60	0.06	0.10	0.01	0.05			0.000	0.2
	31.80	0.17	0.20	0.03	0.13			0.003	1.3
	31.90	0.20	0.10	0.02	0.17			0.003	1.4
	32.00	0.22	0.10	0.00	0.17			0.000	0.0
continued									

General Notes

Appendix 2-13. Manual Discharge Measurements and Levelling Surveys at REFC-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFC-H1			
Stream Name	Reference Lake C outflow			
Date Monitored	11-Jun-12			
Time at Site (24 hr)	Start Time:	10:00:00 AM	End Time:	4:30:00 PM
Personnel	Eli H., Coby H.			
Station Cordinates	Easting	Northing	Elevation	
	396495	7335612	237	
Weather Conditions				

Transducer Information			
PT Model	PT2X	Serial #	21221024
Gain	N/A	Offset	N/A
Status	Active	Battery	100%
# of Records	1	Memory Free	524139 readings
Date Serviced		Crest Gauges	N/A

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes

Summary	
Stage (m)	
Discharge (m^3/s)	
Pressure Transducer Reading (m)	
Pressure Transducer Elevation (m)	

Discharge Measurement - Mid-Section Method (completed)										
Time (24 hr)	Start	12:17	End	15:02	Location	~75m Dowstream of station				
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2004405				
Stage (m)	Start	Reading	0.75	Time	12:17					
	End	Reading	0.748	Time	15:02					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
	32.10	0.24	0.10	0.04	0.18			0.006	2.6
	32.20	0.21	0.10	0.02	0.21			0.004	1.8
	32.30	0.32	0.20	0.02	0.09			0.002	0.9
	32.35	0.10	0.05	0.01	0.23			0.001	0.5
Island RB	32.40	0.00	0.05	0.00	0			0.000	0.0
Island LB	38.45	0.00	6.05	0.00	0			0.000	0.0
	38.55	0.05	0.10	0.01	0.22			0.002	0.7
	38.75	0.07	0.20	0.01	0.19			0.003	1.1
	38.95	0.08	0.20	0.02	0.12			0.003	1.1
	39.30	0.25	0.55	0.04	0.25			0.011	4.4
	39.30	0.19	0.35	0.00	0.21			0.001	0.2
Rock RE	39.33	0.00	0.03	0.00	0			0.000	0.0
Rock LE	39.80	0.00	0.47	0.00	0			0.000	0.0
	39.85	0.12	0.05	0.02	0.33			0.005	2.0
	40.05	0.15	0.20	0.03	0.35			0.011	4.2
	40.25	0.16	0.20	0.03	0.29			0.009	3.7
	40.45	0.09	0.20	0.02	0.31			0.006	2.2
	40.65	0.16	0.20	0.03	0.17			0.005	2.2
	40.85	0.20	0.20	0.04	0.39			0.016	6.3
	41.05	0.20	0.20	0.04	0.51			0.020	8.2
	41.25	0.18	0.20	0.04	0.38			0.014	5.5
	41.45	0.20	0.20	0.03	0.16			0.005	1.9
	41.55	0.18	0.10	0.01	0.07			0.001	0.4
LB	41.60	0.00	0.05	0.00	0			0.000	0.0
Total Q								0.249	100.000

General Notes

Appendix 2-13. Manual Discharge Measurements and Levelling Surveys at REFC-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFC-H1			
Stream Name	Reference Lake C outflow			
Date Monitored	15-Jun-12			
Time at Site (24 hr)	**Start Time:**	9:10:00 AM	**End Time:**	11:50:00 AM
Personnel	Eli H., Coby H.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	396495	7335612	237	
Weather Conditions				

Transducer Information			
PT Model	PT2X	**Serial #**	21221024
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	558	**Memory Free**	523581 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 68	1.223	101.223		100.000	
BM 69			1.536	99.687	
PT			2.600	98.623	
WL			1.914	**99.309**	
BM 70	1.291	101.170	1.344	99.879	
WL			1.860	**99.310**	
PT			2.549	98.621	
BM 69			1.484	99.686	
BM 68			1.170	100.000	
BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**		**Difference (m)**	**Notes**
BM 69	99.687	99.687		0.000	
BM 70	99.880	99.879		-0.001	
PT	98.630	98.622		-0.008	

Summary	
Stage (m)	99.310
Discharge (m^3/s)	0.143
Pressure Transducer Reading (m)	0.716
Pressure Transducer Elevation (m)	98.594

Discharge Measurement - Mid-Section Method (continued on following page)										
Time (24 hr)	**Start**	12:17	**End**	15:02	**Location**	~75m Dowstream of station				
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2004405				
Stage (m)	**Start**	**Reading**	0.75	**Time**	12:17					
	End	**Reading**	0.748	**Time**	15:02					

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	21.80	0.00	0.00	0.00	0			0.000	0.0
Grass	21.90	0.09	0.10	0.01	-0.01			0.000	-0.1
	22.10	0.17	0.20	0.03	0.03			0.001	0.7
	22.30	0.16	0.20	0.03	0.02			0.001	0.4
	22.50	0.14	0.20	0.03	0.07			0.002	1.4
	22.70	0.14	0.20	0.03	0.1			0.003	2.0
Behind shrubs	22.90	0.13	0.20	0.02	-0.02			0.000	-0.3
	23.01	0.11	0.11	0.02	0.03			0.001	0.5
	23.30	0.12	0.29	0.03	0.03			0.001	0.6
	23.50	0.14	0.20	0.03	0.03			0.001	0.6
	23.70	0.19	0.20	0.04	0.06			0.002	1.6
	23.90	0.08	0.20	0.02	0.17			0.003	1.9
	24.10	0.26	0.20	0.05	0.08			0.004	2.9
	24.30	0.38	0.20	0.08	0.07			0.005	3.7
	24.50	0.30	0.20	0.06	0.07			0.004	2.9
	24.70	0.31	0.20	0.06	0.05			0.003	2.2
	24.90	0.22	0.20	0.04	0.01			0.000	0.3
	25.05	0.14	0.15	0.02	0			0.000	0.0
Island RE	25.12	0.00	0.07	0.00	0			0.000	0.0
Island LE	27.00	0.00	1.88	0.01	0			0.000	0.0
	27.10	0.10	0.10	0.02	0.19			0.003	2.0
	27.30	0.14	0.20	0.03	0.22			0.006	4.3
	27.50	0.18	0.20	0.04	0.18			0.006	4.5
	27.70	0.19	0.20	0.04	0.22			0.008	5.8
	27.90	0.10	0.20	0.02	0.37			0.006	3.9
	28.00	0.10	0.10	0.01	0.2			0.002	1.4
	28.10	0.17	0.10	0.01	0.19			0.002	1.7
	28.15	0.04	0.05	0.00	0.38			0.000	0.0
continued									

General Notes
Gradiant= 2%

Appendix 2-13. Manual Discharge Measurements and Levelling Surveys at REFC-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFC-H1			
Stream Name	Reference Lake C outflow			
Date Monitored	15-Jun-12			
Time at Site (24 hr)	Start Time:	9:10:00 AM	End Time:	11:50:00 AM
Personnel	Eli H., Coby H.			
Station Cordinates	Easting	Northing	Elevation	
	396495	7335612	237	
Weather Conditions				

Transducer Information			
PT Model	PT2X	Serial #	21221024
Gain	N/A	Offset	N/A
Status	Active	Battery	100%
# of Records	558	Memory Free	523581 readings
Date Serviced		Crest Gauges	N/A

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM#	Established Elevation (m)	Mean Elevation (this date) (m)		Difference (m)	Notes

Summary	
Stage (m)	
Discharge (m^3/s)	
Pressure Transducer Reading (m)	
Pressure Transducer Elevation (m)	

Discharge Measurement - Mid-Section Method (completed)									
Time (24 hr)	Start	12:17	End	15:02	Location	~75m Dowstream of station			
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			Instrument Serial #		2004405			
Stage (m)	Start	Reading	0.75	Time	12:17				
	End	Reading	0.748	Time	15:02				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
Island RE	28.20	0.00	0.05	0.00	0			0.000	0.0
Island LE	32.20	0.00	4.00	0.01	0			0.000	0.0
	32.30	0.24	0.10	0.02	0.08			0.001	1.0
	32.35	0.23	0.05	0.01	0.08			0.001	0.6
	32.40	0.23	0.05	0.01	0.01			0.000	0.1
	32.45	0.21	0.05	0.02	-0.01			0.000	-0.1
Island RE	32.55	0.00	0.10	0.01	0			0.000	0.0
Island LE	38.75	0.00	6.20	0.02	0			0.000	0.0
	38.95	0.20	0.20	0.04	0.23			0.008	5.6
	39.10	0.15	0.15	0.02	0.34			0.008	5.3
	39.25	0.05	0.15	0.01	0.2			0.001	1.0
	39.40	0.06	0.15	0.01	0.26			0.002	1.6
	39.55	0.14	0.15	0.02	0.19			0.004	2.8
	39.70	0.12	0.15	0.02	0.38			0.007	4.8
	39.85	0.11	0.15	0.02	0.41			0.007	4.7
	40.00	0.16	0.15	0.02	0.32			0.008	5.4
	40.15	0.18	0.15	0.03	0.25			0.007	4.7
	40.30	0.12	0.15	0.02	0.05			0.001	0.6
	40.45	0.18	0.15	0.03	0.21			0.006	4.0
	40.60	0.04	0.15	0.01	0.22			0.002	1.1
	40.80	0.10	0.20	0.02	0.37			0.006	4.5
	40.95	0.06	0.15	0.01	0.31			0.003	1.9
Behind rock	41.10	0.16	0.15	0.02	-0.03			-0.001	-0.5
	41.25	0.20	0.15	0.03	0.2			0.006	4.2
	41.40	0.10	0.15	0.01	0.16			0.002	1.4
	41.50	0.16	0.10	0.02	0.03			0.000	0.3
LB	41.60	0.00	0.10	0.01	0			0.000	0.0
Total Q								**0.143**	**100.000**

General Notes

Appendix 2-13. Manual Discharge Measurements and Levelling Surveys at REFC-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFC-H1			
Stream Name	Reference Lake C outflow			
Date Monitored	10-Jul-12			
Time at Site (24 hr)	**Start Time:**	12:30:00 PM	**End Time:**	5:30:00 PM
Personnel	Eli H., Ryan K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	396495	7335612	237	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PT2X	**Serial #**	21221024
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	3.0V
# of Records	4177	**Memory Free**	519962 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 68	1.242	101.242		100.000	
BM 69			1.538	99.704	
BM 70			1.343	99.899	
PT			2.638	98.604	error
WL			2.029	**99.213**	
TBM	2.282	101.178	2.346	98.896	
WL			1.963	**99.215**	
PT			2.568	98.610	checked, ok
BM 70			1.281	99.897	
BM 69			1.477	99.701	
BM 68			1.181	99.997	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 69	99.687	99.703	0.016	
BM 70	99.880	99.898	0.018	
PT	98.630	98.610	-0.020	

Summary	
Stage (m)	99.214
Discharge (m^3/s)	0.0447
Pressure Transducer Reading (m)	0.643
Pressure Transducer Elevation (m)	98.571

Discharge Measurement - Mid-Section Method (continued on following page)

Time (24 hr)	**Start**	13:43	**End**	14:56	**Location**	~75m Dowstream of station	
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000	
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2007612	
Stage (m)	**Start**	**Reading**	0.645	**Time**	13:43		
	End	**Reading**	0.644	**Time**	14:56		

	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
RB	1.50	0.00	0.00	0.00	0.00	0		0.000	0.0
eddie	1.75	0.10	0.03	0.25	0.01	-0.03		0.000	-0.3
	1.83	0.15	0.05	0.08	0.00	0.05		0.000	0.4
	1.89	0.17	0.05	0.06	0.00	0.1		0.000	0.7
	1.95	0.23	0.07	0.06	0.01	0.14		0.001	1.8
behind rock	2.05	0.23	0.07	0.10	0.01	-0.03		0.000	-0.4
	2.10	0.20	0.06	0.05	0.00	-0.03		0.000	-0.3
	2.20	0.30	0.09	0.10	0.01	0.28		0.002	4.3
	2.25	0.25	0.08	0.05	0.00	0.09		0.000	0.8
	2.30	0.30	0.09	0.05	0.00	0.18		0.001	1.8
	2.35	0.30	0.09	0.05	0.00	0.19		0.001	1.9
	2.40	0.30	0.09	0.05	0.00	0.18		0.001	1.8
	2.45	0.25	0.08	0.05	0.00	0.37		0.001	3.2
	2.50	0.24	0.07	0.05	0.00	0.3		0.001	2.5
	2.55	0.20	0.06	0.05	0.00	0.23		0.001	1.6
	2.60	0.15	0.05	0.05	0.00	0.2		0.001	1.1
	2.66	0.10	0.03	0.06	0.00	0.15		0.000	0.7
island RB	2.73	0.00	0.00	0.07	0.00	0		0.000	0.0
Island LB	7.95	0.00	0.00	5.22	0.00	0		0.000	0.0
behind rock	8.00	0.34	0.10	0.05	0.00	-0.02		0.000	-0.1
	8.10	0.10	0.03	0.10	0.00	0.04		0.000	0.2
	8.15	0.10	0.03	0.05	0.00	0.09		0.000	0.8
	8.35	0.60	0.18	0.20	0.02	0.09		0.002	4.6
	8.40	0.49	0.15	0.05	0.01	0.12		0.001	2.0
	8.45	0.45	0.14	0.05	0.01	0.1		0.001	1.5
	8.50	0.35	0.11	0.05	0.01	0.24		0.001	2.9
	8.55	0.15	0.05	0.05	0.00	0.16		0.001	1.2
	8.65	0.15	0.05	0.10	0.00	0.02		0.000	0.0
continued									

General Notes

Gradiant= 1.5%. Gradiant= 2%. Depth values converted from ft. to m (1ft. = 0.3048m).

Appendix 2-13. Manual Discharge Measurements and Levelling Surveys at REFC-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFC-H1			
Stream Name	Reference Lake C outflow			
Date Monitored	10-Jul-12			
Time at Site (24 hr)	Start Time:	12:30:00 PM	End Time:	5:30:00 PM
Personnel	Eli H., Ryan K.			
Station Cordinates	Easting	Northing	Elevation	
	396495	7335612	237	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PT2X	Serial #	21221024
Gain	N/A	Offset	N/A
Status	Active	Battery	3.0V
# of Records	4177	Memory Free	519962 readings
Date Serviced		Crest Gauges	N/A

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM#	Established Elevation (m)	Mean Elevation (this date) (m)		Difference (m)	Notes

Summary	
Discharge (m^3/s)	
Pressure Transducer Reading (m)	
Pressure Transducer Elevation (m)	

Discharge Measurement - Mid-Section Method (completed)										
Time (24 hr)	Start	13:43	End	14:56	Location	~75m Dowstream of station				
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2007612				
Stage (m)	Start	Reading	0.645	Time	13:43					
	End	Reading	0.644	Time	14:56					

	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
	8.75	0.30	0.09	0.10	0.00	0.08		0.000	0.4
	8.80	0.63	0.19	0.05	0.00	0.29		0.001	3.0
	8.85	0.60	0.18	0.05	0.01	0.33		0.003	6.8
	8.90	0.54	0.16	0.05	0.01	0.22		0.003	5.7
	8.99	0.54	0.16	0.09	0.01	0.12		0.001	2.7
rock	9.02	0.00	0.00	0.03	0.00	0		0.000	0.0
rock	9.30	0.00	0.00	0.28	0.00	0		0.000	0.0
	9.34	0.32	0.10	0.04	0.00	0.23		0.000	0.0
Island RB	9.39	0.00	0.00	0.05	0.00	0		0.000	0.0
Island LB	19.03	0.00	0.00	9.64	0.00	0		0.000	0.0
	19.10	0.30	0.09	0.07	0.01	0.24		0.001	2.9
	19.15	0.55	0.17	0.05	0.01	0.29		0.004	8.2
	19.25	0.69	0.21	0.10	0.02	0.11		0.002	5.2
	19.35	0.67	0.20	0.10	0.02	0.09		0.002	4.1
	19.45	0.49	0.15	0.10	0.01	0.2		0.003	6.7
	19.55	0.40	0.12	0.10	0.01	0.27		0.003	7.4
	19.65	0.41	0.12	0.10	0.01	0.11		0.001	3.1
	19.75	0.41	0.12	0.10	0.01	0.1		0.001	2.8
	19.85	0.41	0.12	0.10	0.01	0.07		0.001	2.0
	19.95	0.45	0.14	0.10	0.01	0.08		0.001	2.5
	20.05	0.39	0.12	0.10	0.01	0.07		0.001	2.3
	20.20	0.15	0.05	0.15	0.01	-0.01		0.000	-0.2
LB	20.35	0.00	0.00	0.15	0.00	0		0.000	0.0
Total Q								0.0447	100.000

General Notes

Appendix 2-13. Manual Discharge Measurements and Levelling Surveys at REFC-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFC-H1			
Stream Name	Reference Lake C outflow			
Date Monitored	12-Aug-12			
Time at Site (24 hr)	Start Time:	9:30:00 AM	End Time:	10:35:00 AM
Personnel	Eli H., Cenling X.			
Station Cordinates	Easting	Northing	Elevation	
	396495	7335612	237	
Weather Conditions	Cloudy, drizzle			

Transducer Information			
PT Model	PT2X	Serial #	21221024
Gain	N/A	Offset	N/A
Status	Active	Battery	3.0V
# of Records	8912	Memory Free	515227 readings
Date Serviced		Crest Gauges	N/A

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 68	1.430	101.430		100.000	
BM 69			1.728	99.702	
BM 70			1.532	99.898	
PT			2.870	98.560	
WL			2.326	**99.104**	
TBM	2.398	101.428	2.400	99.030	
WL			2.325	**99.103**	
PT			2.870	98.558	
BM 70			1.529	99.899	
BM 69			1.727	99.701	
BM 68			1.429	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 69	99.687	99.702	0.015	
BM 70	99.880	99.899	0.019	
PT	98.630	98.559	-0.071	

Summary	
Stage (m)	99.104
Discharge (m^3/s)	0.00207
Pressure Transducer Reading (m)	0.577
Pressure Transducer Elevation (m)	98.526

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	9:30	End	10:35	Location	~100m Dowstream of station			
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			Instrument Serial #		2007612			
Stage (m)	Start	Reading	0.576	Time	9:30	Much of flow is underground and difficult to measure.			
	End	Reading	0.577	Time	10:35				

	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
RB	2.27	0.00	0.00	0.00	0.00	0		0.000	0.0
	2.38	0.10	0.03	0.11	0.00	-0.01		0.000	-1.3
	2.45	0.10	0.03	0.07	0.00	0		0.000	0.0
	2.50	0.15	0.05	0.05	0.00	0		0.000	0.0
	2.55	0.17	0.05	0.05	0.00	0.01		0.000	1.3
	2.60	0.33	0.10	0.05	0.01	0.04		0.000	9.7
	2.65	0.36	0.11	0.05	0.01	0.04		0.000	10.6
	2.70	0.44	0.13	0.05	0.01	0.04		0.000	13.0
	2.75	0.44	0.13	0.05	0.01	0.04		0.000	13.0
	2.80	0.58	0.18	0.05	0.01	0.04		0.000	17.1
	2.85	0.50	0.15	0.05	0.01	0.04		0.000	14.8
	2.90	0.50	0.15	0.05	0.01	0.02		0.000	7.4
	2.95	0.40	0.12	0.05	0.01	0.01		0.000	3.0
	3.00	0.20	0.06	0.05	0.00	0.01		0.000	1.5
	3.05	0.30	0.09	0.05	0.00	0.02		0.000	4.4
	3.10	0.30	0.09	0.05	0.00	0.03		0.000	6.6
Behind Rock	3.15	0.19	0.06	0.05	0.00	0		0.000	0.0
Behind Rock	3.20	0.20	0.06	0.05	0.00	-0.01		0.000	-1.0
LB	3.22	0.00	0.00	0.02	0.00	0		0.000	0.0
Total Q								**0.00207**	**100.0**

General Notes
Gradiant= 1.5%. Gradiant= 2%. Depth values converted from ft. to m (1ft. = 0.3048m).

Appendix 2-13. Manual Discharge Measurements and Levelling Surveys at REFC-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFC-H1			
Stream Name	Reference Lake C outflow			
Date Monitored	11-Sep-12			
Time at Site (24 hr)	Start Time:	12:26:00 PM	End Time:	3:30:00 PM
Personnel	Eli H., Scott C.			
Station Cordinates	Easting	Northing	Elevation	
	396495	7335612	237	
Weather Conditions	Cloudy, cool			

Transducer Information			
PT Model	PT2X	Serial #	21221024
Gain	N/A	Offset	N/A
Status	Active	Battery	3.0V
# of Records	13249	Memory Free	510891
Date Serviced		Crest Gauges	N/A

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 68	1.269	101.269		100.000	
BM 69			1.567	99.702	
BM 70			1.371	99.898	
PT			2.720	98.549	
WL			2.220	**99.049**	
TBM	2.199	101.319	2.149	99.120	
WL			2.268	**99.051**	
PT			2.771	98.548	
BM 70			1.420	99.899	
BM 69			1.617	99.702	
BM 68			1.318	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 69	99.687	99.702	0.016	
BM 70	99.880	99.899	0.019	
PT	98.630	98.549	-0.081	

Summary	
Stage (m)	99.050
Discharge (m^3/s)	0.000388
Pressure Transducer Reading (m)	0.522
Pressure Transducer Elevation (m)	98.528

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	12:23	End	13:11	Location	~75m Dowstream of station				
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2007529				
Stage (m)	Start	Reading	0.522	Time	12:23	Much of flow is underground and difficult to measure.				
	End	Reading	0.522	Time	13:11					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	0.78	0.00	0.00	0.00	0			0.000	0.0
	0.80	0.01	0.02	0.00	0.01			0.000	0.8
	0.84	0.04	0.04	0.00	0.01			0.000	4.1
	0.88	0.02	0.04	0.00	0.01			0.000	2.1
	0.92	0.04	0.04	0.00	0.01			0.000	4.1
	0.96	0.03	0.04	0.00	0.01			0.000	3.1
	1.00	0.05	0.04	0.00	0.01			0.000	5.2
	1.04	0.14	0.04	0.00	0.01			0.000	10.8
	1.06	0.16	0.02	0.01	0.01			0.000	16.5
	1.12	0.07	0.06	0.00	0.01			0.000	9.0
	1.16	0.06	0.04	0.00	0.01			0.000	6.2
	1.20	0.08	0.04	0.00	0.01			0.000	8.2
	1.24	0.04	0.04	0.00	0.01			0.000	4.1
	1.28	0.07	0.04	0.00	0.01			0.000	7.2
	1.32	0.03	0.04	0.00	0.01			0.000	3.1
	1.36	0.06	0.04	0.00	0.01			0.000	6.2
	1.40	0.05	0.04	0.00	0.01			0.000	5.2
	1.44	0.01	0.04	0.00	0.01			0.000	1.0
	1.48	0.01	0.04	0.00	0.01			0.000	1.0
	1.52	0.02	0.04	0.00	0.01			0.000	2.1
	1.56	0.03	0.04	0.00	0			0.000	0.0
RB	1.60	0.00	0.04	0.00	0			0.000	0.0
Total Q								**0.00039**	**100.0**

General Notes
Gradiant= 1.5%

Appendix 2-14. Manual Discharge Measurements and Levelling Surveys at KL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	KL-H1			
Stream Name	Esker Pond outflow			
Date Monitored	10-Jun-12			
Time at Site (24 hr)	**Start Time:**	2:00:00 PM	**End Time:**	4:45:00 PM
Personnel				
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	390592	7309400	310	
Weather Conditions				

Transducer Information			
PT Model	PT2X	**Serial #**	21221019
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	1	**Memory Free**	524139 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 85	0.981	100.981		100.000	
BM 86			0.856	100.125	
PT			2.892	98.089	
WL			1.927	**99.054**	
BM 87	1.331	100.958	1.354	99.627	
WL			1.903	**99.055**	
PT			2.869	98.089	
BM 86			0.833	100.125	
BM 85			0.958	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 86	100.125	100.125		Established June 10 2012
BM 87	99.627	99.627		Established June 10 2012
PT	98.089	98.089		Installed June 10 2012

Summary	
Stage (m)	99.055
Discharge (m^3/s)	1.267
Pressure Transducer Reading (m)	0.984
Pressure Transducer Elevation (m)	98.071

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	14:48	**End**	15:58	**Location**	12m Dowstream of PT, just above riffle			
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2004405			
Stage (m)	**Start**	**Reading**	0.983	**Time**	14:48				
	End	**Reading**	0.984	**Time**	15:58				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.60	0.00	0.00	0.00	0			0.000	0.0
Grass	0.65	0.08	0.05	0.01	0.12			0.001	0.1
Grass	0.80	0.14	0.15	0.01	0.44			0.006	0.4
Grass/Undercut	0.83	0.39	0.03	0.03	0.09			0.003	0.2
	0.95	0.36	0.12	0.05	0.75			0.036	2.9
	1.10	0.44	0.15	0.07	0.88			0.058	4.6
	1.25	0.45	0.15	0.07	0.82			0.055	4.4
	1.40	0.49	0.15	0.07	0.87			0.064	5.0
	1.55	0.49	0.15	0.07	0.94			0.069	5.5
	1.70	0.49	0.15	0.07	0.83			0.061	4.8
	1.85	0.58	0.15	0.09	0.84			0.073	5.8
	2.00	0.64	0.15	0.09	0.96			0.083	6.5
	2.12	0.65	0.12	0.08	1			0.078	6.2
	2.24	0.64	0.12	0.08	0.96			0.074	5.8
	2.36	0.60	0.12	0.07	1.04			0.075	5.9
	2.48	0.63	0.12	0.07	1.15			0.083	6.5
	2.60	0.65	0.12	0.08	1.05			0.079	6.3
	2.72	0.67	0.12	0.08	1.14			0.093	7.3
	2.85	0.56	0.13	0.09	1.24			0.108	8.5
	2.98	0.68	0.13	0.05	0.94			0.050	3.9
Grass	3.04	0.22	0.06	0.07	1			0.075	5.9
Grass	3.20	0.15	0.16	0.03	0.61			0.021	1.6
Grass	3.35	0.12	0.15	0.02	0.52			0.012	0.9
Grass	3.50	0.08	0.15	0.02	0.31			0.006	0.4
Grass	3.65	0.06	0.15	0.01	0.37			0.004	0.4
Grass	3.80	0.05	0.15	0.01	0.14			0.001	0.1
Grass	3.95	0.05	0.15	0.01	0.03			0.000	0.0
LB	4.05	0	0.10	0.00	0			0.000	0.0
Total Q								**1.267**	**100.0**

General Notes

Appendix 2-14. Manual Discharge Measurements and Levelling Surveys at KL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	KL-H1			
Stream Name	Esker Pond outflow			
Date Monitored	15-Jun-12			
Time at Site (24 hr)	**Start Time:**	2:33:00 PM	**End Time:**	4:30:00 PM
Personnel	Eli H., Coby H.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	390592	7309400	310	
Weather Conditions				

Transducer Information			
PT Model	PT2X	**Serial #**	21221019
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	717	**Memory Free**	523422 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 85	1.008	101.008		100.000	
BM 86			0.884	100.124	
PT			2.921	98.087	
WL			2.066	**98.942**	
BM 87	1.369	100.997	1.380	99.628	
WL			2.054	**98.943**	
PT			2.908	98.089	
BM 86			0.870	100.127	
BM 85			0.997	100.000	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 86	100.125	100.126	0.000	
BM 87	99.627	99.628	0.001	
PT	98.089	98.088	-0.001	

Summary	
Stage (m)	98.943
Discharge (m^3/s)	0.719
Pressure Transducer Reading (m)	0.880
Pressure Transducer Elevation (m)	98.063

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	14:34	**End**	15:30	**Location**	20m Dowstream of PT, just above riffle			
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2004405			
Stage (m)	**Start**	**Reading**	0.882	**Time**	14:34				
	End	**Reading**	0.88	**Time**	15:30				

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	20.40	0.00	0.00	0.00	0			0.000	0.0
Grass	20.50	0.04	0.10	0.00	0.03			0.000	0.0
Grass	20.55	0.08	0.05	0.00	0.23			0.001	0.1
undercut	20.60	0.32	0.05	0.02	0.27			0.006	0.9
	20.70	0.35	0.10	0.03	0.55			0.019	2.7
	20.80	0.31	0.10	0.03	0.7			0.022	3.0
	20.90	0.36	0.10	0.04	0.62			0.022	3.1
	21.00	0.34	0.10	0.03	0.59			0.020	2.8
	21.10	0.31	0.10	0.03	0.66			0.020	2.8
	21.20	0.36	0.10	0.04	0.78			0.028	3.9
	21.30	0.40	0.10	0.04	0.71			0.028	3.9
	21.40	0.44	0.10	0.04	0.58			0.026	3.5
	21.50	0.44	0.10	0.04	0.58			0.026	3.5
	21.60	0.44	0.10	0.04	0.66			0.029	4.0
	21.70	0.48	0.10	0.05	0.72			0.035	4.8
	21.80	0.48	0.10	0.05	0.77			0.037	5.1
	21.90	0.51	0.10	0.05	0.79			0.040	5.6
	22.00	0.54	0.10	0.05	0.72			0.039	5.4
	22.10	0.46	0.10	0.05	0.84			0.039	5.4
	22.20	0.47	0.10	0.05	0.84			0.039	5.5
	22.30	0.48	0.10	0.05	0.89			0.043	5.9
	22.40	0.52	0.10	0.05	0.93			0.048	6.7
	22.50	0.51	0.10	0.05	0.93			0.047	6.6
	22.60	0.48	0.10	0.05	0.92			0.044	6.1
	22.70	0.45	0.10	0.03	0.91			0.031	4.3
	22.75	0.50	0.05	0.02	0.76			0.019	2.6
Grass	22.80	0.15	0.05	0.01	0.71			0.008	1.1
Grass	22.90	0.08	0.10	0.01	0.24			0.002	0.3
Grass	23.00	0.06	0.10	0.01	0.06			0.001	0.1
LB	23.20	0	0.20	0.01	0			0.000	0.0
Total Q								**0.719**	**100.0**

General Notes
gradiant = 2%

Appendix 2-14. Manual Discharge Measurements and Levelling Surveys at KL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	KL-H1			
Stream Name	Esker Pond outflow			
Date Monitored	11-Jul-12			
Time at Site (24 hr)	**Start Time:**	3:10:00 PM	**End Time:**	5:30:00 PM
Personnel	Eli H., Ryan K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	390592	7309400	310	
Weather Conditions	Mix of Sun and Cloud			

Transducer Information			
PT Model	PT2X	**Serial #**	21221019
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	4466	**Memory Free**	519673 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 85	1.331	101.331		100.000	
BM 86			1.204	100.127	
BM 87			1.707	99.624	
PT			3.243	98.088	
WL			2.582	**98.749**	
TBM	1.647	101.364	1.614	99.717	
WL			2.618	**98.746**	
PT			3.277	98.087	
BM 85			1.738	99.626	
BM 86			1.239	100.125	
BM 87			1.365	99.999	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 86	100.125	100.126	0.001	
BM 87	99.627	99.625	-0.002	
PT	98.089	98.088	-0.001	

Summary	
Stage (m)	98.748
Discharge (m^3/s)	0.284
Pressure Transducer Reading (m)	0.682
Pressure Transducer Elevation (m)	98.066

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	15:15	**End**	15:57	**Location**	10m Dowstream of PT			
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2007612			
Stage (m)	**Start**	**Reading**	0.682	**Time**	15:15				
	End	**Reading**	0.682	**Time**	15:57				

	Station	**Depth**		**Distance**	**Area**	**Velocity @60%**	**Cal. Velocity**	**Q**	**% of Total Q**
Notes	**(m)**	**(ft)**	**(m)**	**(m)**	**(m^2)**	**(m/s)**	**(m/s)**	**(m^3/s)**	**%**
RB	0.27	0.00	0.00	0.00	0.00	0		0.000	0.0
Grass	0.36	0.15	0.05	0.09	0.00	0		0.000	0.0
Grass	0.42	0.31	0.09	0.06	0.01	-0.01		0.000	0.0
Grass	0.50	0.64	0.20	0.08	0.01	0.12		0.001	0.5
	0.53	1.53	0.47	0.03	0.02	0.05		0.001	0.4
	0.60	1.65	0.50	0.07	0.04	0.12		0.005	1.8
	0.70	1.70	0.52	0.10	0.05	0.31		0.016	5.7
	0.80	1.70	0.52	0.10	0.05	0.32		0.017	5.8
	0.90	1.63	0.50	0.10	0.05	0.32		0.016	5.6
	1.00	1.60	0.49	0.10	0.05	0.3		0.015	5.2
	1.10	1.60	0.49	0.10	0.05	0.31		0.015	5.3
	1.20	1.59	0.48	0.10	0.05	0.28		0.014	4.8
	1.30	1.58	0.48	0.10	0.05	0.27		0.013	4.6
	1.40	1.53	0.47	0.10	0.05	0.27		0.013	4.4
	1.50	1.53	0.47	0.10	0.05	0.31		0.014	5.1
	1.60	1.50	0.46	0.10	0.05	0.3		0.014	4.8
	1.70	1.40	0.43	0.10	0.04	0.3		0.013	4.5
	1.80	1.43	0.44	0.10	0.04	0.28		0.012	4.3
	1.90	1.35	0.41	0.10	0.04	0.3		0.012	4.3
	2.00	1.29	0.39	0.10	0.04	0.29		0.011	4.0
	2.10	1.25	0.38	0.10	0.04	0.31		0.012	4.2
	2.20	1.22	0.37	0.10	0.04	0.3		0.011	3.9
	2.30	1.21	0.37	0.10	0.04	0.29		0.011	3.8
	2.40	1.22	0.37	0.10	0.04	0.3		0.011	3.9
	2.50	1.28	0.39	0.10	0.04	0.31		0.012	4.3
	2.60	1.32	0.40	0.10	0.04	0.28		0.011	4.0
	2.70	1.30	0.40	0.10	0.03	0.27		0.009	3.2
	2.77	1.10	0.34	0.07	0.02	0.23		0.005	1.6
Grass	2.82	0.20	0.06	0.05	0.00	0.03		0.000	0.0
LB	2.87	0.00	0	0.05	0.00	0		0.000	0.0
Total Q								**0.284**	**100.0**

General Notes
gradiant = 1%. Imperial Rod used. Depth values converted from ft. to m (1ft. = 0.3048m)

Appendix 2-14. Manual Discharge Measurements and Levelling Surveys at KL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	KL-H1			
Stream Name	Esker Pond outflow			
Date Monitored	12-Aug-12			
Time at Site (24 hr)	Start Time:	12:10:00 PM	End Time:	2:00:00 PM
Personnel	Eli H., Ryan K.			
Station Cordinates	Easting	Northing	Elevation	
	390592	7309400	310	
Weather Conditions	Cloudy, cool			

Transducer Information			
PT Model	PT2X	Serial #	21221019
Gain	N/A	Offset	N/A
Status	Active	Battery	100%
# of Records	9056	Memory Free	515083
Date Serviced		Crest Gauges	N/A

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 85	0.842	100.842		100.000	
BM 86			0.715	100.127	
BM 87			1.215	99.627	
PT			2.760	98.082	
WL			2.232	**98.610**	
TBM	2.079	100.769	2.152	98.690	
WL			2.156	**98.613**	
PT			2.689	98.080	
BM 85			1.143	99.626	
BM 86			0.642	100.127	
BM 87			0.771	99.998	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 86	100.125	100.127	0.002	
BM 87	99.627	99.627	-0.001	
PT	98.089	98.081	-0.008	

Summary	
Stage (m)	98.612
Discharge (m^3/s)	0.06040
Pressure Transducer Reading (m)	0.555
Pressure Transducer Elevation (m)	98.057

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	12:30	End	13:20	Location	10m Dowstream of PT			
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			Instrument Serial #		2006042			
Stage (m)	Start	Reading	0.554	Time	12:30				
	End	Reading	0.555	Time	13:20				

	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
RB	0.24	0.00	0.00	0.00	0.00	0		0.000	0.0
	0.33	0.10	0.03	0.09	0.00	0.01		0.000	0.0
	0.35	1.00	0.30	0.02	0.02	0.02		0.000	0.6
	0.45	1.19	0.36	0.10	0.04	0.05		0.002	3.0
	0.55	1.29	0.39	0.10	0.04	0.1		0.004	6.5
	0.65	1.35	0.41	0.10	0.04	0.13		0.005	8.9
	0.75	1.34	0.41	0.10	0.04	0.13		0.005	8.8
	0.85	1.27	0.39	0.10	0.04	0.12		0.005	7.7
	0.95	1.27	0.39	0.10	0.04	0.09		0.003	5.8
	1.05	1.27	0.39	0.10	0.04	0.05		0.002	3.2
	1.15	1.23	0.37	0.10	0.04	0.07		0.003	4.3
	1.25	1.32	0.40	0.10	0.04	0.09		0.004	6.0
	1.35	1.30	0.40	0.10	0.04	0.1		0.004	6.6
	1.45	1.17	0.36	0.10	0.04	0.08		0.003	4.7
	1.55	1.22	0.37	0.10	0.04	0.03		0.001	1.8
	1.65	1.10	0.34	0.10	0.03	0.04		0.001	2.2
	1.75	0.97	0.30	0.10	0.03	0.03		0.001	1.5
	1.85	0.94	0.29	0.10	0.03	0.04		0.001	1.9
	1.95	0.91	0.28	0.10	0.03	0.08		0.002	3.7
	2.05	0.90	0.27	0.10	0.03	0.07		0.002	3.2
	2.15	0.89	0.27	0.10	0.03	0.07		0.002	3.1
	2.25	0.95	0.29	0.10	0.03	0.08		0.002	3.8
	2.35	0.95	0.29	0.10	0.03	0.11		0.003	5.3
	2.45	0.95	0.29	0.10	0.03	0.11		0.003	5.3
	2.55	0.93	0.28	0.10	0.02	0.06		0.001	2.3
	2.61	0.71	0.22	0.06	0.01	-0.01		0.000	-0.1
LB	2.63	0.00	0.00	0.02	0.00	0		0.000	0.0
Total Q								**0.0604**	**100.0**

General Notes

gradiant = 1%. Imperial Rod used. Depth values converted from ft. to m (1ft. = 0.3048m)

Appendix 2-14. Manual Discharge Measurements and Levelling Surveys at KL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	KL-H1			
Stream Name	Esker Pond outflow			
Date Monitored	12-Sep-12			
Time at Site (24 hr)	Start Time:	10:35:00 AM	End Time:	12:45:00 PM
Personnel	Eli H., Scott C.			
Station Cordinates	Easting	Northing	Elevation	
	390592	7309400	310	
Weather Conditions	Cloudy, light snow			

Transducer Information			
PT Model	PT2X	Serial #	21221019
Gain	N/A	Offset	N/A
Status	Active	Battery	100%
# of Records	13510	Memory Free	510629
Date Serviced		Crest Gauges	N/A

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 85	0.817	100.817		100.000	
BM 86			0.690	100.127	
BM 87			1.191	99.626	
PT			2.754	98.063	
WL			2.128	**98.689**	
TBM	2.611	100.755	2.673	98.144	
WL			2.068	**98.687**	
PT			2.693	98.062	
BM 85			1.128	99.627	
BM 86			0.628	100.127	
BM 87			0.755	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 86	100.125	100.127	0.002	
BM 87	99.627	99.627	-0.001	
PT	98.089	98.063	-0.026	

Summary	
Stage (m)	98.688
Discharge (m^3/s)	0.132
Pressure Transducer Reading (m)	0.646
Pressure Transducer Elevation (m)	98.042

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	10:32	End	11:29	Location	7m Dowstream of PT				
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2007529				
Stage (m)	Start	Reading	0.645	Time	12:30					
	End	Reading	0.646	Time	13:20					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.30	0.00	0.00	0.00	0			0.000	0.0
	0.35	0.08	0.05	0.01	0.01			0.000	0.0
	0.44	0.42	0.09	0.03	0.06			0.002	1.4
	0.50	0.47	0.06	0.04	0.1			0.004	2.9
	0.60	0.49	0.10	0.05	0.13			0.006	4.8
	0.70	0.49	0.10	0.05	0.15			0.007	5.6
	0.80	0.49	0.10	0.05	0.15			0.007	5.6
	0.90	0.48	0.10	0.05	0.15			0.007	5.5
	1.00	0.47	0.10	0.05	0.16			0.008	5.7
	1.10	0.46	0.10	0.05	0.12			0.006	4.2
	1.20	0.46	0.10	0.05	0.13			0.006	4.5
	1.30	0.48	0.10	0.05	0.14			0.007	5.1
	1.40	0.48	0.10	0.05	0.15			0.007	5.5
	1.50	0.46	0.10	0.05	0.15			0.007	5.2
	1.60	0.44	0.10	0.04	0.12			0.005	4.0
	1.70	0.42	0.10	0.04	0.13			0.005	4.1
	1.80	0.39	0.10	0.04	0.14			0.005	4.1
	1.90	0.36	0.10	0.04	0.15			0.005	4.1
	2.00	0.36	0.10	0.04	0.15			0.005	4.1
	2.10	0.35	0.10	0.04	0.16			0.006	4.2
	2.20	0.34	0.10	0.03	0.15			0.005	3.9
	2.30	0.36	0.10	0.04	0.14			0.005	3.8
	2.40	0.38	0.10	0.04	0.14			0.005	4.0
	2.50	0.38	0.10	0.04	0.14			0.005	4.0
	2.60	0.37	0.10	0.03	0.13			0.004	2.7
	2.65	0.35	0.05	0.01	0.09			0.001	0.8
LB	2.67	0.00	0.02	0.00	0			0.000	0.0
Total Q								**0.132**	**100.0**

General Notes

Appendix 2-15. Manual Discharge Measurements and Levelling Surveys at KL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	KL-H2			
Stream Name	George Lake Outflow			
Date Monitored	10-Jun-12			
Time at Site (24 hr)	**Start Time:**	11:00:00 AM	**End Time:**	1:50:00 PM
Personnel	Eli H., Coby H.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	386687	7314673	337	
Weather Conditions	Clear, cool			

Transducer Information			
PT Model	PT2X	**Serial #**	21221021
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	1	**Memory Free**	524138 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 73	1.484	101.484		100.000	
BM 74			1.636	99.848	
PT			2.420	99.064	
WL			1.849	**99.635**	
BM 78	0.690	101.422	0.752	100.732	
WL			1.786	**99.636**	
PT			2.358	99.064	
BM 74			1.575	99.847	
BM 73			1.421	100.001	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 74	99.848	99.848		Established June 10 2012
BM 78	100.732	100.732		Established June 10 2012
PT	99.064	99.064		Installed June 10 2012

Summary	
Stage (m)	99.636
Discharge (m^3/s)	0.497
Pressure Transducer Reading (m)	0.595
Pressure Transducer Elevation (m)	99.040

Discharge Measurement - Mid-Section Method										
Time (24 hr)	**Start**	11:57	**End**	13:00	**Location**	~15m Downstream of PT				
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2004405				
Stage (m)	**Start**	**Reading**	0.594	**Time**	11:57					
	End	**Reading**	0.595	**Time**	13:00					

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	21.40	0.00	0.00	0.01	0			0.000	0.0
	21.60	0.07	0.20	0.02	0.04			0.001	0.2
	21.95	0.07	0.35	0.02	0.22			0.005	0.9
	22.20	0.22	0.25	0.07	0.4			0.026	5.3
	22.55	0.36	0.35	0.13	0.47			0.059	11.9
	22.90	0.29	0.35	0.10	0.46			0.047	9.4
	23.25	0.34	0.35	0.12	0.53			0.063	12.7
	23.60	0.39	0.35	0.14	0.39			0.053	10.7
	23.95	0.27	0.35	0.09	0.55			0.052	10.5
	24.30	0.33	0.35	0.12	0.43			0.050	10.0
	24.65	0.32	0.35	0.11	0.27			0.030	6.1
	25.00	0.39	0.35	0.14	0.21			0.029	5.8
	25.35	0.33	0.35	0.12	0.17			0.020	4.0
	25.70	0.37	0.35	0.13	0.13			0.017	3.4
	26.05	0.46	0.35	0.16	0.1			0.016	3.2
	26.40	0.47	0.35	0.16	0.08			0.013	2.6
Deep Pool, low flow	26.75	0.49	0.35	0.17	0.06			0.010	2.1
Deep Pool, low flow	27.10	0.56	0.35	0.20	0.02			0.004	0.8
Deep Pool, low flow	27.45	0.56	0.35	0.22	0.01			0.002	0.5
Deep Pool, low flow	27.90	0.64	0.45	0.30	0			0.000	0.0
Deep Pool, low flow	28.40	0.49	0.50	0.31	0			0.000	0.0
LB	29.15	0.00	0.75	0.18	0			0.000	0.0
Total Q								**0.497**	**100.0**

General Notes
Gradiant= 2.5%

Appendix 2-15. Manual Discharge Measurements and Levelling Surveys at KL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	KL-H2			
Stream Name	George Lake Outflow			
Date Monitored	15-Jun-12			
Time at Site (24 hr)	**Start Time:**	12:15:00 PM	**End Time:**	2:00:00 PM
Personnel	Eli H., Coby H.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	386687	7314673	337	
Weather Conditions	Mix Sun and Cloud, cool			

Transducer Information			
PT Model	PT2X	**Serial #**	21221021
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	722	**Memory Free**	523417 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 73	1.510	101.510		100.000	
BM 74			1.667	99.843	
PT			2.452	99.058	
WL			1.929	**99.581**	
BM 78	0.741	101.469	0.782	100.728	
WL			1.890	**99.579**	
PT			2.413	99.056	
BM 74			1.625	99.844	
BM 73			1.470	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 74	99.848	99.844	-0.004	
BM 78	100.732	100.728	-0.004	
PT	99.064	99.057	-0.007	

Summary	
Stage (m)	99.580
Discharge (m^3/s)	0.271
Pressure Transducer Reading (m)	0.544
Pressure Transducer Elevation (m)	99.036

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	12:29	**End**	13:34	**Location**	~15m Downstream of PT			
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2004405			
Stage (m)	**Start**	**Reading**	0.545	**Time**	12:29				
	End	**Reading**	0.544	**Time**	13:34				

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	20.00	0.00	0.00	0.01	0			0.000	0.0
Eddy	20.10	0.10	0.10	0.01	-0.01			0.000	0.0
	20.20	0.18	0.10	0.01	-0.03			0.000	-0.1
	20.25	0.20	0.05	0.02	0.05			0.001	0.4
	20.40	0.21	0.15	0.04	0.28			0.010	3.8
	20.60	0.36	0.20	0.06	0.1			0.006	2.3
	20.75	0.41	0.15	0.06	0.27			0.017	6.1
	20.90	0.41	0.15	0.07	0.3			0.022	7.9
	21.10	0.45	0.20	0.08	0.3			0.024	8.7
	21.25	0.37	0.15	0.06	0.36			0.023	8.6
	21.45	0.47	0.20	0.08	0.14			0.012	4.2
	21.60	0.44	0.15	0.08	0.03			0.002	0.9
	21.80	0.46	0.20	0.08	0.05			0.004	1.5
	21.95	0.38	0.15	0.07	0.16			0.011	3.9
	22.15	0.43	0.20	0.08	0.23			0.017	6.4
	22.30	0.42	0.15	0.07	0.29			0.021	7.9
	22.50	0.39	0.20	0.07	0.26			0.018	6.5
	22.65	0.38	0.15	0.07	0.16			0.011	3.9
Deep Pool, low flow	22.85	0.38	0.20	0.10	0.08			0.008	3.1
Deep Pool, low flow	23.20	0.39	0.35	0.14	0.02			0.003	1.0
Deep Pool, low flow	23.55	0.50	0.35	0.18	-0.02			-0.004	-1.3
Deep Pool, low flow	23.90	0.41	0.35	0.14	-0.02			-0.003	-1.1
Deep Pool, low flow	24.25	0.43	0.35	0.18	0			0.000	0.0
Deep Pool, low flow	24.75	0.49	0.50	0.25	0.03			0.015	5.4
Deep Pool, low flow	25.25	0.56	0.50	0.28	0.06			0.025	9.3
Deep Pool, low flow	25.75	0.57	0.50	0.21	0.09			0.015	5.5
Deep Pool, low flow	26.00	0.56	0.25	0.18	0.07			0.013	4.7
Deep Pool, low flow	26.40	0.16	0.40	0.06	0.07			0.001	0.5
Deep Pool, low flow	26.80	0.08	0.40	0.02	0.02			0.000	0.0
LB	26.95	0	0.15	0.00	0			0.000	0.0
Total Q								**0.271**	**100.0**

General Notes
Gradiant= 1.5%

Appendix 2-15. Manual Discharge Measurements and Levelling Surveys at KL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	KL-H2			
Stream Name	George Lake Outflow			
Date Monitored	12-Jul-12			
Time at Site (24 hr)	**Start Time:**	8:10:00 AM	**End Time:**	12:30:00 PM
Personnel	Eli H., Ryan K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	386687	7314673	337m	
Weather Conditions	Mix Sun and Cloud			

Transducer Information			
PT Model	PT2X	**Serial #**	21221021
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	4585	**Memory Free**	519554 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 73	2.111	102.111		100.000	
BM 74			2.259	99.852	
BM 78			1.374	100.737	
PT			3.009	99.102	error
WL			2.601	**99.510**	
TBM	1.764	102.066	1.809	100.302	
WL			2.558	**99.508**	
PT			3.065	99.001	checked, ok
BM 78			1.331	100.735	
BM 74			2.215	99.851	
BM 73			2.063	100.003	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 74	99.848	99.852	0.004	
BM 78	100.732	100.736	0.004	
PT	99.064	99.001	-0.063	

Summary	
Stage (m)	99.509
Discharge (m^3/s)	0.179
Pressure Transducer Reading (m)	0.516
Pressure Transducer Elevation (m)	98.993

Discharge Measurement - Mid-Section Method										
Time (24 hr)	**Start**	8:25	**End**	9:19	**Location**	~12m Downstream of PT				
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2007612				
Stage (m)	**Start**	**Reading**	0.518	**Time**	8:25					
	End	**Reading**	0.516	**Time**	9:19					

	Station	**Depth**		**Distance**	**Area**	**Velocity @60%**	**Cal. Velocity**	**Q**	**% of Total Q**
Notes	**(m)**	**(ft)**	**(m)**	**(m)**	**(m^2)**	**(m/s)**	**(m/s)**	**(m^3/s)**	**%**
RB	2.40	0.00	0.00	0.00	0.00	0		0.000	0.0
eddy	2.50	0.10	0.03	0.10	0.00	-0.03		0.000	-0.1
	2.60	0.20	0.06	0.10	0.01	-0.03		0.000	-0.1
	2.70	0.15	0.05	0.10	0.01	0.05		0.000	0.2
	2.85	0.38	0.12	0.15	0.02	0.39		0.007	3.8
	3.00	0.50	0.15	0.15	0.02	0.48		0.011	6.3
	3.16	1.02	0.31	0.16	0.05	0.28		0.013	7.3
	3.30	1.07	0.33	0.14	0.05	0.21		0.010	5.5
	3.45	1.10	0.34	0.15	0.05	0.3		0.015	8.4
	3.60	1.16	0.35	0.15	0.05	0.08		0.004	2.4
behind rock	3.75	1.04	0.32	0.15	0.05	-0.02		-0.001	-0.5
behind rock	3.90	1.00	0.30	0.15	0.05	-0.02		-0.001	-0.5
behind rock	4.05	0.95	0.29	0.15	0.04	-0.03		-0.001	-0.7
	4.20	0.96	0.29	0.15	0.04	0.06		0.003	1.5
	4.35	1.00	0.30	0.15	0.05	0.15		0.007	3.8
	4.50	0.90	0.27	0.15	0.04	0.22		0.009	5.0
	4.65	0.98	0.30	0.15	0.06	0.13		0.008	4.3
	4.90	1.00	0.30	0.25	0.08	0.06		0.005	2.8
	5.20	0.73	0.22	0.30	0.07	0.08		0.005	3.0
	5.50	0.90	0.27	0.30	0.09	0.02		0.002	1.0
	5.85	1.02	0.31	0.35	0.11	0.07		0.008	4.2
	6.20	1.09	0.33	0.35	0.12	0.02		0.002	1.3
	6.55	0.95	0.29	0.35	0.10	0.07		0.007	4.0
	6.90	1.11	0.34	0.35	0.12	0.08		0.009	5.3
	7.25	1.35	0.41	0.35	0.14	0.08		0.012	6.4
	7.60	1.42	0.43	0.35	0.15	0.12		0.018	10.1
	7.95	1.40	0.43	0.35	0.15	0.11		0.016	9.2
	8.30	1.19	0.36	0.35	0.10	0.11		0.011	6.1
	8.50	1.15	0.35	0.20	0.11	0.19		0.022	12.1
	8.95	0.20	0.06	0.45	0.02	0.04		0.001	0.4
LB	9.15	0.00	0.00	0.20	0.00	0		0.000	0.0
Total Q								**0.179**	**100.0**

General Notes
Gradiant= 2%. Depth values converted from ft. to m (1ft. = 0.3048m).

Appendix 2-15. Manual Discharge Measurements and Levelling Surveys at KL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	KL-H2			
Stream Name	George Lake Outflow			
Date Monitored	12-Aug-12			
Time at Site (24 hr)	**Start Time:**	2:15:00 PM	**End Time:**	4:35:00 PM
Personnel	Eli H., Cenling X.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	386687	7314673	337m	
Weather Conditions	Cloudy, cool			

Transducer Information			
PT Model	PT2X	**Serial #**	21221021
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	9086	**Memory Free**	515053 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 73	1.518	101.518		100.000	
BM 74			1.671	99.847	
BM 78			0.786	100.732	
PT			2.570	98.948	
WL			2.095	**99.423**	
TBM	0.763	101.420	0.861	100.657	
WL			1.999	**99.421**	
PT			2.472	98.948	
BM 78			0.688	100.732	
BM 74			1.573	99.847	
BM 73			1.421	99.999	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 74	99.848	99.847	0.000	
BM 78	100.732	100.732	0.000	
PT	99.064	98.948	-0.116	

Summary	
Stage (m)	99.422
Discharge (m^3/s)	0.0245
Pressure Transducer Reading (m)	0.493
Pressure Transducer Elevation (m)	98.929

Discharge Measurement - Mid-Section Method										
Time (24 hr)	**Start**	14:30	**End**	15:11	**Location**	~20m Downstream of PT				
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2006042				
Stage (m)	**Start**	**Reading**	0.493	**Time**	14:30					
	End	**Reading**	0.493	**Time**	15:11					

	Station	**Depth**		**Distance**	**Area**	**Velocity @60%**	**Cal. Velocity**	**Q**	**% of Total Q**
Notes	**(m)**	**(ft)**	**(m)**	**(m)**	**(m^2)**	**(m/s)**	**(m/s)**	**(m^3/s)**	**%**
RB	3.20	0.00	0.00	0.00	0.00	0		0.000	0.0
pool/behind rocks	3.30	0.25	0.08	0.10	0.02	-0.01		0.000	-0.6
pool/behind rocks	3.60	0.10	0.03	0.30	0.01	0		0.000	0.0
pool/behind rocks	3.90	0.53	0.16	0.30	0.05	0		0.000	0.0
pool/behind rocks	4.20	0.63	0.19	0.30	0.06	0.01		0.001	2.4
	4.50	0.78	0.24	0.30	0.06	0.04		0.002	9.7
	4.70	0.70	0.21	0.20	0.04	0.05		0.002	8.7
	4.90	0.63	0.19	0.20	0.04	0.01		0.000	1.6
	5.10	0.64	0.20	0.20	0.05	0.02		0.001	4.0
	5.40	0.25	0.08	0.30	0.02	0.02		0.000	1.6
	5.60	0.50	0.15	0.20	0.03	0.02		0.001	2.5
	5.80	0.48	0.15	0.20	0.03	0.02		0.001	2.4
	6.00	0.52	0.16	0.20	0.03	0.02		0.001	2.6
	6.20	0.71	0.22	0.20	0.04	0		0.000	0.0
	6.40	0.80	0.24	0.20	0.05	0.01		0.000	2.0
	6.60	0.75	0.23	0.20	0.05	0.01		0.000	1.9
	6.80	0.60	0.18	0.20	0.04	0		0.000	0.0
	7.00	0.42	0.13	0.20	0.02	0		0.000	0.0
	7.15	0.64	0.20	0.15	0.03	0.02		0.001	2.4
	7.30	0.64	0.20	0.15	0.03	0.03		0.001	4.2
	7.50	0.75	0.23	0.20	0.05	0.03		0.001	5.6
	7.70	0.78	0.24	0.20	0.05	0.03		0.001	5.8
	7.90	0.80	0.24	0.20	0.05	0.02		0.001	4.0
	8.10	0.95	0.29	0.20	0.06	0.04		0.002	9.5
	8.30	1.00	0.30	0.20	0.06	0.03		0.002	7.5
	8.50	1.00	0.30	0.20	0.06	0.03		0.002	7.5
	8.70	0.90	0.27	0.20	0.05	0.04		0.002	9.0
	8.90	1.10	0.34	0.20	0.05	0.03		0.002	6.2
	9.00	1.00	0.30	0.10	0.04	0.02		0.001	3.1
	9.15	0.40	0.12	0.15	0.02	0.01		0.000	0.7
LB	9.30	0.00	0.00	0.15	0.01	0		0.000	0.0
Total Q								**0.0245**	**100.0**

General Notes
Gradiant= 2%. Depth values converted from ft. to m (1ft. = 0.3048m).

Appendix 2-15. Manual Discharge Measurements and Levelling Surveys at KL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	KL-H2			
Stream Name	George Lake Outflow			
Date Monitored	12-Sep-12			
Time at Site (24 hr)	**Start Time:**	8:00:00 AM	**End Time:**	10:00:00 AM
Personnel	Eli H., Scott C.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	386687	7314673	337m	
Weather Conditions	Mis of Sun and Cloud, Flurries			

Transducer Information			
PT Model	PT2X	**Serial #**	21221021
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	13512	**Memory Free**	510627
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 73	1.861	101.861		100.000	
BM 74			2.012	99.849	
BM 78			1.127	100.734	
PT			2.925	98.936	
WL			2.425	**99.436**	
TBM	2.366	101.779	2.448	99.413	
WL			2.341	**99.438**	
PT			2.838	98.941	
BM 78			1.044	100.735	
BM 74			1.929	99.850	
BM 73			1.778	100.001	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 74	99.848	99.850	0.002	
BM 78	100.732	100.735	0.003	
PT	99.064	98.939	-0.125	

Summary	
Stage (m)	99.437
Discharge (m^3/s)	0.03738
Pressure Transducer Reading (m)	0.528
Pressure Transducer Elevation (m)	98.909

Discharge Measurement - Mid-Section Method										
Time (24 hr)	**Start**	8:04	**End**	9:15	**Location**	~15m Downstream of PT				
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2007529				
Stage (m)	**Start**	**Reading**	0.527	**Time**	8:04					
	End	**Reading**	0.528	**Time**	9:15					

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	16.60	0.00	0.00	0.00	0			0.000	0.0
	16.65	0.11	0.05	0.02	0			0.000	0.0
	16.90	0.06	0.25	0.01	0			0.000	0.0
	17.10	0.06	0.20	0.01	0			0.000	0.0
	17.20	0.24	0.10	0.04	0			0.000	0.0
	17.40	0.12	0.20	0.03	0.05			0.002	4.0
	17.70	0.29	0.30	0.02	0.04			0.001	2.3
	17.55	0.29	0.15	0.04	0.03			0.001	3.5
	18.00	0.27	0.45	0.10	0.01			0.001	2.7
	18.30	0.24	0.30	0.07	0			0.000	0.0
	18.60	0.13	0.30	0.04	0.05			0.002	5.2
	18.90	0.18	0.30	0.05	0.08			0.004	11.6
	19.20	0.20	0.30	0.06	0.04			0.002	6.4
	19.50	0.29	0.30	0.07	0			0.000	0.0
	19.70	0.26	0.20	0.05	0			0.000	0.0
	19.90	0.22	0.20	0.06	0.01			0.001	1.5
	20.20	0.22	0.30	0.07	0.01			0.001	1.8
	20.50	0.27	0.30	0.08	0.01			0.001	2.2
	20.80	0.30	0.30	0.09	0.02			0.002	4.8
	21.10	0.30	0.30	0.09	0.03			0.003	7.2
	21.40	0.31	0.30	0.08	0.04			0.003	8.3
	21.60	0.32	0.20	0.06	0.04			0.003	6.8
	21.80	0.32	0.20	0.06	0.05			0.003	8.6
	22.00	0.32	0.20	0.06	0.06			0.004	10.3
	22.20	0.38	0.20	0.08	0.04			0.003	8.1
	22.40	0.44	0.20	0.09	0.02			0.002	4.7
	22.60	0.16	0.20	0.02	0			0.000	0.0
LB	22.70	0.00	0.10	0.01	0			0.000	0.0
Total Q								**0.0374**	**100.0**

General Notes
Gradiant= 2%.

Appendix 3
Rating Curves

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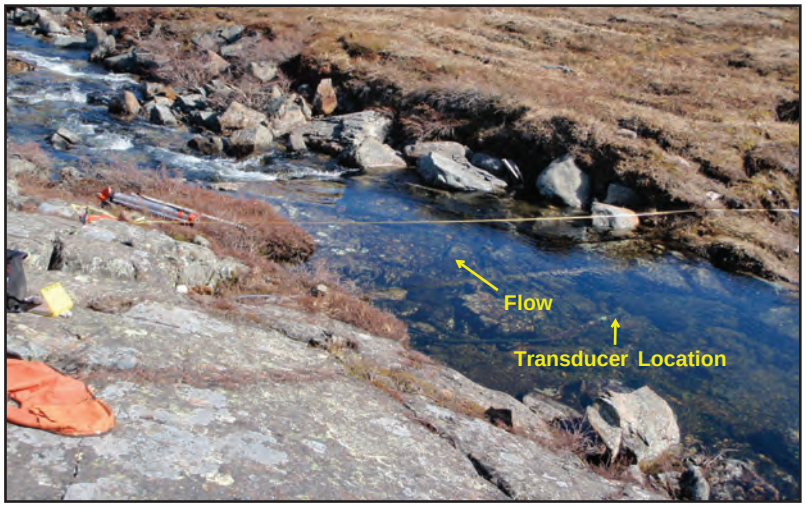
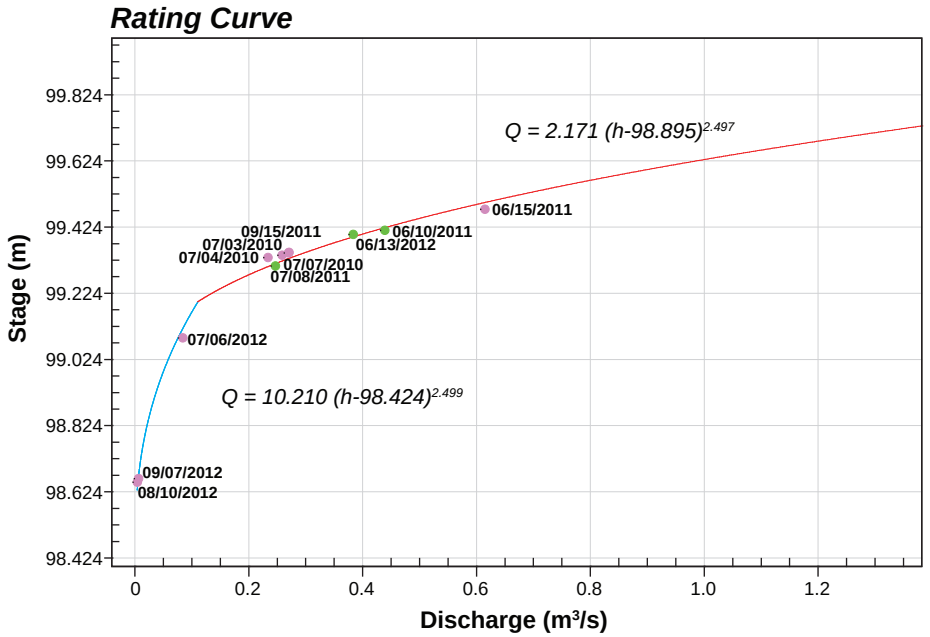


GL-H1 from the left bank looking downstream and across the channel. The bed of this channel is composed of bedrock and the transducer is located in large pool upstream of a cascade section. The flow gauging section is indicated by the measuring tape. Photograph taken June 13, 2012.



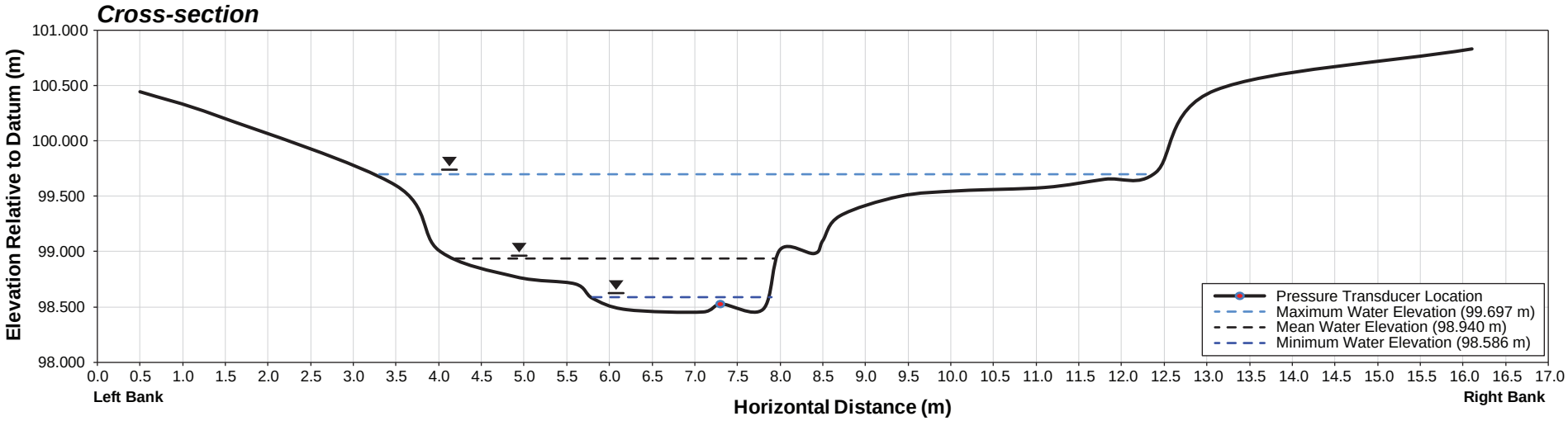


Figure A3.1

Sabina GOLD & SILVER CORP.

GL-H1 -Stage Discharge Rating Curve and Cross-Section
(Rating Period from July 7, 2010 -September 7, 2012)

Figure A3.1

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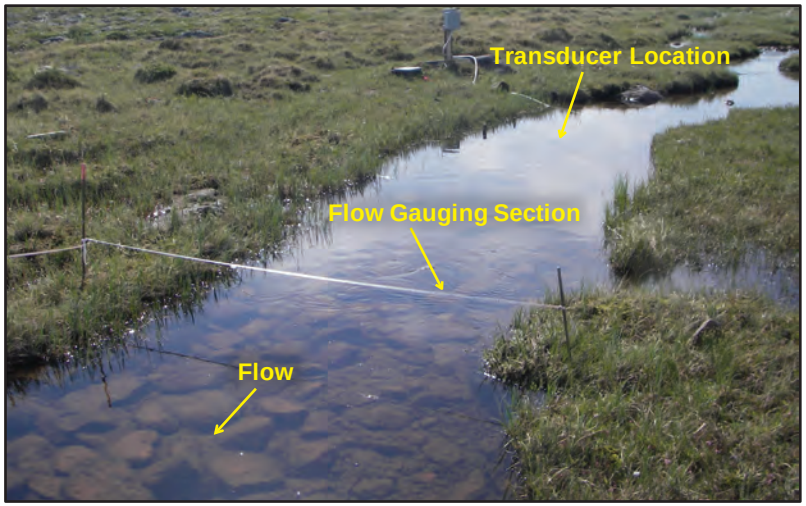
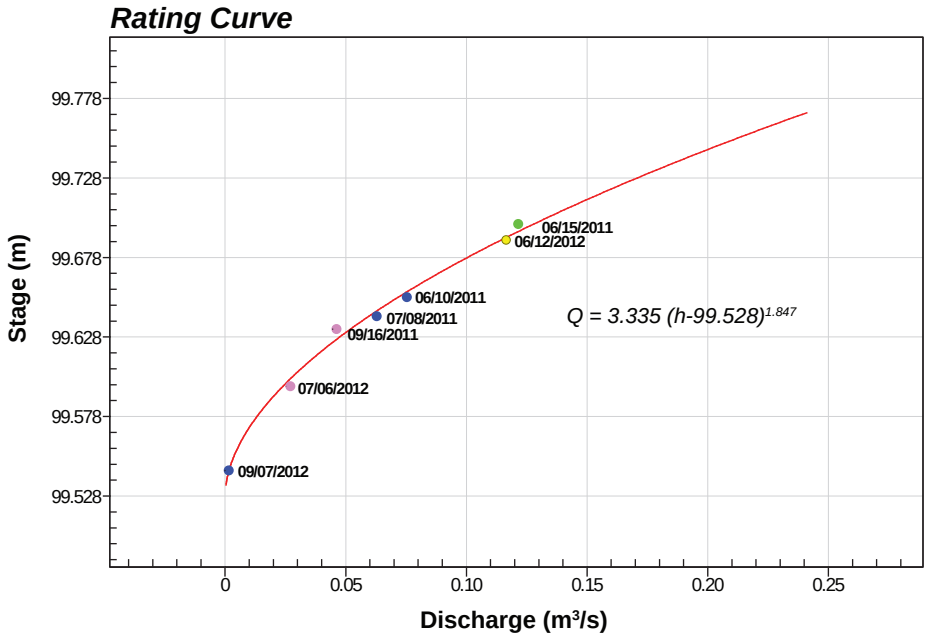


Upstream view of station GL-H3 with the flow gauging section in the foreground, downstream of the transducer location. The stream is narrow with very low flow velocities under most conditions and it floods onto the floodplain under high flow conditions. Photograph taken during mid-level flow conditions (July 6, 2012).



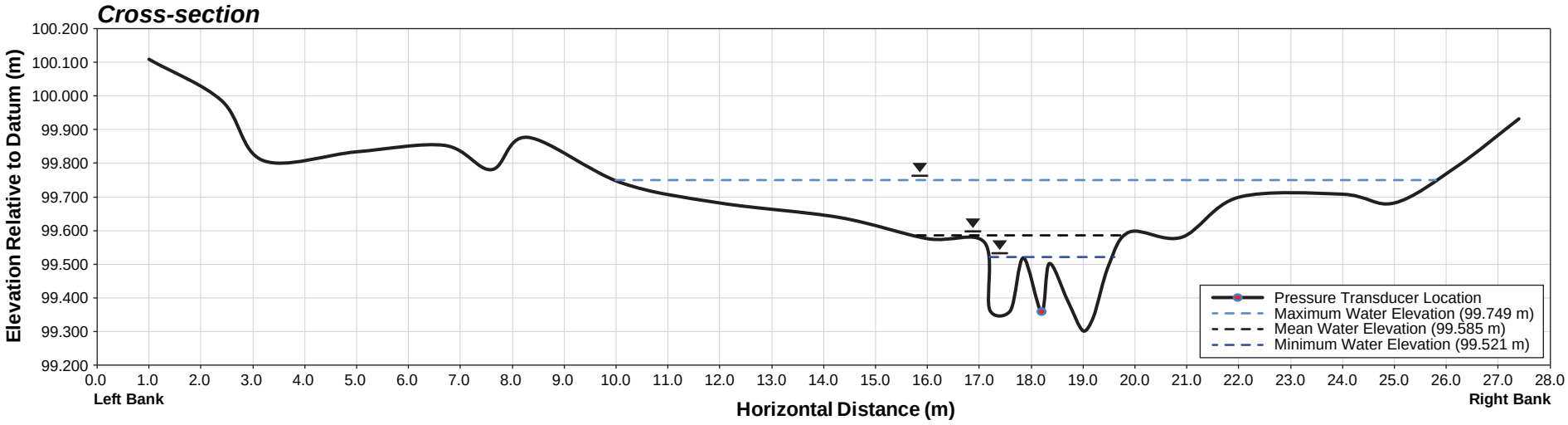


Figure A3-2

Sabina GOLD & SILVER CORP.

GL-H2 -Stage Discharge Rating Curve and Cross-Section
(Rating Period from June 10, 2011 -September 7, 2012)

Figure A3-2

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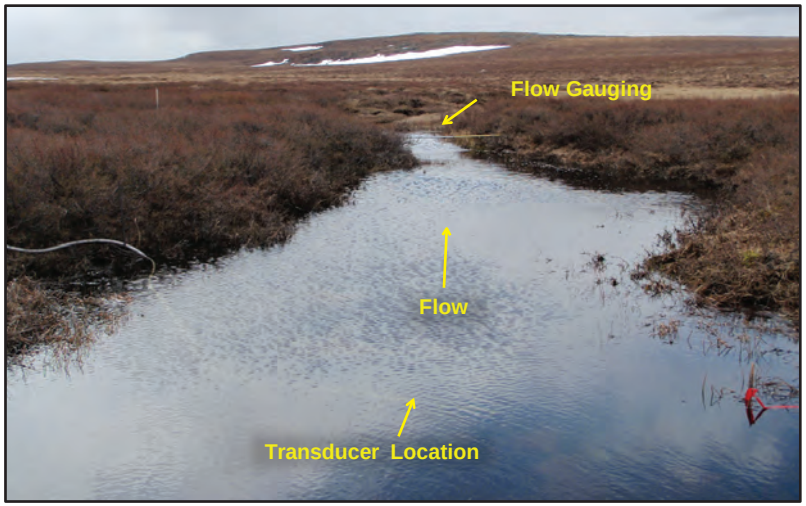
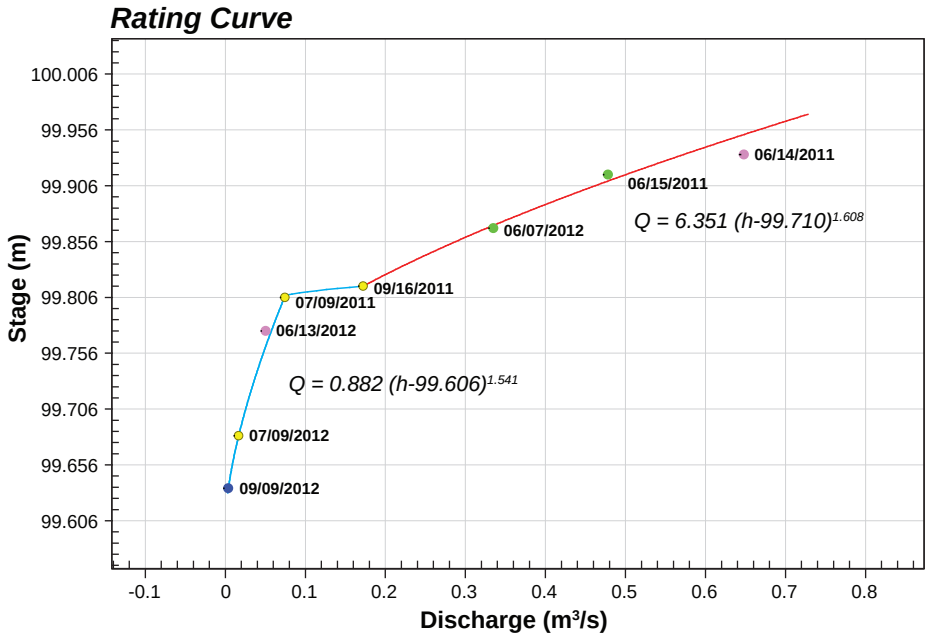


Upstream view of the monitored reach at station GL-H3. The transducer is located in a deep pool with the channel becoming much shallower upstream near the location of the flow gauging section. Photo taken June 13, 2012.



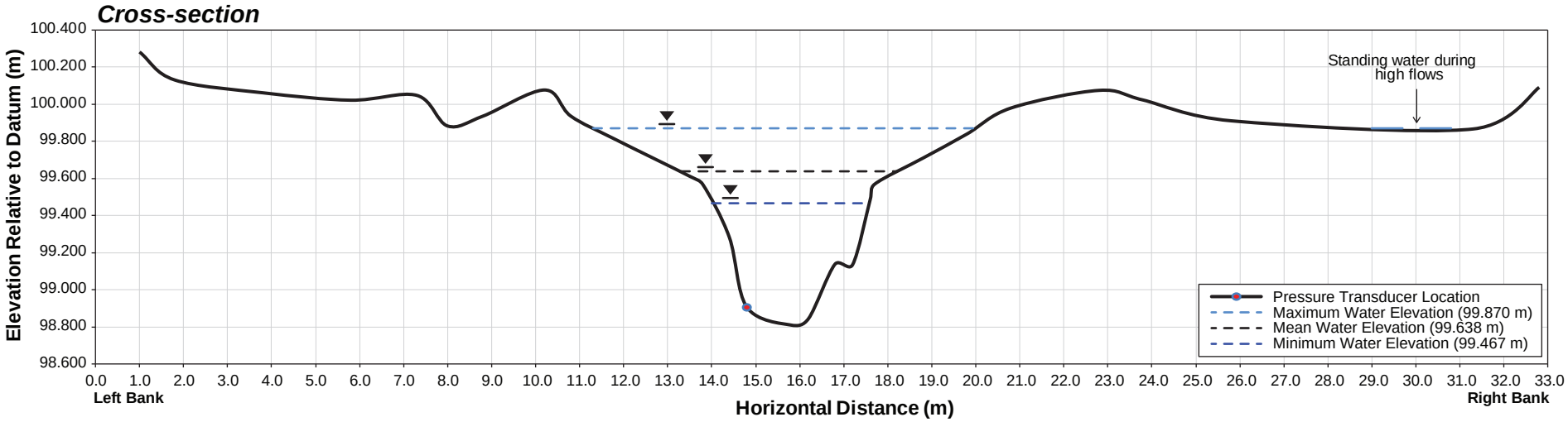


Figure A3-3

Sabina GOLD & SILVER CORP.

GL-H3 -Stage Discharge Rating Curve and Cross-Section
(Rating Period from July 7, 2011 -September 7, 2012)

Figure A3-3

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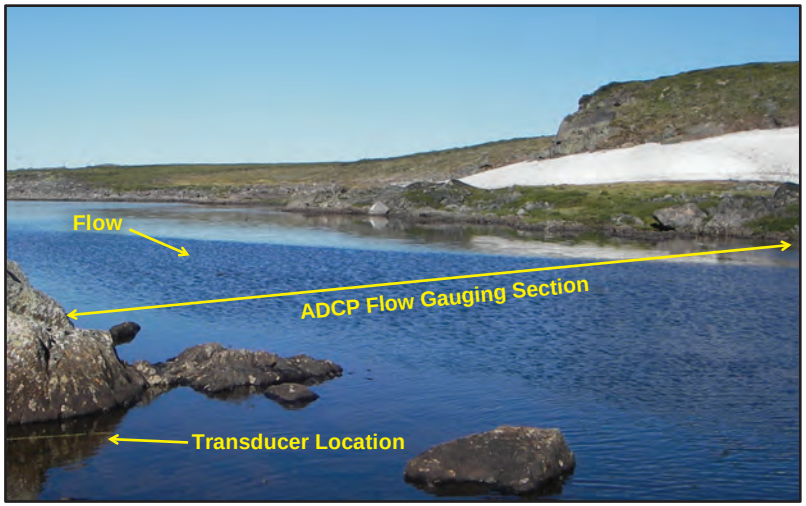
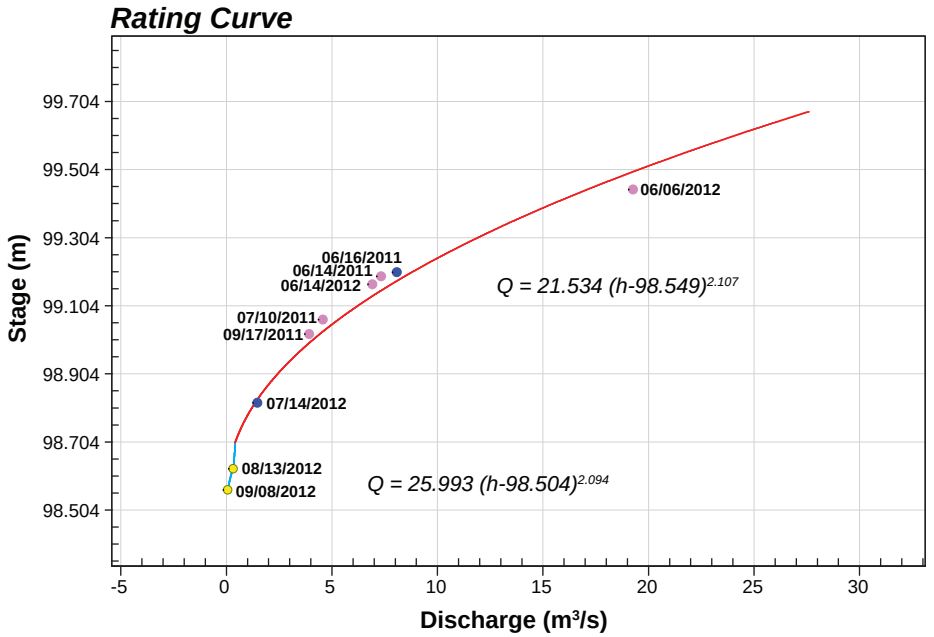


Upstream view of the flow gauging section at PL-H1 during July mid-flow conditions. The monitored reach is a low energy channel that is deep and wide with a bouldery bottom and bedrock banks. An ADCP was used at this location in order to measure discharge. Photograph taken July 15, 2012.



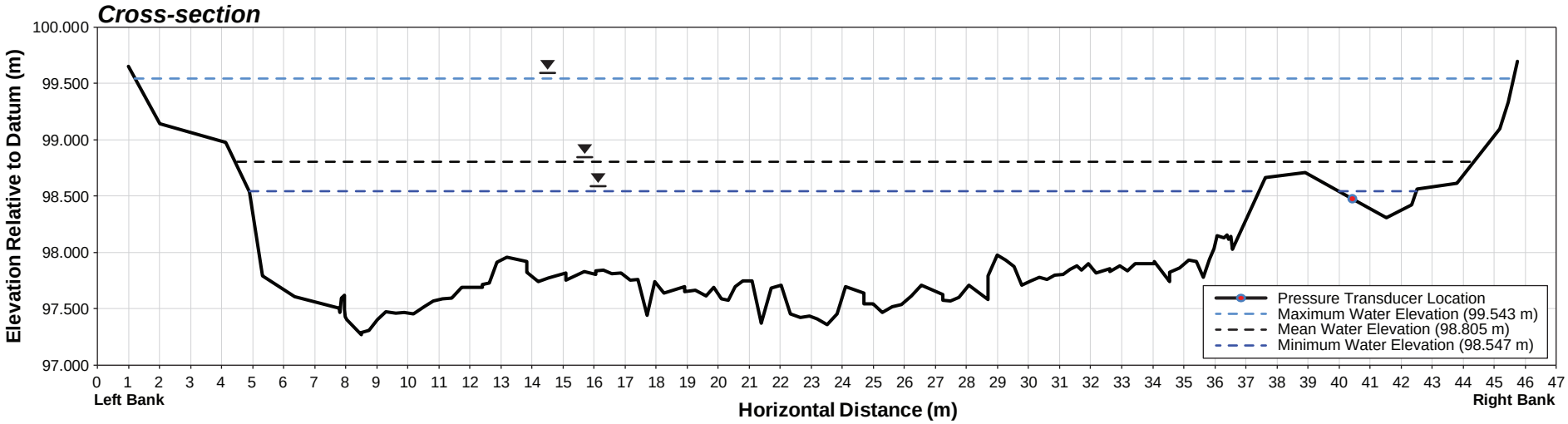


Figure A3-4

Sabina GOLD & SILVER CORP.

PL-H1 - Stage Discharge Rating Curve and Channel Geometry
(Rating Period from June 14, 2011 to September 8, 2012)

Figure A3-4

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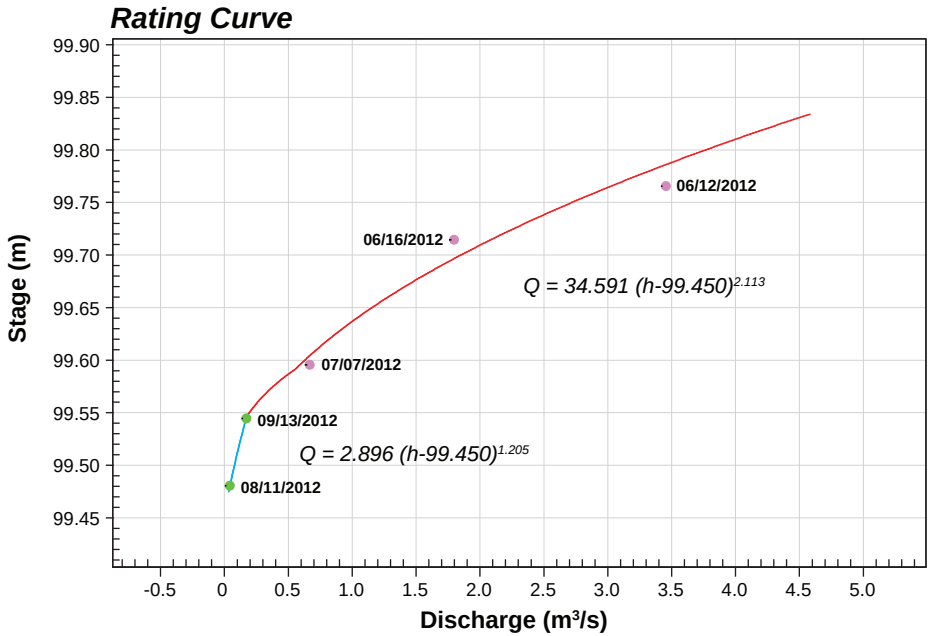
PL-H2, looking downstream from the station. The monitored reach is approximately 55 m wide at this location during high flow conditions. The channel has a cobble/boulder bed substrate and is confined by low vegetated banks. Photograph taken on June 12, 2012.



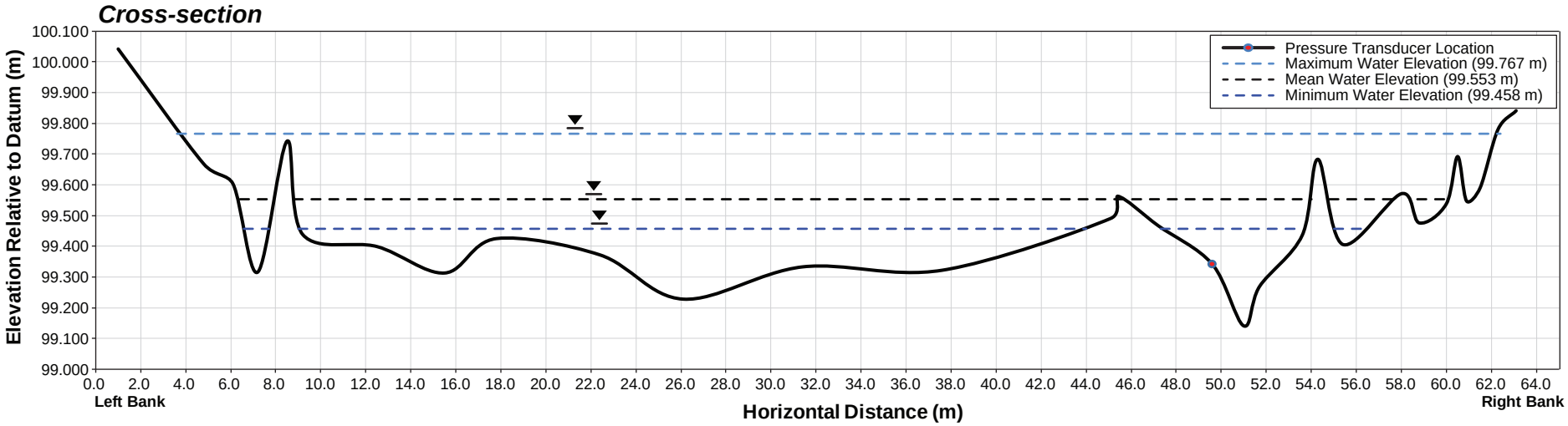


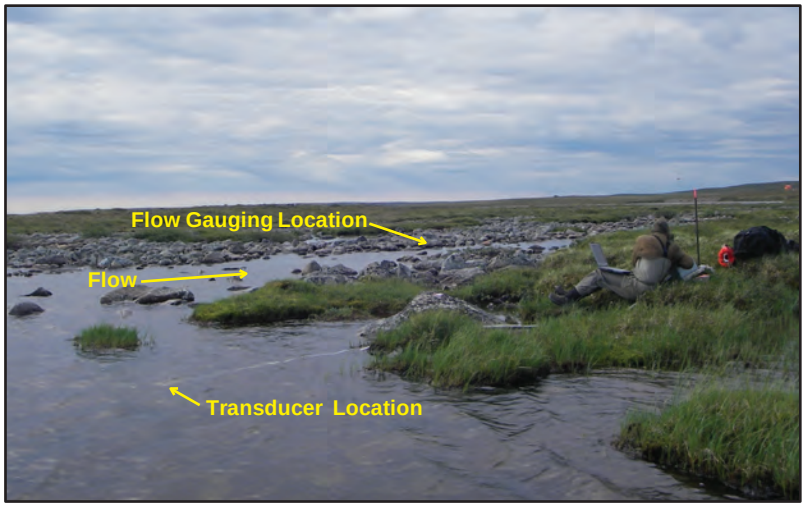
Figure A3-5

Sabina GOLD & SILVER CORP.

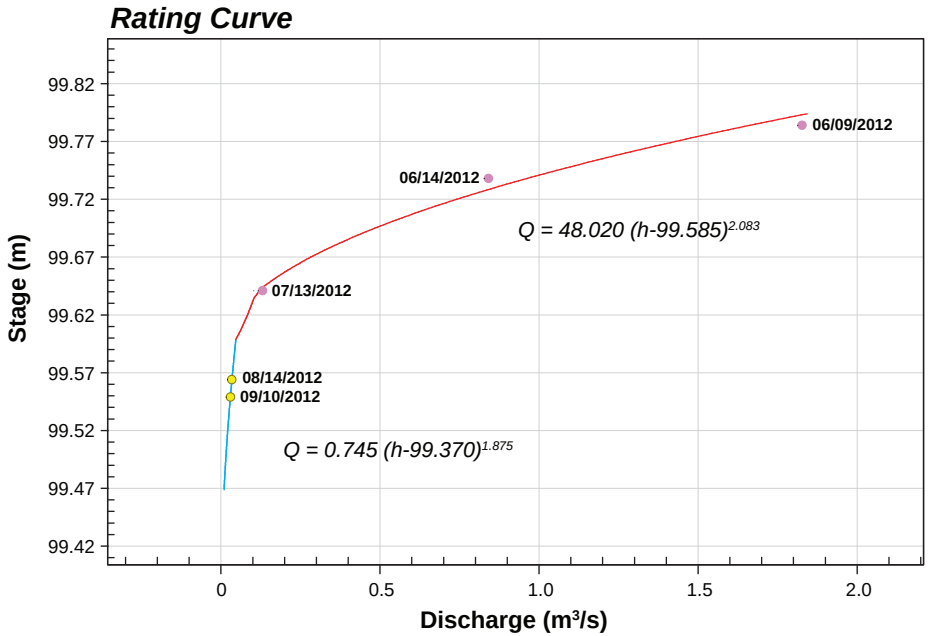
PL-H2 - Stage Discharge Rating Curve and Channel Geometry
(Rating Period from June 12 - September 12 2012)

Figure A3-5

Rescan Engineers & Scientists



Downstream view of station GI-H1. The transducer is located at the outflow of Giraffe lake with the flow gauging section shown further downstream. Note the bouldery nature of the channel. Photograph taken July 13, 2012.



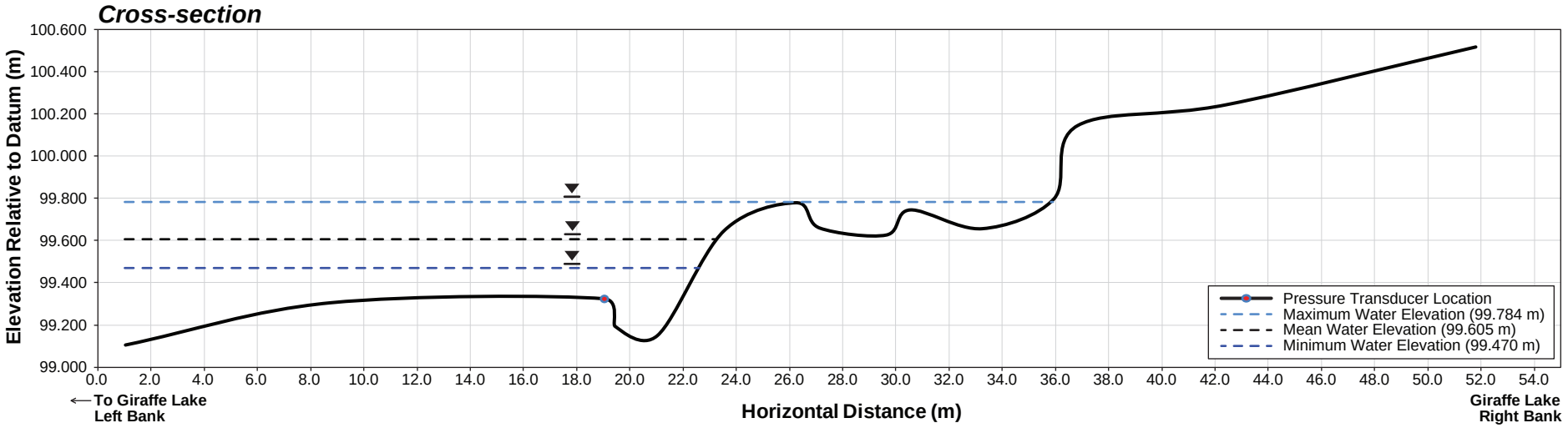


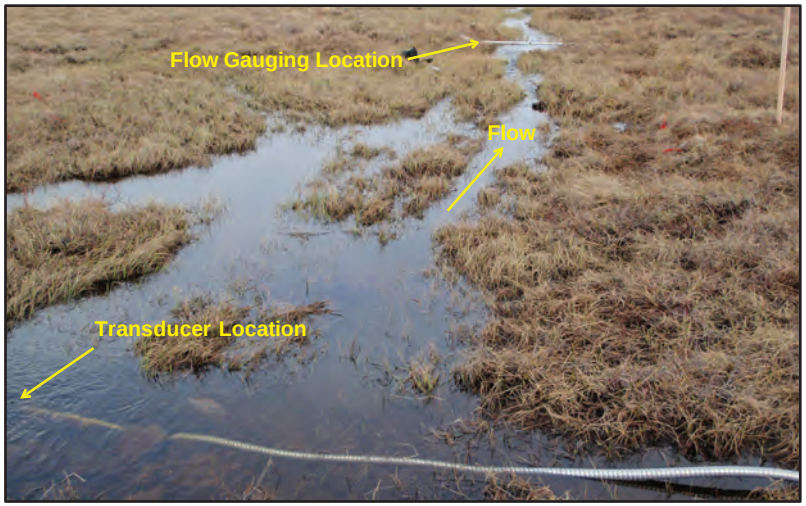
Figure A3-6

Sabina GOLD & SILVER CORP.

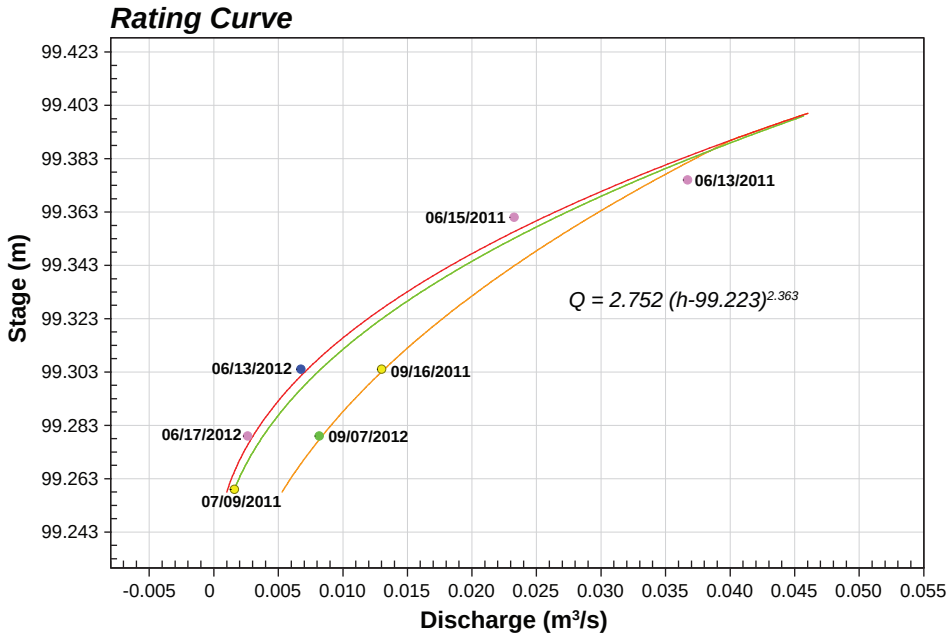
GI-H1 - Stage Discharge Rating Curve and Shoreline Profile
(Rating Period from June 9, 2012 - September 14, 2012)

Figure A3-6

Rescan Engineers & Scientists



Downstream view of station EL-H1 during freshet with the transducer location and flow gauging location shown. Note the the channel is ephemeral and flows over mostly grass. Photo taken June 13, 2012.



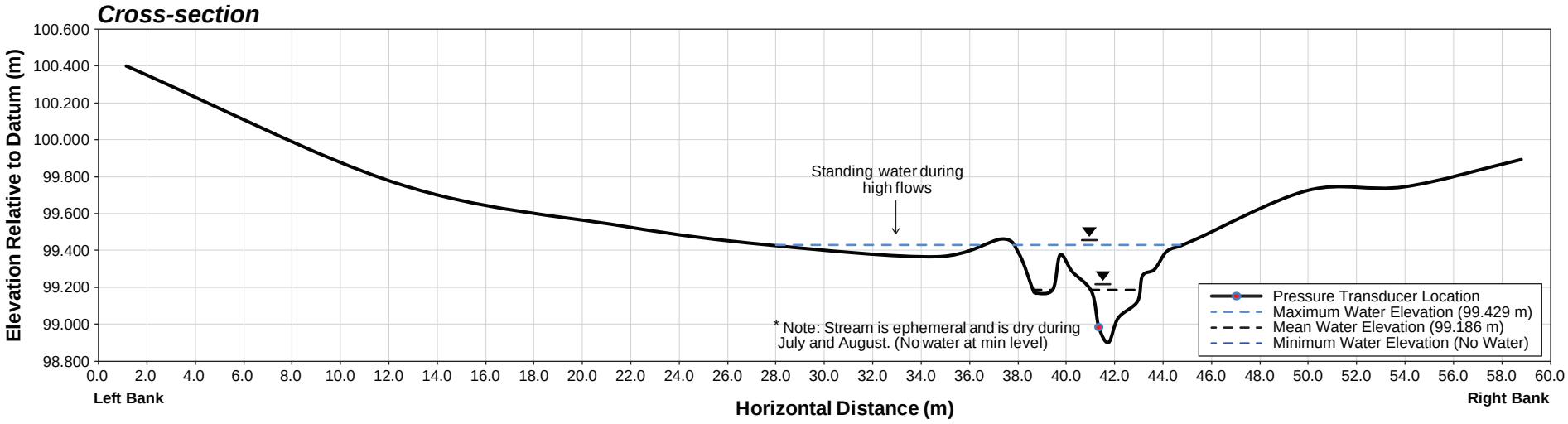


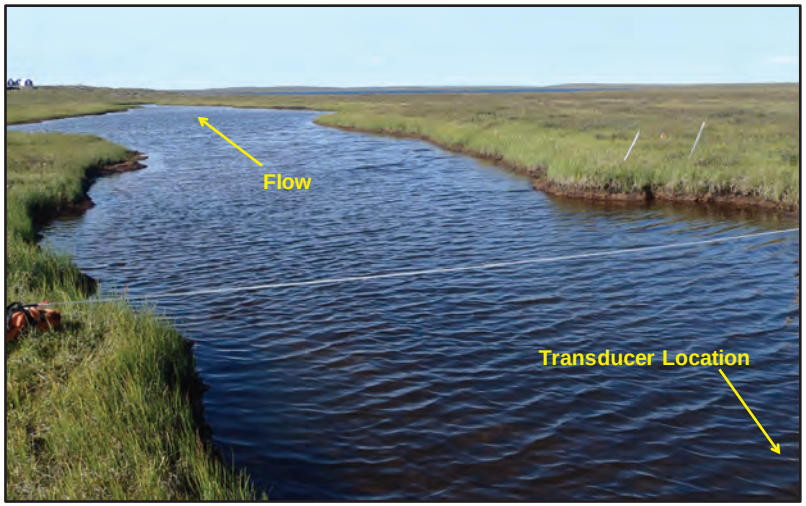
Figure A3-7

Sabina GOLD & SILVER CORP.

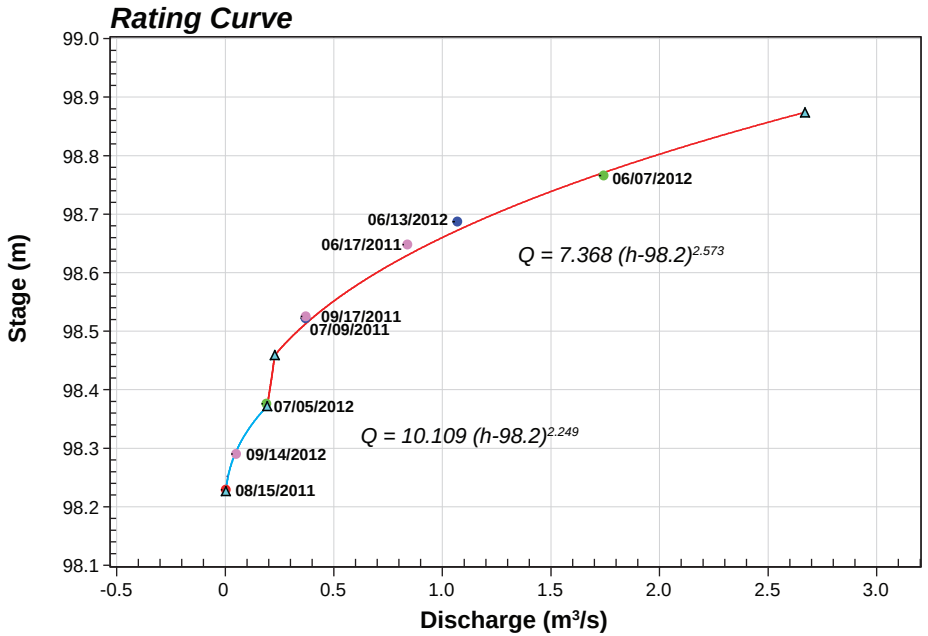
EL-H1 - Stage Discharge Rating Curve and Channel Geometry
(Rating Period from June 13, 2012 - September 7, 2012)

Figure A3-7

Rescan Engineers & Scientists



WL-H1, looking downstream along the monitored reach towards Goose Lake. Note that the channel is confined within its banks on this date. During high flow conditions the stream overflows the banks onto the adjacent floodplain, leading to a different relationship between low and high stage conditions. Photograph taken August 10, 2012.



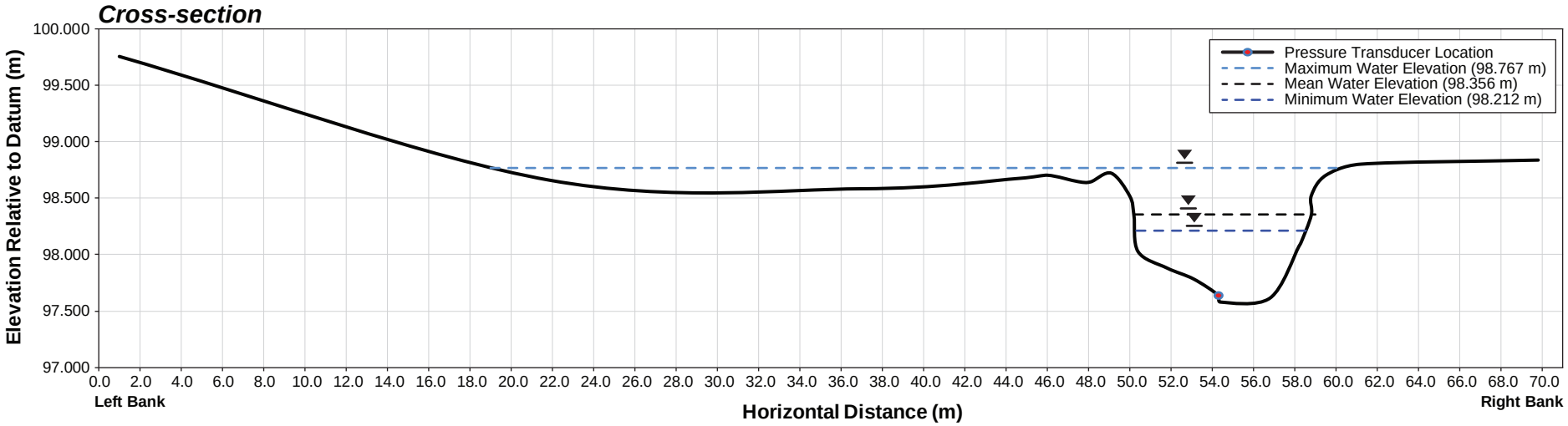


Figure A3-8

Sabina GOLD & SILVER CORP.

WL-H1 - Stage Discharge Rating Curve and Channel Geometry
(Rating Period from June 17, 2011 - September 14, 2012)

Figure A3-8

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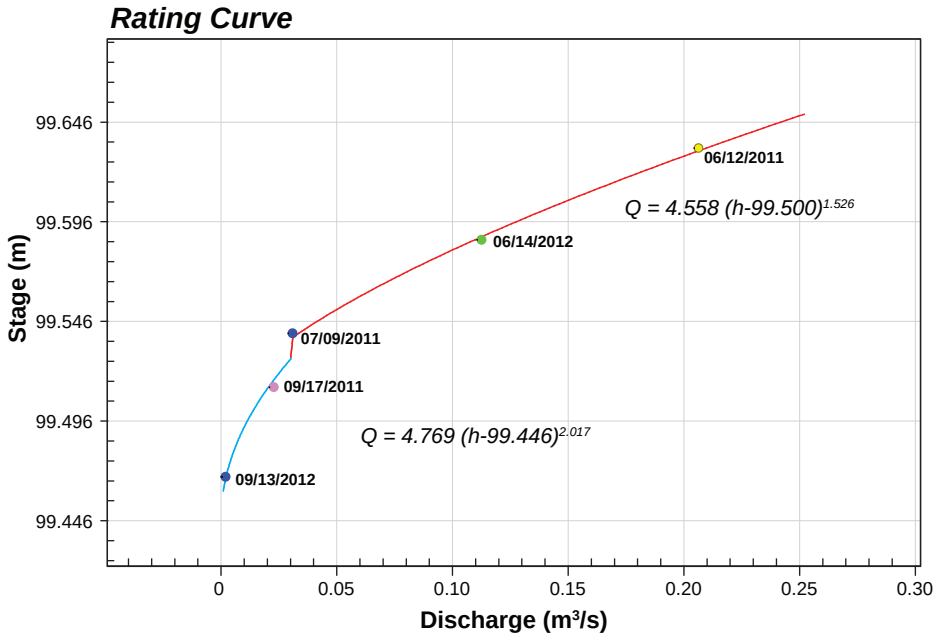
Downstream view of REFB-H1 during spring high flow conditions. Note that the channel is flowing through the grass banks. During low flow dry conditions there is no flow in the channel allowing for vegetation to grow on the bed. Photograph taken June 14, 2012.



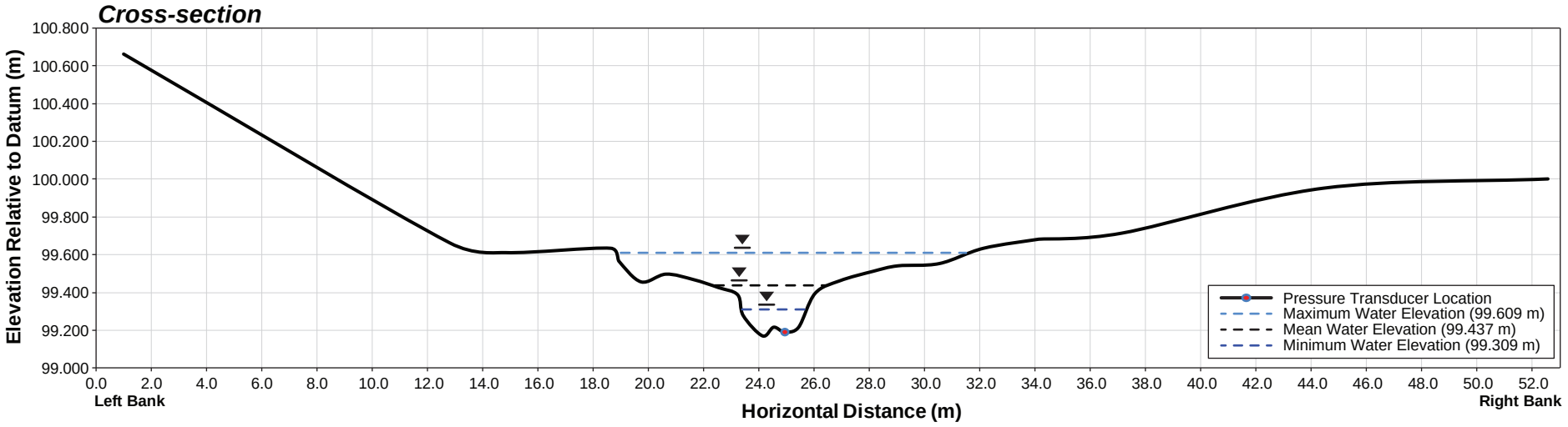


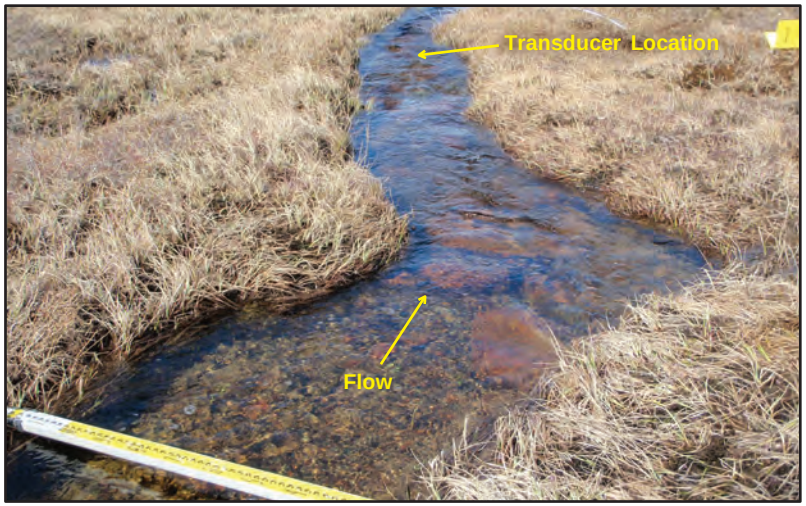
Figure A3-9

Sabina GOLD & SILVER CORP.

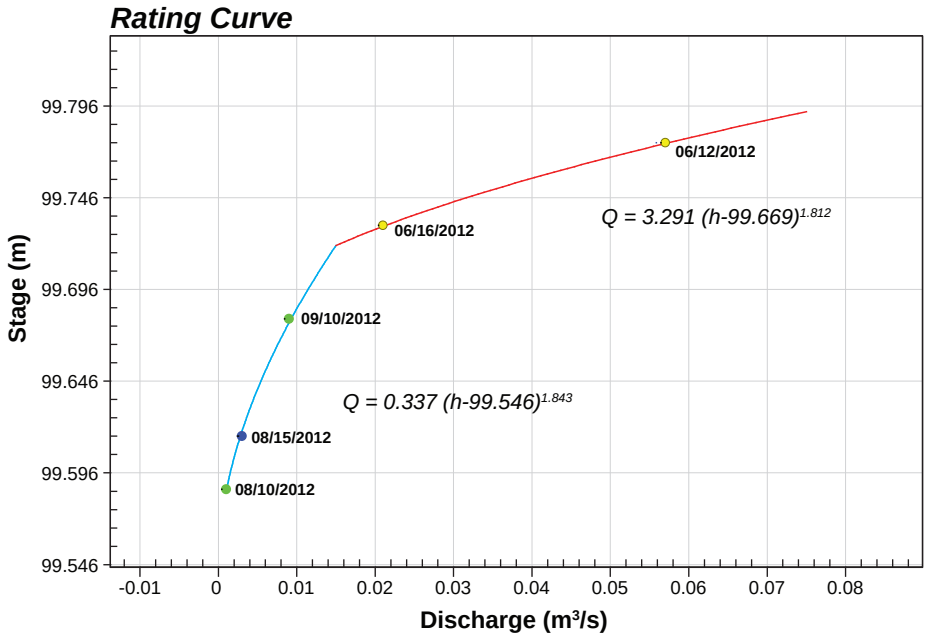
REFB-H1 - Stage Discharge Rating Curve and Channel Geometry
(Rating Period from June 12, 2011 to September 13, 2012)

Figure A3-9

Rescan Engineers & Scientists



BL-H1, looking downstream along the monitored reach. Note the water flowing through the grass along the edges of the channel. The rod across the channel indicates where mannual flow measurements were conducted. Photograph taken June 12, 2012.



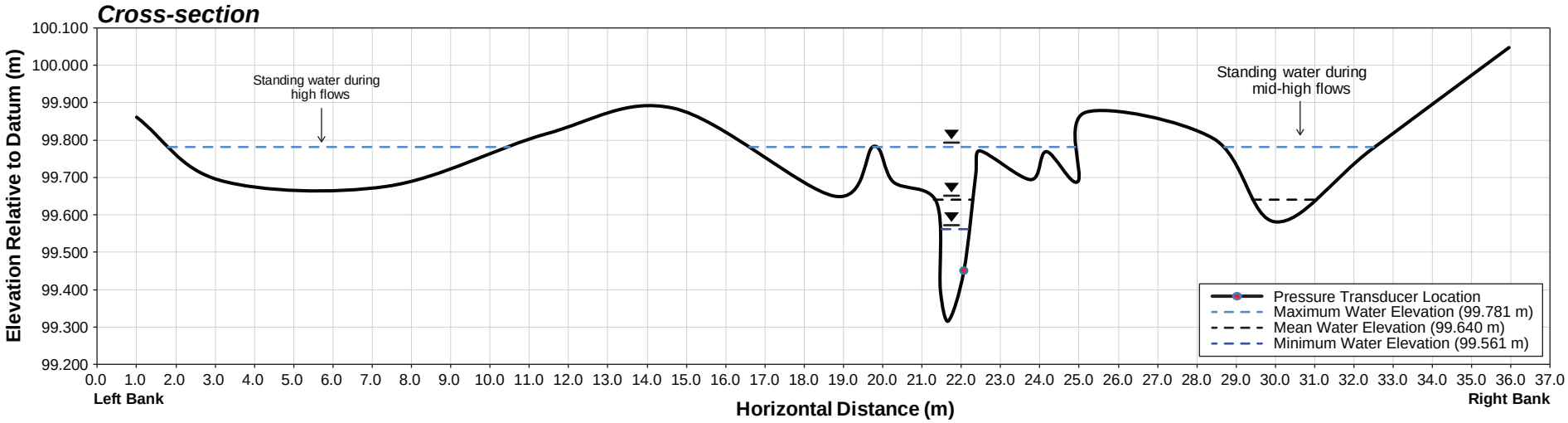


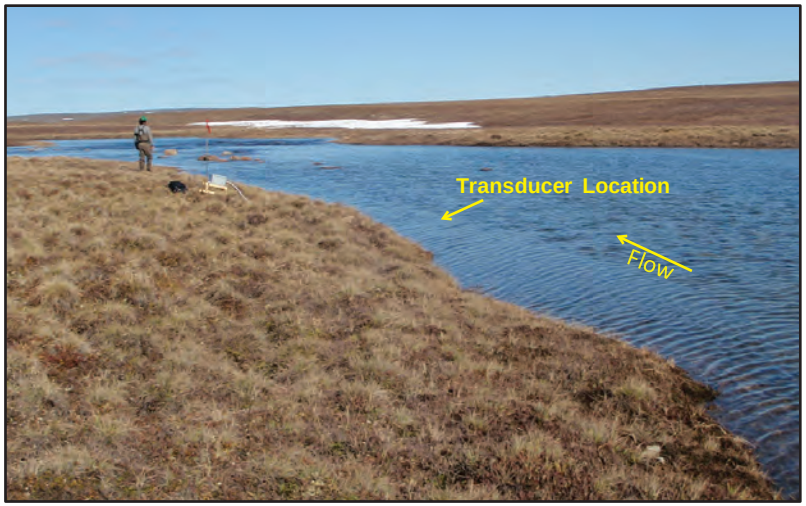
Figure A3-10

Sabina GOLD & SILVER CORP.

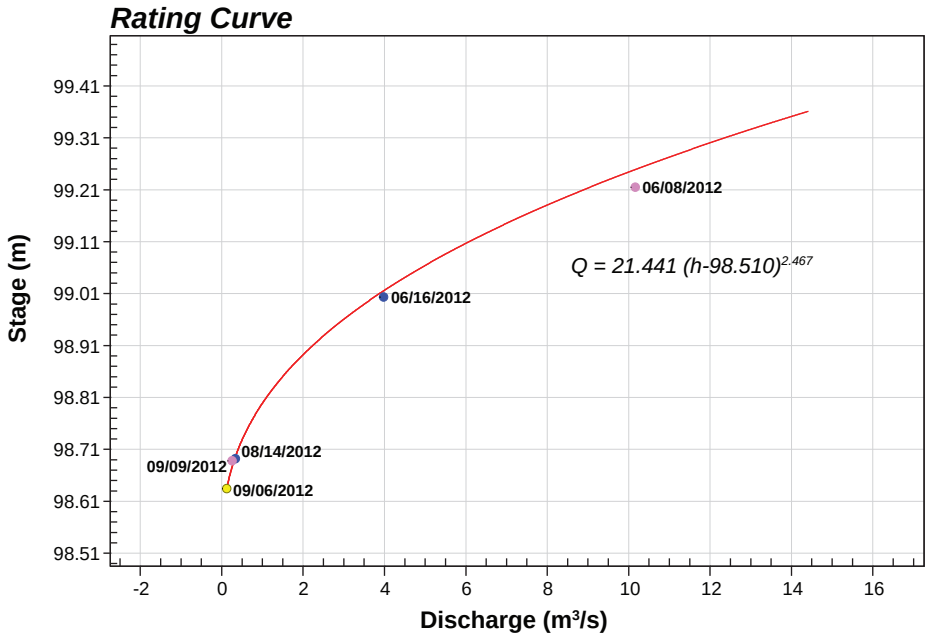
BL-H1 - Stage Discharge Rating Curve and Channel Geometry
(Rating Period from June 12 - September 9, 2012)

Figure A3-10

Rescan Engineers & Scientists



BL-H2 looking downstream along the monitored reach. Manual flow measurements were conducted near the transducer location in June and further downstream during low flow periods. Photograph taken June 12, 2012.



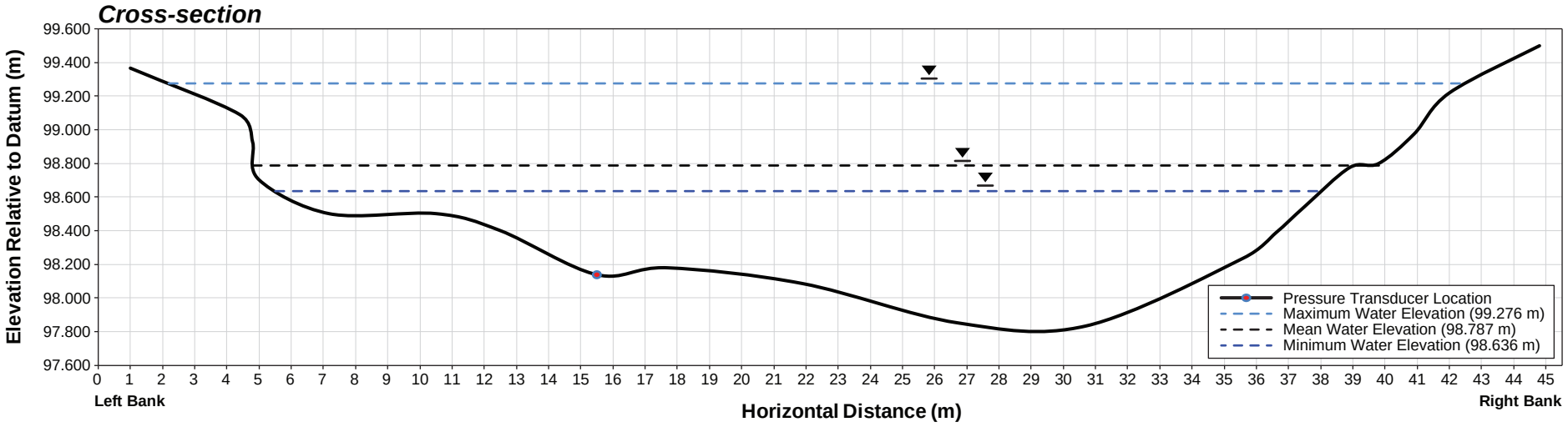


Figure A3-11

Sabina GOLD & SILVER CORP.

BL-H2 - Stage Discharge Rating Curve and Channel Geometry
(Rating Period from June 8 - September 9, 2012)

Figure A3-11

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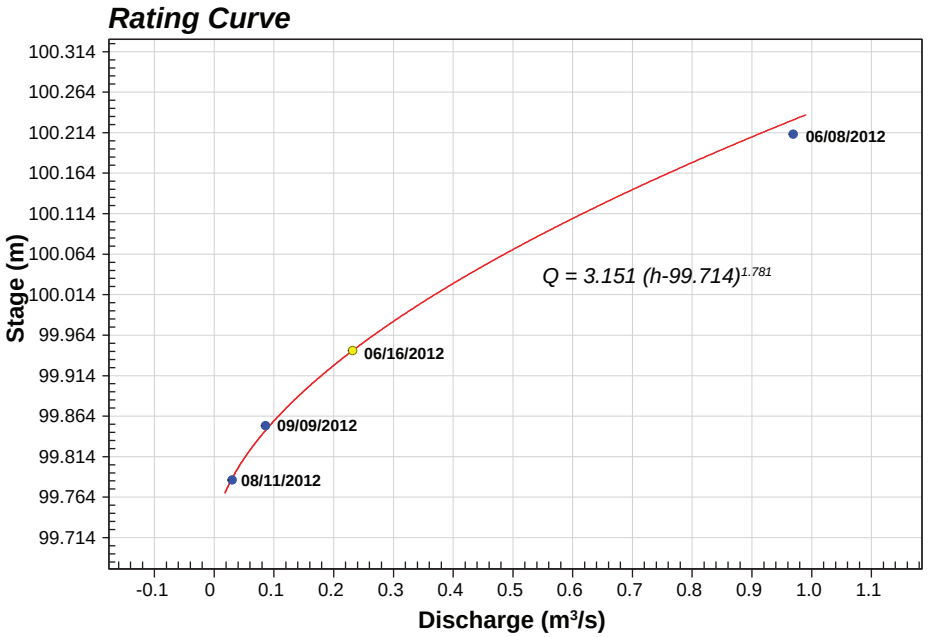
BL-H3, looking downstream along the monitored reach with the transducer location in the foreground. The rod across the channel indicates where manual flow measurements were conducted. Photograph taken June 12, 2012



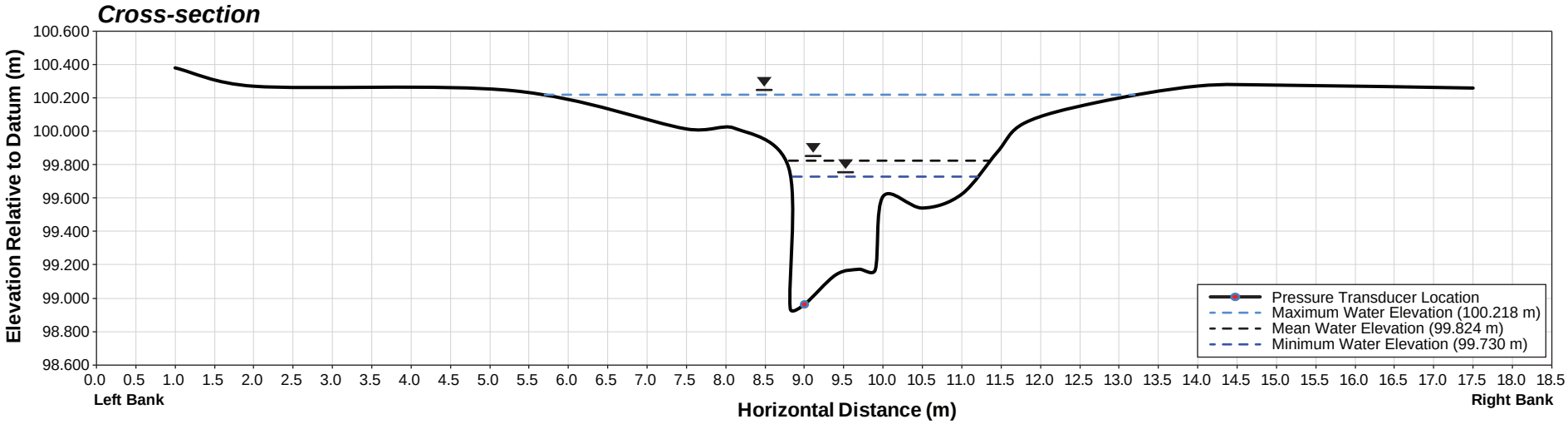


Figure A3-12

Sabina GOLD & SILVER CORP.

BL-H3 - Stage Discharge Rating Curve and Channel Geometry
(Rating Period from June 8 - September 9, 2012)

Figure A3-12

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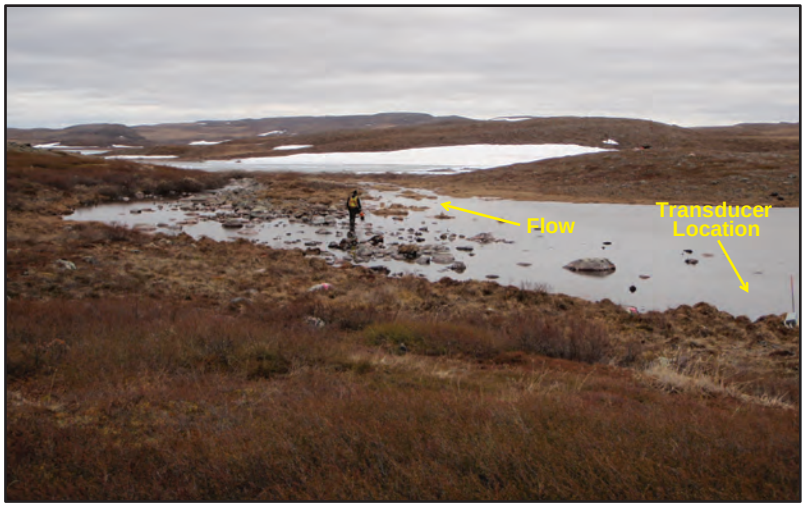
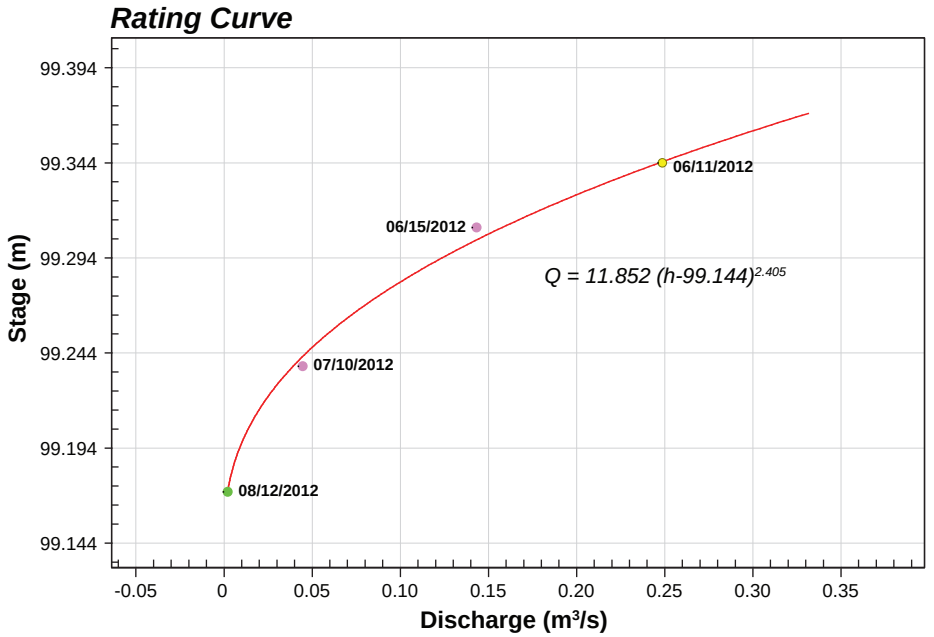


REFC-H1, looking downstream towards the monitored reach. The channel is characterized by vegetation and rocks with the flow splitting in two sections along its length. The pressure transducer is located in Reference Lake C near the outlet. Photograph taken June 11, 2012.



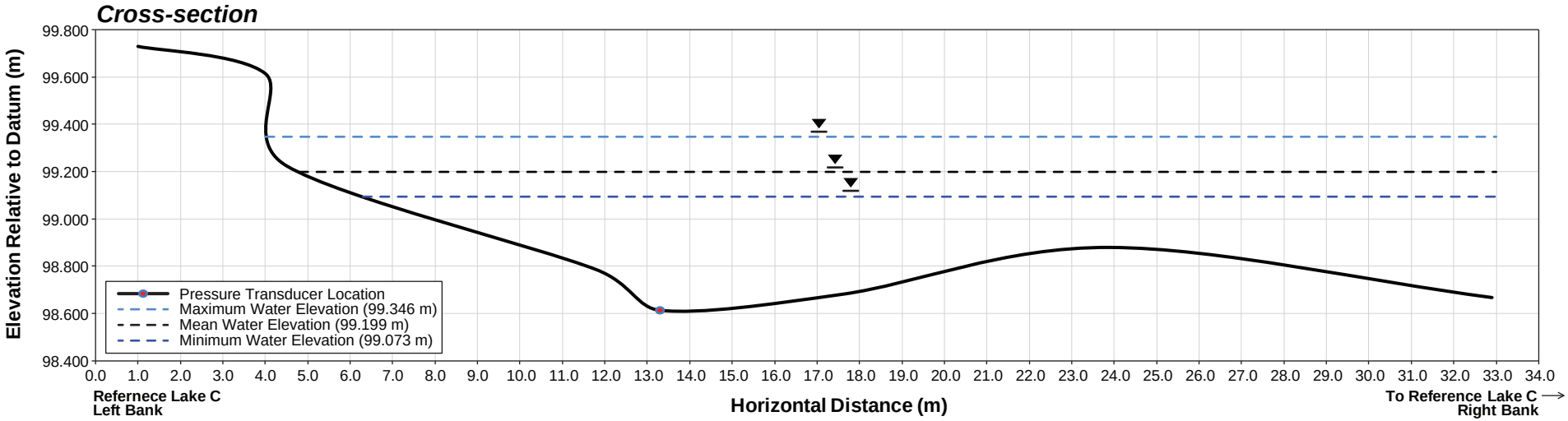


Figure A3-13

Sabina GOLD & SILVER CORP.

REFC-H1 - Stage Discharge Rating Curve and Shoreline Profile
(Rating Period from June 11 - September 11, 2012)

Figure A3-13

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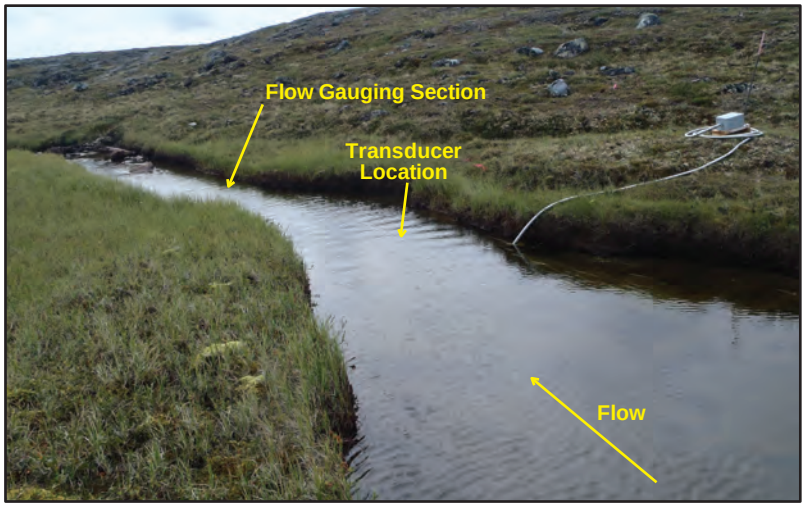
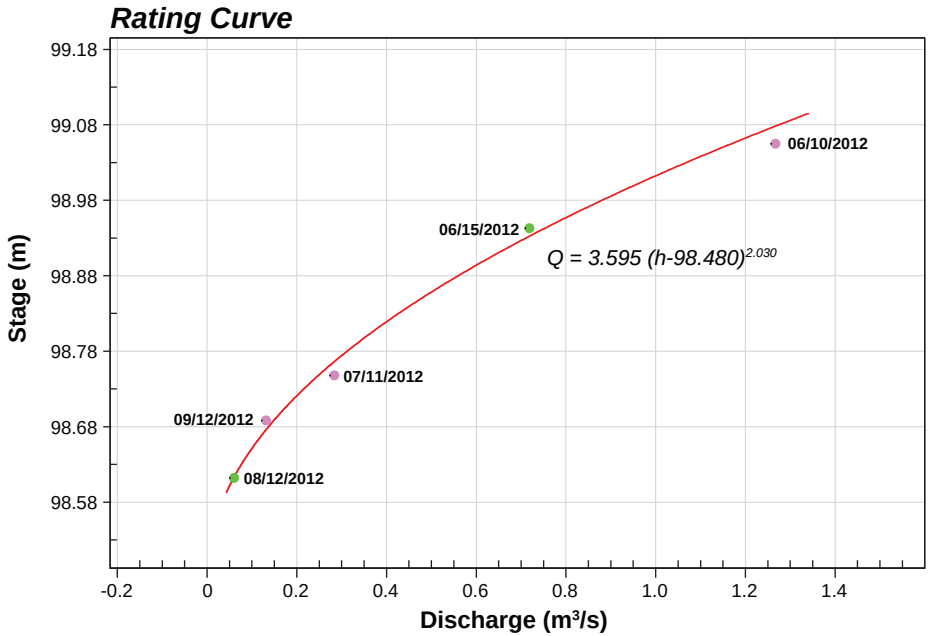


Downstream view of the flow gauging section at KL-H1 under low flow conditions. Note that during the freshet period water flows above the level of the grass banks. Photograph taken August 12, 2012.



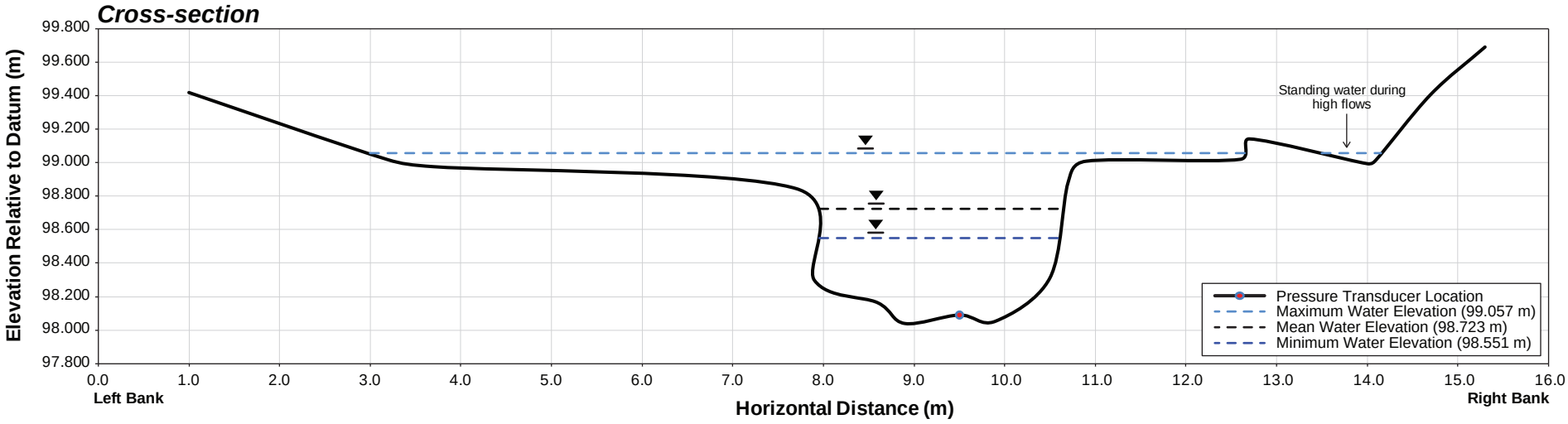


Figure A3-14

Sabina GOLD & SILVER CORP.

KL-H1 - Stage Discharge Rating Curve and Cross-Section
(Rating Period from June 10 - September 12, 2012)

Figure A3-14

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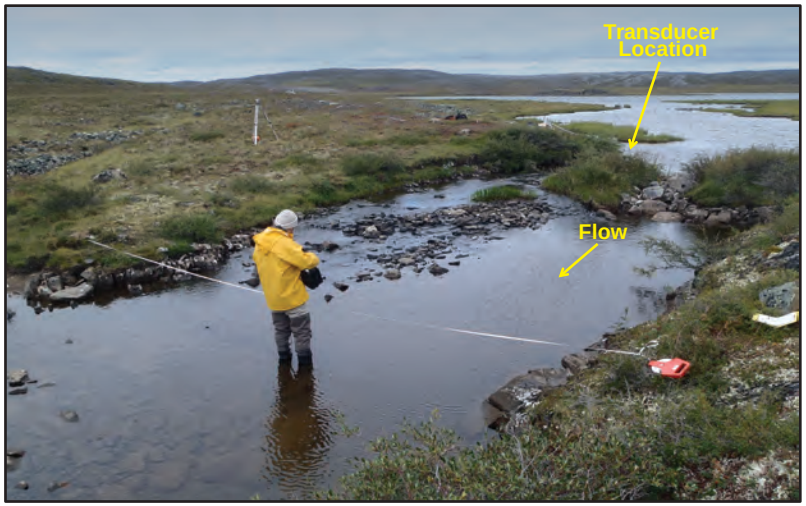
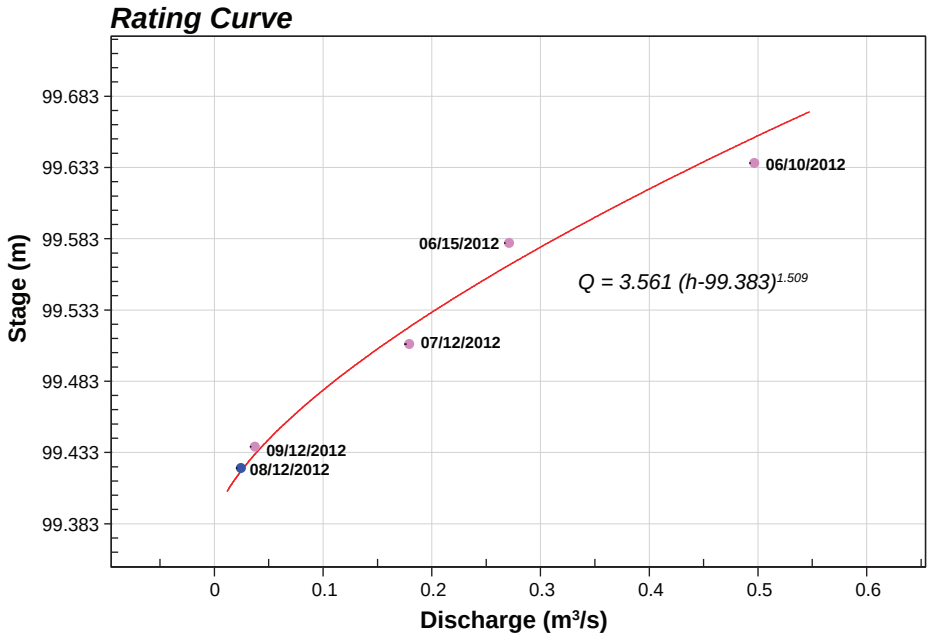


Upstream view of station KL-H2 on George Lake outflow during a flow measurement. The pressure transducer is located in George Lake with the flow gauging section downstream of the outlet. Photograph taken August 12, 2012.



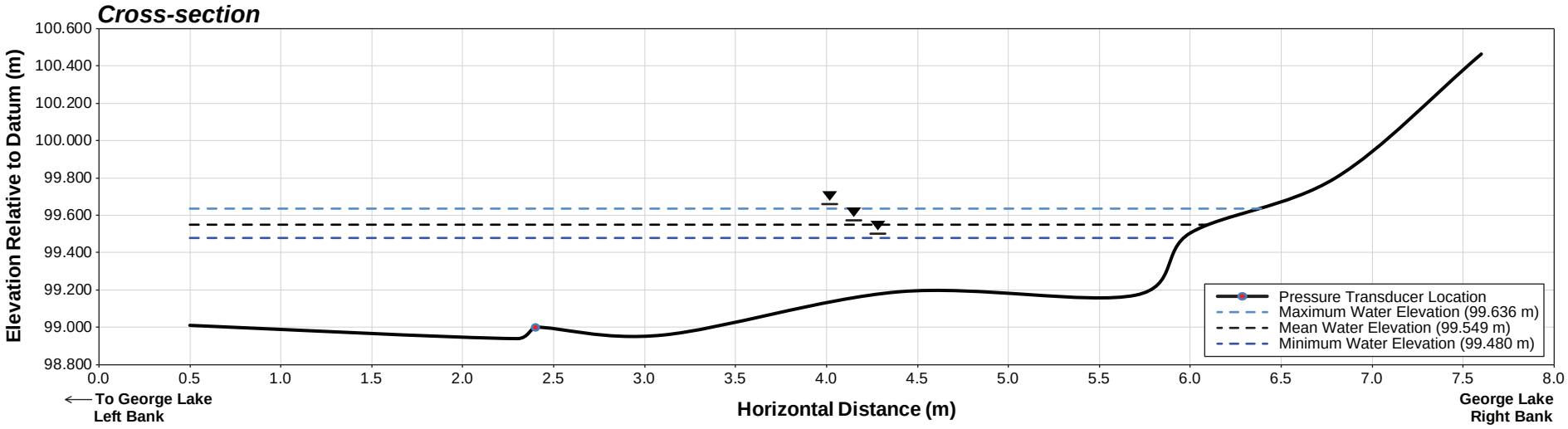


Figure A3-15

Sabina GOLD & SILVER CORP.

KL-H2 - Stage Discharge Rating Curve and Shoreline Profile
(Rating Period from June 10 - September 12, 2012)

Figure A3-15

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Appendix 4
Daily Discharge Tables

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Appendix 4.1. Summary of Daily Discharge [Q] at Hydrometric Station GL-H1

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.275*	0.107	0.011	0.000	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.510*	0.101	0.010	0.000	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.416*	0.094	0.009	0.000	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.322*	0.085	0.008	0.000	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.227	0.079	0.007	0.000	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.133	0.074	0.006	0.000	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.029	0.069	0.005	0.005	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.853	0.065	0.005	*0.002*	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.714	0.062	0.004	*0.002*	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.604	0.062	0.004	*0.002*	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.524	0.059	0.005	*0.002*	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.464	0.061	0.005	*0.002*	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.415	0.058	0.004	*0.002*	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.370	0.055	0.004	*0.001*	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.331	0.051	0.000	*0.001*	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.294	0.046	0.000	*0.001*	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.269	0.043	0.000	*0.001*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.249	0.040	0.000	*0.001*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.233	0.037	0.000	*0.001*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.238	0.034	0.000	*0.001*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.249	0.031	0.000	*0.001*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.228	0.028	0.000	*0.000*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.202	0.026	0.000	*0.000*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.182	0.024	0.000	*0.000*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.173	0.023	0.000	*0.000*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.155	0.023	0.000	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.132	0.021	0.000	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.115	0.019	0.000	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.002*	0.109	0.016	0.000	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.009*	0.111	0.014	0.000	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.050*		0.013	0.000		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.002**	**0.504**	**0.049**	**0.003**	**0.001**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.050**	**1.510**	**0.107**	**0.011**	**0.005**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.109**	**0.013**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.061**	**15.128**	**1.518**	**0.087**	**0.025**	**0.000**	**0.000**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 4.2. Summary of Daily Discharge [Q] at Hydrometric Station GL-H2

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.052*	0.049	0.000	0.000	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.217*	0.044	0.000	0.000	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.212*	0.038	0.000	0.000	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.208*	0.033	0.000	0.000	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.203	0.028	0.000	0.000	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.198	0.024	0.000	0.000	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.197	0.021	0.000	0.001	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.181	0.018	0.000	*0.001*	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.164	0.015	0.000	*0.001*	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.144	0.015	0.000	*0.001*	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.130	0.013	0.000	*0.001*	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.116	0.013	0.000	*0.001*	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.112	0.011	0.000	*0.001*	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.105	0.009	0.000	*0.001*	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.098	0.007	0.000	*0.001*	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.095	0.006	0.000	*0.001*	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.093	0.006	0.000	*0.001*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.092	0.005	0.000	*0.000*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.095	0.006	0.000	*0.000*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.098	0.006	0.000	*0.000*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.100	0.003	0.000	*0.000*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.093	0.002	0.000	*0.000*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.087	0.002	0.000	*0.000*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.083	0.001	0.000	*0.000*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.078	0.002	0.000	*0.000*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.072	0.001	0.000	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.067	0.001	0.000	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.062	0.001	0.000	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.059	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.003*	0.055	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.013*		0.000	0.000		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.001**	**0.119**	**0.012**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.013**	**0.217**	**0.049**	**0.000**	**0.001**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.052**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.016**	**3.567**	**0.382**	**0.001**	**0.011**	**0.000**	**0.000**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 4.3. Summary of Daily Discharge [Q] at Hydrometric Station GL-H3

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.110*	0.036	0.000	0.000	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.516*	0.033	0.000	0.000	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.479*	0.028	0.000	0.000	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.442*	0.025	0.000	0.000	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.404*	0.021	0.000	0.000	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.367*	0.018	0.000	0.001	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.330	0.017	0.000	0.000	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.293	0.017	0.000	0.003	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.230	0.018	0.000	0.004	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.159	0.021	0.000	*0.004*	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.074	0.019	0.000	*0.004*	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.065	0.017	0.000	*0.003*	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.057	0.011	0.000	*0.003*	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.047	0.007	0.000	*0.003*	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.045	0.005	0.000	*0.003*	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.040	0.002	0.000	*0.002*	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.035	0.002	0.000	*0.002*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.031	0.001	0.000	*0.002*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.027	0.000	0.000	*0.002*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.035	0.000	0.000	*0.001*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.041	0.000	0.000	*0.001*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.044	0.000	0.000	*0.001*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.042	0.000	0.000	*0.001*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.043	0.000	0.000	*0.001*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.044	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.043	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.040	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.038	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.042	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.005*	0.042	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.023*		0.000	0.000		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.001**	**0.140**	**0.010**	**0.000**	**0.001**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.023**	**0.516**	**0.036**	**0.000**	**0.004**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.027**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.030**	**4.207**	**0.299**	**0.000**	**0.042**	**0.000**	**0.000**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 4.4. Summary of Daily Discharge [Q] at Hydrometric Station PL-H1

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*2.504*	3.265	0.383	0.075	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*19.883*	3.081	0.377	0.002	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*19.151*	2.919	0.371	0.000	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*18.418*	2.721	0.366	0.000	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*17.685*	2.528	0.356	0.000	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	16.953	2.381	0.328	0.000	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	16.220	2.228	0.312	0.080	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	14.867	2.084	0.289	0.071	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	13.322	1.971	0.292	*0.062*	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	11.869	1.929	0.295	*0.053*	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	10.625	1.760	0.325	*0.044*	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	9.539	1.700	0.337	*0.035*	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	8.605	1.528	0.319	*0.026*	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	7.828	1.374	0.274	*0.017*	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	7.211	1.266	0.207	*0.009*	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	6.651	1.179	0.186	*0.000*	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	6.153	1.114	0.164	*0.000*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	5.741	1.062	0.156	*0.000*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	5.438	0.930	0.161	*0.000*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	5.331	0.756	0.160	*0.000*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	5.211	0.721	0.136	*0.000*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	4.956	0.694	0.111	*0.000*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	4.686	0.599	0.094	*0.000*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	4.530	0.516	0.083	*0.000*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	4.396	0.547	0.072	*0.000*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	4.170	0.480	0.030	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	3.960	0.440	0.068	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	3.752	0.415	0.100	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.005*	3.622	0.404	0.085	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.040*	3.485	0.396	0.078	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.315*		0.388	0.045		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.012**	**8.892**	**1.399**	**0.212**	**0.016**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.315**	**19.883**	**3.265**	**0.383**	**0.080**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**2.504**	**0.388**	**0.030**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.361**	**266.762**	**43.378**	**6.561**	**0.475**	**0.000**	**0.000**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 4.5. Summary of Daily Discharge [Q] at Hydrometric Station PL-H2

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.664*	0.960	0.053	0.103	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*4.224*	0.857	0.050	0.084	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*4.098*	0.799	0.048	0.084	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*3.973*	0.742	0.044	0.086	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*3.848*	0.692	0.008	0.089	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*3.722*	0.656	0.000	0.113	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*3.597*	0.601	0.000	0.129	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*3.472*	0.559	0.026	0.134	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*3.346*	0.486	0.000	0.134	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*3.221*	0.510	0.001	0.133	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*3.095*	0.423	0.043	0.108	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.970	0.378	0.062	0.113	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.845	0.323	0.068	*0.147*	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.589	0.303	0.059	*0.147*	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.320	0.260	0.053	*0.132*	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.123	0.217	0.046	*0.117*	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.958	0.182	0.056	*0.102*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.824	0.197	0.055	*0.087*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.725	0.153	0.060	*0.072*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.732	0.150	0.075	*0.057*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.683	0.142	0.066	*0.042*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.572	0.138	0.056	*0.027*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.498	0.123	0.050	*0.012*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.425	0.107	0.044	*0.000*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.342	0.105	0.044	*0.000*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.236	0.104	0.048	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.153	0.096	0.060	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.085	0.095	0.075	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.003*	1.067	0.081	0.068	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.016*	1.023	0.064	0.071	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.104*		0.056	0.095		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.004**	**2.348**	**0.341**	**0.048**	**0.075**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.104**	**4.224**	**0.960**	**0.095**	**0.147**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.664**	**0.056**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.124**	**70.432**	**10.559**	**1.483**	**2.253**	**0.000**	**0.000**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 4.6. Summary of Daily Discharge [Q] at Hydrometric Station GI-H1

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.429*	0.515	0.020	0.031	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*2.541*	0.459	0.021	0.030	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*2.410*	0.396	0.020	0.030	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*2.280*	0.353	0.018	0.030	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*2.150*	0.310	0.022	0.030	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*2.020*	0.261	0.019	0.030	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.889*	0.231	0.013	0.030	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.759*	0.212	0.011	0.030	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.629	0.166	0.013	0.030	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.499	0.196	0.021	0.030	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.294	0.146	0.032	0.032	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.142	0.137	0.031	0.028	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.051	0.114	0.027	0.031	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.912	0.099	0.031	0.029	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.836	0.079	0.032	*0.026*	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.787	0.061	0.032	*0.024*	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.753	0.049	0.032	*0.021*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.720	0.068	0.032	*0.019*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.721	0.078	0.032	*0.017*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.724	0.098	0.032	*0.014*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.760	0.034	0.032	*0.012*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.736	0.032	0.032	*0.009*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.703	0.053	0.031	*0.007*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.705	0.023	0.031	*0.004*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.704	0.029	0.031	*0.002*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.642	0.032	0.031	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.602	0.038	0.031	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.572	0.035	0.031	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.002*	0.573	0.025	0.031	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.012*	0.557	0.021	0.031	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.073*		0.020	0.031		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.003**	**1.137**	**0.141**	**0.027**	**0.019**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.073**	**2.541**	**0.515**	**0.032**	**0.032**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.429**	**0.020**	**0.011**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.087**	**34.098**	**4.370**	**0.834**	**0.577**	**0.000**	**0.000**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 4.7. Summary of Daily Discharge [Q] at Hydrometric Station EL-H1

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.027*	0.002	0.000	0.001	*0.002*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.100*	0.001	0.000	0.004	*0.002*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.090*	0.000	0.000	0.004	*0.001*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.079*	0.000	0.000	0.005	*0.001*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.069*	0.000	0.000	0.005	*0.001*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.058	0.000	0.000	0.004	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.048	0.000	0.000	0.009	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.036	0.000	0.000	*0.009*	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.028	0.000	0.000	*0.008*	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.021	0.000	0.000	*0.008*	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.018	0.000	0.000	*0.008*	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.016	0.000	0.000	*0.008*	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.013	0.000	0.000	*0.007*	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.010	0.000	0.000	*0.007*	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.009	0.000	0.000	*0.007*	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.008	0.000	0.000	*0.006*	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.007	0.000	0.000	*0.006*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.006	0.000	0.000	*0.006*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.006	0.000	0.000	*0.005*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.010	0.000	0.000	*0.005*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.011	0.000	0.000	*0.005*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.009	0.000	0.000	*0.005*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.006	0.000	0.000	*0.004*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.005	0.000	0.000	*0.004*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.005	0.000	0.000	*0.004*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.003	0.000	0.000	*0.003*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.002	0.000	0.000	*0.003*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.001	0.000	0.000	*0.003*	*0.000*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.003	0.000	0.000	*0.002*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.002*	0.004	0.000	0.000	*0.002*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.007*		0.000	0.000		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.023**	**0.000**	**0.000**	**0.005**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.007**	**0.100**	**0.002**	**0.000**	**0.009**	**0.002**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.001**	**0.000**	**0.000**	**0.001**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.010**	**0.703**	**0.003**	**0.000**	**0.156**	**0.006**	**0.000**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 4.8. Summary of Daily Discharge [Q] at Hydrometric Station WL-H1

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.359*	0.220	0.006	0.017	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*2.063*	0.215	0.005	0.016	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.986*	0.208	0.003	0.019	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.908*	0.202	0.001	0.020	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.831*	0.197	0.001	0.019	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.753*	0.193	0.000	0.020	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.676	0.187	0.000	0.055	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.598	0.180	0.000	0.049	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.504	0.167	0.000	0.055	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.409	0.182	0.008	0.054	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.326	0.161	0.016	0.053	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.247	0.144	0.012	0.043	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.167	0.113	0.009	0.052	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.082	0.090	0.009	0.045	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.002	0.077	0.007	*0.038*	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.917	0.071	0.006	*0.032*	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.822	0.073	0.007	*0.025*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.729	0.077	0.008	*0.018*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.652	0.060	0.009	*0.012*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.657	0.043	0.010	*0.005*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.584	0.029	0.008	*0.000*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.486	0.028	0.007	*0.000*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.433	0.027	0.006	*0.000*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.402	0.016	0.006	*0.000*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.356	0.022	0.006	*0.000*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.302	0.019	0.006	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.250	0.019	0.013	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.225	0.014	0.014	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.002*	0.231	0.010	0.012	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.011*	0.225	0.008	0.017	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.063*		0.007	0.015		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.002**	**0.973**	**0.099**	**0.007**	**0.021**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.063**	**2.063**	**0.220**	**0.017**	**0.055**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.225**	**0.007**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.076**	**29.181**	**3.060**	**0.229**	**0.644**	**0.000**	**0.000**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 4.9. Summary of Daily Discharge [Q] at Hydrometric Station REFB-H1

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.067*	0.002	0.000	0.000	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.292*	0.001	0.000	0.000	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.272*	0.000	0.000	0.000	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.251*	0.000	0.000	0.000	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.231*	0.000	0.000	0.000	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.211*	0.000	0.000	0.000	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.190*	0.000	0.000	0.000	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.170*	0.000	0.000	0.000	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.150	0.000	0.000	0.000	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.129	0.000	0.000	0.000	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.107	0.000	0.000	0.000	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.083	0.000	0.000	0.000	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.065	0.000	0.000	0.000	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.050	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.033	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.026	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.019	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.015	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.014	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.013	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.014	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.010	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.008	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.007	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.006	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.004	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.003	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.003	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.003	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.004*	0.003	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.015*		0.000	0.000		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.001**	**0.082**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.015**	**0.292**	**0.002**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.003**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.020**	**2.450**	**0.003**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 4.10. Summary of Daily Discharge [Q] at Hydrometric Station BL-H1

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.026*	0.009	0.000	0.006	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.095*	0.007	0.000	0.006	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.090*	0.006	0.000	0.006	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.085*	0.005	0.000	0.006	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.080*	0.004	0.000	0.007	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.075*	0.003	0.000	0.007	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.070*	0.004	0.000	0.010	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.065*	0.004	0.000	0.011	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.060*	0.003	0.000	0.012	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.055*	0.006	0.000	0.011	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.050*	0.005	0.001	*0.011*	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.045	0.006	0.002	*0.010*	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.040	0.004	0.003	*0.009*	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.033	0.003	0.002	*0.008*	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.029	0.002	0.003	*0.008*	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.026	0.002	0.002	*0.007*	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.023	0.002	0.003	*0.006*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.022	0.002	0.003	*0.006*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.022	0.002	0.003	*0.005*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.024	0.001	0.003	*0.004*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.022	0.001	0.003	*0.004*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.019	0.000	0.003	*0.003*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.016	0.000	0.003	*0.002*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.016	0.000	0.003	*0.002*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.014	0.000	0.003	*0.001*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.012	0.001	0.003	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.010	0.001	0.005	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.009	0.001	0.006	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.012	0.000	0.006	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.002*	0.011	0.000	0.007	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.007*		0.000	0.007		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.039**	**0.003**	**0.002**	**0.006**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.007**	**0.095**	**0.009**	**0.007**	**0.012**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.009**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.010**	**1.157**	**0.085**	**0.073**	**0.169**	**0.000**	**0.000**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 4.11. Summary of Daily Discharge [Q] at Hydrometric Station BL-H2

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.012*	1.776	0.281	0.254	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.028*	1.648	0.280	0.205	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.062*	1.523	0.251	0.226	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.138*	1.453	0.227	0.252	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.307*	1.368	0.316	0.246	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.686*	1.259	0.264	0.204	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.531*	1.188	0.206	0.163	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	7.632	1.151	0.190	0.121	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	9.568	1.089	0.209	0.079	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	7.694	1.217	0.279	*0.038*	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	6.544	1.115	0.314	*0.000*	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	5.486	1.019	0.292	*0.000*	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	5.012	0.988	0.254	*0.000*	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	4.843	0.928	0.307	*0.000*	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	4.185	0.821	0.260	*0.000*	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	3.724	0.722	0.204	*0.000*	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	3.446	0.646	0.205	*0.000*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	3.176	0.758	0.221	*0.000*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	3.067	0.841	0.237	*0.000*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.825	0.820	0.306	*0.000*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.770	0.485	0.258	*0.000*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.656	0.465	0.231	*0.000*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.510	0.595	0.202	*0.000*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.385	0.362	0.189	*0.000*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.252	0.451	0.184	*0.000*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.064	0.445	0.176	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.960	0.517	0.201	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	1.890	0.437	0.275	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	1.879	0.351	0.251	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.002*	1.848	0.313	0.347	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.006*		0.289	0.242		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**3.073**	**0.872**	**0.247**	**0.060**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.006**	**9.568**	**1.776**	**0.347**	**0.254**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.012**	**0.289**	**0.176**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.010**	**92.183**	**27.040**	**7.656**	**1.788**	**0.000**	**0.000**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 4.12. Summary of Daily Discharge [Q] at Hydrometric Station BL-H3

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.288*	0.087	0.000	0.066	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.595*	0.070	0.000	0.064	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.478*	0.055	0.000	0.061	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.361*	0.046	0.000	0.059	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.244*	0.038	0.000	0.059	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.128*	0.032	0.000	0.057	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.011*	0.026	0.000	0.084	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.894	0.024	0.000	0.094	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.777	0.025	0.000	0.095	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.608	0.055	0.025	*0.094*	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.488	0.049	0.029	*0.089*	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.401	0.042	0.029	*0.083*	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.341	0.033	0.025	*0.077*	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.294	0.028	0.024	*0.072*	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.257	0.023	0.025	*0.066*	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.227	0.014	0.027	*0.061*	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.204	0.011	0.035	*0.055*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.184	0.023	0.040	*0.049*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.176	0.011	0.040	*0.044*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.188	0.002	0.040	*0.038*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.184	0.000	0.042	*0.033*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.167	0.000	0.040	*0.027*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.147	0.000	0.038	*0.021*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.138	0.000	0.037	*0.016*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.128	0.000	0.037	*0.010*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.111	0.000	0.036	*0.005*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.095	0.000	0.061	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.083	0.000	0.067	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.002*	0.103	0.000	0.064	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.009*	0.107	0.000	0.072	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.052*		0.000	0.068		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.002**	**0.480**	**0.022**	**0.029**	**0.049**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.052**	**1.595**	**0.087**	**0.072**	**0.095**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.083**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.064**	**14.406**	**0.695**	**0.898**	**1.478**	**0.000**	**0.000**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 4.13. Summary of Daily Discharge [Q] at Hydrometric Station REFC-H1

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.095*	0.069	0.002	0.000	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.440*	0.065	0.000	0.000	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.418*	0.060	0.000	0.000	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.396*	0.057	0.000	0.000	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.374*	0.053	0.000	0.000	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.352*	0.048	0.000	0.000	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.330*	0.045	0.000	0.000	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.308*	0.042	0.000	0.000	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.286*	0.039	0.000	0.000	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.264*	0.041	0.000	0.000	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.242	0.039	0.000	0.000	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.220	0.042	0.000	*0.000*	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.192	0.039	0.000	*0.000*	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.171	0.036	0.000	*0.000*	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.156	0.032	0.000	*0.000*	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.144	0.028	0.000	*0.000*	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.132	0.024	0.000	*0.000*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.122	0.025	0.000	*0.000*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.117	0.024	0.000	*0.000*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.115	0.021	0.000	*0.000*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.112	0.016	0.000	*0.000*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.107	0.015	0.000	*0.000*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.100	0.015	0.000	*0.000*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.099	0.009	0.000	*0.000*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.095	0.008	0.000	*0.000*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.090	0.008	0.000	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.085	0.008	0.000	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.081	0.006	0.000	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.077	0.005	0.000	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.005*	0.074	0.004	0.000	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.021*		0.003	0.000		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.001**	**0.193**	**0.030**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.021**	**0.440**	**0.069**	**0.002**	**0.000**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.074**	**0.003**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.026**	**5.795**	**0.924**	**0.004**	**0.000**	**0.000**	**0.000**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 4.14. Summary of Daily Discharge [Q] at Hydrometric Station KL-H1

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.310*	0.452	0.000	0.102	*0.101*	*0.021*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.740*	0.418	0.000	0.086	*0.098*	*0.018*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.666*	0.387	0.000	0.083	*0.096*	*0.016*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.592*	0.360	0.000	0.085	*0.093*	*0.013*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.518*	0.337	0.000	0.084	*0.091*	*0.011*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.444*	0.312	0.000	0.077	*0.088*	*0.008*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.370*	0.286	0.000	0.153	*0.085*	*0.006*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.296*	0.266	0.000	0.169	*0.083*	*0.003*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.222*	0.250	0.000	0.157	*0.080*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.148	0.264	0.005	0.153	*0.078*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.074	0.253	0.047	0.153	*0.075*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.943	0.252	0.056	0.150	*0.073*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.870	0.232	0.053	*0.147*	*0.070*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.819	0.211	0.053	*0.145*	*0.067*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.766	0.190	0.048	*0.142*	*0.065*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.714	0.168	0.006	*0.140*	*0.062*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.675	0.147	0.001	*0.137*	*0.060*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.653	0.147	0.000	*0.135*	*0.057*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.652	0.150	0.033	*0.132*	*0.055*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.674	0.148	0.086	*0.129*	*0.052*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.681	0.116	0.080	*0.127*	*0.049*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.629	0.096	0.069	*0.124*	*0.047*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.601	0.094	0.059	*0.122*	*0.044*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.604	0.070	0.054	*0.119*	*0.042*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.588	0.062	0.053	*0.116*	*0.039*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.557	0.060	0.052	*0.114*	*0.036*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.529	0.069	0.067	*0.111*	*0.034*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.506	0.061	0.100	*0.109*	*0.031*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.002*	0.495	0.043	0.103	*0.106*	*0.029*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.010*	0.483	0.000	0.124	*0.104*	*0.026*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.055*		0.000	0.110		*0.024*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.002**	**0.894**	**0.190**	**0.041**	**0.124**	**0.062**	**0.003**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.055**	**1.740**	**0.452**	**0.124**	**0.169**	**0.101**	**0.021**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.310**	**0.000**	**0.000**	**0.077**	**0.024**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.067**	**26.820**	**5.901**	**1.261**	**3.710**	**1.930**	**0.096**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 4.15. Summary of Daily Discharge [Q] at Hydrometric Station KL-H2

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.132*	0.245	0.000	0.025	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.644*	0.236	0.000	0.022	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.618*	0.224	0.000	0.022	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.592*	0.214	0.000	0.024	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.567*	0.201	0.021	0.023	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.541*	0.189	0.025	0.018	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.515*	0.177	0.019	0.037	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.489*	0.169	0.014	0.040	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.464*	0.162	0.022	0.042	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.438	0.169	0.029	0.045	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.412	0.160	0.027	0.052	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.373	0.168	0.026	0.047	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.353	0.159	0.023	*0.041*	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.336	0.144	0.025	*0.036*	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.313	0.131	0.019	*0.031*	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.294	0.119	0.017	*0.026*	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.285	0.113	0.017	*0.021*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.279	0.104	0.018	*0.016*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.291	0.102	0.022	*0.011*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.289	0.095	0.027	*0.006*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.297	0.073	0.027	*0.001*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.290	0.063	0.025	*0.000*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.284	0.061	0.024	*0.000*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.285	0.044	0.023	*0.000*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.286	0.045	0.022	*0.000*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.281	0.036	0.021	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.275	0.036	0.026	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.267	0.028	0.030	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.262	0.021	0.032	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.006*	0.255	0.018	0.038	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.027*		0.010	0.024		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.001**	**0.367**	**0.120**	**0.021**	**0.020**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.027**	**0.644**	**0.245**	**0.038**	**0.052**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.132**	**0.010**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.034**	**11.006**	**3.716**	**0.645**	**0.587**	**0.000**	**0.000**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 5
Annual Hydrographs

Rescan™
Engineers and Scientists

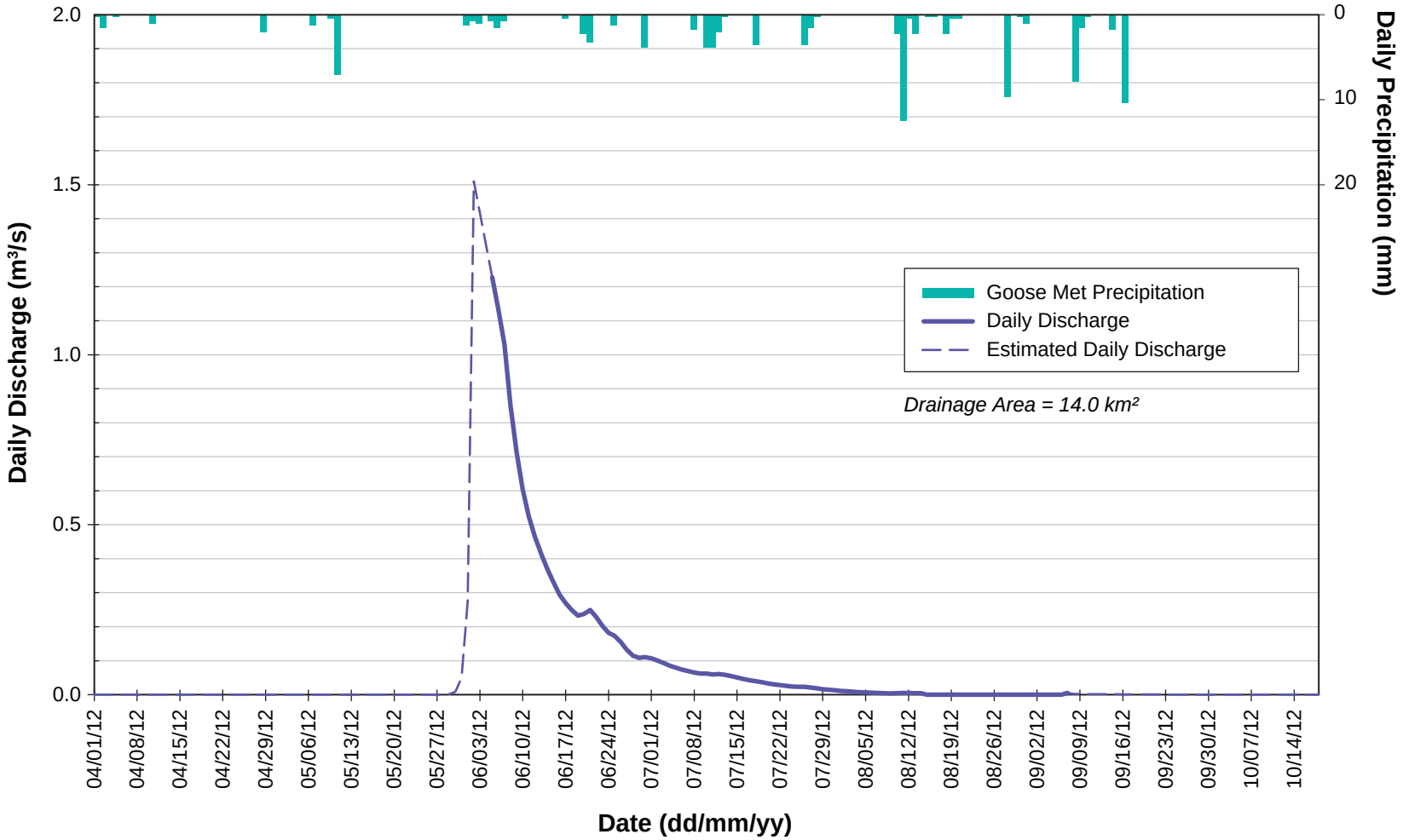


Figure A5-1

Sabina GOLD & SILVER CORP.

Annual Hydrograph at GL-H1 Hydrometric Monitoring Station, 2012

Figure A5-1

Rescan™ Engineers & Scientists

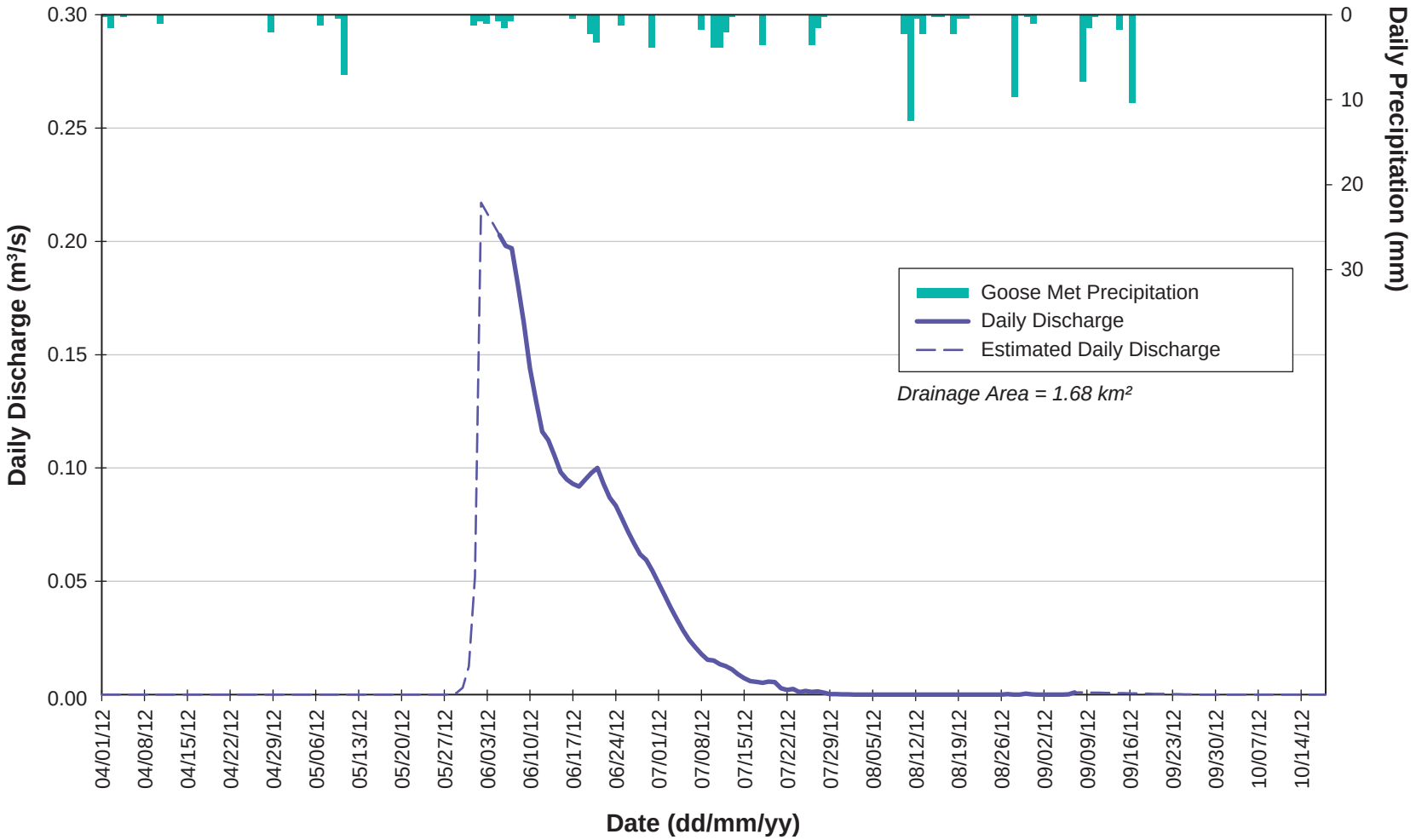


Figure A5-2

Sabina GOLD & SILVER CORP.

Annual Hydrograph at GL-H2
Hydrometric Monitoring Station, 2012

Figure A5-2

Rescan™ Engineers & Scientists

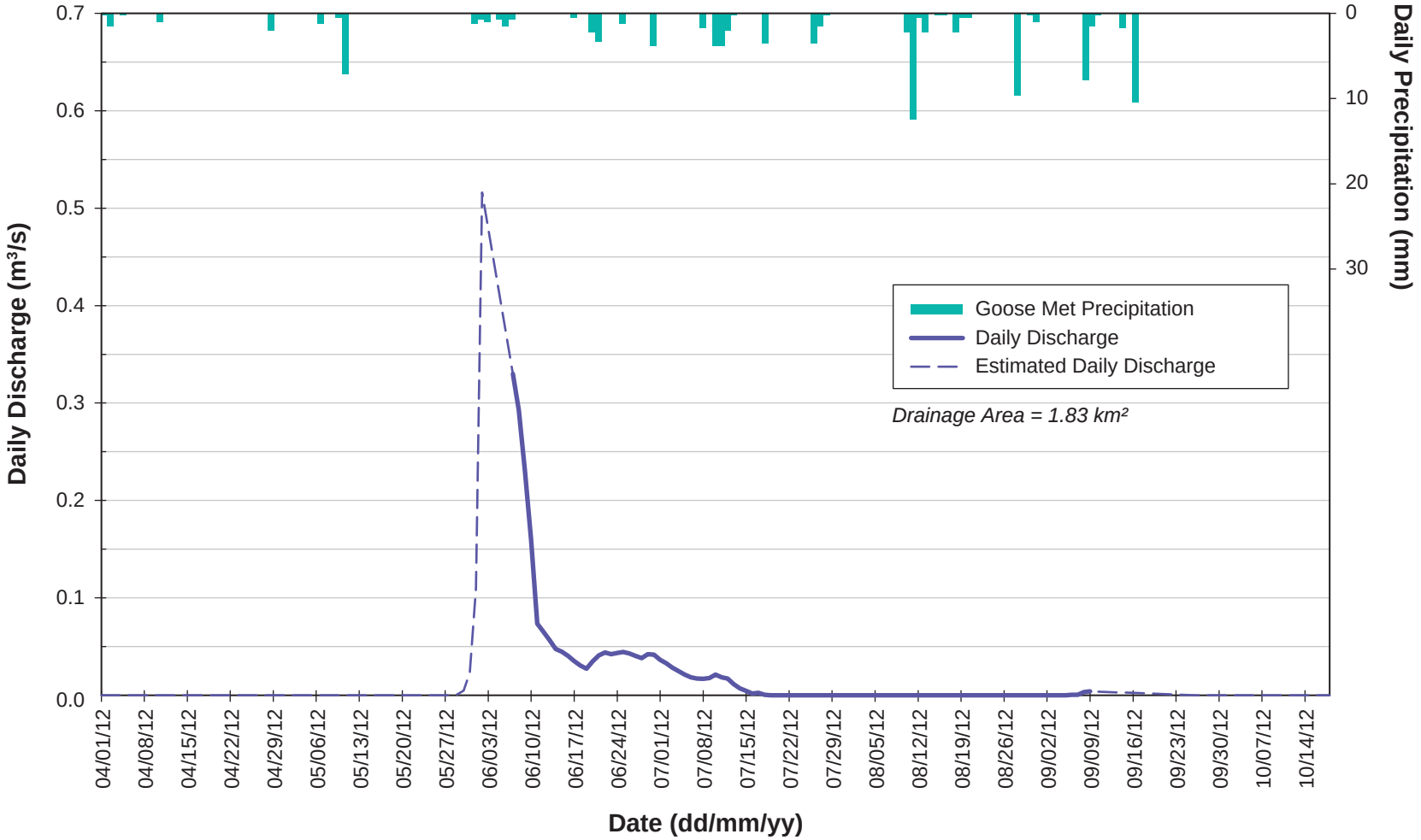


Figure A5-3

Sabina GOLD & SILVER CORP.

Annual Hydrograph at GL-H3 Hydrometric Monitoring Station, 2012

Figure A5-3

Rescan™ Engineers & Scientists

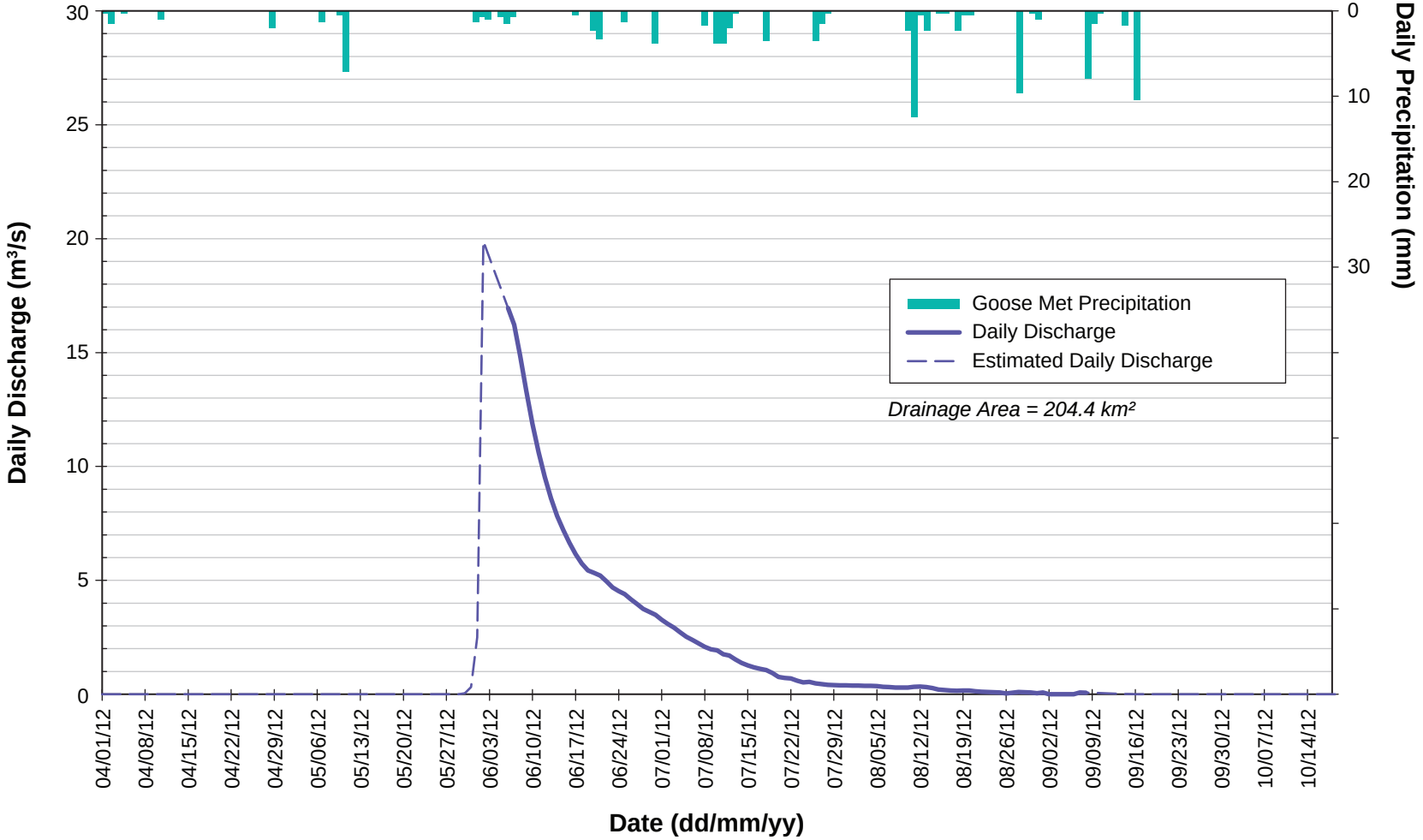


Figure A5-4

Sabina GOLD & SILVER CORP.

Annual Hydrograph at PL-H1
Hydrometric Monitoring Station, 2012

Figure A5-4

Rescan™ Engineers & Scientists

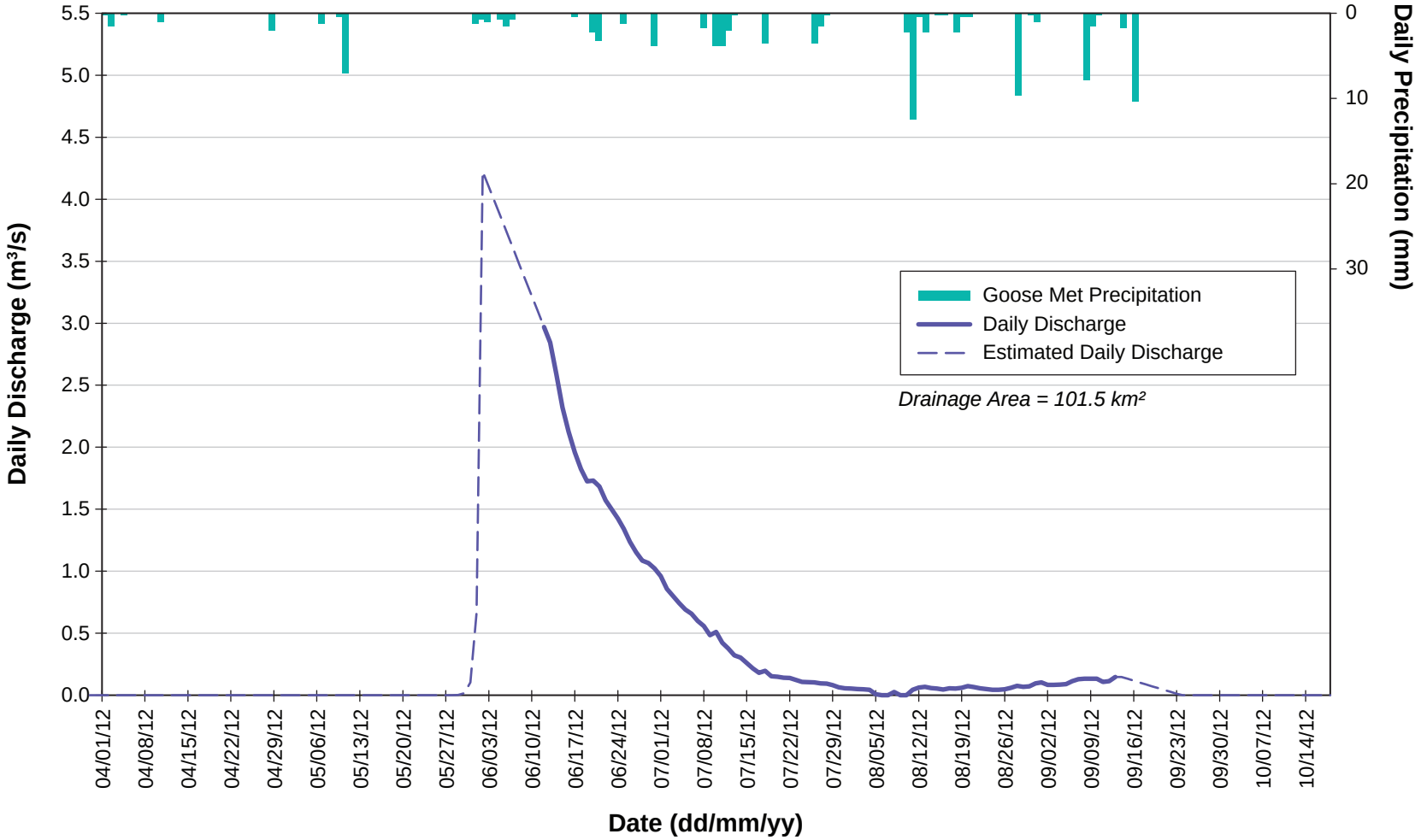


Figure A5-5

Sabina GOLD & SILVER CORP.

Annual Hydrograph at PL-H2
Hydrometric Monitoring Station, 2012

Figure A5-5

Rescan™ Engineers & Scientists

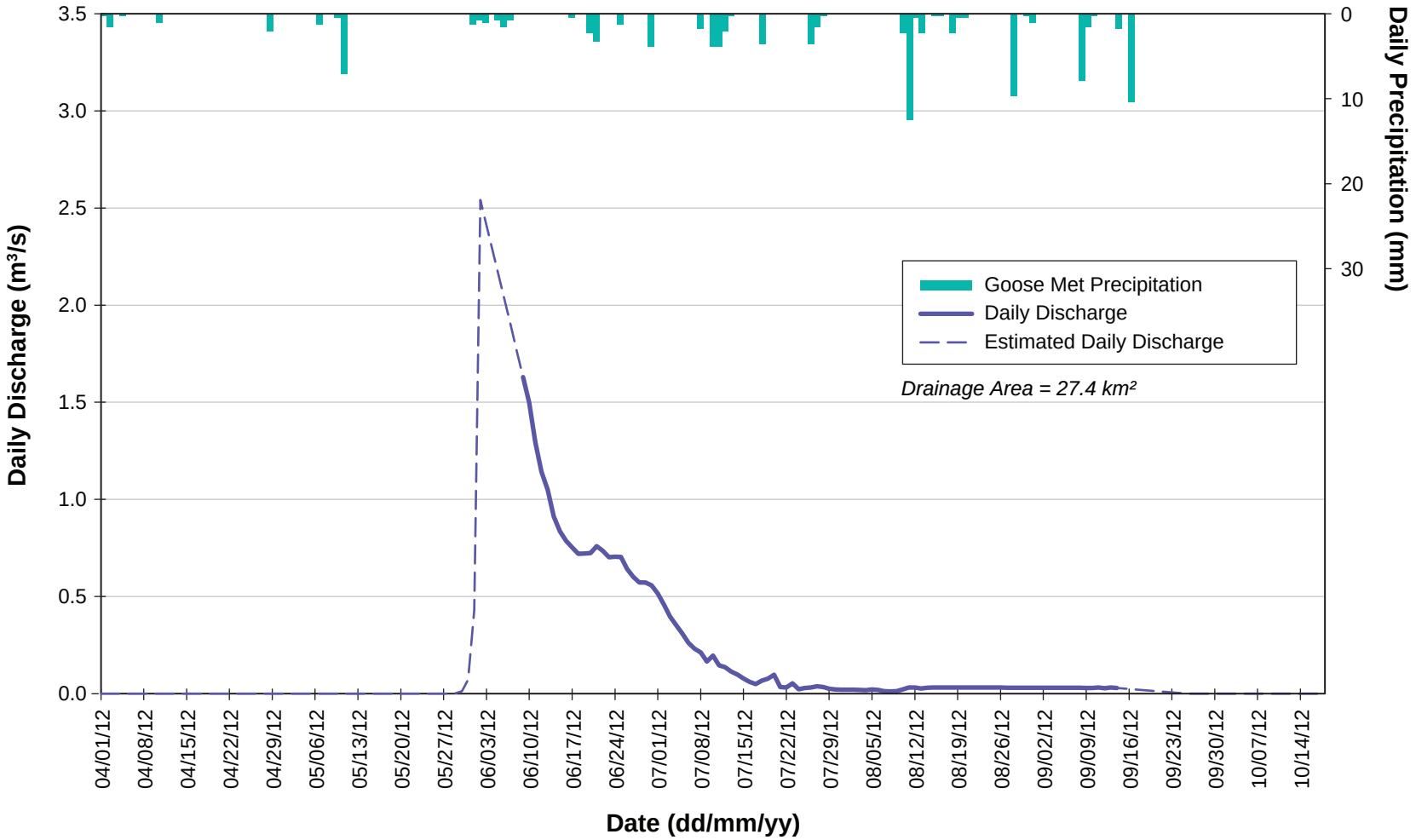


Figure A5-6

Sabina GOLD & SILVER CORP.

Annual Hydrograph at GI-H1 Hydrometric Monitoring Station, 2012

Figure A5-6

Rescan™ Engineers & Scientists

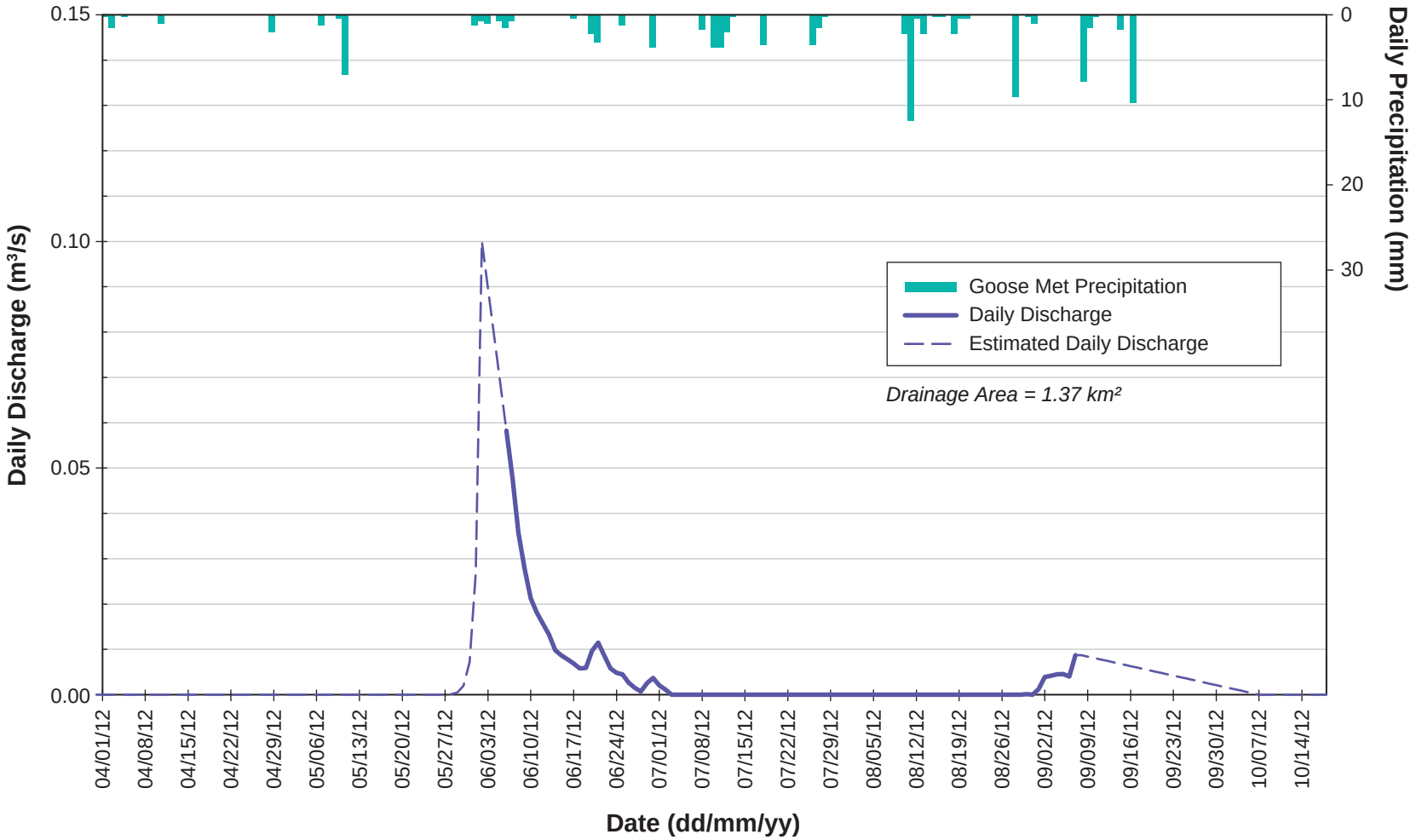


Figure A5-7

Sabina GOLD & SILVER CORP.

Annual Hydrograph at EL-H1 Hydrometric Monitoring Station, 2012

Figure A5-7

Rescan™ Engineers & Scientists

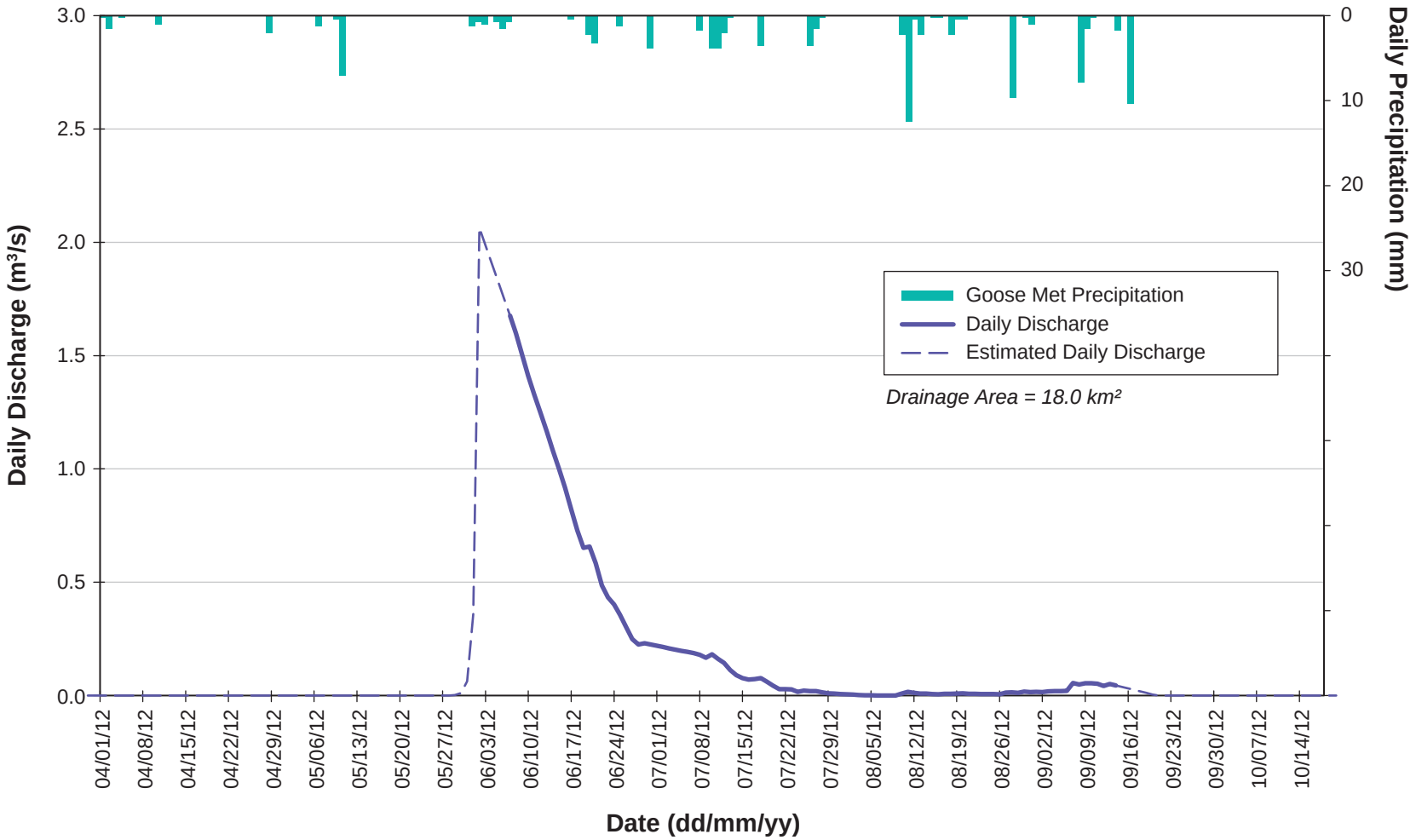


Figure A5-8

Sabina GOLD & SILVER CORP.

Annual Hydrograph at WL-H1
Hydrometric Monitoring Station, 2012

Figure A5-8

Rescan™ Engineers & Scientists

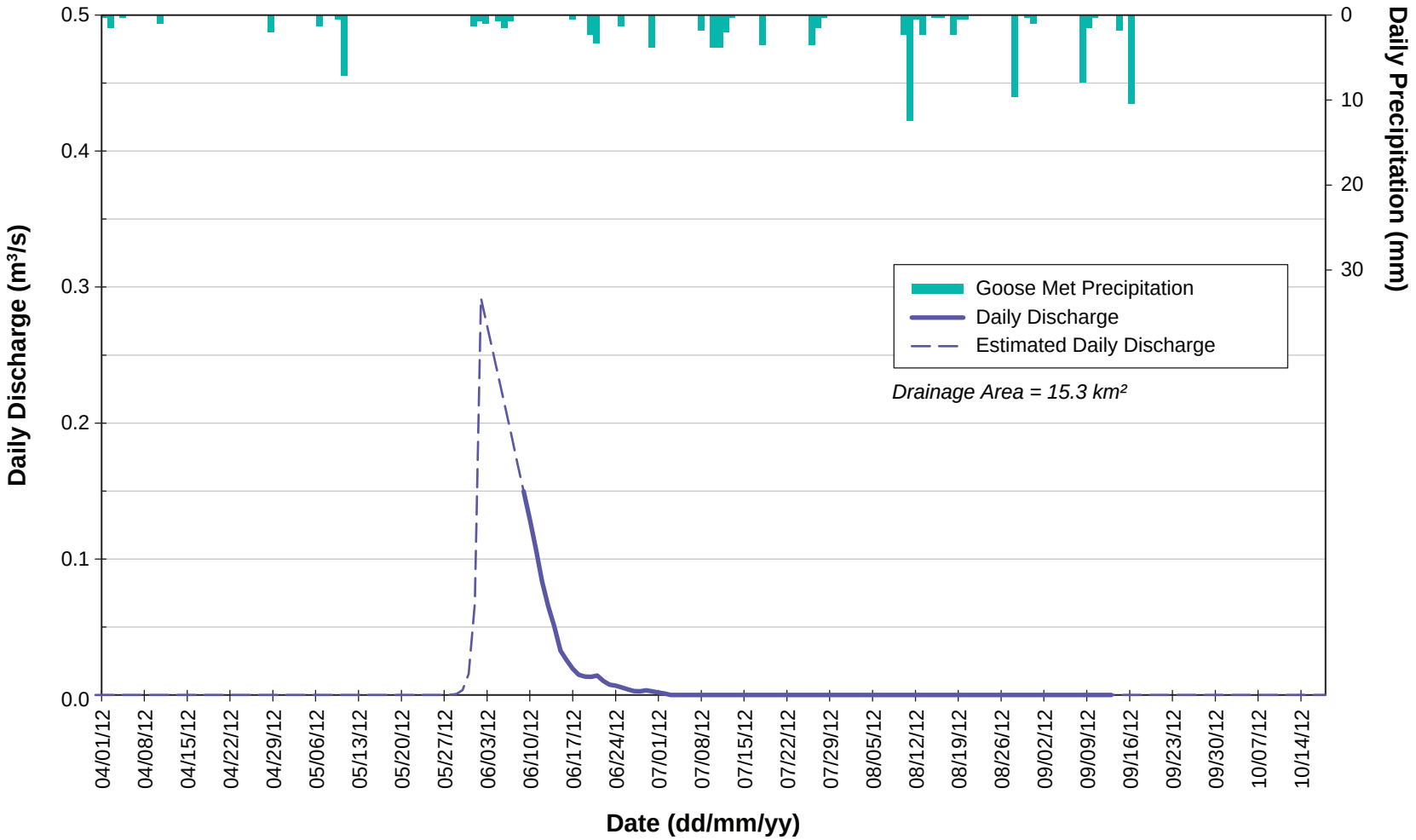


Figure A5-9

Sabina GOLD & SILVER CORP.

Annual Hydrograph at REFB-H1 Hydrometric Monitoring Station, 2012

Figure A5-9

Rescan™ Engineers & Scientists

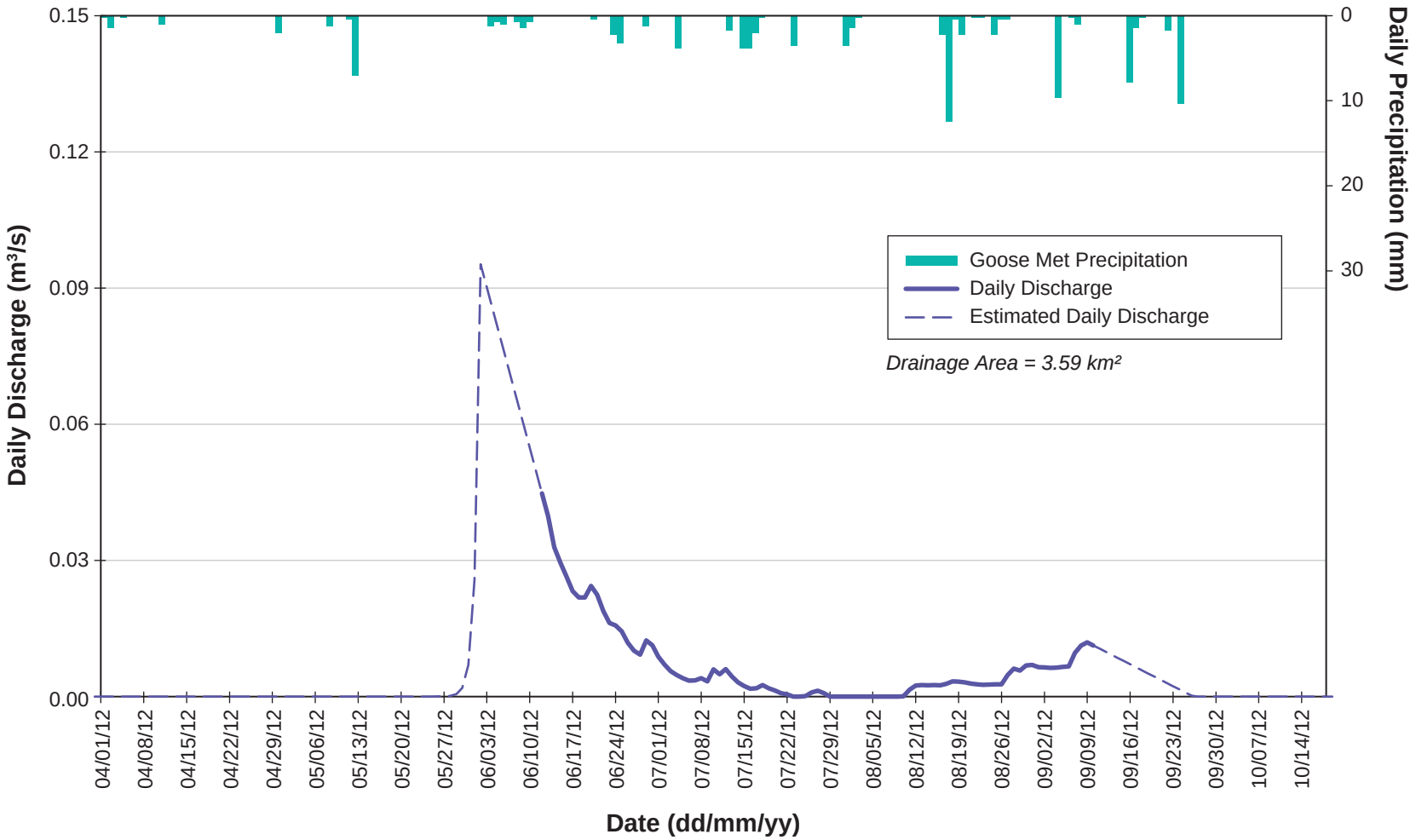


Figure A5-10

Sabina GOLD & SILVER CORP.

Annual Hydrograph at BL-H1
Hydrometric Monitoring Station, 2012

Figure A5-10

Rescan™ Engineers & Scientists

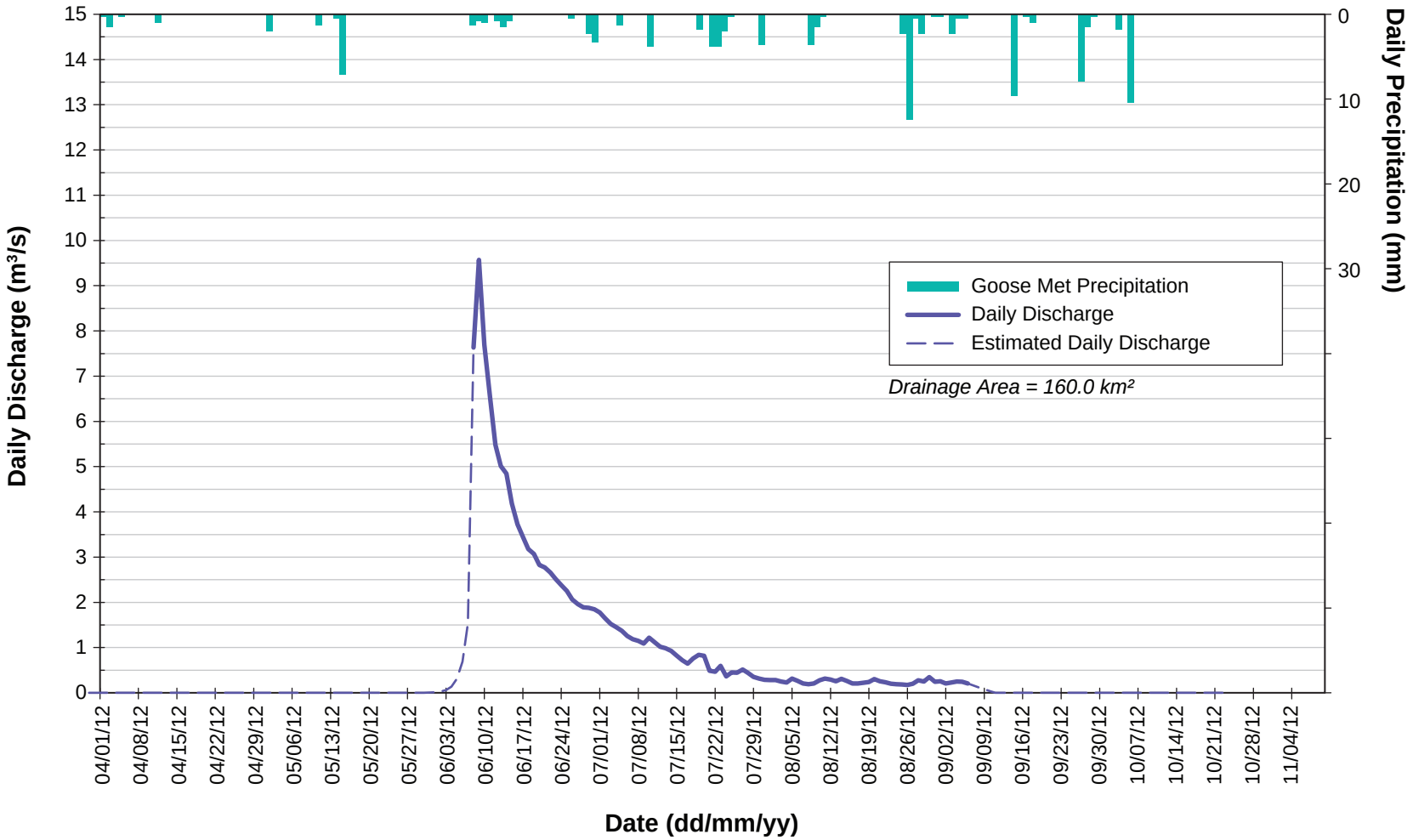


Figure A5-11

Sabina GOLD & SILVER CORP.

Annual Hydrograph at BL-H2
Hydrometric Monitoring Station, 2012

Figure A5-11

Rescan™ Engineers & Scientists

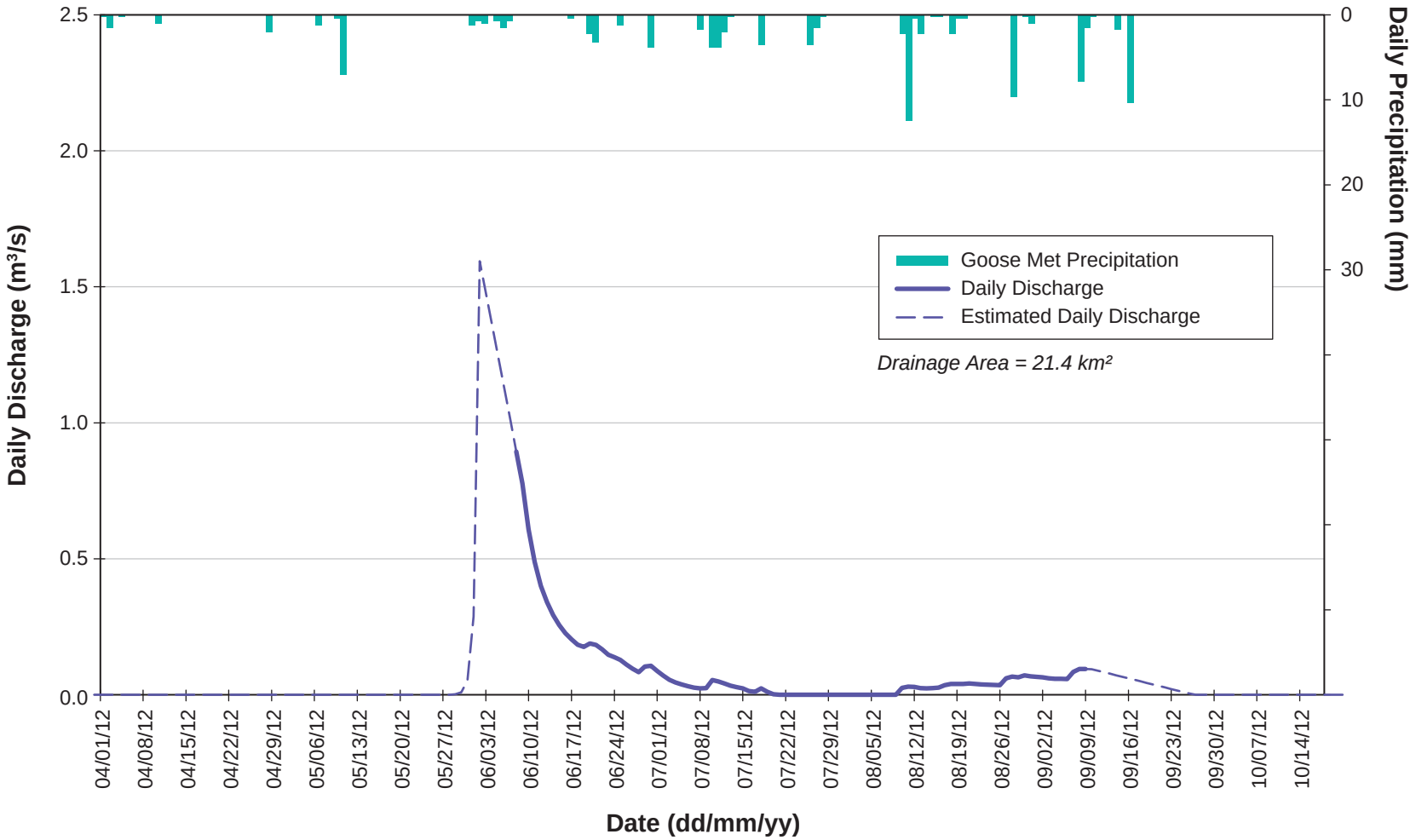


Figure A5-12

Sabina GOLD & SILVER CORP.

Annual Hydrograph at BL-H3
Hydrometric Monitoring Station, 2012

Figure A5-12

Rescan™ Engineers & Scientists

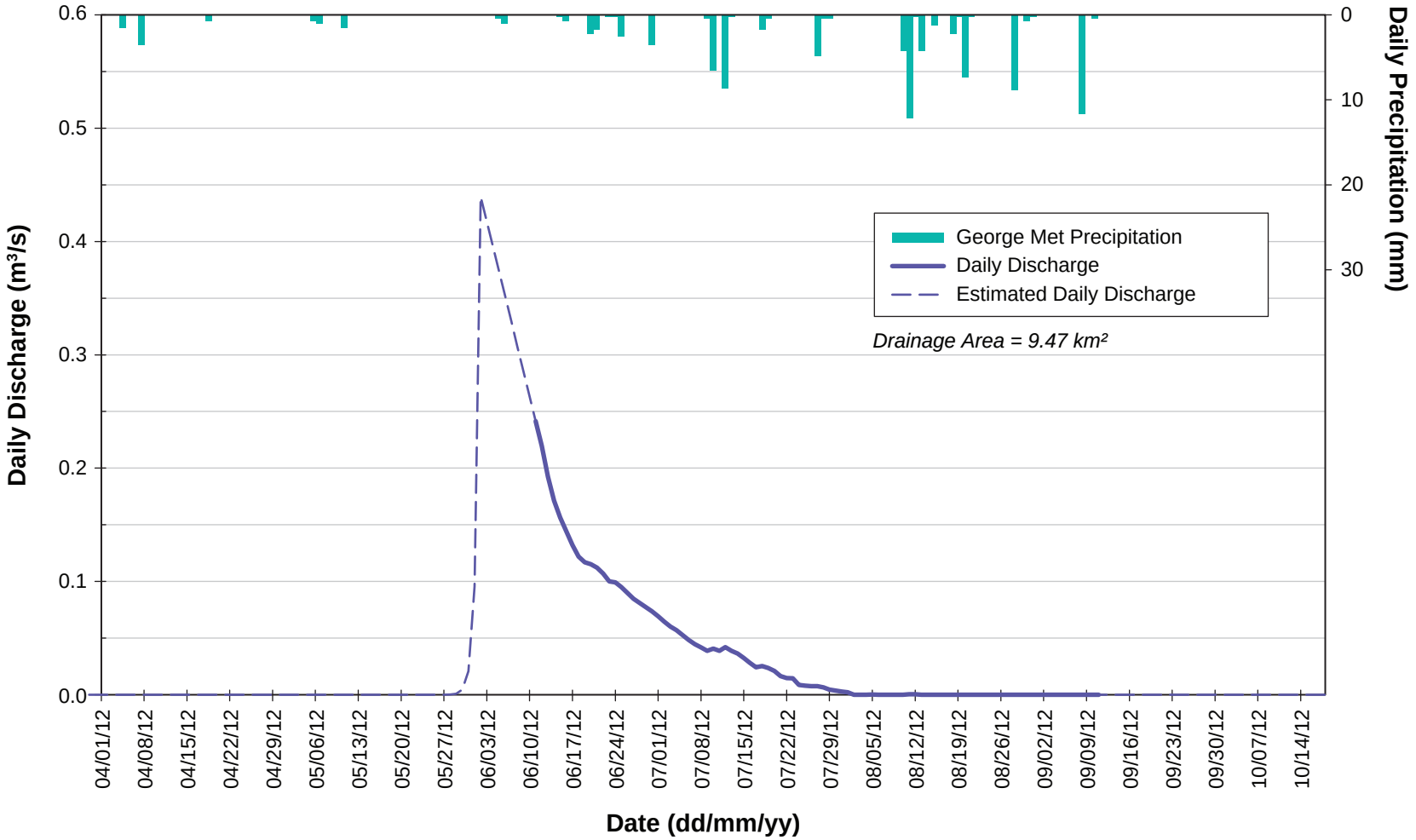


Figure A5-13

Sabina GOLD & SILVER CORP.

Annual Hydrograph at REFC-H1 Hydrometric Monitoring Station, 2012

Figure A5-13

Rescan™ Engineers & Scientists

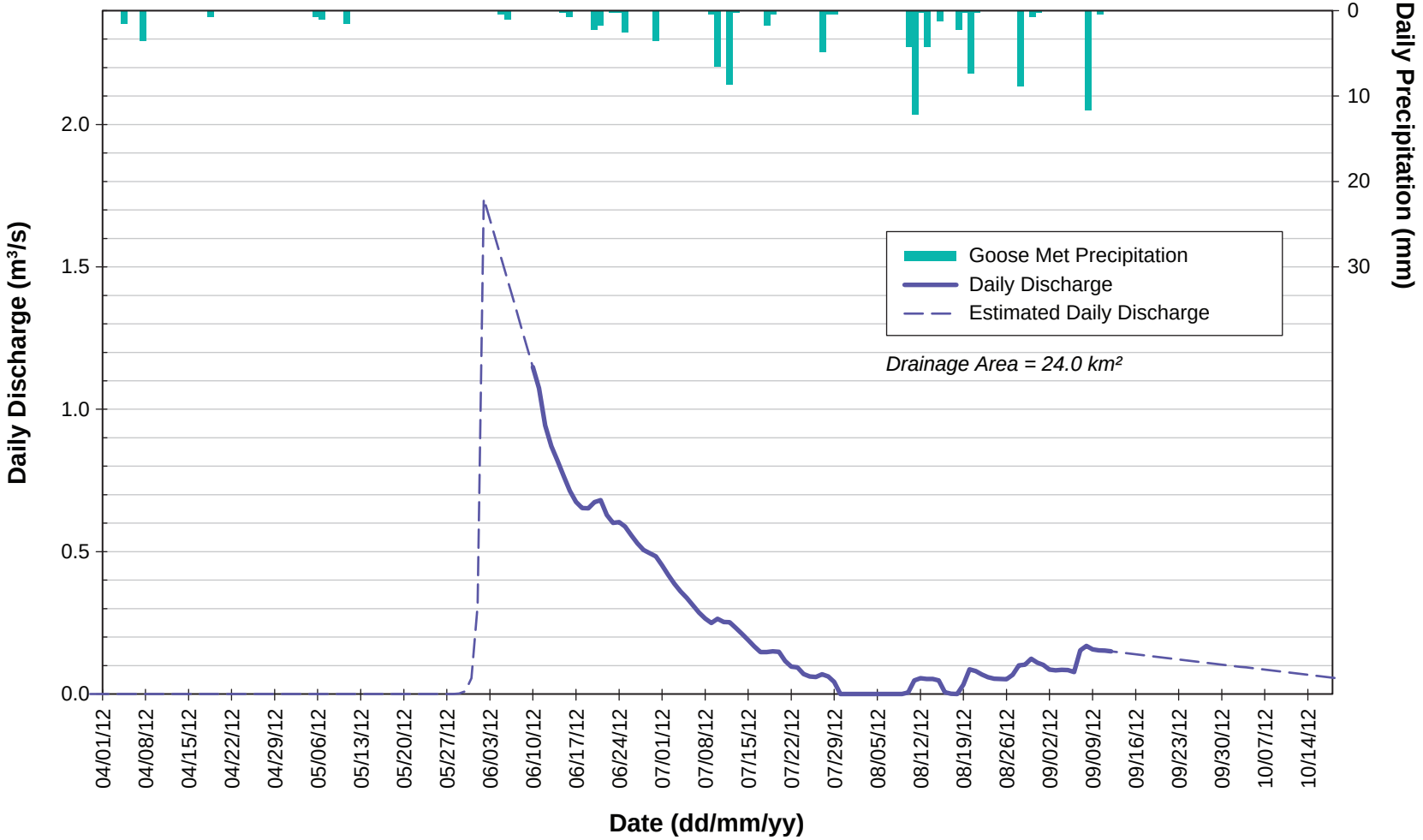


Figure A5-14

Sabina GOLD & SILVER CORP.

Annual Hydrograph at KL-H1 Hydrometric Monitoring Station, 2012

Figure A5-14

Rescan™ Engineers & Scientists

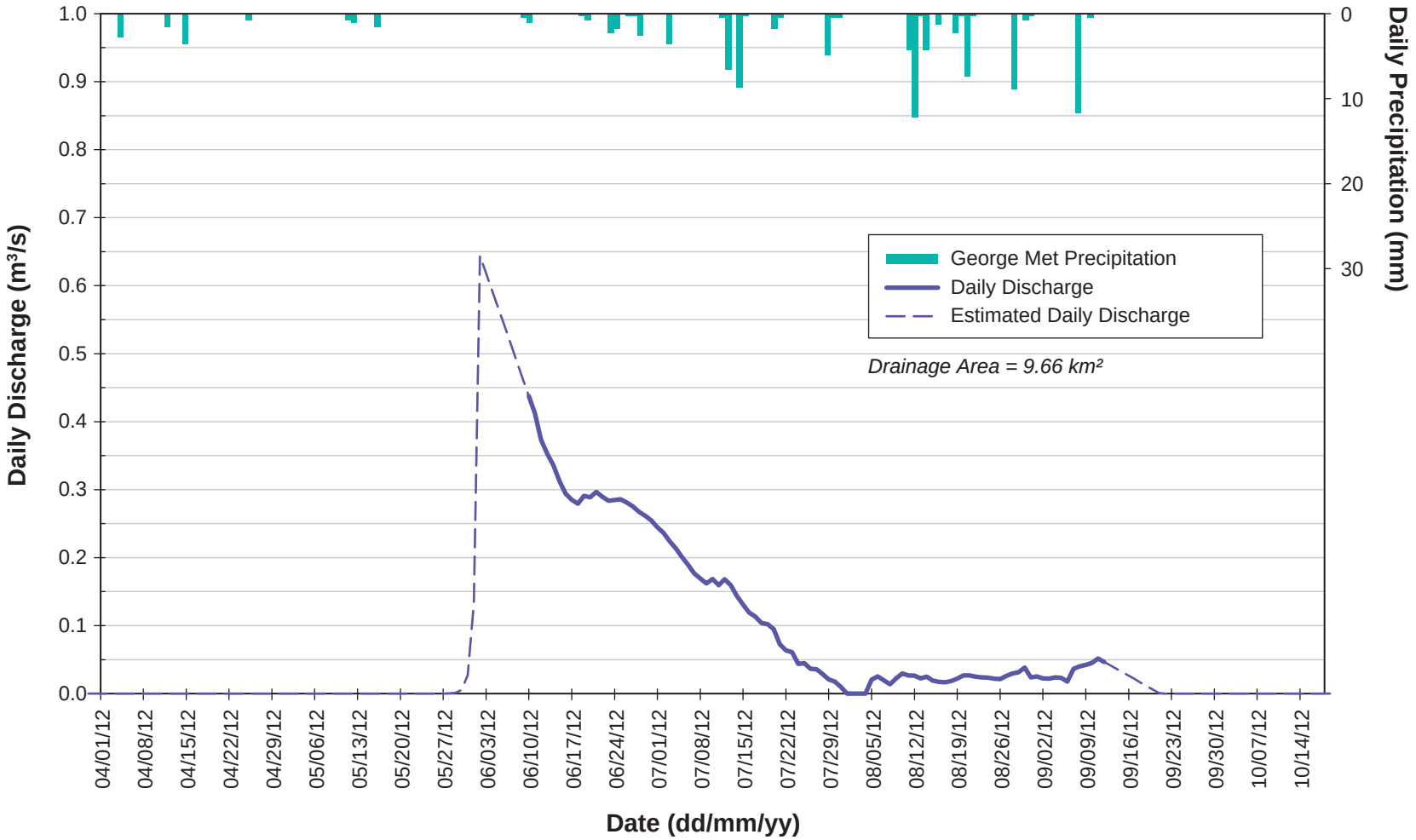


Figure A5-15

Sabina GOLD & SILVER CORP.

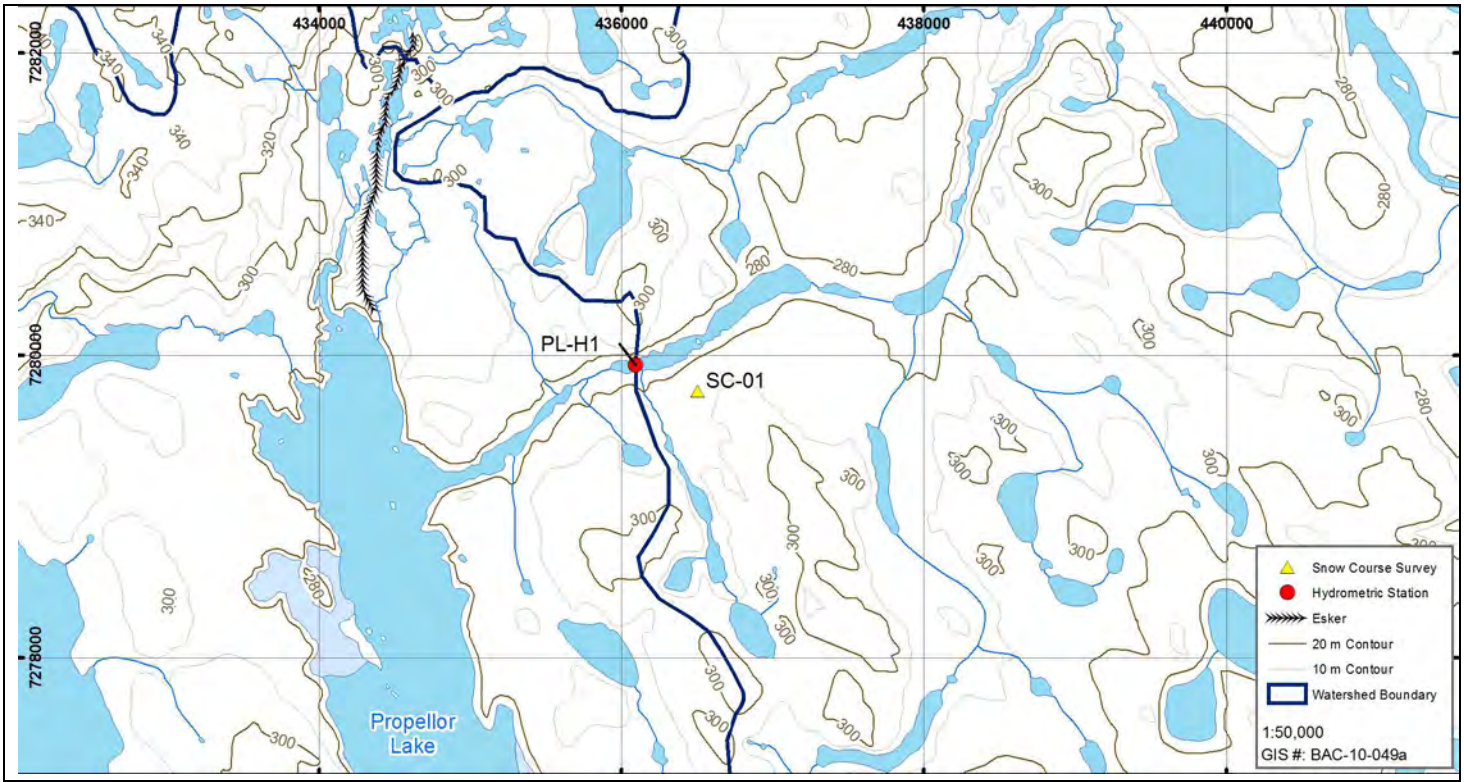
Annual Hydrograph at KL-H2 Hydrometric Monitoring Station, 2012

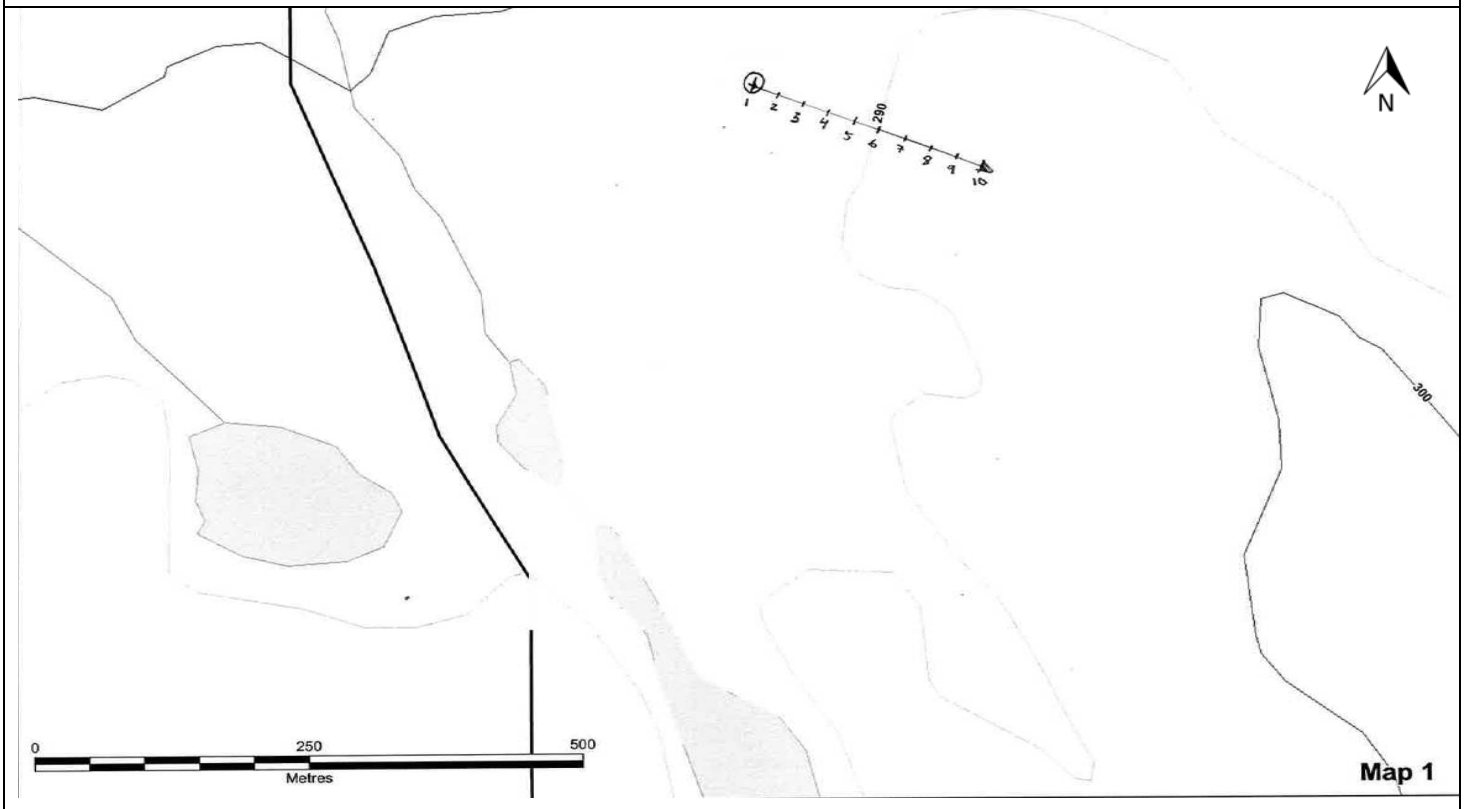
Figure A5-15

Rescan™ Engineers & Scientists

Appendix 6
Snow Course Survey

Rescan™
Engineers and Scientists





BEARING	110	ASPECT.	WNW
MAP No.	1	DATE SURVEYED	April 25 2012
DATE ESTD.	April 25 2012		
DRAINAGE	Propellor	UTM Zone 13	436502E 7279764N
REMARKS			

Rescan™

Sabina GOLD & SILVER CORP.

Snow Course: SC-01 Goose Property

Back River

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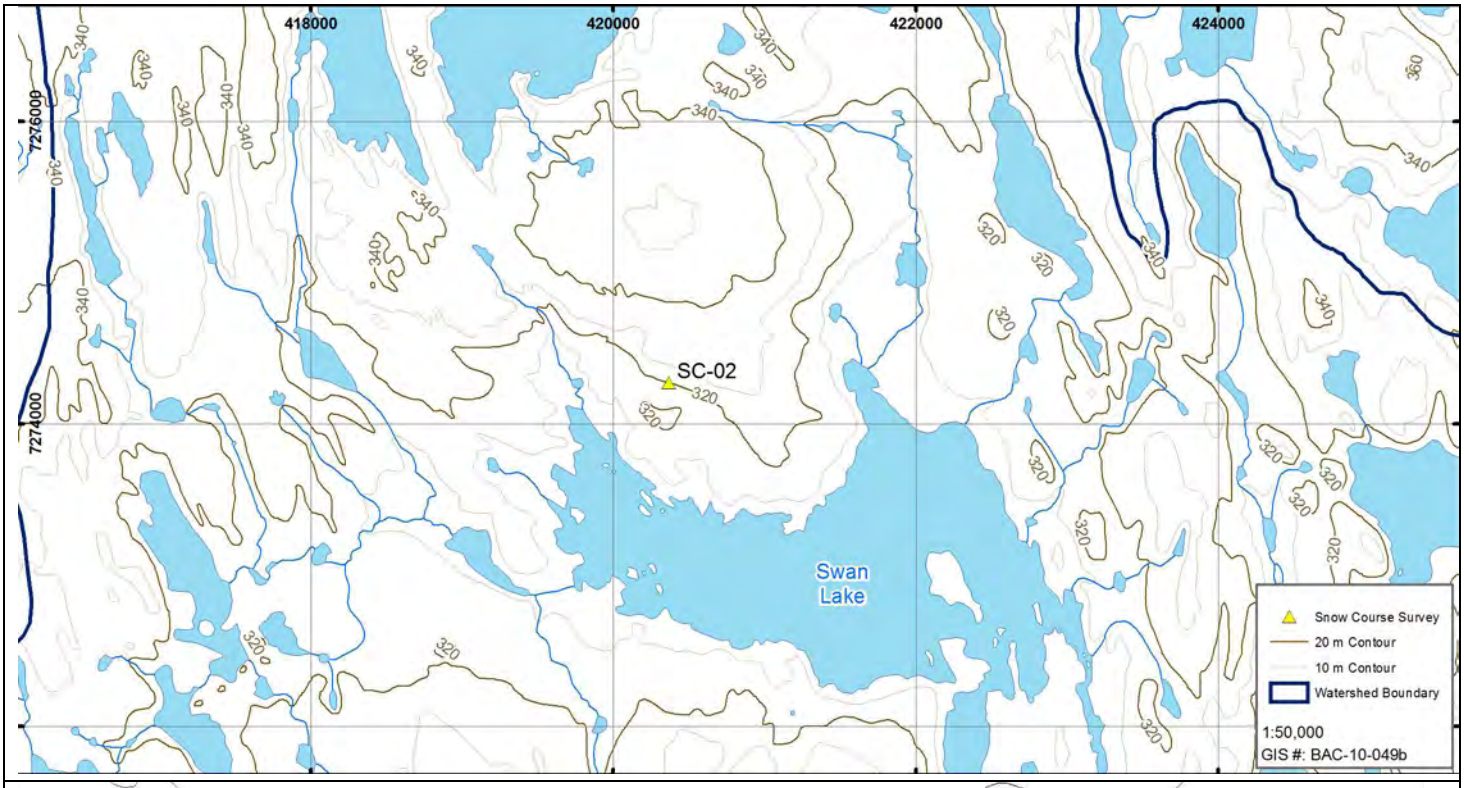
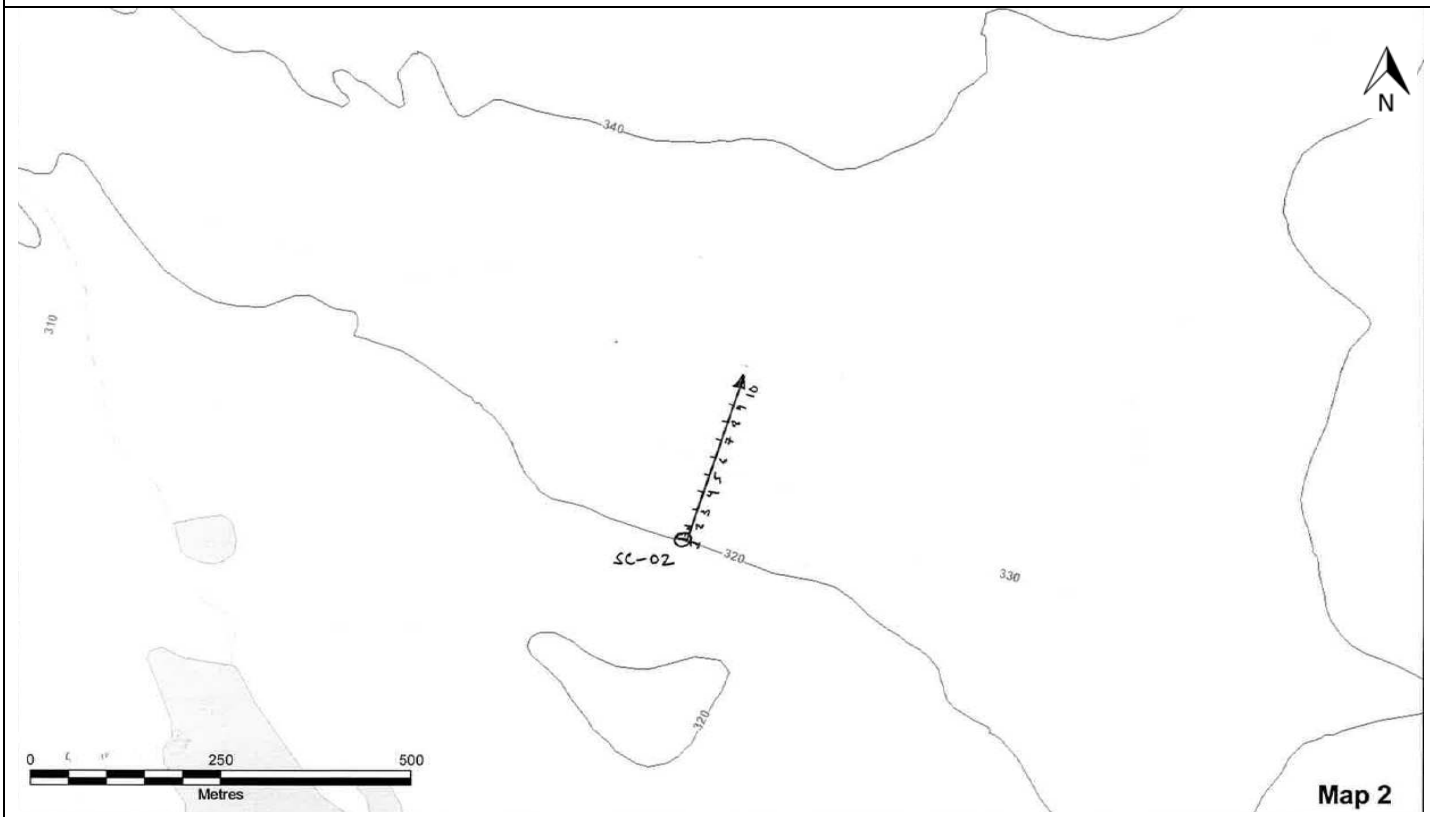




BEARING	18	ASPECT.	SSW
MAP No.	2	DATE SURVEYED	April 21 2012
DATE ESTD.	April 21 2012		
DRAINAGE	Swan Lake	UTM Zone 13	420367E 7274271N
REMARKS			

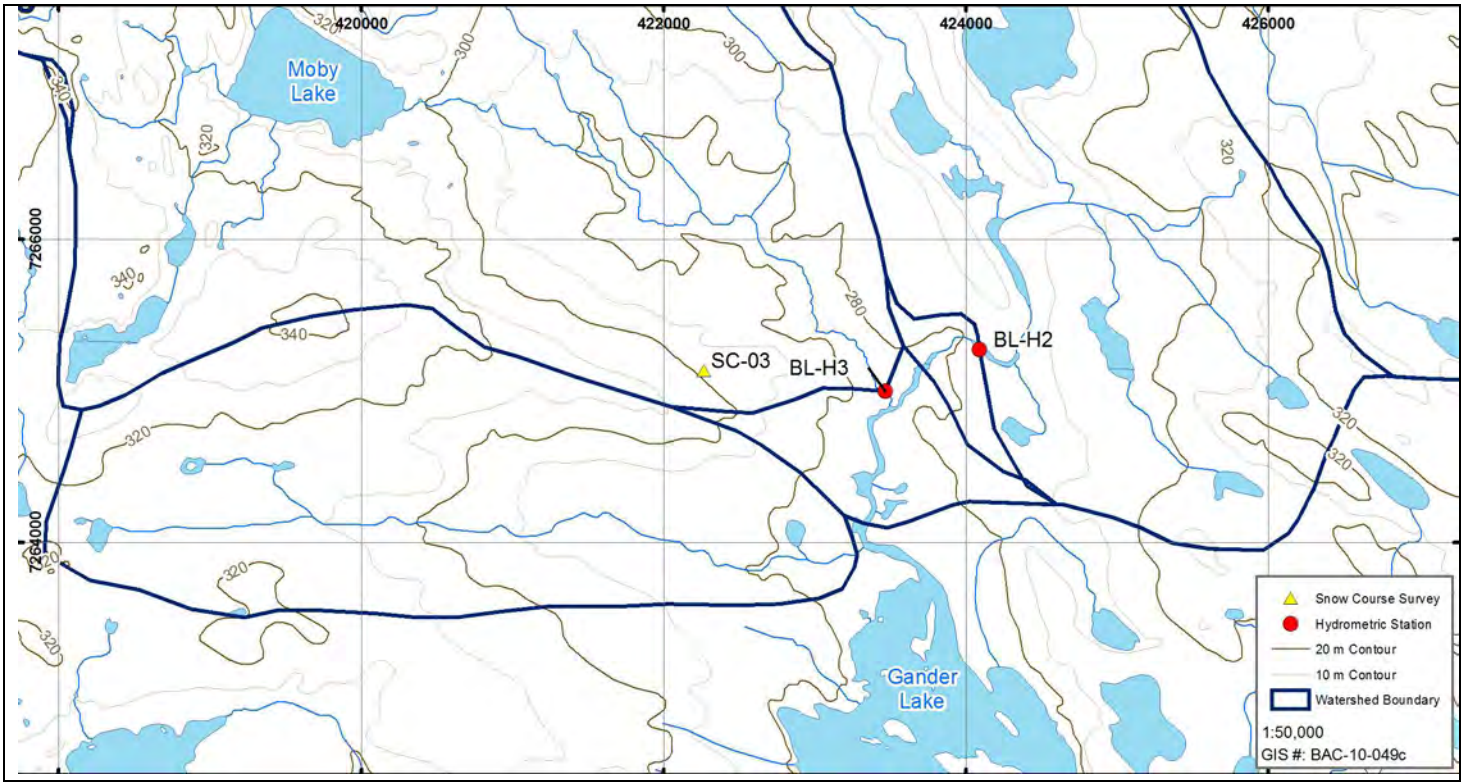
Rescan™

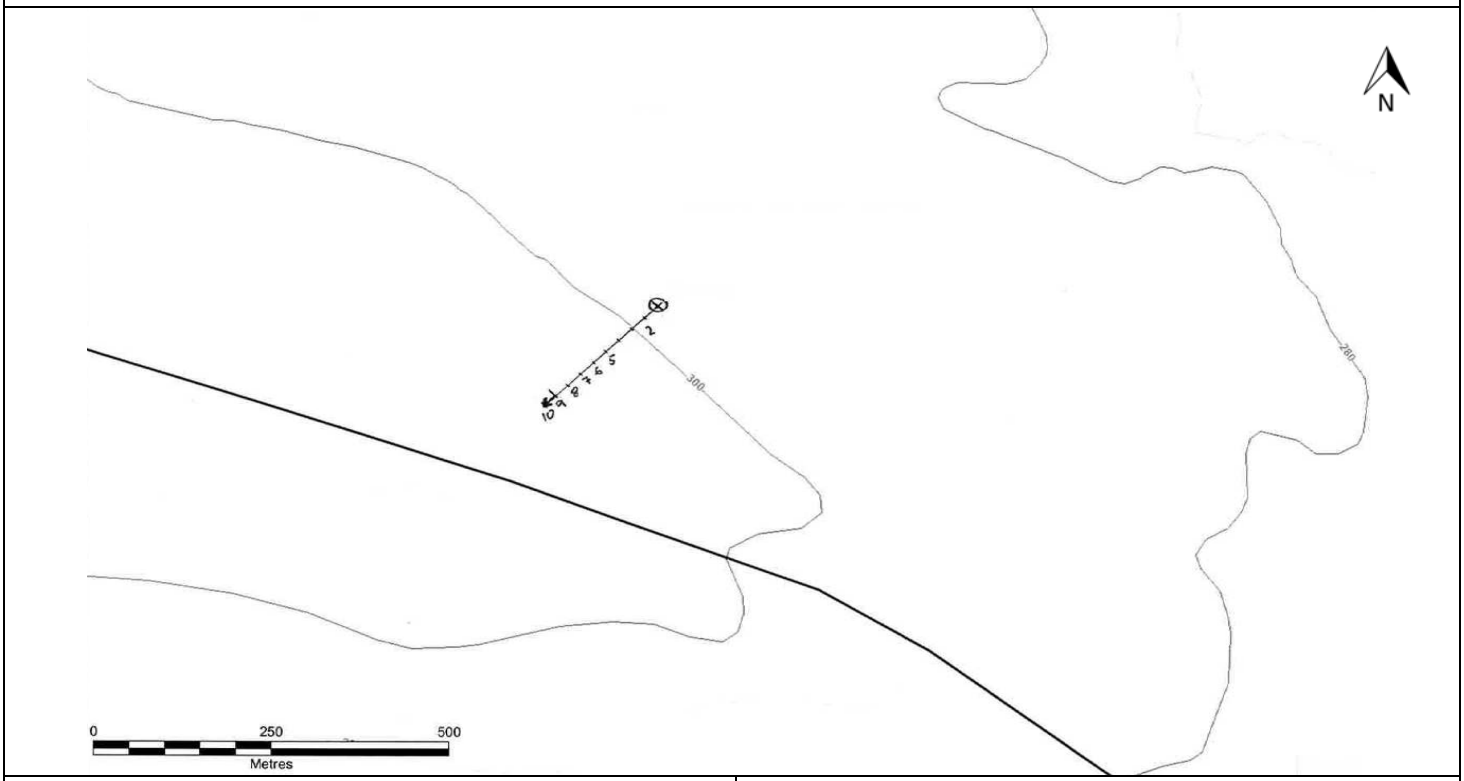
Sabina GOLD & SILVER CORP.

Snow Course: SC-02 Goose Property

Back River

G:\mtaylor\public\Snow Course Templates\





BEARING	229	ASPECT.	NE
MAP No.	3	DATE SURVEYED	April 24 2012
DATE ESTD.	April 24 2012		
DRAINAGE	Moby Lake	UTM Zone 13	422265E 7265136N
REMARKS			

Rescan™

Sabina GOLD & SILVER CORP.

Snow Course: SC-03 Goose Property

Back River

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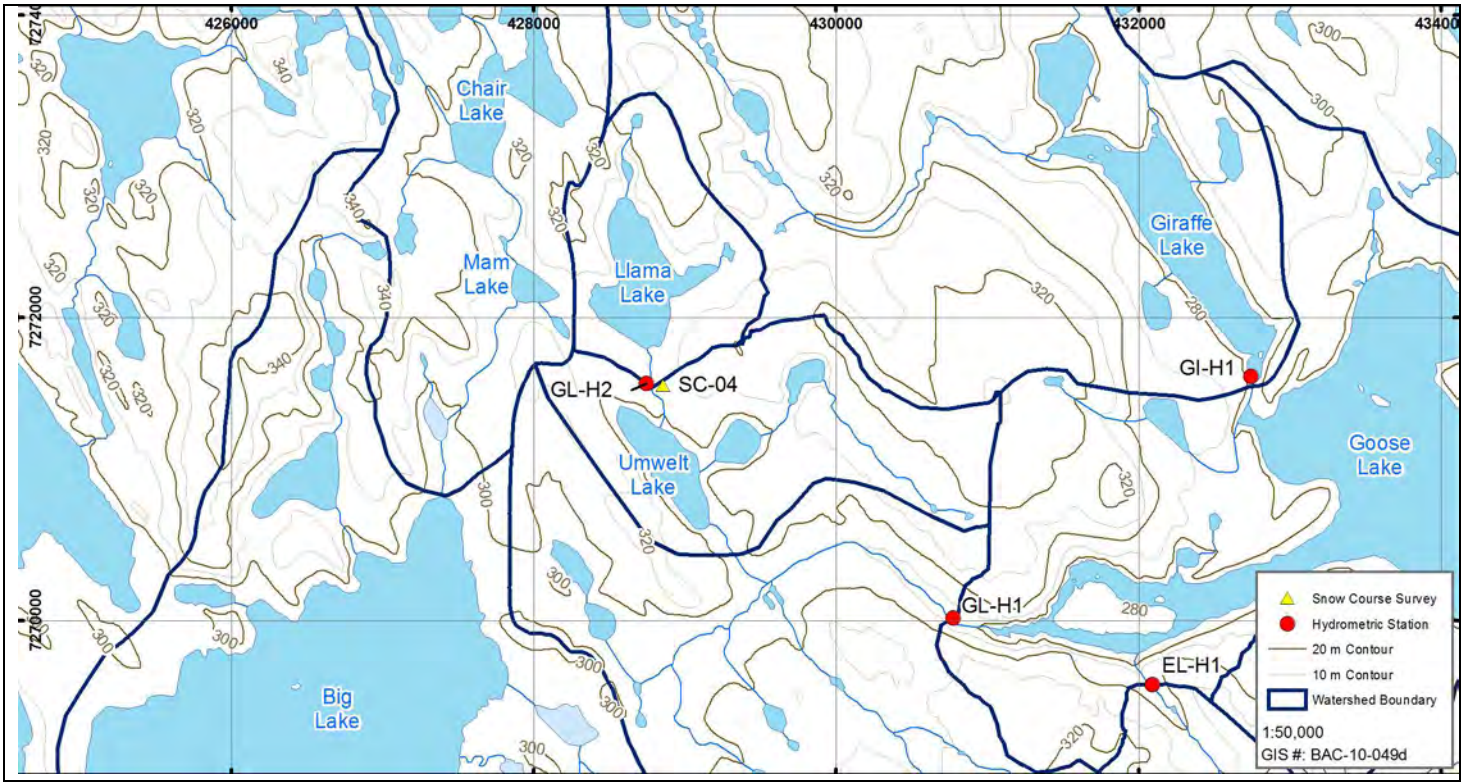

Map 4

BEARING	90	ASPECT.	Flat
MAP No.	4	DATE SURVEYED	April 24 2012
DATE ESTD.	April 24 2012		
DRAINAGE	Llama Lake	UTM Zone 13	428855E 7271553N
REMARKS	Flat		

Rescan™

Sabina GOLD & SILVER CORP.

Snow Course: SC-04 Goose Property

Back River

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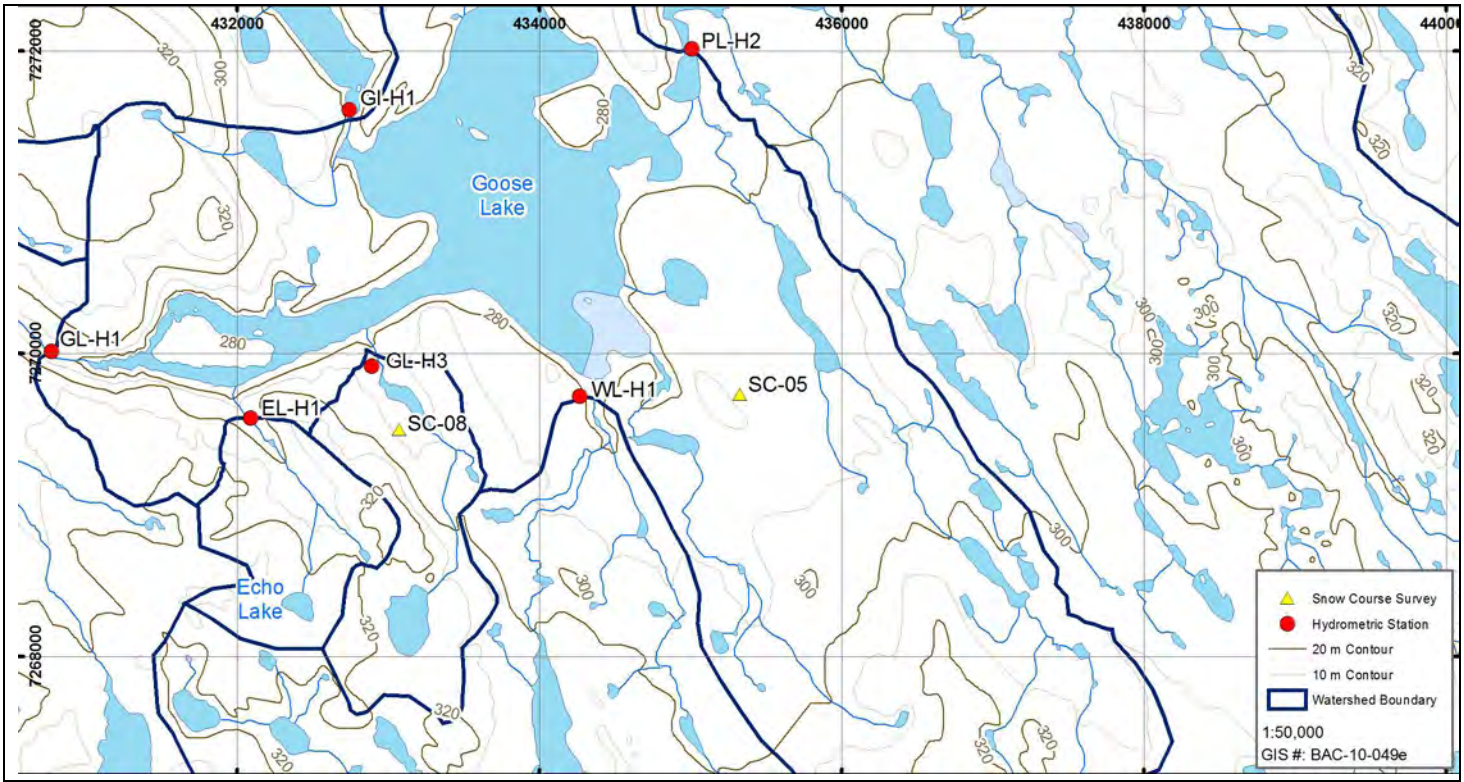

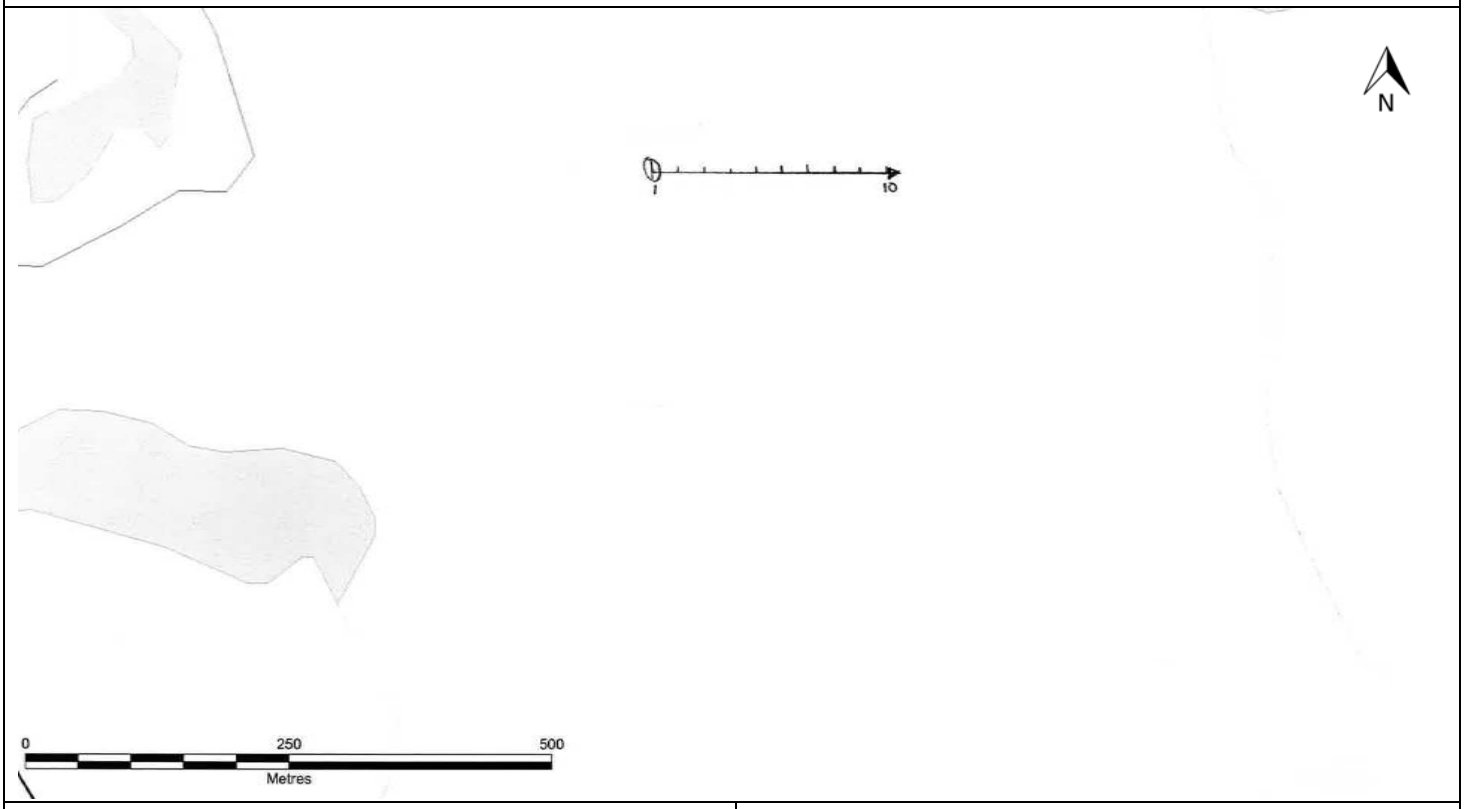

BEARING	90	ASPECT.	Flat
MAP No.	5	DATE SURVEYED	April 24 2012
DATE ESTD.	April 24 2012		
DRAINAGE	Goose Lake	UTM Zone 13	435325E 7269732N
REMARKS	Flat		

Rescan™

Sabina GOLD & SILVER CORP.

Snow Course: SC-05 Goose Property

Back River

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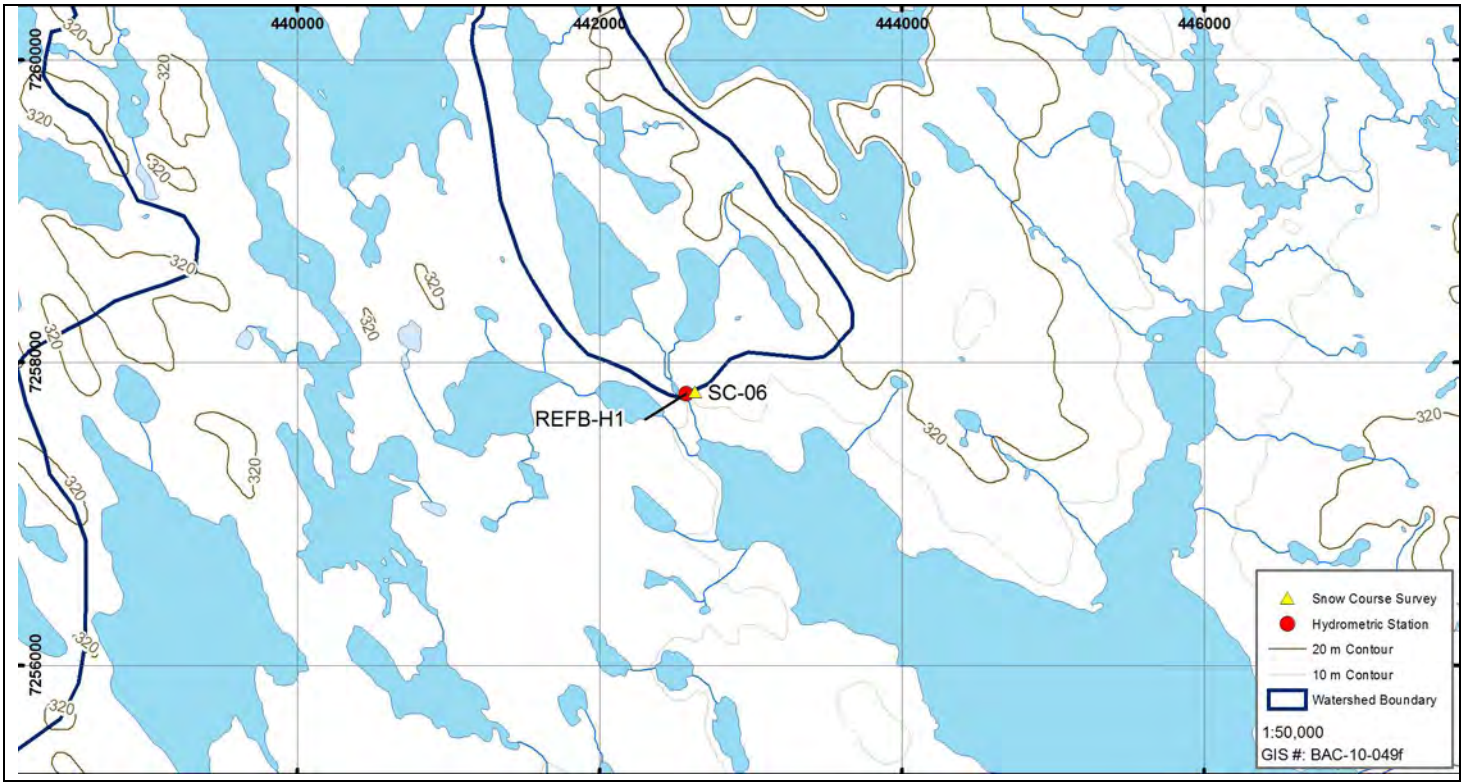

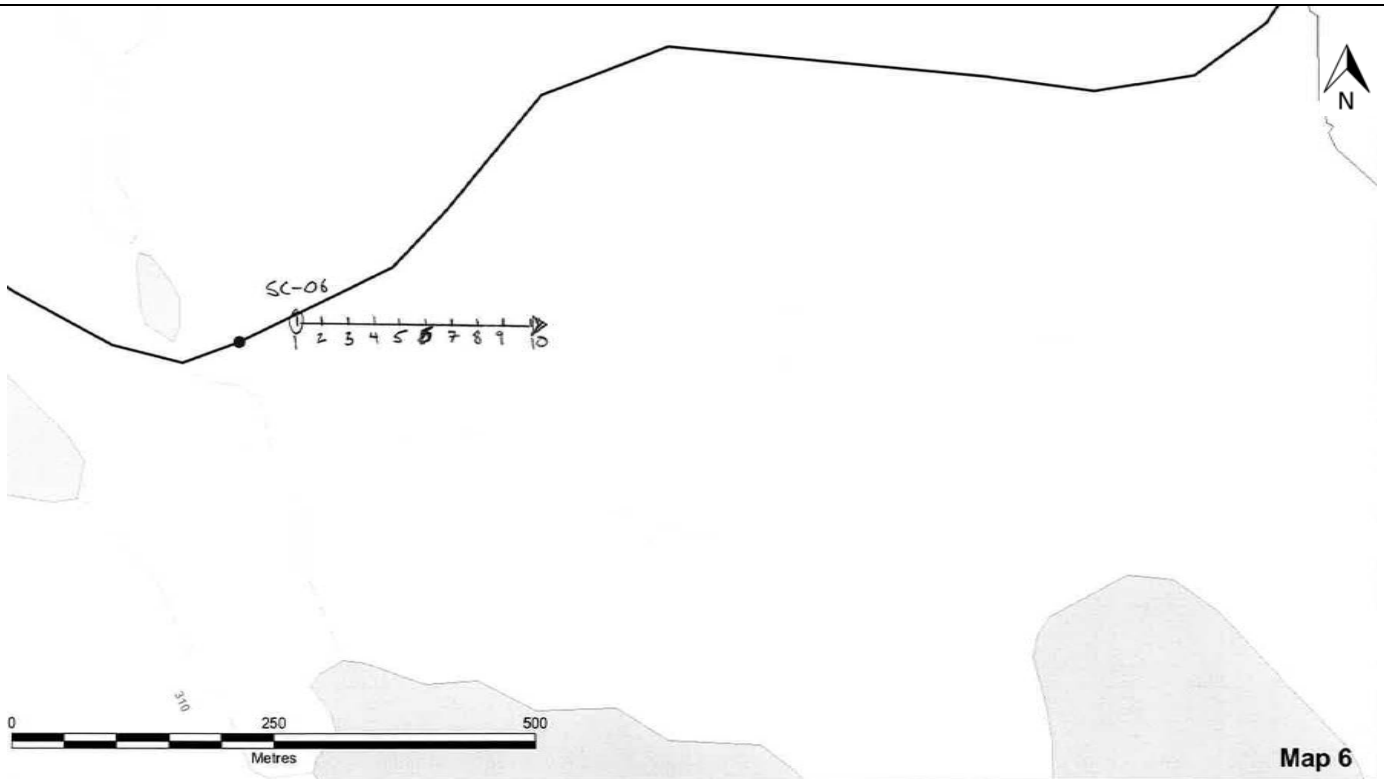

BEARING	90	ASPECT.	Flat
MAP No.	6	DATE SURVEYED	April 24 2012
DATE ESTD.	April 24 2012		
DRAINAGE	Reference Lake B	UTM Zone 13	442629E 7257810N
REMARKS	Flat		

Rescan™

Sabina GOLD & SILVER CORP.

Snow Course: SC-06 Goose Property

Back River

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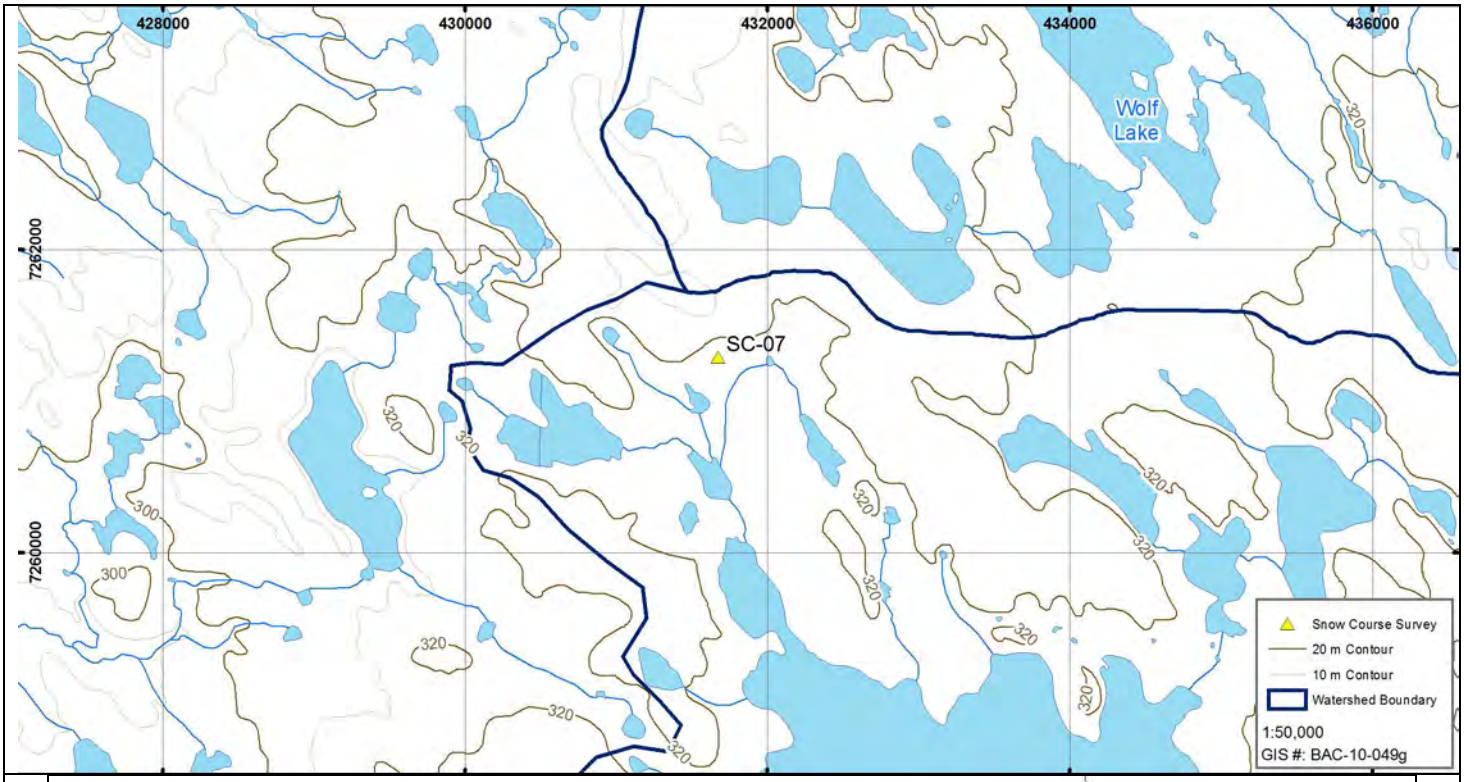

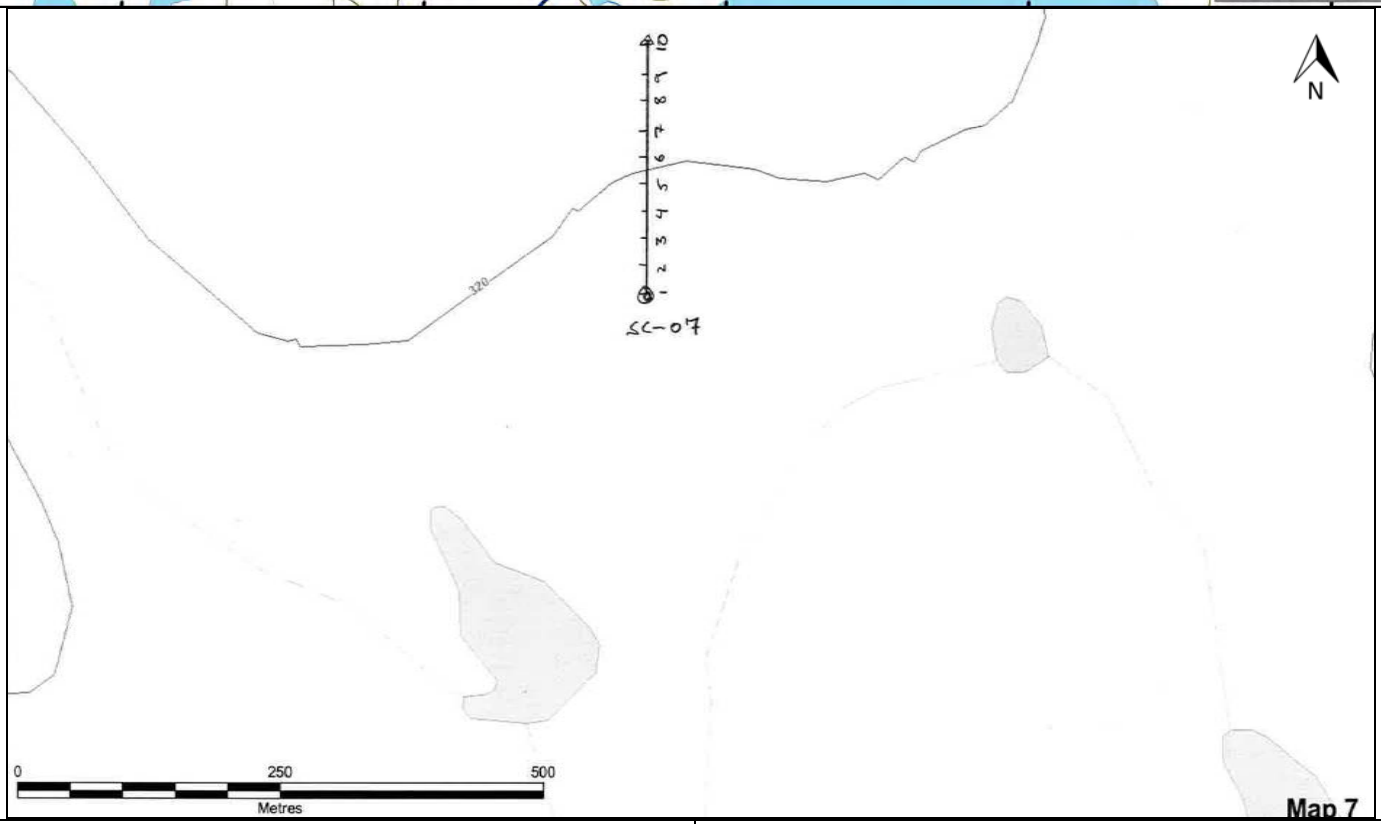

BEARING	0	ASPECT.	SE
MAP No.	7	DATE SURVEYED	April 23 2012
DATE ESTD.	April 23 2012		
DRAINAGE	South of Wolf	UTM Zone 13	431670E 7261290N
REMARKS			

Snow Course: SC-07 Goose Property

Back River

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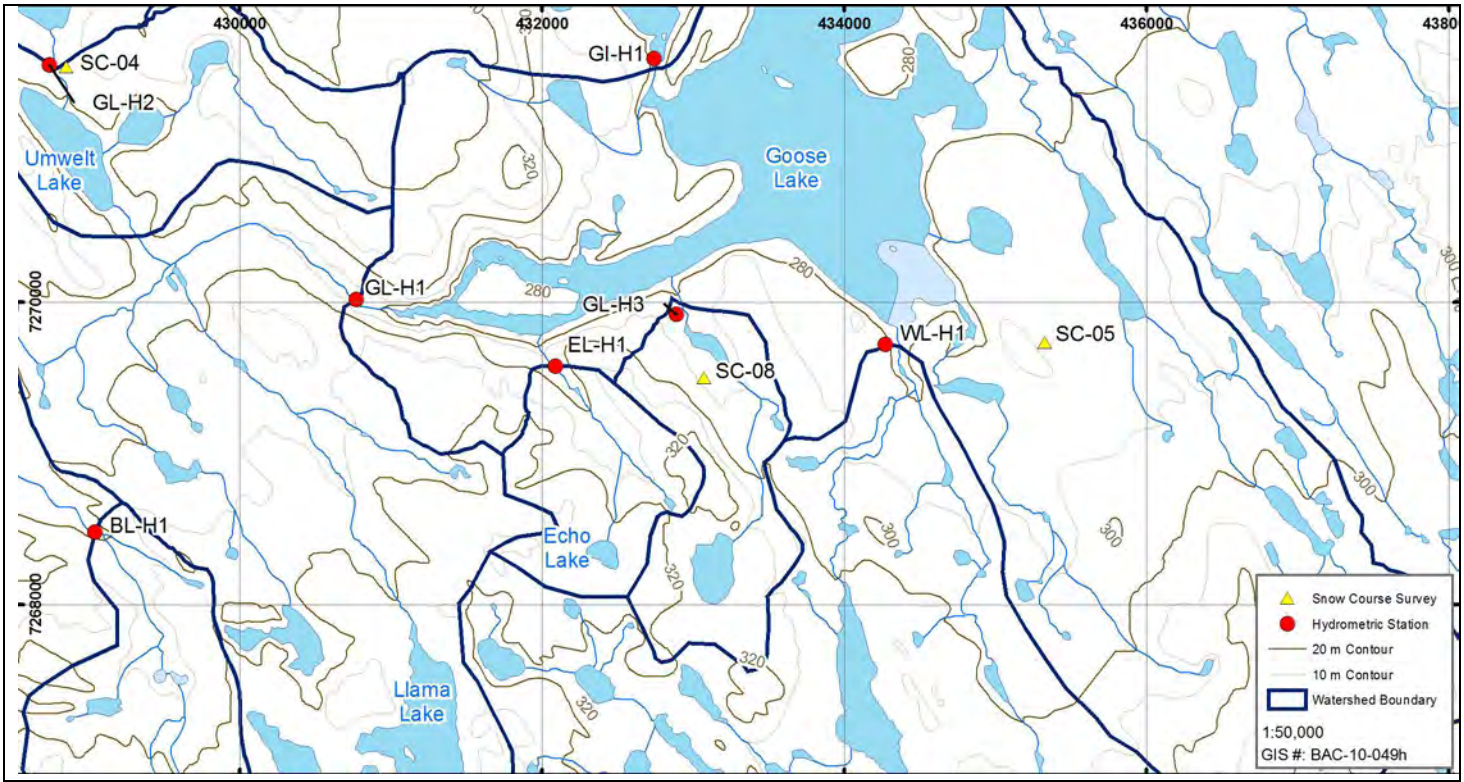

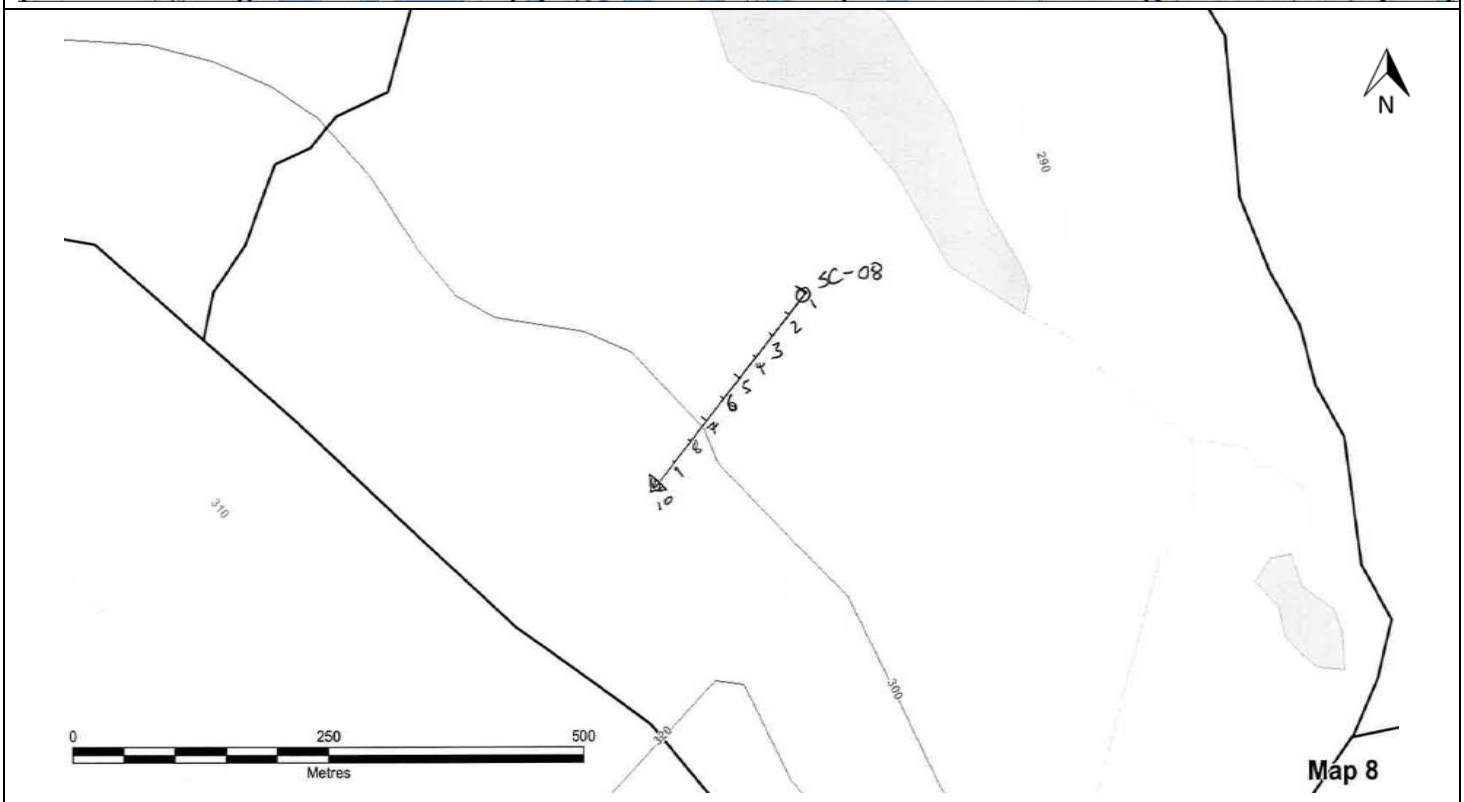

BEARING	220	ASPECT.	NE
MAP No.	8	DATE SURVEYED	April 25 2012
DATE ESTD.	April 25 2012		
DRAINAGE	Llama Lake	UTM Zone 13	433071E 7269498N
REMARKS	Steep		

Snow Course: SC-08 Goose Property

Back River

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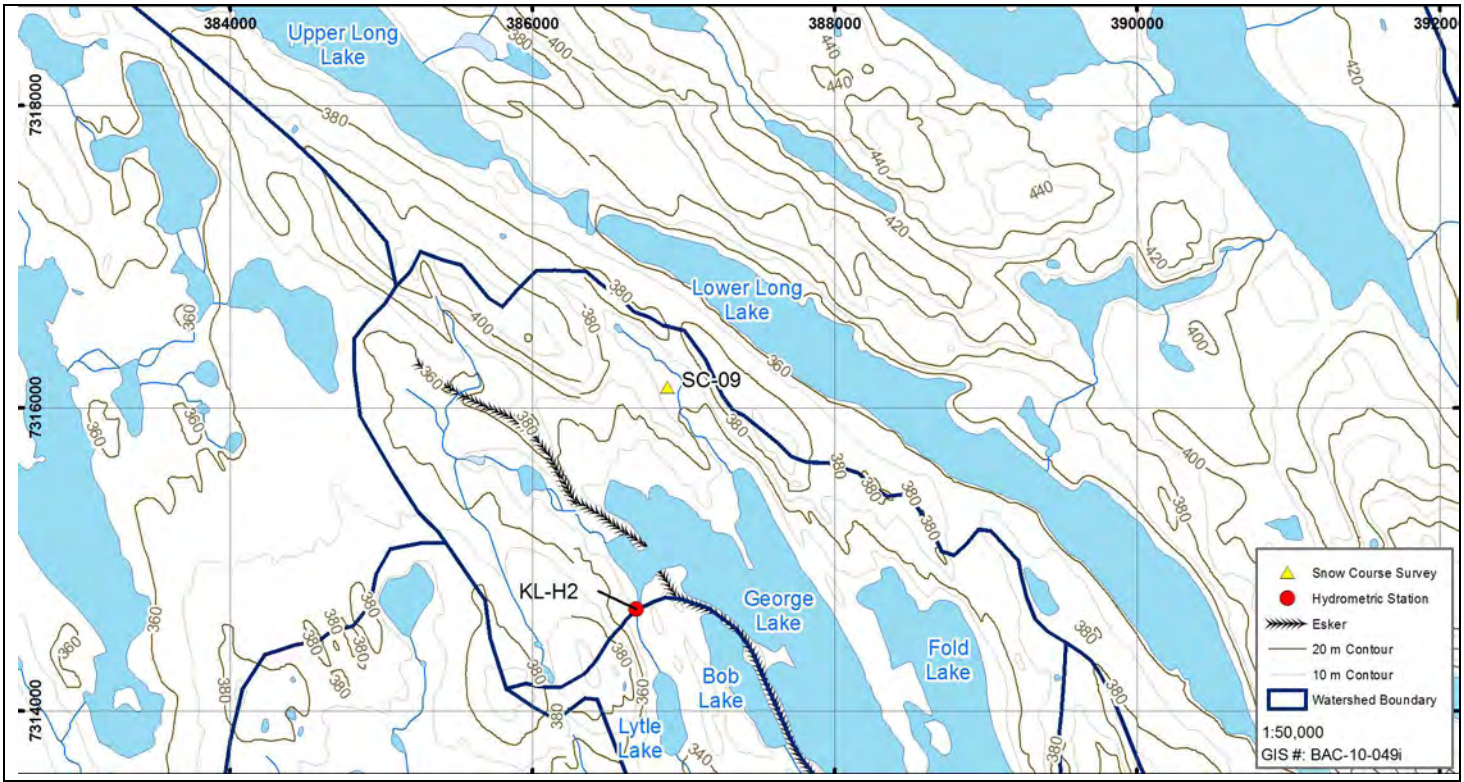

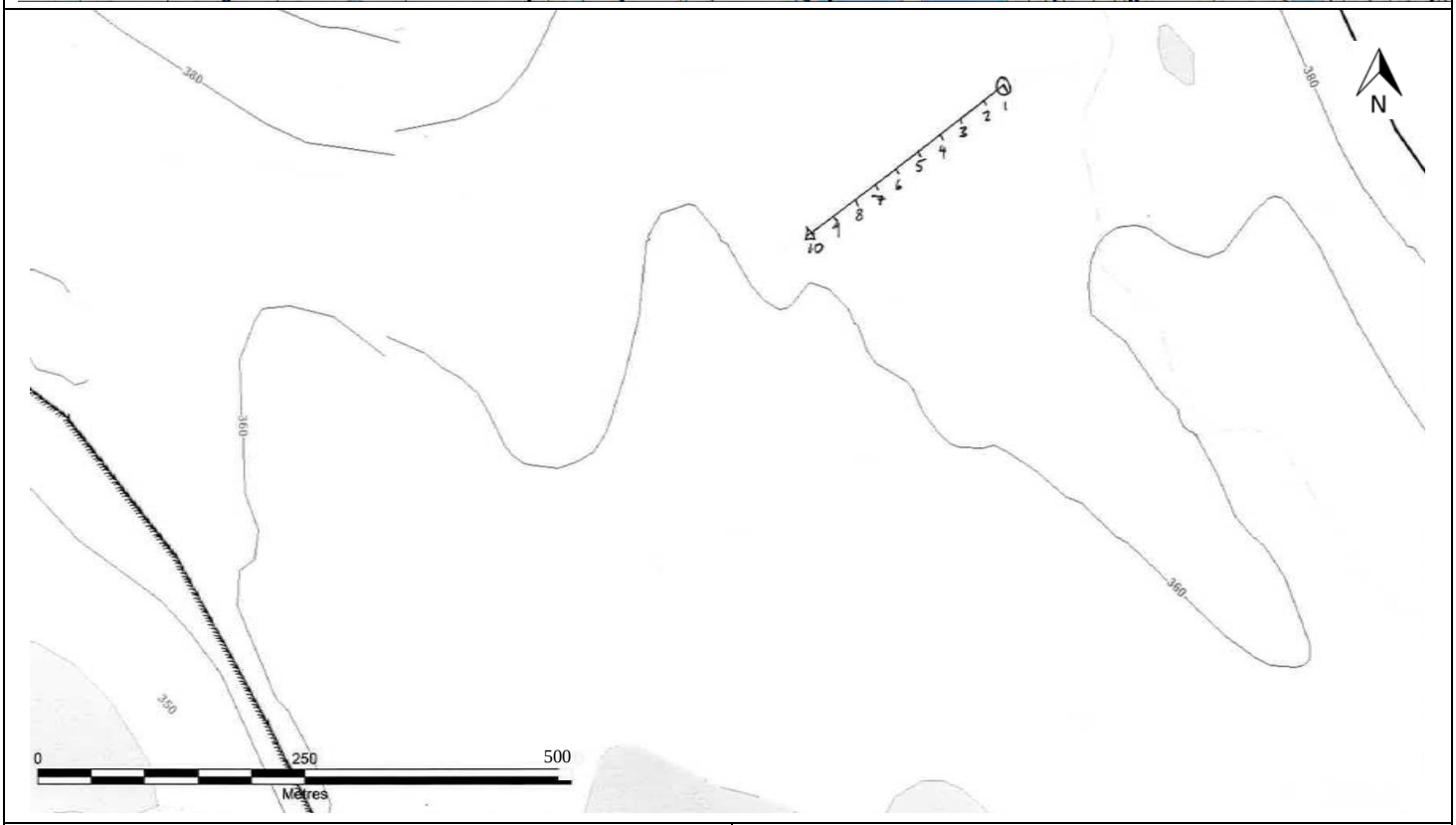

BEARING	220	ASPECT.	NE
MAP No.	8	DATE SURVEYED	April 20 2012
DATE ESTD.	April 20 2012		
DRAINAGE	George Lake	UTM Zone 13	386892E 7316137N
REMARKS	Steep		

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Snow Course: SC-09 George Property

Back River

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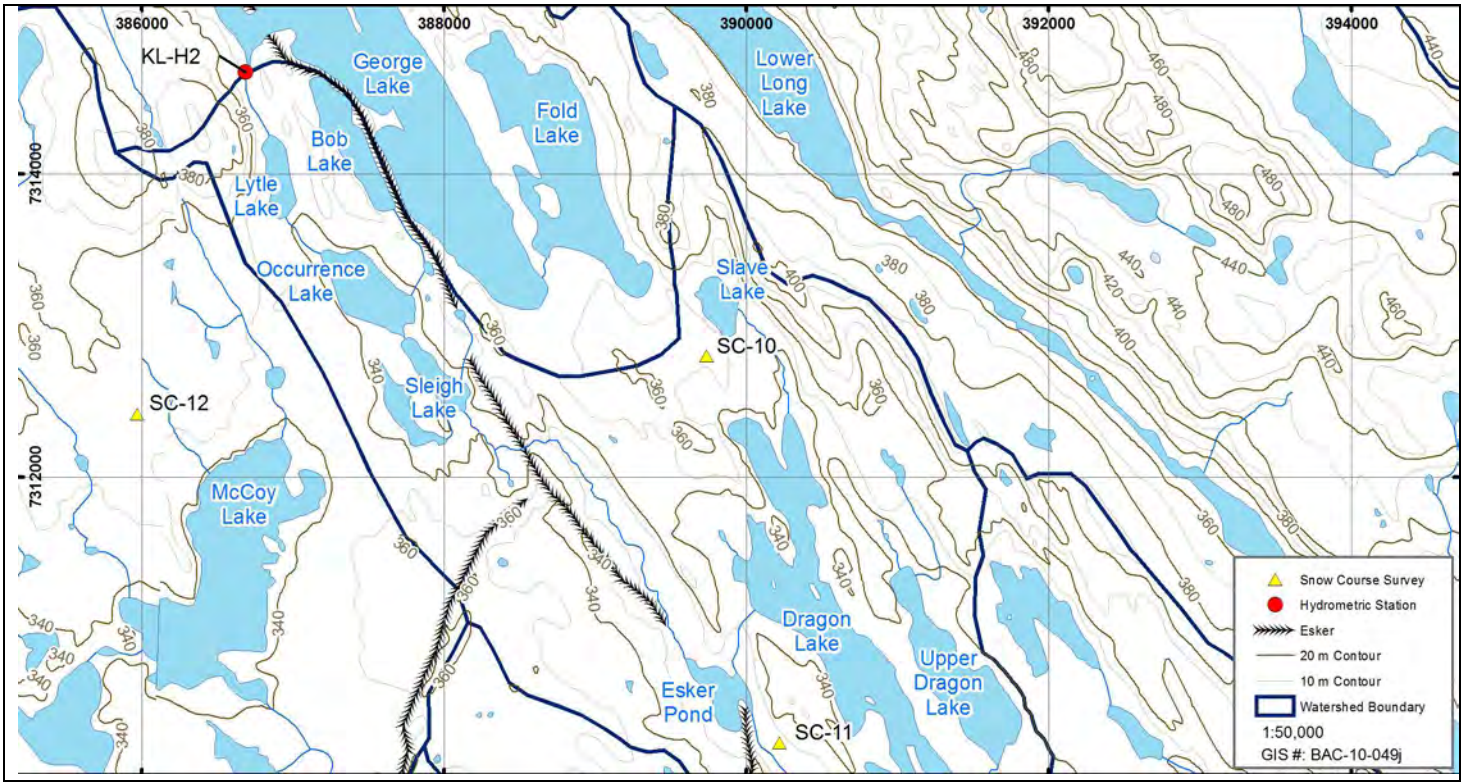

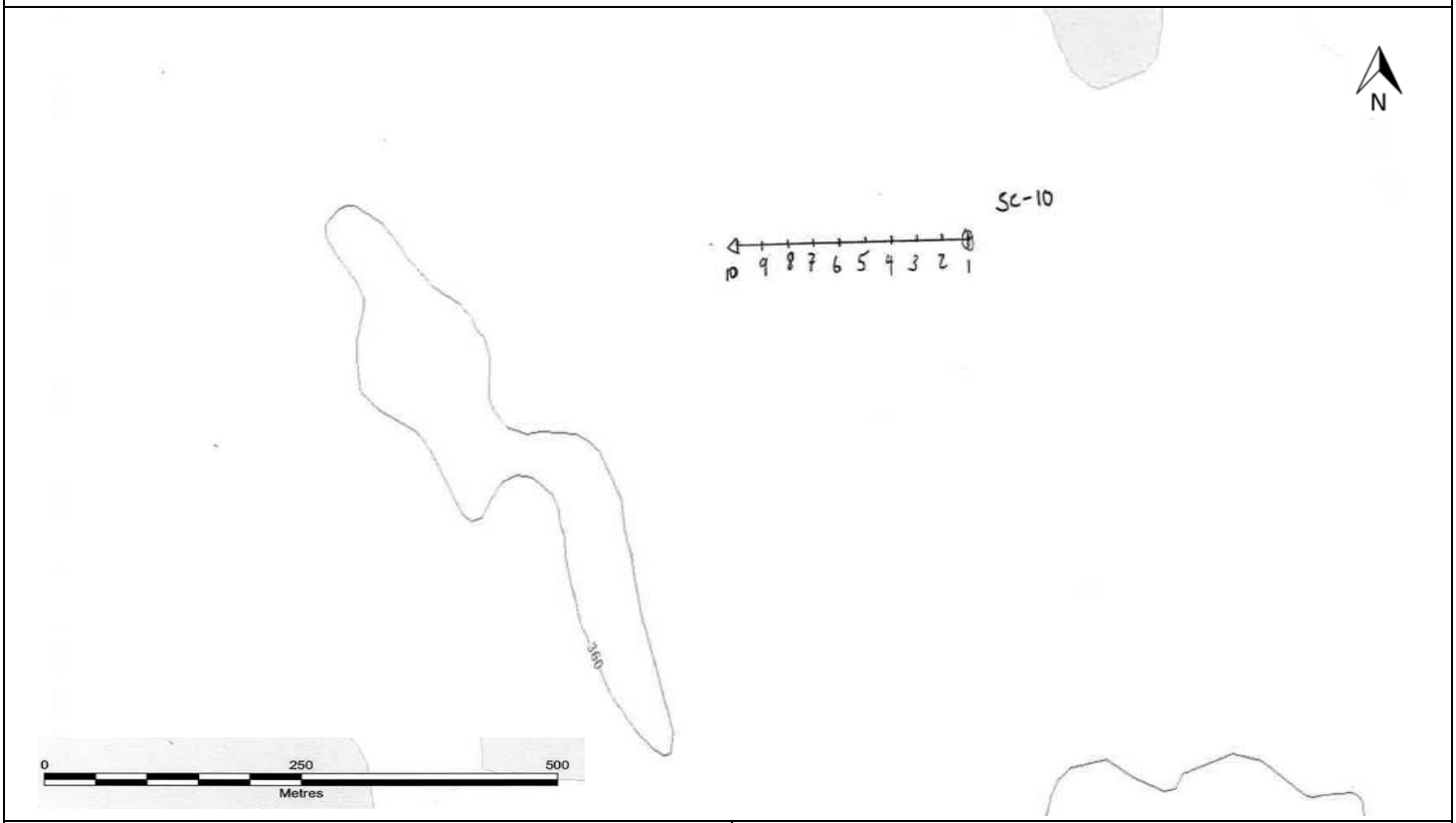

BEARING	270	ASPECT.	Flat
MAP No.	10	DATE SURVEYED	April 20 2012
DATE ESTD.	April 20 2012		
DRAINAGE	George Lake	UTM Zone 13	389735E 7312798N
REMARKS	Flat		

Rescan™

Sabina GOLD & SILVER CORP.

Snow Course: SC-10 George Property

Back River

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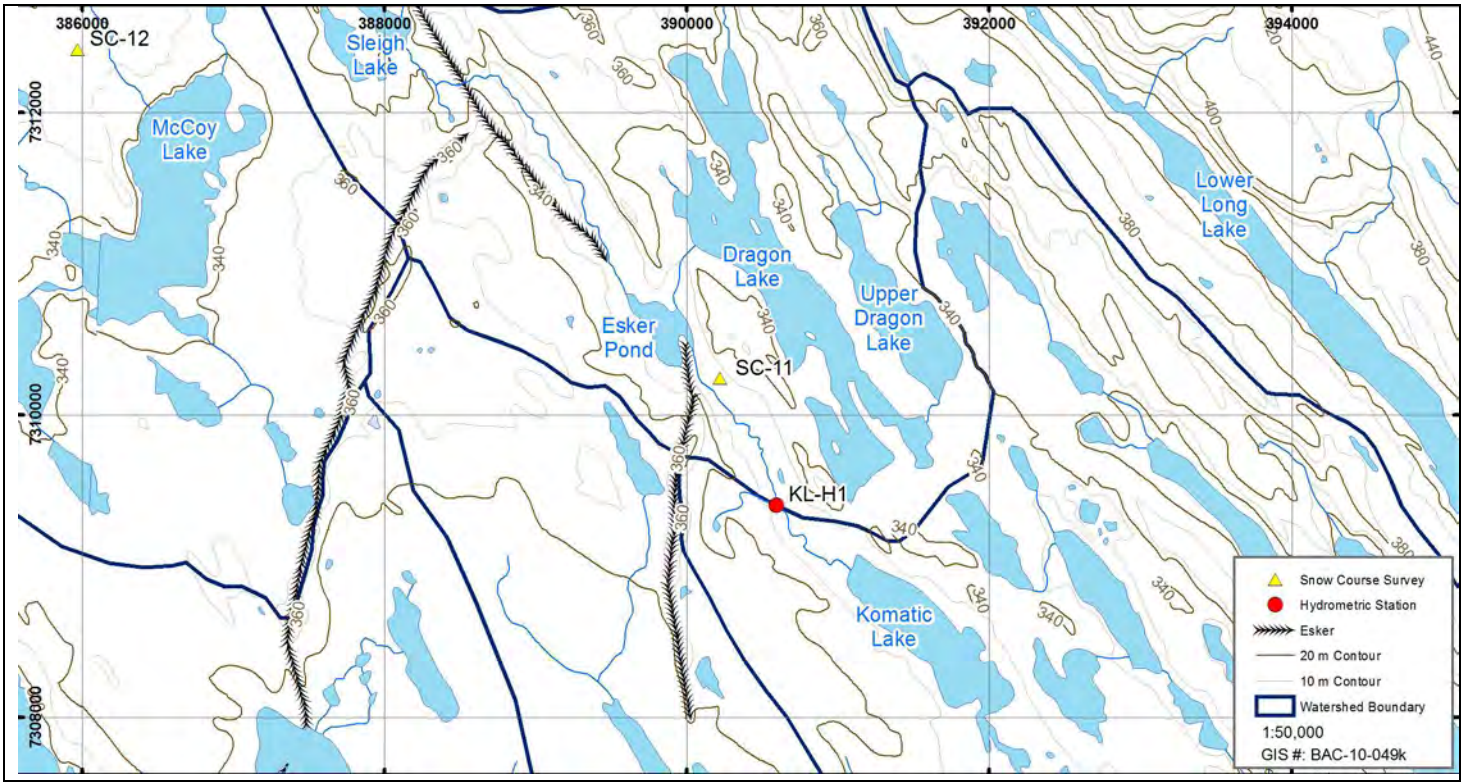

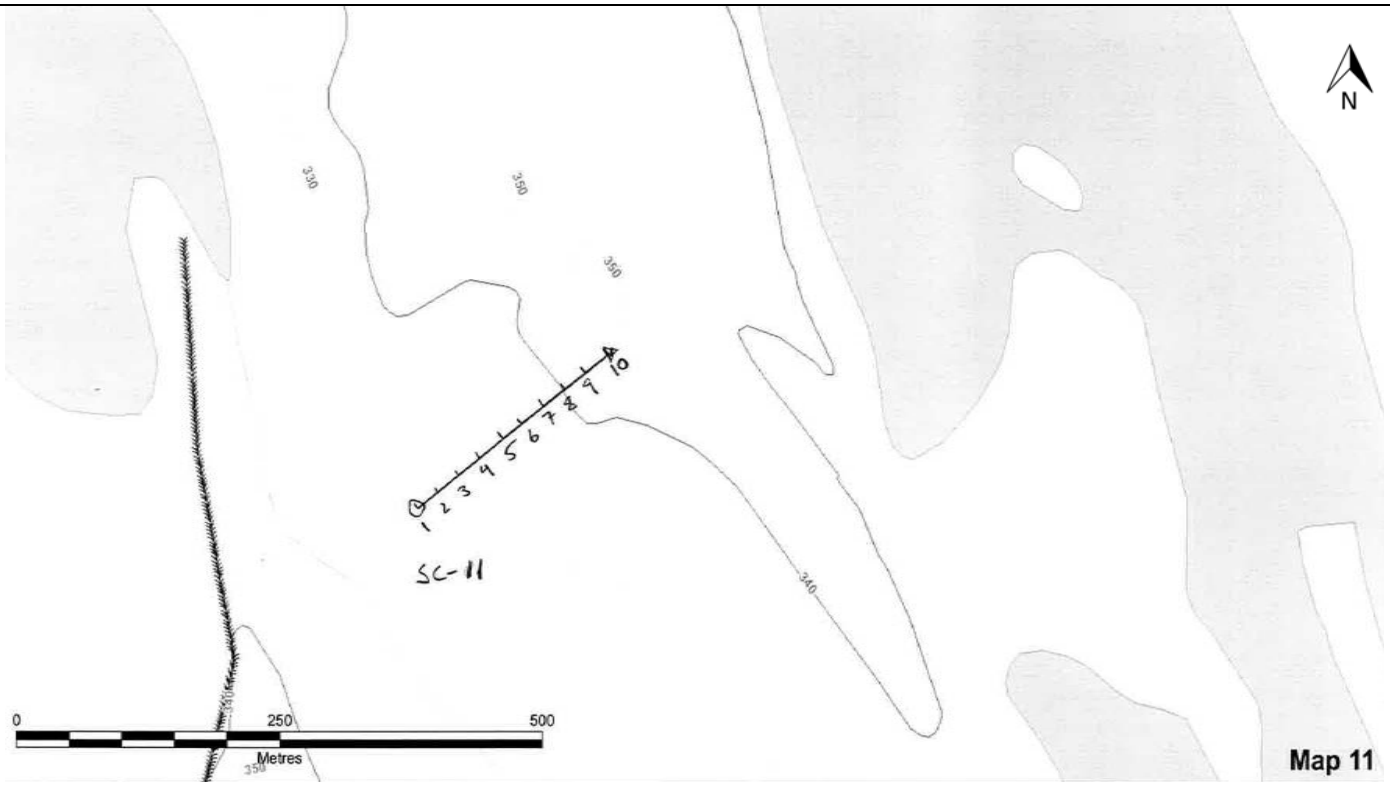

BEARING	56	ASPECT.	SW
MAP No.	11	DATE SURVEYED	April 22 2012
DATE ESTD.	April 22 2012		
DRAINAGE	Komatic Lake	UTM Zone 13	390220E 7310240N
REMARKS			

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Sabina GOLD & SILVER CORP.

Snow Course: SC-11 George Property

Back River

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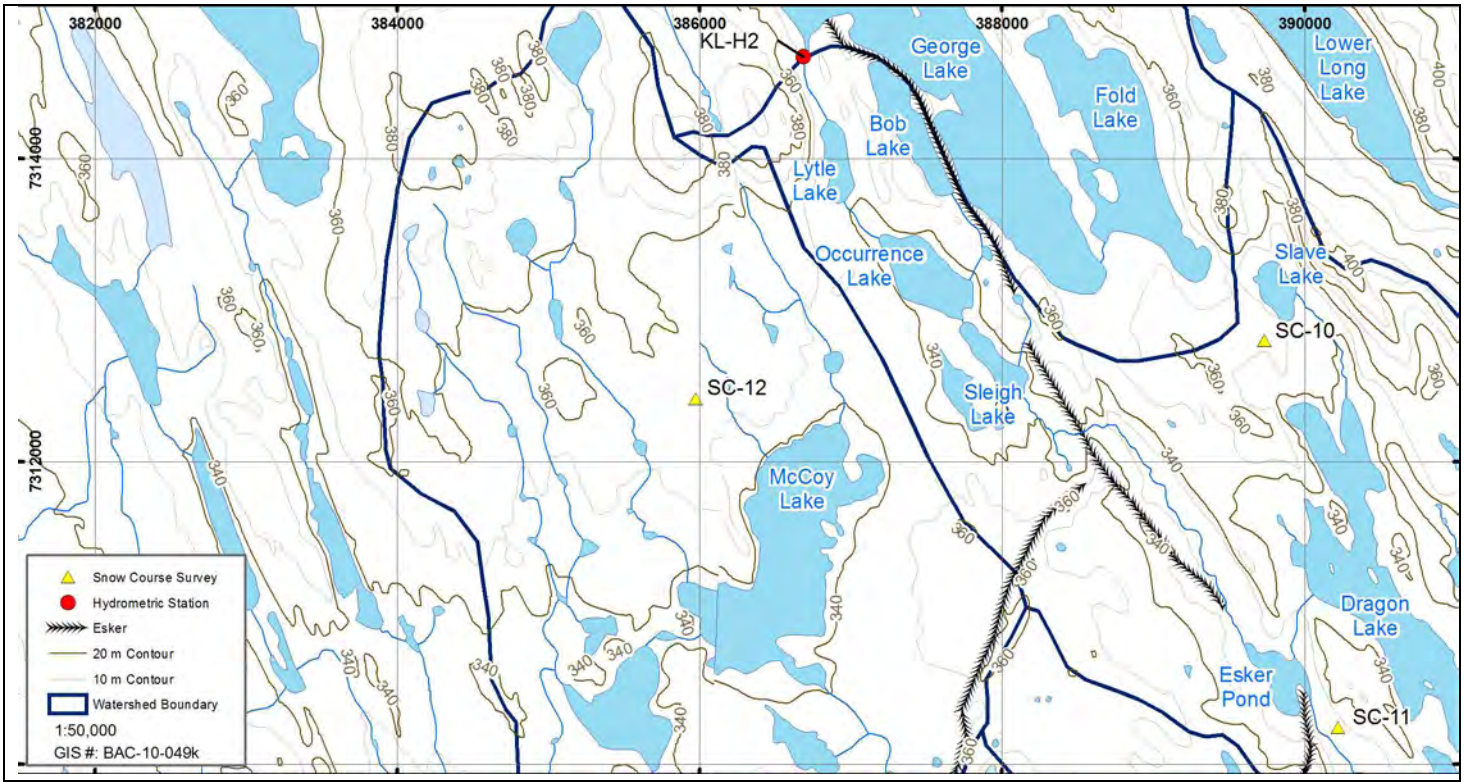

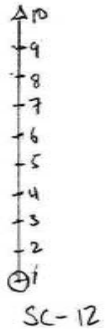

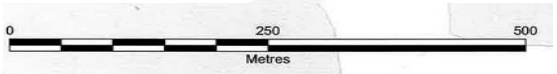

BEARING	0	ASPECT.	Flat
MAP No.	12	DATE SURVEYED	April 22 2012
DATE ESTD.	April 22 2012		
DRAINAGE	Dragon Lake	UTM Zone 13	385971E 7312414N
REMARKS	Flat		

Rescan™

Sabina GOLD & SILVER CORP.

Snow Course: SC-12 George Property

Back River

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British Columbia Ministry of Water, Land and Air Protection- Environmental Protection Division- Flood Hazard/River Forecast Centre

Back River Project Environmental Baseline Study (Project no. 833-002-02)

SNOW SURVEY FIELD DATA SHEET

Snow Course No.	SC-01		2012	4	25
			Year	**Month**	**Day**
Snow Course Name:	Back River Project - Goose Property				
Observer's Name:	C.Hall				
Number of		**Driving Wrench Used: Yes:**	X	**Scale No.:**	4S141
Tubes Used:	2	**No:**			

Station Number	Snow Depth (cm)		Core Length (cm)	Weight of Tube and Core (cm)	Weight Tube Only Before Sampling (cm)	Snow-Water Equivalent (cm)	Density (%)
	With Dirt Plug	Without Dirt Plug					
1	31	27	31	79	70	9	33
2	48	46	43	86	70	16	35
3	30	29	27	79	70	9	31
4	51	51	50	88	70	18	35
5	46	42	39	83	70	13	31
6	53	50	52	88	70	18	36
7	34	34	33	82	70	12	35
8	24	19	22	76	70	6	32
9	25	22	25	77	70	7	32
10	37	37	37	83	70	13	35
Total		357				121	
Average		**36**				**12.1**	**34**

Please complete in field or as soon after snow sampling as possible.

Time sampling began 9:10 a.m. p.m. ended 10:05 a.m. p.m.

A. Weather Conditions at Snow Course

	Freezing	X	Thawing		Temp	-14.4	˚C
	Blowing		Calm	X			
Skies:	Clear	X	Partly Cloudy		Overcast		
Precipitation:	None	X	Raining		Snowing		

B. Surface Snow Conditions at Snow Course

Fresh fallen snow depth 0 cm

	Wet		Dry	X			
	Soft		Crusted	X			
Support:	None		Person on skies/snowshoes		Person on foot	X	
Serious Drifting:	No	X	Yes*		Which Stations		
Evidence of oversnow traffic:	Yes*		No	X			

C. Sampling Conditions

	Easy		Moderately Difficult	X	Very Difficult		
Ground Reached on all Samples:	Yes	X	No*				
Ice Layers:	In snowpack	X	On ground	X			
Ground under snow:	Dry	X	Damp		Wet		Frozen X

D. General Condition en Route

Snow line elevation n/a metres

Thaw:	None	X	Sunny slopes		General		
Small streams:	Bridged with snow	X	Open		Clear		Muddy

*Describe fully under remarks

E. Remarks:

British Columbia Ministry of Water, Land and Air Protection- Environmental Protection Division- Flood Hazard/River Forecast Centre

Back River Project Environmental Baseline Study (Project no. 833-002-02)

SNOW SURVEY FIELD DATA SHEET

Snow Course No.	SC-02		2012	4	21
			Year	**Month**	**Day**
Snow Course Name:	Back River Project - Goose Property				
Observer's Name:	C.Hall				
Number of Tubes Used:	3	**Driving Wrench Used: Yes:**	X	**Scale No.:**	4S141
		No:			

Station Number	Snow Depth (cm)		Core Length (cm)	Weight of Tube and Core (cm)	Weight Tube Only Before Sampling (cm)	Snow-Water Equivalent (cm)	Density (%)
	With Dirt Plug	Without Dirt Plug					
1	104	101	97	108	71	37	37
2	195	192	190	192	113	79	41
3	30	26	29	81	71	10	38
4	63	60	50	90	71	19	32
5	52	51	50	91	71	20	39
6	46	42	45	88	71	17	40
7	21	19	19	78	71	7	37
8	16	15	14	76	71	5	33
9	10	8	10	74	71	3	38
10	21	16	20	76	71	5	31
Total		530				202	
Average		**53**				**20.2**	**37**

Please complete in field or as soon after snow sampling as possible.

Time sampling began 1:45 a.m. p.m. ended 3:20 a.m. p.m.

A. Weather Conditions at Snow Course

	Freezing	X	Thawing		Temp	-14	˚C
	Blowing	X	Calm				
Skies:	Clear	X	Partly Cloudy		Overcast		
Precipitation:	None	X	Raining		Snowing		

B. Surface Snow Conditions at Snow Course

Fresh fallen snow depth 0 cm

	Wet		Dry	X			
	Soft		Crusted	X			
Support:	None		Person on skies/snowshoes		Person on foot	X	
Serious Drifting:	No	X	Yes*		Which Stations		
Evidence of oversnow traffic:	Yes*		No	X			

C. Sampling Conditions

	Easy		Moderately Difficult	X	Very Difficult		
Ground Reached on all Samples:	Yes	X	No*				
Ice Layers:	In snowpack	X	On ground				
Ground under snow:	Dry	X	Damp		Wet		Frozen

D. General Condition en Route

Snow line elevatio 0 metres

Thaw:	None	X	Sunny slopes		General		
Small streams:	Bridged with snow	X	Open		Clear		Muddy

*Describe fully under remarks

E. Remarks:

British Columbia Ministry of Water, Land and Air Protection- Environmental Protection Division- Flood Hazard/River Forecast Centre

Back River Project Environmental Baseline Study (Project no. 833-002-02)

SNOW SURVEY FIELD DATA SHEET

Snow Course No.	SC-03		2012	4	24
			Year	**Month**	**Day**
Snow Course Name:	Back River Project - Goose Property				
Observer's Name:	C.Hall				
Number of		**Driving Wrench Used: Yes:**	X	**Scale No.:**	4S141
Tubes Used:	2	**No:**			

Station Number	Snow Depth (cm)		Core Length (cm)	Weight of Tube and Core (cm)	Weight Tube Only Before Sampling (cm)	Snow-Water Equivalent (cm)	Density (%)
	With Dirt Plug	Without Dirt Plug					
1	60	57	59	90	71	19	33
2	84	80	80	96	71	25	31
3	47	44	47	88	71	17	39
4	47	44	42	84	71	13	30
5	47	42	44	86	71	15	36
6	8	3	8	72	71	1	33
7	43	43	37	85	71	14	33
8	18	15	18	76	71	5	33
9	60	60	55	92	71	21	35
10	78	73	73	96	71	25	34
Total		461				155	
Average		**46**				**15.5**	**34**

Please complete in field or as soon after snow sampling as possible.

Time sampling began 9:20 a.m. ended 10:05 a.m.

A. Weather Conditions at Snow Course

	Freezing	X	Thawing		Temp	-14.1	˚C
	Blowing		Calm	X			
Skies:	Clear	X	Partly Cloudy		Overcast		
Precipitation:	None	X	Raining		Snowing		

B. Surface Snow Conditions at Snow Course

Fresh fallen snow depth 0 cm

	Wet		Dry	X			
	Soft		Crusted	X			
Support:	None		Person on skies/snowshoes		Person on foot	X	
Serious Drifting:	No	X	Yes*		Which Stations		
Evidence of oversnow traffic:	Yes*		No	X			

C. Sampling Conditions

	Easy		Moderately Difficult	X	Very Difficult		
Ground Reached on all Samples:	Yes	X	No*				
Ice Layers:	In snowpack	X	On ground				
Ground under snow:	Dry		Damp		Wet		Frozen	X

D. General Condition en Route

Snow line elevation n/a metres

Thaw:	None	X	Sunny slopes		General		
Small streams:	Bridged with snow	X	Open		Clear		Muddy	

*Describe fully under remarks

E. Remarks:

British Columbia Ministry of Water, Land and Air Protection- Environmental Protection Division- Flood Hazard/River Forecast Centre

Back River Project Environmental Baseline Study (Project no. 833-002-02)

SNOW SURVEY FIELD DATA SHEET

Snow Course No.	SC-04		2012	4	21
			Year	**Month**	**Day**
Snow Course Name:	Back River Project - Goose Property				
Observer's Name:	C.Hall				
Number of		**Driving Wrench Used: Yes:**	X	**Scale No.:**	4S141
Tubes Used:	2	**No:**			

Station Number	Snow Depth (cm)		Core Length (cm)	Weight of Tube and Core (cm)	Weight Tube Only Before Sampling (cm)	Snow-Water Equivalent (cm)	Density (%)
	With Dirt Plug	Without Dirt Plug					
1	51	48	49	87	71	16	33
2	80	80	79	100	72	28	35
3	42	41	42	83	71	12	29
4	69	69	65	94	71	23	33
5	111	107	111	112	71	41	38
6	67	67	65	94	71	23	34
7	12	10	12	74	71	3	30
8	39	35	36	81	71	10	29
9	31	27	28	79	71	8	30
10	30	26	28	81	71	10	38
Total		510				174	
Average		**51**				**17.4**	**33**

Please complete in field or as soon after snow sampling as possible.

Time sampling began 9:45 a.m. p.m. ended 11:07 a.m. p.m.

A. Weather Conditions at Snow Course

	Freezing	X	Thawing		Temp	-14.6	˚C
	Blowing	X	Calm				
Skies:	Clear	X	Partly Cloudy		Overcast		
Precipitation:	None	X	Raining		Snowing		

B. Surface Snow Conditions at Snow Course

Fresh fallen snow depth 0 cm

	Wet		Dry	X			
	Soft		Crusted	X			
Support:	None		Person on skies/snowshoes		Person on foot	X	
Serious Drifting:	No	X	Yes*		Which Stations		
Evidence of oversnow traffic:	Yes*		No	X			

C. Sampling Conditions

	Easy		Moderately Difficult	X	Very Difficult			
Ground Reached on all Samples:	Yes	X	No*					
Ice Layers:	In snowpack	X	On ground					
Ground under snow:	Dry	X	Damp		Wet		Frozen	

D. General Condition en Route

Snow line elevation n/a metres

Thaw:	None	X	Sunny slopes		General			
Small streams:	Bridged with snow	X	Open		Clear		Muddy	

*Describe fully under remarks

E. Remarks:

British Columbia Ministry of Water, Land and Air Protection- Environmental Protection Division- Flood Hazard/River Forecast Centre

Back River Project Environmental Baseline Study (Project no. 833-002-02)

SNOW SURVEY FIELD DATA SHEET

Snow Course No.	SC-05			2012	4	24
				Year	**Month**	**Day**
Snow Course Name:	Back River Project - Goose Property					
Observer's Name:	C.Hall					
Number of		**Driving Wrench Used:**	**Yes:**	X	**Scale No.:**	4S141
Tubes Used:	2		**No:**			

Station Number	Snow Depth (cm)		Core Length (cm)	Weight of Tube and Core (cm)	Weight Tube Only Before Sampling (cm)	Snow-Water Equivalent (cm)	Density (%)
	With Dirt Plug	Without Dirt Plug					
1	43	42	43	84	70	14	33
2	68	67	68	92	70	22	33
3	69	66	63	92	70	22	33
4	74	70	73	93	70	23	33
5	54	50	49	84	70	14	28
6	16	13	14	74	70	4	31
7	40	38	40	83	70	13	34
8	56	51	53	89	70	19	37
9	33	30	32	80	70	10	33
10	50	50	43	86	70	16	32
Total		477				157	
Average		**48**				**15.7**	**33**

Please complete in field or as soon after snow sampling as possible.

Time sampling began 1:25 a.m. ended 2:30 a.m.

A. Weather Conditions at Snow Course

	Freezing	X	Thawing		Temp	-11.7	˚C
	Blowing		Calm	X			
Skies:	Clear	X	Partly Cloudy		Overcast		
Precipitation:	None	X	Raining		Snowing		

B. Surface Snow Conditions at Snow Course

Fresh fallen snow depth 0 cm

	Wet		Dry	X			
	Soft		Crusted	X			
Support:	None		Person on skies/snowshoes		Person on foot	X	
Serious Drifting:	No	X	Yes*		Which Stations		
Evidence of oversnow traffic:	Yes*		No	X			

C. Sampling Conditions

	Easy	X	Moderately Difficult		Very Difficult		
Ground Reached on all Samples:	Yes	X	No*				
Ice Layers:	In snowpack	X	On ground				
Ground under snow:	Dry		Damp		Wet		Frozen	X

D. General Condition en Route

Snow line elevation n/a metres

Thaw:	None	X	Sunny slopes		General		
Small streams:	Bridged with snow	X	Open		Clear		Muddy	

*Describe fully under remarks

E. Remarks:

British Columbia Ministry of Water, Land and Air Protection- Environmental Protection Division- Flood Hazard/River Forecast Centre

Back River Project Environmental Baseline Study (Project no. 833-002-02)

SNOW SURVEY FIELD DATA SHEET

Snow Course No.	SC-06		2012	4	23
Snow Course Name:	Back River Project - Goose Property		**Year**	**Month**	**Day**
Observer's Name:	C.Hall				
Number of Tubes Used:	2	**Driving Wrench Used: Yes:**	X	**Scale No.:**	4S141
		No:			

Station Number	Snow Depth (cm)		Core Length (cm)	Weight of Tube and Core (cm)	Weight Tube Only Before Sampling (cm)	Snow-Water Equivalent (cm)	Density (%)
	With Dirt Plug	Without Dirt Plug					
1	53	48	47	86	71	15	31
2	71	69	65	94	71	23	33
3	50	50	48	88	71	17	34
4	43	39	42	84	71	13	33
5	39	37	39	83	71	12	32
6	38	34	38	82	71	11	32
7	66	66	64	96	71	25	38
8	75	72	69	95	71	24	33
9	77	77	75	99	71	28	36
10	72	69	70	95	71	24	35
Total		561				192	
Average		**56**				**19.2**	**34**

Please complete in field or as soon after snow sampling as possible.

Time sampling began 9:45 a.m. p.m. ended 11:07 a.m. p.m.

A. Weather Conditions at Snow Course

	Freezing	X	Thawing		Temp	-14.6	˚C
	Blowing	X	Calm				
Skies:	Clear	X	Partly Cloudy		Overcast		
Precipitation:	None	X	Raining		Snowing		

B. Surface Snow Conditions at Snow Course

Fresh fallen snow depth 0 cm

	Wet		Dry	X			
	Soft		Crusted	X			
Support:	None		Person on skies/snowshoes		Person on foot	X	
Serious Drifting:	No	X	Yes*		Which Stations		
Evidence of oversnow traffic:	Yes*		No	X			

C. Sampling Conditions

	Easy		Moderately Difficult	X	Very Difficult			
Ground Reached on all Samples:	Yes	X	No*					
Ice Layers:	In snowpack	X	On ground					
Ground under snow:	Dry	X	Damp		Wet		Frozen	

D. General Condition en Route

Snow line elevation n/a metres

Thaw:	None	X	Sunny slopes		General			
Small streams:	Bridged with snow	X	Open		Clear		Muddy	

*Describe fully under remarks

E. Remarks:

British Columbia Ministry of Water, Land and Air Protection- Environmental Protection Division- Flood Hazard/River Forecast Centre

Back River Project Environmental Baseline Study (Project no. 833-002-02)

SNOW SURVEY FIELD DATA SHEET

Snow Course No.	SC-07		2012	4	23
			Year	**Month**	**Day**
Snow Course Name:	Back River Project - Goose Property				
Observer's Name:	C.Hall				
Number of		**Driving Wrench Used:** **Yes:**	X	**Scale No.:**	4S141
Tubes Used:	3	**No:**			

Station Number	Snow Depth (cm)		Core Length (cm)	Weight of Tube and Core (cm)	Weight Tube Only Before Sampling (cm)	Snow-Water Equivalent (cm)	Density (%)
	With Dirt Plug	Without Dirt Plug					
1	143	140	142	169	113	56	40
2	49	46	48	132	113	19	41
3	57	54	54	134	113	21	39
4	50	47	50	130	113	17	36
5	63	61	63	135	113	22	36
6	96	96	94	151	113	38	40
7	128	126	117	162	113	49	39
8	98	98	98	152	113	39	40
9	71	71	68	139	113	26	37
10	52	50	51	134	113	21	42
Total		789				308	
Average		**79**				**30.8**	**39**

Please complete in field or as soon after snow sampling as possible.

Time sampling began 12:23 a.m. ended 1:30 a.m.

A. Weather Conditions at Snow Course

	Freezing	X	Thawing		Temp	-10.5	˚C
	Blowing	X	Calm				
Skies:	Clear	X	Partly Cloudy		Overcast		
Precipitation:	None	X	Raining		Snowing		

B. Surface Snow Conditions at Snow Course

Fresh fallen snow depth 0 cm

	Wet		Dry	X			
	Soft		Crusted	X			
Support:	None		Person on skies/snowshoes		Person on foot	X	
Serious Drifting:	No	X	Yes*		Which Stations		
Evidence of oversnow traffic:	Yes*		No	X			

C. Sampling Conditions

	Easy		Moderately Difficult	X	Very Difficult		
Ground Reached on all Samples:	Yes	X	No*				
Ice Layers:	In snowpack	X	On ground				
Ground under snow:	Dry	X	Damp		Wet		Frozen	

D. General Condition en Route

Snow line elevation n/a metres

Thaw:	None	X	Sunny slopes		General		
Small streams:	Bridged with snow	X	Open		Clear		Muddy	

*Describe fully under remarks

E. Remarks:

British Columbia Ministry of Water, Land and Air Protection- Environmental Protection Division- Flood Hazard/River Forecast Centre

Back River Project Environmental Baseline Study (Project no. 833-002-02)

SNOW SURVEY FIELD DATA SHEET

Snow Course No.	SC-08		2012	4	25
Snow Course Nam	Back River Project - Goose Property		**Year**	**Month**	**Day**
Observer's Name:	C.Hall				
Number of Tubes Used:	4	**Driving Wrench Used: Yes:**	X	**Scale No.:**	4S141
		No:			

Station Number	Snow Depth (cm)		Core Length (cm)	Weight of Tube and Core (cm)	Weight Tube Only Before Sampling (cm)	Snow-Water Equivalent (cm)	Density (%)
	With Dirt Plug	Without Dirt Plug					
1	88	81	75	185	154	31	38
2	51	58	51	175	154	21	36
3	44	40	38	168	154	14	35
4	37	32	32	166	154	12	38
5	63	60	61	175	154	21	35
6	135	135	125	204	154	50	37
7	293	292	283	280	154	126	43
8	163	160	155	216	154	62	39
9	17	17	17	161	154	7	41
10	28	25	28	163	154	9	36
Total		900				353	
Average		**90**				**35.3**	**38**

Please complete in field or as soon after snow sampling as possible.

Time sampling began 1:45 a.m. ended 3:00 a.m.

A. Weather Conditions at Snow Course

	Freezing	X	Thawing		Temp	-10.3	˚C
	Blowing		Calm	X			
Skies:	Clear	X	Partly Cloudy		Overcast		
Precipitation:	None	X	Raining		Snowing		

B. Surface Snow Conditions at Snow Course

Fresh fallen snow depth 0 cm

	Wet		Dry	X			
	Soft		Crusted	X			
Support:	None		Person on skies/snowshoes		Person on foot	X	
Serious Drifting:	No	X	Yes*		Which Stations		
Evidence of oversnow traffic:	Yes*		No	X			

C. Sampling Conditions

	Easy		Moderately Difficult	X	Very Difficult		
Ground Reached on all Samples:	Yes	X	No*				
Ice Layers:	In snowpack	X	On ground	X			
Ground under snow:	Dry	X	Damp		Wet		Frozen	X

D. General Condition en Route

Snow line elevation n/a metres

Thaw:	None	X	Sunny slopes		General		
Small streams:	Bridged with snow	X	Open		Clear		Muddy	

*Describe fully under remarks

E. Remarks:

British Columbia Ministry of Water, Land and Air Protection- Environmental Protection Division- Flood Hazard/River Forecast Centre

Back River Project Environmental Baseline Study (Project no. 833-002-02)

SNOW SURVEY FIELD DATA SHEET

Snow Course No.	SC-09		2012	4	20
Snow Course Name:	Back River Project - George Property		**Year**	**Month**	**Day**
Observer's Name:	C.Hall				
Number of Tubes Used:	3	**Driving Wrench Used: Yes:**	X	**Scale No.:**	4S141
		No:			

Station Number	Snow Depth (cm)		Core Length (cm)	Weight of Tube and Core (cm)	Weight Tube Only Before Sampling (cm)	Snow-Water Equivalent (cm)	Density (%)
	With Dirt Plug	Without Dirt Plug					
1	8	6	8	Container & Core*	Container**	Core***	n/a
2	37	37	37	Container & Core*	Container*	Core***	n/a
3	12	10	12	Container & Core*	Container*	Core***	n/a
4	66	63	60	Container & Core*	Container*	Core***	n/a
5	23	23	23	Container & Core*	Container*	Core***	n/a
6	13	11	13	Container & Core*	Container*	Core***	n/a
7	8	8	8	Container & Core*	Container*	Core***	n/a
8	18	17	18	Container & Core*	Container*	Core***	n/a
9	3	3	3	Container & Core*	Container*	Core***	n/a
10	158	156	157	191	56	135	n/a
Total		334				135	
Average		**33**				**13.5**	**40.4**

**Weight of bulk sampling container and total snow cores sampled*

***Weight of bulk sampling container*

****Weight of total snow cores sampled*

Please complete in field or as soon after snow sampling as possible.

Time sampling began 9:25 a.m. p.m. ended 10:30 a.m. p.m.

A. Weather Conditions at Snow Course

	Freezing	X	Thawing		Temp	-6.5	˚C
	Blowing		Calm	X			
Skies:	Clear	X	Partly Cloudy		Overcast		
Precipitation:	None	X	Raining		Snowing		

B. Surface Snow Conditions at Snow Course

Fresh fallen snow depth 0 cm

	Wet		Dry	X			
	Soft		Crusted	X			
Support:	None		Person on skies/snowshoes		Person on foot	X	
Serious Drifting:	No		Yes*	X	Which Stations	10	
Evidence of oversnow traffic:	Yes*		No	X			

C. Sampling Conditions

	Easy		Moderately Difficult	X	Very Difficult			
Ground Reached on all Samples:	Yes	X	No*					
Ice Layers:	In snowpack		On ground					
Ground under snow:	Dry	X	Damp		Wet		Frozen	

D. General Condition en Route

Snow line elevation n/a metres

Thaw:	None	X	Sunny slopes		General			
Small streams:	Bridged with snow	X	Open		Clear		Muddy	

*Describe fully under remarks

E. Remarks:

Scouring on ridges and drifting in the low areas.

British Columbia Ministry of Water, Land and Air Protection- Environmental Protection Division- Flood Hazard/River Forecast Centre

Back River Project Environmental Baseline Study (Project no. 833-002-02)

SNOW SURVEY FIELD DATA SHEET

Snow Course No.	SC-10		2012	4	20
			Year	**Month**	**Day**
Snow Course Name:	Back River Project - George Property				
Observer's Name:	C.Hall				
Number of		**Driving Wrench Used: Yes:**	X	**Scale No.:**	4S141
Tubes Used:	4	**No:**			

Station Number	Snow Depth (cm)		Core Length (cm)	Weight of Tube and Core (cm)	Weight Tube Only Before Sampling (cm)	Snow-Water Equivalent (cm)	Density (%)
	With Dirt Plug	Without Dirt Plug					
1	18	17	17	Container & Core*	Container**	Core***	n/a
2	178	178	178	Container & Core*	Container*	Core***	n/a
3	0	0	0	Container & Core*	Container*	Core***	n/a
4	410	410	410	Container & Core*	Container*	Core***	n/a
5	147	145	145	Container & Core*	Container*	Core***	n/a
6	5	5	5	Container & Core*	Container*	Core***	n/a
7	5	3	5	Container & Core*	Container*	Core***	n/a
8	8	6	8	Container & Core*	Container*	Core***	n/a
9	57	54	53	Container & Core*	Container*	Core***	n/a
10	33	27	32	296	56	240	n/a
Total		845				240	
Average		85				24	28.4

**Weight of bulk sampling container and total snow cores sampled*

***Weight of bulk sampling container*

****Weight of total snow cores sampled*

Please complete in field or as soon after snow sampling as possible.

Time sampling began 12:50 a.m. ended 2:20 a.m.

A. Weather Conditions at Snow Course

	Freezing	X	Thawing		Temp	-1.1	˚C
	Blowing		Calm	X			
Skies:	Clear		Partly Cloudy	X	Overcast		
Precipitation:	None	X	Raining		Snowing		

B. Surface Snow Conditions at Snow Course

Fresh fallen snow depth 0 cm

	Wet		Dry	X			
	Soft		Crusted	X			
Support:	None		Person on skies/snowshoes		Person on foot	X	
Serious Drifting:	No		Yes*	X	Which Stations	2, 4 and 5	
Evidence of oversnow traffic:	Yes*		No	X			

C. Sampling Conditions

	Easy		Moderately Difficult		Very Difficult	X		
Ground Reached on all Samples:	Yes		No*	X				
Ice Layers:	In snowpack	X	On ground					
Ground under snow:	Dry	X	Damp		Wet		Frozen	

D. General Condition en Route

Snow line elevation n/a metres

Thaw:	None	X	Sunny slopes		General			
Small streams:	Bridged with snow	X	Open		Clear		Muddy	

*Describe fully under remarks

E. Remarks:

Scouring on ridges and drifting in the low areas.

Ground not reached at station 4 but sample was included in the bulk sample (probing adjacent to the sample indicated the ground was almost reached but ice layers prevented digging in any further).

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Back River Project Environmental Baseline Study (Project no. 833-002-02)

SNOW SURVEY FIELD DATA SHEET

Snow Course No.	SC-11			2012	4	22
Snow Course Name:	Back River Project - George Property			**Year**	**Month**	**Day**
Observer's Name:	C.Hall					
Number of		**Driving Wrench Used:**	**Yes:**	X	**Scale No.:**	4S141
Tubes Used:	4		**No:**			

Station Number	Snow Depth (cm)		Core Length (cm)	Weight of Tube and Core (cm)	Weight Tube Only Before Sampling (cm)	Snow-Water Equivalent (cm)	Density (%)
	With Dirt Plug	Without Dirt Plug					
1	28	23	26	161	154	7	30
2	81	81	79	185	154	31	38
3	58	58	57	177	154	23	40
4	25	24	23	162	154	8	33
5	27	20	25	160	154	6	30
6	5	5	5	156	154	2	40
7	12	8	11	157	154	3	38
8	9	6	7	156	154	2	33
9	62	60	62	178	154	24	40
10	46	43	45	170	154	16	37
Total		328				122	
Average		33				12.2	36

Please complete in field or as soon after snow sampling as possible.

Time sampling began 9:20 a.m. p.m. ended 10:40 a.m. p.m.

A. Weather Conditions at Snow Course

	Freezing	X	Thawing		Temp	-16	˚C
	Blowing	X	Calm				
Skies:	Clear	X	Partly Cloudy		Overcast		
Precipitation:	None	X	Raining		Snowing		

B. Surface Snow Conditions at Snow Course

Fresh fallen snow depth 0 cm

	Wet		Dry	X			
	Soft		Crusted	X			
Support:	None		Person on skies/snowshoes		Person on foot	X	
Serious Drifting:	No	X	Yes*		Which Stations		
Evidence of oversnow traffic:	Yes*		No	X			

C. Sampling Conditions

	Easy		Moderately Difficult	X	Very Difficult		
Ground Reached on all Samples:	Yes	X	No*				
Ice Layers:	In snowpack	X	On ground				
Ground under snow:	Dry	X	Damp		Wet		Frozen

D. General Condition en Route

Snow line elevatio 0 metres

Thaw:	None	X	Sunny slopes		General		
Small streams:	Bridged with snow	X	Open		Clear		Muddy

*Describe fully under remarks

E. Remarks:

British Columbia Ministry of Water, Land and Air Protection- Environmental Protection Division- Flood Hazard/River Forecast Centre

Back River Project Environmental Baseline Study (Project no. 833-002-02)

SNOW SURVEY FIELD DATA SHEET

Snow Course No.	SC-12			2012	4	22
				Year	**Month**	**Day**
Snow Course Name:	Back River Project - George Property					
Observer's Name:	C.Hall					
Number of Tubes Used:	2	**Driving Wrench Used:**	**Yes:** X	**Scale No.:**	4S141	
			No:			

Station Number	Snow Depth (cm)		Core Length (cm)	Weight of Tube and Core (cm)	Weight Tube Only Before Sampling (cm)	Snow-Water Equivalent (cm)	Density (%)
	With Dirt Plug	Without Dirt Plug					
1	16	14	15	66	61	5	36
2	59	59	53	83	61	22	37
3	103	103	101	105	61	44	43
4	60	56	55	80	61	19	34
5	75	72	74	90	61	29	40
6	56	53	55	83	61	22	42
7	76	76	75	93	61	32	42
8	13	9	13	64	61	3	33
9	17	12	17	66	61	5	42
10	48	45	43	79	61	18	40
Total		499				199	
Average		50				19.9	39

Please complete in field or as soon after snow sampling as possible.

Time sampling began 12:28 a.m. ended 1:36 a.m.

A. Weather Conditions at Snow Course

	Freezing	X	Thawing		Temp	-10	˚C
	Blowing	X	Calm				
Skies:	Clear	X	Partly Cloudy		Overcast		
Precipitation:	None	X	Raining		Snowing		

B. Surface Snow Conditions at Snow Course

Fresh fallen snow depth 0 cm

	Wet		Dry	X			
	Soft		Crusted	X			
Support:	None		Person on skies/snowshoes		Person on foot	X	
Serious Drifting:	No	X	Yes*		Which Stations		
Evidence of oversnow traffic:	Yes*		No	X			

C. Sampling Conditions

	Easy		Moderately Difficult	X	Very Difficult		
Ground Reached on all Samples:	Yes	X	No*				
Ice Layers:	In snowpack	X	On ground				
Ground under snow:	Dry	X	Damp		Wet		Frozen

D. General Condition en Route

Snow line elevatio 0 metres

Thaw:	None	X	Sunny slopes		General		
Small streams:	Bridged with snow	X	Open		Clear		Muddy

*Describe fully under remarks

E. Remarks:

Appendix V6-1C

Back River Project: 2013 Hydrology Baseline Report

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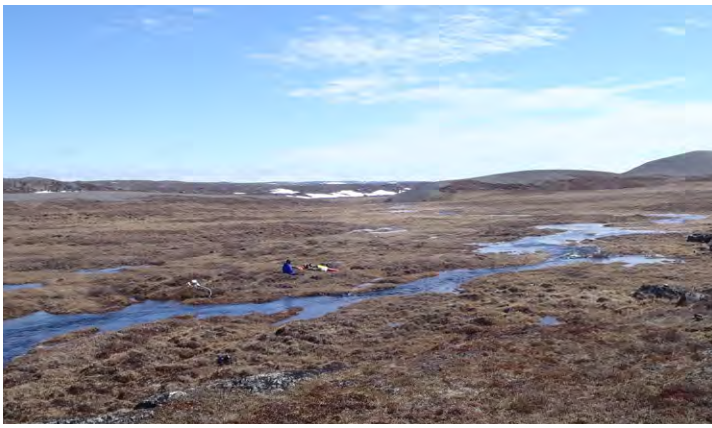
Sabina Gold & Silver Corp.

BACK RIVER PROJECT
2013 Hydrology Baseline Report



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January 2014

BACK RIVER PROJECT
2013 HYDROLOGY BASELINE REPORT

January 2014
Project #0194096-0002

Citation:
Rescan. 2014. *Back River Project: 2013 Hydrology Baseline Report*. Prepared for Sabina Gold & Silver Corp. by Rescan Environmental Services Ltd., an ERM company.

Prepared for:

Sabina Gold & Silver Corp.

Prepared by:

Rescan Environmental Services Ltd., an ERM company
Vancouver, British Columbia

Executive Summary

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Executive Summary

The Back River Project (the Project) lies in the West Kitikmeot region of Nunavut and is situated within the continuous permafrost zone of the continental Canadian Arctic. The baseline work in 2013 focused on the Goose Property and the George Property areas to support the permitting of the Project and the submission of the Draft Environmental Impact Statement.

The 2013 monitoring network on the Goose Property included 15 hydrometric stations, monitoring a total drainage area of 209.9 km2. The monitoring network on the George Property comprised 8 hydrometric stations, monitoring a total drainage area of 301.8 km2. The hydrometric networks were operated through the open water season from May 31, 2013 to October 3, 2013. During this time period, continuous time series water level (stage) data were collected at each streamflow monitoring station and more than 100 manual discharge measurements were completed. Based on the stage and discharge data collected, stage-discharge rating equations were determined and annual hydrographs produced.

The annual hydrographs in 2013 were characterized by snowmelt-driven high flows during the spring freshet. A snowmelt-driven high flow event occurred in each of the hydrographs during the freshet period in late May to early June in most basins. One rainfall-driven high flow event occurred in early September.

Daily peak flows ranged from 0.11 m^3/s at TIA-H1 to 9.50 m^3/s at PL-H1 in the Goose Property area and from 0.44 m^3/s at LY-H1 to 16.62 m^3/s at LG-H1 in the George Property area.

Volumetric outflows from monitored drainages were generally a function of drainage area. In the Goose Property area, the minimum volumetric outflows were observed at TIA-H1 (drainage area = 5.0 km^2) which had a total annual water output of 0.17 million m^3. The maximum annual volumetric output was 20.38 million m^3 at PL-H1 (drainage area = 204.6 km^2). In the George Property area, the minimum volumetric outflows were observed at MC-H1 (drainage area = 10.8 km^2) which had a total annual water output of 0.64 million m^3. The maximum annual volumetric output was 35.83 million m^3 at LG-H1 (drainage area = 271.1 km^2).

Average annual runoff was 100 mm for the Goose Property area (PL-H1) and 107 mm for the George Property area (KL-H1). Variable drainage divides between the sub-watersheds increased the uncertainty in runoff estimates for the smaller sub-watersheds. In general, 2013 was a drier year than 2011 and 2012.

Generally, the maximum monthly runoff occurred in June (67% in PL-H1 and 74% in KL-H1 which represent the Goose and George Property areas, respectively). The exceptions are EL-H1 and WR-H1 where the maximum monthly runoff was in September. The concentration of the annual runoff in June was greater than that of 2011 and less than that of 2012.

Acknowledgements

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Acknowledgements

This Report was prepared by Rescan Environmental Services Ltd. an ERM company for Sabina Gold and Silver Corp. (Sabina). Field data collection was conducted by Eli Heyman (B.Sc.), Jeff Anderson (M.Sc.), Byeong Kim and Merle Keefe (Sabina). The report was prepared and written by Ali Naghibi (Ph.D., P.Eng.) and Eli Heyman (B.Sc.), and technically reviewed by David Luzi (M.Sc.). Michael Soloducha (B.Sc.), Ted Lewis (Ph.D.), and Natasha Cowie (M.Sc.) provided technical support. The project was managed by Deborah Muggli (Ph.D., M.Sc., R.P.Bio.). Field assistance and on-site logistical support were gratefully provided by Sabina personnel, and Northern Air Support provided helicopter services.

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BACK RIVER PROJECT
2013 HYDROLOGY BASELINE REPORT

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Glossary and Abbreviations

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Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

ADCP	Acoustic Doppler Current Profiler.
Annual runoff	Annual runoff is a measure of the hydrologic response of a watershed. It is often presented as a depth of water, in mm, over an entire watershed allowing direct comparison with precipitation totals.
Arctic nival	A hydrological regime in which snowmelt is the major hydrological event producing runoff and continuous permafrost impedes deep infiltration reducing baseflow and winter flow.
Baseflow	The groundwater component of flow discharge that is attributed to soil moisture and groundwater drainage into a channel.
Break-up	The melting and dissipation of the ice cover on a water body.
Canadian Shield	A vast geologic area of exposed Precambrian crystalline igneous and high-grade metamorphic rocks that form tectonically stable areas covered by a thin layer of soil. It has a deep, common, joined bedrock region in eastern and central Canada and stretches North from the Great Lakes to the Arctic Ocean, covering over half of Canada.
Drainage Basin	The zone or portion of land that contributes water to the surface water runoff that flows past a given point along a stream channel.
Ephemeral	A stream which flows only during or after rain or snowmelt and has no baseflow component.
Freeze-up	The formation of an ice cover on a water body.
Freshet	In channels, the relatively high water discharge period resulting from spring/summer meltwater runoff of the snowpack accumulated over the winter.
Hydrograph	A graphic presentation of the variation in discharge with elapsed time.
Intermittent	A stream which flows only part of the year.
ISO	International Organization for Standardization
LSA	Local Study Area
MAD	The mean annual discharge, computed as an average discharge over the year.
NAD 83	North American Datum 1983. A datum is a reference system for computing or correlating the results of a survey. The NAD83 datum is based on the spheroid (GRS80).
Permafrost	Bedrock, organic or earth material that has temperatures below 0°C persisting over at least two consecutive years.

Stage	The height of the water surface in a water course or channel above a fixed datum.
Stage-Discharge Curve	A curve derived from concurrently measured stage and discharge data that is used to estimate the discharge for any given observed stage. Often referred to as a rating curve for a streamflow monitoring station.
Talik	An unfrozen section of ground within a layer of discontinuous permafrost. Taliks can also be found underneath water bodies in a layer of continuous permafrost.
The Project	The Back River Project
Unit Yield	It is a ratio of water discharges normalized to the drainage area for a basin. This parameter allows for direct comparison of the hydrological response of basins with different size drainage areas.
WSC	Water Survey of Canada.
UTM	Universal Transverse Mercator. A mathematical transformation (map projection) of the earth's surface to create a flat map sheet.

1. Introduction

1. Introduction

The Back River Project (the Project) is a proposed gold project owned by Sabina Gold and Silver Corporation (Sabina) located in the West Kitikmeot region of Nunavut (Figure 1-1). The 2013 hydrology baseline program was designed within the local study areas (LSA) of the Goose Property and George Property areas.

This report presents the results from the 2013 hydrology baseline program. The program included the collection of site-specific data from streams, rivers, and lakes in the Goose Property area and the George Property area. Monitoring was focussed on drainages within the potential development area (PDA), but drainages outside the PDA were monitored to characterize the LSA hydrology. Additionally, monitoring sites were established at reference drainages for the Goose Property area and George Property area.

The objectives of the 2013 hydrology program were:

- the continued operation of nine hydrometric monitoring stations in the Goose Property area that were established in 2011 and operated in 2012;
- the expansion of the 2012 hydrometric monitoring network in the Goose Property area with the installation and operation of six additional hydrometric monitoring stations;
- the continued operation of two hydrometric monitoring stations in the George Property area that were established in 2012;
- the expansion of the 2012 hydrometric monitoring network in the George Property area with the installation and operation of five additional monitoring stations, and a new reference station adjacent to the area;
- the development of stage-discharge relations for each of the hydrometric monitored stations;
- the calculation of water discharges and production of annual hydrographs for each of the monitored drainage basins; and
- the calculation of hydrologic indices, including annual runoff, monthly runoff distribution, peak flows, and low flows.

A description of the hydrological setting is presented in Chapter 2 of this report. Overall monitoring design, and the methods used for data collection is provided in Chapter 3. Results of the 2013 monitoring program are presented in Chapter 4. All raw data collected in 2013 are provided as appendices to this report.

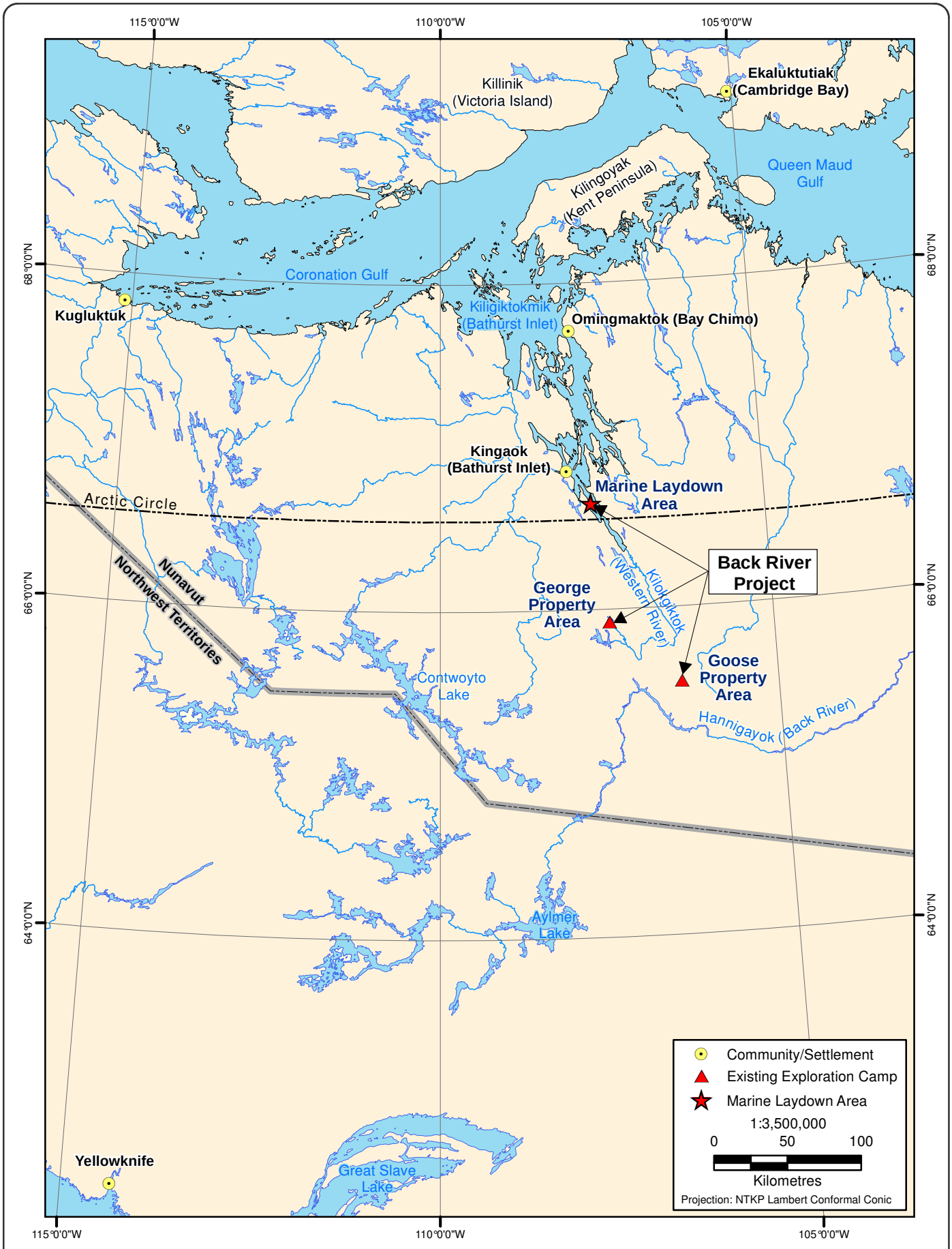

Figure 1-1

Back River Project Location

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2. Hydrological Setting

2. Hydrological Setting

2.1 ARCTIC HYDROLOGY

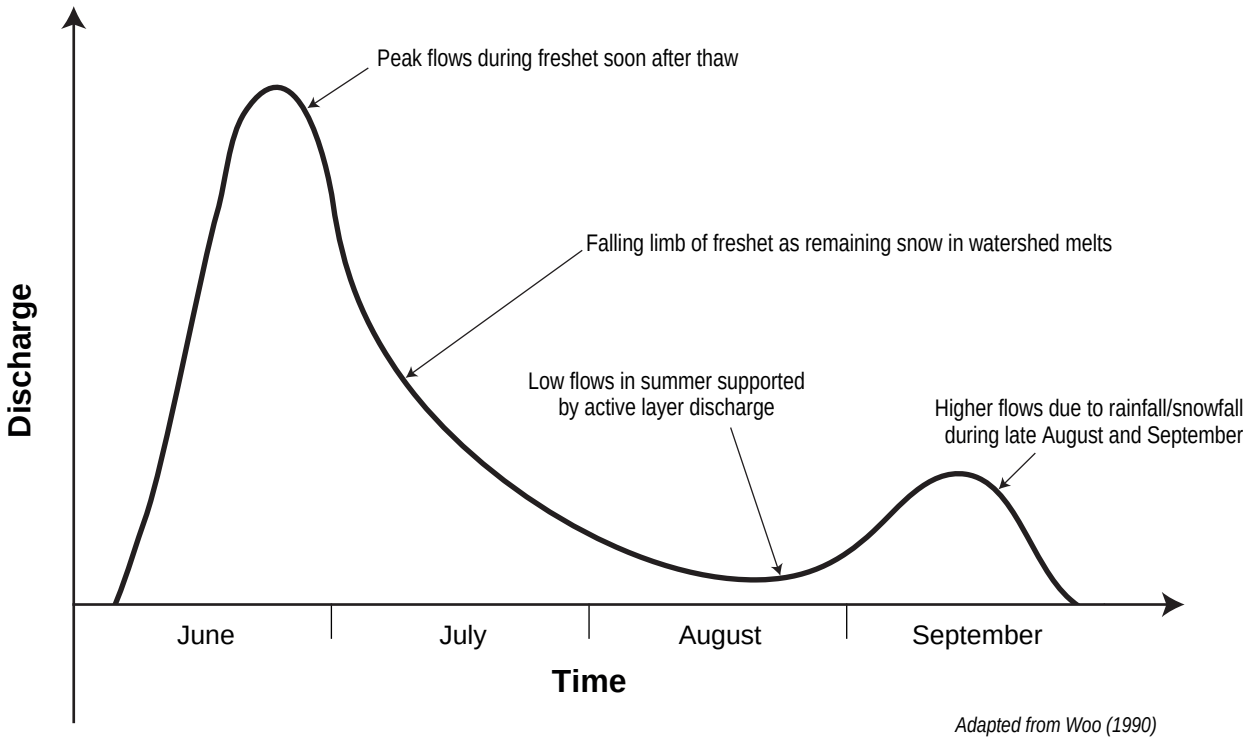
The Project area lies within the continuous permafrost zone of the continental Canadian Arctic. The physiography of the region is dominated by vegetated tundra hillslopes with lakes and scattered wetlands. The presence of permafrost is hydrologically significant as it has a very low hydraulic conductivity and thus acts as a barrier to deep groundwater recharge. This physical restriction tends to increase surface runoff and decrease subsurface flow.

Compared to non-permafrost regions, permafrost watersheds tend to have higher peak flow and lower baseflow (Kane et al. 1997). Hydrologic processes in permafrost watersheds are generally dominated by snow accumulation and melt, surface runoff, and runoff routed through lakes. The annual flow hydrograph is defined by the long cold winters and the short summers. Most of the annual runoff occurs during spring freshet and is derived from the melting snow pack. Additionally, frontal systems may generate precipitation events that produce moderate runoff. Following the freshet, a low flow period typically develops through July and August. Due to the presence of permafrost, there is limited groundwater support for smaller streams; however, there may be interaction between groundwater systems and larger rivers and/or lakes through taliks or openings in the permafrost. As a result of the permafrost, baseflow in streams is supported only by flow through the shallow upper active layer of the soil and release from storage features including lakes and wetlands. Overall, surface runoff in Arctic basins is largely controlled by snowmelt and the presence of permafrost, which accentuates runoff peaks while reducing baseflow conditions (Woo 1990).

The hydrologic year for the region is defined by break-up and freeze-up. According to regional data from the Water Survey of Canada (WSC), break-up typically occurs in early June and freeze-up in October. Water is stored in the snowpack during winter and is released as temperatures increase during the spring freshet. Small to medium sized streams typically freeze dry during the winter, due to the limited storage capacity of the surrounding landscape. Even some large rivers in the continuous permafrost region cease to flow after freeze-up (Woo 1990).

Arctic hydrographs are characterized by a steep rising limb leading to a peak during the freshet period, and a second rainfall-generated peak that can be observed in certain years in late August or early to mid-September. Generally, within the continuous permafrost region discharge is dominated by snowmelt floods, referred to as a nival regime. A conceptual hydrograph showing typical annual discharge patterns for small watersheds is shown in Figure 2.1-1.

In very small basins the freshet can be as short as a few days and will often occur immediately after ice break-up in the lakes, if lakes are present in the basin. Streamflow in these basins may cease after freshet and streams remain dry until the late summer rains begin. In contrast to smaller basins, in rivers draining larger watersheds the freshet peak may be delayed after ice break-up. The delay occurs as snowmelt from upper portions of the larger watershed is routed through the drainage network. Smaller basins can also have more dramatic responses to precipitation than larger watersheds. In larger watersheds the presence of lakes creates significant flow attenuation, which may diminish the magnitude of peak flows.



Adapted from Woo (1990)

Note: Approximate scale only

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Theoretical Typical Annual Flow Hydrograph for a Small Arctic Watershed

Figure 2.1-1

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A number of factors influence the volume of freshet runoff in Arctic watersheds, these factors include:

- *Amount of snowpack available to be melted in spring*. Snowpack depth is dependent on the amount of snowfall during the previous winter and the amount of snow remaining in each watershed prior to freshet. Snow can be lost or redistributed due to sublimation, melting, or wind;
- *Air temperature*. Above freezing air temperatures combined with a rapid air temperature increase can greatly affect peak flow rates as a rapid increase in temperature after the snowpack is already saturated can produce high melt rates. Differential melt rates on north and south facing slopes can also occur which may affect the size of the area contributing to the melt. Warm air temperatures can increase evapotranspiration and sublimation, reducing surface water availability;
- *Timing of opening of stream channels linking lakes*. Snowmelt from hillslopes surrounding lakes can occur before the stream channels draining the lakes become ice free. In this case, meltwater can be stored in the lake and then released once the channels are open to flow; and,
- *Soil moisture conditions and lake levels at the end of the previous summer*. If there was a dry summer during the previous year, lake levels could have been lowered and a soil moisture deficit could have developed within the hillslopes surrounding the lakes. As a result, a portion of the annual runoff will recharge the lakes and soil moisture and not be transmitted from the watershed as streamflow.

After snowmelt-generated runoff ends, the remaining runoff in summer and fall is controlled by rainfall, evaporation, and release of stored water in lakes and the active layer. Smaller basins with minimal lake area tend to exhibit a more rapid response to precipitation than larger basins. Open-water evaporation rates in summer often exceed total rainfall, causing soil moisture deficits in the shallow active layer of the soil. Studies of hillslope processes in northern watersheds have shown that summer rainfall can produce little or no runoff from hillslopes in the permafrost zone (Quinton and Marsh 1998). In this case, streamflow increases only due to rain falling directly onto lake surfaces or when there is significant rainfall from short-term/high intensity events, or longer-term/sustained lower intensity events (Dugan et al. 2009)

2.2 AVAILABLE REGIONAL HYDROLOGIC DATA

Regional data are available from hydrometric stations operated by WSC and by mining projects in the region (Table 2.2-1 and Figure 2.2-1). The drainage areas of these stations range from 7 km^2 to 19,600 km^2. Data from these stations with the closest proximity to the Project area were analyzed to provide background information on the regional surface water hydrology (for details, see Rescan 2013a, Volume 6, Chapter 1).

Analysis of historical data revealed that break-up in these rivers has typically occurred in May and freeze-up in October (Figure 2.2-2). Peak flows were typically observed in early to mid-June during freshet and some stations recorded a second substantial peak in late summer or early autumn. Hydrometric stations with smaller watershed areas (e.g., Atitok Creek) frequently report zero flow throughout the winter.

2.3 STUDY AREA

The study area is located near the watershed boundaries of the Ellice River, the Back River, and the Western River (Figure 2.2-1). The Ellice River discharges north to the Arctic Ocean into the Queen Maud Gulf approximately 300 km from the project area and the Western River discharges north to the Bathurst Inlet approximately 80 km from the project area. The Back River flows northeast to its mouth at Cockburn Bay on the Arctic Ocean in the eastern portion of the Kitikmeot Region, south of Gjoa Haven. The basins within the Project area are characterized by extensive networks of lakes, low relief hummocky topography, and exposed bedrock uplands (Plates 2.3-1 and 2.3-2).

Table 2.2-1. Regional Water Survey of Canada (WSC) Stations Relevant to the Study Area

WSC Station ID	Station Name	Latitude	Longitude	Drainage Area (km^2)	Period of Record
06MA002	Qinguq Creek near Baker Lake	64°15'42" N	96°18'53" W	432	1969-1994
07RC001	Thonokied River near the mouth	64°8'49" N	108°55'2" W	1,780	1980-1990
10JA004	Acasta River Above LittleCrapeau Lake	64°52'32" N	116°8'30" W	2,280	1980-1994
10JE001	Sloan River Near The Mouth	66°31'19" N	117°16'26" W	2,040	1976-1991
10PC002	Atitok Creek Near Dismal lakes	67°12'52" N	116°36'32" W	217	1980-1990
10RA001	Back River below Beechey Lake	65°11'14" N	106°05'09" W	19,600	1978–2012
10RA002	Baillie River near the mouth	65°00'38" N	104°29'26" W	14,500	1978–2012
10QC001	Burnside River near the mouth	66°43'34" N	108°48'47" W	16,800	1976–2012
10QC002	Gordon River near the mouth	66°48'36" N	107°06'04" W	1,530	1977–1994
10QD001	Ellice River near the mouth	67°42'30" N	104°8'21" W	16,900	1971-2012
n/a	Slipper-Lac de Gras Stream*	64°36'33" N	110°50'27" W	185	1995-2011
n/a	Vulture-Polar Stream*	64°44'24" N	110°32'56" W	7.2	1997-2011

** from Ekati Project (Rescan 2013b)*

Plate 2.3-1. High angle oblique view showing the extensive lake coverage and low relief hummocky topography typical of the Goose and the George Property areas. This photograph was taken of the George Property area on July 14, 2013.

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Figure 2.2-1

Regional Hydrometric Stations Relevant to the Study Area

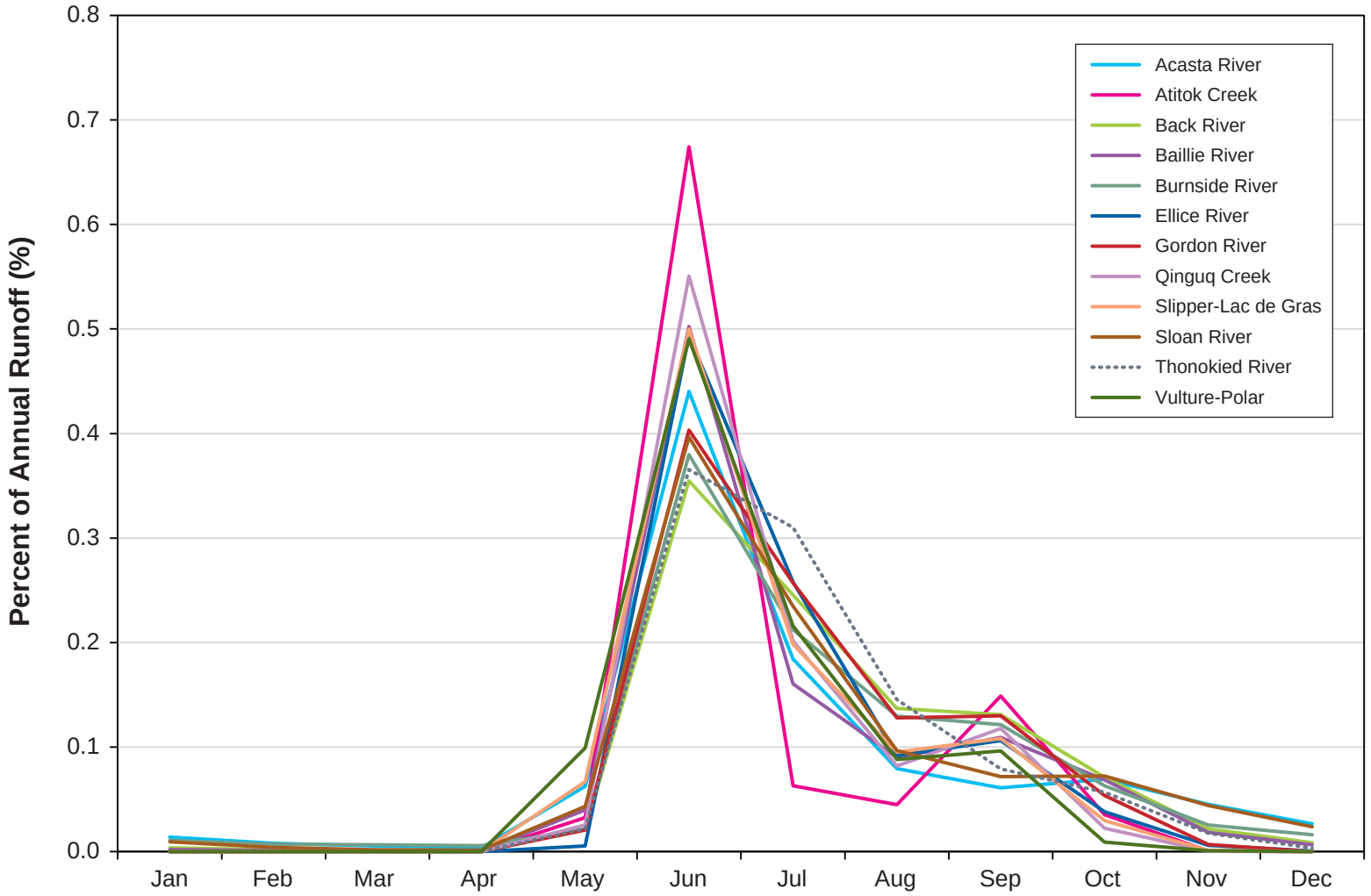

Figure 2.2-2

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Monthly Distribution of Annual Runoff at Regional and Project Stations

Figure 2.2-2

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Plate 2.3-2. Looking north along the outflow from Esker Pond on the George Property. Note the relatively low relief topography, bedrock outcrops and low tundra vegetation typical of the region. June 4 2013.

For the Goose Property, the 2013 study area was reduced to 209.9 km2 from 391.3 km2 in 2012 following changes to the Project infrastructure which no longer included drainages within the Back River watershed. Figure 2.3-1 shows the locations of the hydrometric stations within the sub-watershed boundaries of the Goose Property area. The study was designed to monitor a 204.6 km2 area encompassing the potential infrastructure within the Goose Property local study area (LSA), which is located within the Ellice River watershed. An additional reference station was located in a 5.3 km2 drainage basin within the Back River watershed approximately 14 km to the south of the potential infrastructure (Figure 2.3-1).

The Goose Property LSA has approximately 18% lake coverage, an average ground slope of 1.4%, and a total relief of 85 m. The gauged streams within the study area range from small ephemeral channels, less than 1 m in width, to larger streams with widths exceeding 50 m. Larger streams are located at the outlets of the larger lakes. Although some large rivers in the region may still have flow during the winter, it is likely that most stream channels around the Project area freeze to their bed and have zero flow during the winter months. Based on available data from WSC, the Ellice River near its mouth typically stops flowing over the winter period.

For the George Property, the 2013 study area was expanded from 33.5 km^2 in 2012 to 301.8 km^2 in 2013. Figure 2.3-2 shows the locations of the hydrometric stations and their associated sub-watershed boundaries on the George Property. The study was designed to monitor a 287.1 km^2 area encompassing the potential infrastructure within the George Property LSA, which is located within the Western watershed. An additional reference station was located in a 14.7 km^2 drainage basin approximately 10 km to the southwest of the potential infrastructure (Figure 2.3-2).

The George Property LSA has approximately 16% lake coverage, an average ground slope of 2.8%, and a total relief of 177 m. This region exhibits higher relief than the Goose Property, with ridges of bedrock and esker deposits separating glacial valleys. Many of the gauged streams on the George Property were deep and narrow and meandered within the over-widened valleys created by glaciers, while others flowed through wide beds.

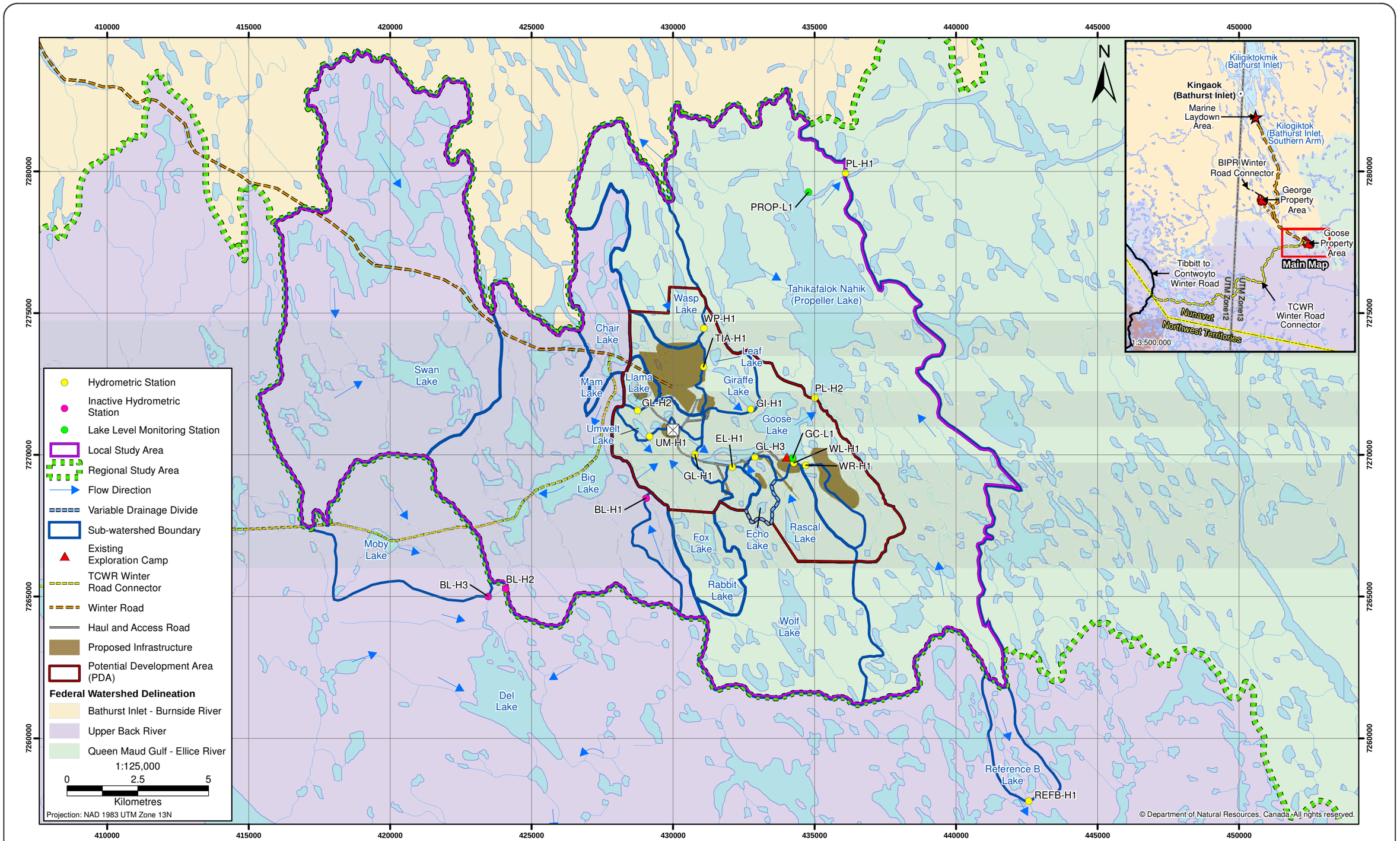

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Figure 2.3-1

Study Area Drainage Basins - Goose Property Area

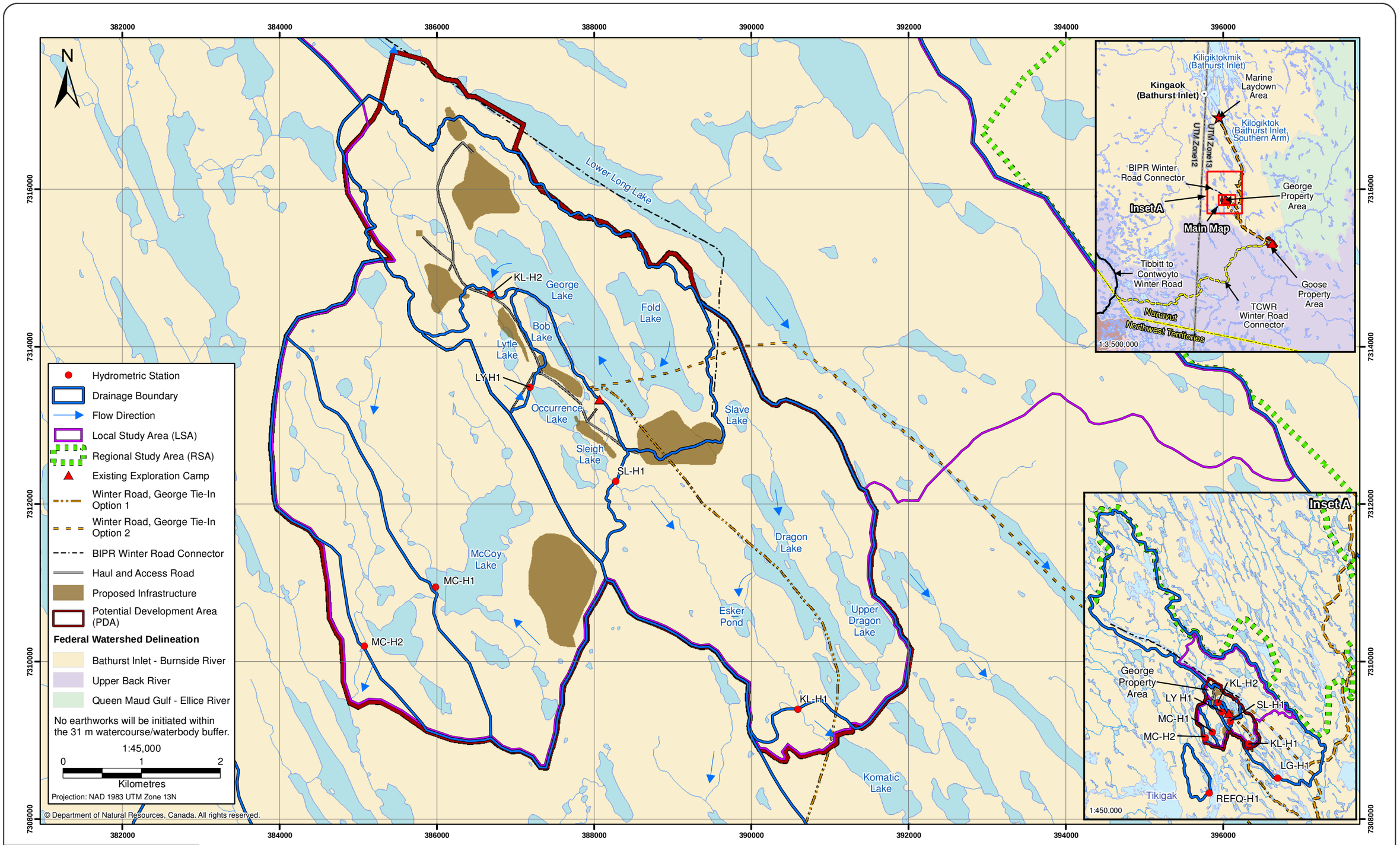


Figure 2.3-2

Study Area Drainage Basins - George Property Area

3. Methodology

3. Methodology

3.1 HYDROMETRIC MONITORING NETWORK

A network of hydrometric monitoring stations was initiated in 2010 and expanded in the following years to collect continuous water level data at selected locations within the Project area (Table 3.1-1). The automated stations recorded stream and lake water level data at ten minute intervals during the open water season. Information sheets for hydrometric stations are presented in Appendix 1 and watershed maps associated with these hydrometric stations are provided in Appendix 2.

Table 3.1-1. Hydrometric Monitoring Stations in the Goose Property Area

Hydrometric Station	Location	Geographic Coordinates*		Drainage Area (km^2)	Lake Coverage (%)	Monitoring Years	Period of Operation in 2013	Monitoring Type
		Easting	Northing					
BL-H1	Big Lake inflow	429,044	7,268,478	3.6	2.5	2012	n/a	stream water level
BL-H2	Swan Lake	424,087	7,265,274	160	18.9	2012	n/a	stream water level
BL-H3	Moby Lake outflow	423,467	7,264,998	21.4	4.7	2012	n/a	stream water level
EL-H1	Echo Drainage outflow	432,091	7,269,573	1.4	2.2	2011-2013	May 31 to Sep 12	stream water level
GC-L1	Goose Camp	434,227	7.269,886	n/a†	n/a†	2013	Jun 7 to Oct 4	lake water level
GI-H1	Giraffe Lake outflow	432,744	7,271,610	27.4	13.3	2011-2013	Jun 5 to Sep 10	stream water level
GL-H1	Goose Lake inflow	430,772	7,270,016	18.0**	10.6	2010-2013	Jun 2 to Sep 12	stream water level
GL-H2	Llama Lake outflow	428,746	7,271,567	1.7	23.1	2010-2013	Jun 3 to Sep 11	stream water level
GL-H3	Goose Lake inflow	432,891	7,269,919	1.8	7.5	2011-2013	May 31 to Sep 13	stream water level
PL-H1	Propeller Lake outflow	436,094	7,279,939	204.6	18.9	2011-2013	Jun 8 to Oct 4	stream water level
PL-H2	Propeller Lake inflow	435,007	7,272,014	101.6	15.1	2011-2013	Jun 2 to Oct 4	stream water level
PROP-L1	Propeller Lake	434,782	7,279,265	n/a†	n/a†	2013	Sep 9 to Oct 4	lake water level
REFB-H1	Reference B Lake outflow	442,573	7,257,794	5.3	19.1	2011-2013	Jun 6 to Sep 16	stream water level
TIA-H1	Tailings impoundment outflow	431,074	7,273,105	5.0	4.4	2013	Jun 5 to Sep 12	stream water level
UM-H1	Umwelt Lake outflow	429,166	7,270,648	4.1	17.0	2013	Jun 3 to Sep 16	stream water level
WL-H1	Wolf Drainage outflow	434,269	7,269,719	32.7**	16.6	2011-2013	Jun 1 to Sep 15	stream water level

(continued)

Table 3.1-1. Hydrometric Monitoring Stations in the Goose Property Area (completed)

Hydrometric Station	Location	Geographic Coordinates*		Drainage Area (km^2)	Lake Coverage (%)	Monitoring Years	Period of Operation in 2013	Monitoring Type
		Easting	Northing					
WP-H1	Wasp Lake outflow	431,087	7,274,467	17.6	14.0	2013	Jun 5 to Sep 12	stream water level
WR-H1	WRSA B outflow	434,688	7,269,634	2.7	2.4	2013	Jun 1 to Sep 15	stream water level

** UTM, Datum NAD 83, Zone 13 W*
*** Adjusted in 2012*
†*Drainage areas and lake coverage not applicable for lake water level stations.*

In 2010, a small network of two hydrometric monitoring stations within the Goose Property area (GL-H1 and GL-H2) was operated from July 3 to September 13, 2010 (Table 3.1-1).

In 2011, a network of nine hydrometric monitoring stations was operated from June 10 to September 17 in the Goose Property area (Rescan 2012a). The 2011 network included the remobilization of the two stations established in 2010, plus the installation of six new stations within the Goose Property area and one reference station south of the Project drainage boundary. The network focused on monitoring basins and sub-basins around the known deposits in the Project area, and the furthest downstream river associated with the property at Propeller Lake outflow (Table 3.1-1).

2012 was the first year of hydrometric monitoring in the George Property area (Table 3.1-2). The network in the Goose Property area was operated from June 5 to September 14 and the network in the George Property area was operated from June 10 to September 12 (Rescan 2012b). The 2012 networks focused on monitoring basins and sub-basins around the known deposits in each property area (Tables 3.1-1 and 3.1-2).

Table 3.1-2. Hydrometric Monitoring Stations in the George Property Area

Hydrometric Station	Location	Geographic Coordinates*		Drainage Area (km^2)	Lake Coverage (%)	Monitoring Years	Period of Operation in 2013	Monitoring Type
		Easting	Northing					
KL-H1	Komatic Lake inflow	390,592	7,309,400	24.2	19.7	2012-2013	June 4 to Sep. 17	stream water level
KL-H2	George Lake outflow	386,687	7,314,673	9.6	24.6	2012-2013	June 11 to Sep. 14	stream water level
LG-H1	Long Lake outflow	394,280	7,305,113	271.1	17.0	2013	June 11 to Sep. 9	stream water level
SL-H1	Sleigh Lake outflow	388,274	7,312,296	13.0	23.2	2013	June 9 to Sep. 17	stream water level
LY-H1	Lytle Lake outflow	387,172	7,313,489	10.6	23.4	2013	June 10 to Sep. 14	stream water level
MC-H1	McCoy Lake	385,983	7,310,949	10.8	12.6	2013	June 10 to Sep. 14	stream water level
MC-H2	McCoy outflow	385,070	7,310,204	15.8	11.6	2013	June 9 to Sep. 17	stream water level
REFQ-H1	Reference Q Lake	385,551	7,303,203	14.7	9.4	2013	June 12 to Sep. 18	stream water level

** UTM, Datum NAD 83, Zone 13 W*

The 2012 network in the Goose Property area included the remobilization of the nine stations established in 2011, plus the installation of three new stations. All of the three new stations were located within the Back River watershed (BL-H1, BL-H2, and BL-H3). The 2012 network in the George Property area included the installation of three new stations. Two of the stations, KL-H1 and KL-H2, encompassed the George Property, and the other one, REFC-H1, operated as a reference station.

In 2013, the network within the Goose Property area included thirteen streamflow monitoring stations and two lake level monitoring stations operated from May 31st to October 4th. In the George Property area, eight hydrometric stations were operated from June 4th to September 18th.

In the Goose Property area, the 2013 network was further subdivided and expanded to monitor the watersheds affected by the updated plans for the Tailings Impoundment Area (TIA) and Waste Rock Storage Areas (WRSAs). However, monitoring at hydrometric stations within the Back River watershed (BL-H1, BL-H2, and BL-H3) was not continued, because the infrastructure was no longer planned to be located within this watershed.

The 2013 network in the Goose Property area included the installation of four new stations and the remoblization of nine of the stations operated in 2012. Two of the new stations WP-H1 and TIA-H1 were installed within the presently monitored Giraffe Lake watershed. Station UM-H1 was installed in the Llama watershed and WR-H1 was installed in the Goose Lake watershed. In addition two lake level monitoring stations were installed in Goose Lake and Propeller Lake (GC-L1 and PROP-L1).

The George Property area was subdivided in the vicinity of the present-day George exploration camp and expanded to include the McCoy Lake watershed (Tables 3.1-2). Six new stations were installed and two stations from the 2012 network were remobilized. Stations LY-H1 and SL-H1 were installed within the watershed monitored by KL-H1 and the McCoy watershed was monitored with the addition of stations MC-H1 and MC-H2. Finally, station LG-H1 was located on Long Lake outflow and REFQ-H1 was added to the network as a reference station.

3.2 HYDROMETRIC MONITORING STATION SETUPS

Hydrometric monitoring stations were setup within the Project area to obtain water level data at selected stream and lake sites. Specific station locations were determined during initial field reconnaissance conducted in late May 2013. Sites were selected to best meet the basic criteria required for desirable gauging locations. Such criteria include: the ability to obtain accurate water level data and to measure discharge at all stages; a stable natural control of water elevation at the site; and accessibility during the entire operational period.

Each hydrometric monitoring station consisted of a PS-98i® 0-5 PSI vented pressure transducer (Instrumentation Northwest Inc.) paired with an ELF-2 data logger (Terrascience Ltd.) or an AquiStar® PT2X integrated datalogger and pressure transducer (Instrumentation Northwest Inc.). The instrumentation measured and recorded water levels at 10 minute intervals. Pressure transducers were encased within aluminum flex conduit which was secured to angle iron (1.5 m lengths by 50 mm width and 6 mm thickness) and laid flat on the stream/lake bed in order to keep the transducer weighted in place. The flex conduit housing the transducer cable was routed to a steel weather proof enclosure containing the data logger. The box was securely installed above the high water mark. An example of a typical station set-up is shown in Plate 3.2-1.

Plate 3.2-1. Photographs illustrating the hydrometric monitoring station design.

3.3 DISCHARGE MEASUREMENTS

At each hydrometric station, current velocity measurements were performed so that discharges could be determined. Measurements were taken throughout the open water season in order to obtain a wide range of discharges under different flow conditions. Four site visits were conducted during mid-June, mid-July, mid-August, and mid-September time periods, and multiple flow measurements were carried out during some visits (details provided in Section 4.1).

Manual flow measurements were carried out at each site using two different methods depending on the flow conditions and morphology of the stream. At one site where the channel was too deep to wade, an Acoustic Doppler Current Profiler (ADCP) was used to determine discharge. At all other sites, where the stream channels could be safely waded, a handheld current velocity meter was used.

3.3.1 Current Velocity Measurements

The location of the metered section at each site was determined based on channel geometry and flow conditions at time of measurement. Generally, the stream was measured along a straight reach near the station where the bed was as uniform as possible. Areas with submerged vegetation and/or immovable rocks were avoided where possible.

Current velocities were measured using an electromagnetic current meter (Hach FH950 Portable Flow Meter™ or Marsh-McBirney Flo-mate™). A fixed sampling interval of 40 seconds was selected for each velocity measurement, during which an average velocity was determined.

Water discharge was computed from stream velocity measurements by employing the velocity-area method, which determines discharge across the channel between observation verticals. In this method it is assumed that the velocity sampled at each vertical represents the mean velocity in a segment. The segment area extends laterally from half the distance from the preceding vertical to half the distance to the next, and vertically from the water surface to the sounded depth. The partial discharges across the channel are then summed to obtain the estimated total discharge measurement. Typically a minimum of 20 current velocity measurements are obtained across the width of a channel with the aim of having each measurement interval accounting for less than 10% of the total discharge (Plate 3.3-1).

Plate 3.3-1. Velocity-area discharge measurements at hydrometric station KL-H2 using a handheld current velocity meter. September 14, 2013.

At each sounding point, if the observed water depth was less than 0.75 m, the current water velocities were measured at 60% of the flow depth of water. The measurement at 60% of the flow depth is generally accepted as representing the mean velocity of the vertical water section (Herschy 2009). When water depths were greater than 0.75 m, current velocities were measured at 20% and 80% of the flow depth of water and the average of the two readings was taken as the mean velocity for the vertical. In all cases, the adopted methods followed standard WSC operating procedures (Terzi 1981).

3.3.2 ADCP Measurements

At one hydrometric station (i.e., PL-H1), water depth was too high during the spring freshet to allow field personnel to safely wade and measure discharge with a handheld current velocity meter. Therefore, discharge was measured at this site by means of a StreamPro® (Teledyne RD Instruments) ADCP. All measurements were conducted according to standard operating procedures (Rehmel et al. 2003, WSC 2004).

The location of the ADCP measurements was selected following the same general principles as with the handheld current velocity meter. In addition, the section was chosen where the channel was relatively narrow to allow for better instrument control during the ADCP measurements.

At the selected location personnel walked to an upstream location to cross the channel with a rope system. A cableway was used to manoeuvre the ADCP in controlled transects perpendicular to the direction of flow (Plate 3.3-2). Multiple transects were conducted until a minimum of four transects recorded discharges that were all within 5% of the measured mean discharge. The total discharge measurement was computed by taking the average of the four valid transects.

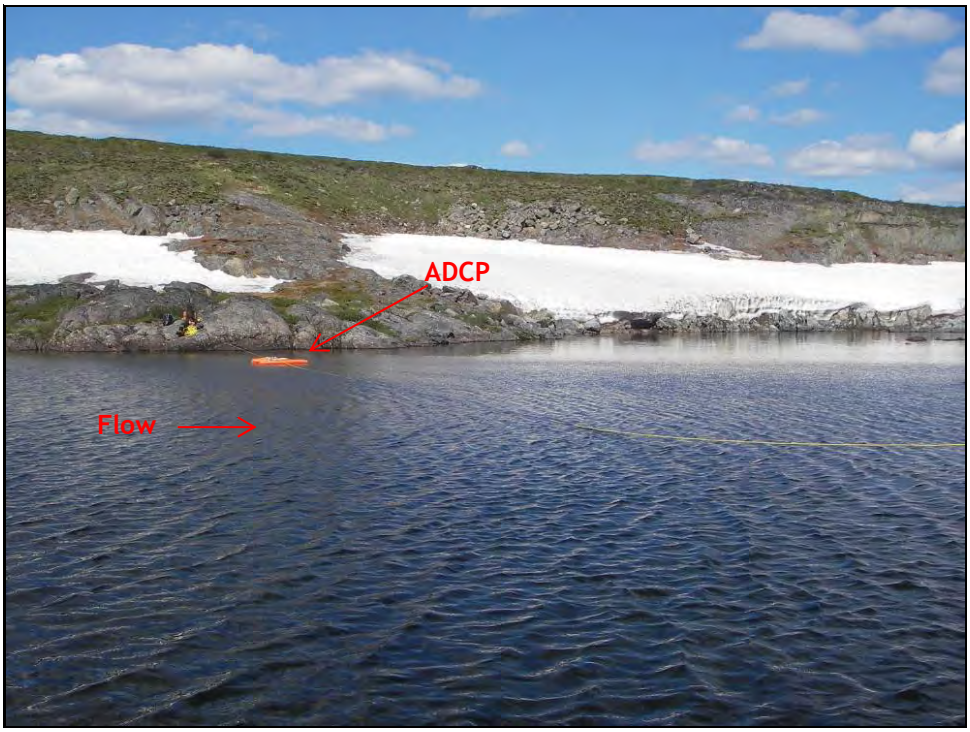


Plate 3.3-2. Discharge measurements at hydrometric station PL-H1 using an Acoustic Doppler Current Profiler (ADCP). Photograph taken on July 14, 2012.

3.4 HYDROMETRIC STATION SURVEYS

3.4.1 Levelling Surveys

The water surface elevation or stage is measured above a specific reference or gauge datum at hydrometric stations. In order to check for the accuracy and consistency of the recorded data, it is necessary to periodically verify the elevation of the gauge in relation to the established station datum.

To establish and maintain vertical elevation control at the Project hydrometric monitoring locations, three local benchmarks were installed at each station. Benchmarks consisted of 76 mm concrete expansion bolts secured in bedrock or large stable boulders found in the vicinity of the stations. One benchmark at each station was assigned to be the primary reference point, and assigned an arbitrary local elevation of 100.000 m. All recorded water levels were then referenced to this primary benchmark.

Throughout the 2013 monitoring period, hydrometric levelling surveys were conducted during each site visit. Each survey was completed using an engineer's level and levelling rod.

3.4.2 Channel Geometry Surveys

Surveys were completed at each streamflow monitoring station in order to define the channel geometry of the gauged stream section. At the majority of hydrometric stations, a suitable channel reach was defined by locating the hydraulic controls upstream and downstream of the station. Three cross-sections, perpendicular to the channel reach, were surveyed at the upstream and downstream boundaries of the reach, and in line with the station using an engineer's level and levelling rod.

For the stations located at the outflows of Giraffe Lake (GI-H1), George Lake (KL-H2) and McCoy Lake (MC-H1), a near-shore longitudinal profile was measured at the station and one additional channel cross-section was measured at the lake outlet. At the outflow of Propeller Lake (PL-H1), information of the channel bed topography was obtained from the ADCP, and was merged with topographic information of the adjacent banks surveyed using an engineer's level and rod. At each station, all surveyed cross-sections were referenced to the established arbitrary local datum.

3.5 STAGE – DISCHARGE RELATIONS

In 2013, stage-discharge relations were developed for each streamflow monitoring station. Stage-discharge relations are expressed as rating curves. Rating curves are used to convert water level data (stage) recorded by the streamflow monitoring stations into a continuous discharge time series or hydrograph.

The quality of a rating curve is a function of the number and accuracy of the individual data points that are used to generate the curve as well as the hydraulic characteristics of the monitoring location. To develop a robust rating curve 10 to 15 manual streamflow measurements are recommended. Although a rating curve can be developed with as few as three points, each additional point adds increased robustness, particularly if the newly added measurements have a different magnitude than preceding measurements. Flow measurements at the higher end of the flow range are especially important as they help to define the upper end of the rating curve, which is particularly relevant for the design of water management infrastructure. The rating relationship can also change from low flow periods to high flow periods, due to alterations in the geometry of the channel. When this is the case, a two-stage rating relation may be developed. One relation reflects low stage conditions, while the other relation represents high stage conditions.

Where possible, 2013 rating curves for the Project area were developed using manual flow measurements collected in previous years to increase the robustness of the curve. For the most part, 2011 and 2012 measurements were used along with 2013, while 2010 points were excluded due to their limited temporal (July to September) and spatial (two stations) coverage.

In the absence of a stage–discharge measurement corresponding to high flow conditions, the rating curve is often extrapolated to a high flow value that is beyond the range of the observed data used to generate the curve. Extrapolation beyond 2 times (Rantz et al. 1982) the greatest manually measured

discharge is not recommended as the resulting value has a high associated uncertainty. Most stage-discharge relations in this study were extrapolated to values less than or equal to 2 times the greatest measured discharge. The stage-discharge relation for hydrometric stations EL-H1 and REFQ-H1 was extended beyond 2 times the highest measured discharge to account for the range of measured stages; therefore, there is greater uncertainty in the high discharges calculated at these stations. No rating curve was developed at hydrometric station MC-H2 because the subsurface flow conditions along the length of the channel did not allow for accurate discharge measurements.

Rating curves were developed using Aquarius™ Time Series Hydrologic Software (Aquatics Informatics Inc.). The software uses standard methods outlined by the United States Geological Survey and the International Organization for Standardization (Kennedy 1984; ISO 2010). The concurrently measured water level (stage) and water discharge data were plotted on a logarithmic scale, and the root mean square error was assessed to produce a best-fit line for the rating curve. The best-fit line was represented by a power function (Equation 1) for the stage-discharge relationship.

$$Q = C\ (h - a)^{b} \qquad (1)$$

Where Q is the discharge (m^3/s), C and b are regression coefficients; h is the stage (water level; m). Variable a represents a datum correction for stage at zero flow (m), assuming that the gauge is positioned at a level below the point of zero flow. By convention, the rating curve is defined by a two dimensional graph whereby the dependent variable (Q) is plotted as the x-coordinate along the abscissa and the independent variable (h) is plotted as the y-coordinate along the ordinate (Herschy 2009).

3.6 DAILY DISCHARGE HYDROGRAPHS

Annual hydrographs, presented as mean daily discharge, were generated for each of the streamflow monitoring stations operated in 2013. For the operational period at each hydrometric station, water discharges were calculated at 10 minute intervals by applying the developed rating curve to the recorded stage data. The 10 minute discharge data were averaged over a 24 hour period to calculate mean daily discharge.

By normalizing daily discharge values to the drainage area for a basin, unit discharge hydrographs were developed. Unit discharge values allow for direct comparison of the hydrological response of basins with different size drainage areas.

All hydrometric stations were demobilized through the 2012-2013 winter months to protect the pressure transducers from damage due to freezing. Prior to annual remobilization, rising limbs of the hydrographs were estimated assuming a logarithmic growth function. The onset of the spring freshet was determined using available temperature data from the George and Goose meteorological stations (Rescan 2014) along with 2013 provisional daily discharge hydrograph of the regional WSC stations shown in Table 2.2-1. This date was determined to be May 23rd and May 25th for stations on the Goose and George Property areas, respectively. Stations EL-H1 (in Goose Property area) and KL-H1 (in George Property area) were installed early enough to capture the freshet peak. The available extended time series from these stations was used to estimate the freshet flows of nearby stations through regression analyses.

Following seasonal demobilization, the recession limb of each hydrograph was extended down to a zero flow date based on a linear or logarithmic decay function. For the decay functions, based on site observations, it was assumed that the streams froze on October 10th and October 20th in George and Goose Property area, respectively. In the Goose Property area, two streamflow monitoring stations (PL-H1 and PL-H2) were demobilized by Sabina employees in October 2013. The extended time series

from these stations (all other stations were demobilized in September) was used to model the late season flows of nearby stations through regression analysis.

3.7 VOLUMETRIC OUTFLOW

At each hydrometric station, the monthly and annual volumetric water outflows were determined. Volumetric outflows are expressed in millions of cubic meters per month for each of the monitored basins.

3.8 HYDROLOGIC INDICES

Annual runoff, monthly distribution of annual runoff, mean annual discharge (MAD), peak flow, and low flow indices were calculated to assist with the design of mine Project infrastructure as well as water management planning.

3.8.1 Annual Runoff

Annual runoff is the total quantity of water that is discharged (runs off) from a drainage basin in a year and is determined by dividing the volume of annual streamflow observed at a station by the drainage area upstream of that station. Runoff represents the difference between total inputs (annual rain and snow) and losses (e.g., evaporation and the difference between groundwater recharge and discharge). It is commonly presented as a depth of water over a drainage basin. Runoff is valuable for obtaining gross estimates of the water available in a basin. Because it is standardized by drainage area, it is also a useful index for comparing the hydrologic response of basins of different sizes. Total annual runoff for each hydrometric station consists of measured and estimated runoff values during the period of record.

3.8.2 Monthly Runoff Distribution

Monthly runoff distribution was determined by summing the daily runoff by month for each basin. Monthly runoff as a depth and as a percent of the total annual runoff was calculated and presented to illustrate the spatial and temporal distribution of runoff in the Project area.

3.8.3 Mean Annual Discharge

The mean annual discharge (MAD), computed as an average discharge over the year, is an additional variable that gives an indication of the potential amount of water a basin can provide as a function of drainage area, geology, and climate.

3.8.4 Annual Peak and Low Flow

Peak flows represent the maximum flow rate of a catchment during a year in response to precipitation events or snowmelt. Peak flows are used in combination with flood frequency analysis techniques in order to estimate design flows used in the sizing of ditches, diversion channels, or stream crossings. Conversely, low flows provide an estimate of the normal baseflow conditions during the open water season, which is important to the sustained health of a stream’s aquatic community.

4. Results

4. Results

Results from the 2013 hydrology program are presented as follows: (1) completed discharge measurements, (2) hydrometric surveys, (3) determined stage-discharge relations, (4) daily discharge hydrographs and volumetric outflows, and (5) hydrologic indices for the Project area.

4.1 DISCHARGE MEASUREMENT SUMMARY

Discharge measurements were taken during the late May and June freshet period at each hydrometric station with additional measurements conducted in July, August, and September 2013, for a total of 105 measurements. The measurements were collected through the open water season in order to obtain a range of discharges at different flow conditions (Tables 4.1-1 and 4.1-2, and Appendix 3).

Table 4.1-1. Summary of Discharge Measurements in the Goose Property Area in 2013

Hydrometric Station	Date Measured	Stage (m)*	Measured Discharge (m^3/s)	Method (Equipment Used)
GL-H1	June 2	99.510 [a]	0.549	Velocity-Area (FH950)
	July 15	98.903 [a]	0.013	Velocity-Area (FH950)
	August 20	98.702 [a]	0.007	Velocity-Area (FlowMate)
	September 12	98.944 [a]	0.017	Velocity-Area (FlowMate)
GL-H2	June 3	99.677 [a]	0.119	Velocity-Area (FH950)
	July 15	99.546 [a]	0.005	Velocity-Area (FH950)
	August 20	99.536 [a]	0.000	Velocity-Area (FlowMate)
	September 11	99.542 [a]	0.001	Velocity-Area (FlowMate)
GL-H3	May 31	99.862 [b]	0.214	Velocity-Area (FH950)
	July 15	99.618 [b]	0.001	Velocity-Area (FH950)
	August 16	99.580 [a]	No Flow	N/A[†]
	September 9	99.659 [b]	0.007	Velocity-Area (FlowMate)
PL-H1	June 8	99.182 [a]	7.80	Velocity-Area (ADCP)
	July 19	98.715 [a]	0.493	Velocity-Area (FH950)
	August 21	98.612 [a]	0.208	Velocity-Area (FlowMate)
	September 13	98.666 [b]	0.304	Velocity-Area (FlowMate)
PL-H2	June 2	99.806 [a]	4.014	Velocity-Area (FH950)
	June 16	99.703 [a]	1.874	Velocity-Area (FH950)
	July 18	99.520 [a]	0.181	Velocity-Area (FH950)
	August 22	99.517 [a]	0.104	Velocity-Area (FlowMate)
	September 15	99.637 [a]	1.026	Velocity-Area (FlowMate)
GI-H1	June 5	99.732 [a]	1.034	Velocity-Area (FH950)
	July 17	99.568 [b]	0.070	Velocity-Area (FH950)
	August 19	99.440 [b]	0.050	Velocity-Area (FlowMate)
	September 10	99.547 [b]	0.105	Velocity-Area (FlowMate)

(continued)

Table 4.1-1. Summary of Discharge Measurements in the Goose Property Area in 2013 (completed)

Hydrometric Station	Date Measured	Stage (m)*	Measured Discharge (m^3/s)	Method (Equipment Used)
EL-H1	May 31	99.414[a]	0.078	Velocity-Area (FH950)
	June 16	99.324 [b]	0.004	Velocity-Area (FH950)
	July 17	99.205 [a]	No Flow	N/A†
	August 16	99.220 [a]	No Flow	N/A†
	September 13	99.367 [a]	0.016	Velocity-Area (FlowMate)
WL-H1	June 1	98.638 [a]	0.742	Velocity-Area (FH950)
	July 16	98.309 [b]	0.072	Velocity-Area (FH950)
	August 18	98.246 [b]	0.008	Velocity-Area (FlowMate)
	September 13	98.496 [b]	0.257	Velocity-Area (FlowMate)
REFB-H1	June 6	99.577 [a]	0.055	Velocity-Area (FH950)
	July 19	99.426 [a]	0.001	Velocity-Area (FH950)
	August 21	99.326 [a]	No Flow	N/A†
	September 16	99.413 [a]	0.002	Velocity-Area (FlowMate)
TIA-H1	June 5	99.647 [a]	0.122	Velocity-Area (FH950)
	June 16	99.269 [a]	0.024	Velocity-Area (FH950)
	September 12	99.178 [a]	0.013	Velocity-Area (FlowMate)
UM-H1	June 3	99.879 [a]	0.167	Velocity-Area (FH950)
	June 16	99.805 [b]	0.101	Velocity-Area (FH950)
	July 15	99.657 [b]	0.005	Velocity-Area (FH950)
	July 15	99.662 [b]	0.005	Velocity-Area (FH950)
	August 20	99.632 [b]	0.002	Velocity-Area (FlowMate)
	September 11	99.667 [b]	0.005	Velocity-Area (FlowMate)
	September 16	99.714 [b]	0.034	Velocity-Area (FlowMate)
WP-H1	June 5	99.413 [a]	0.748	Velocity-Area (FH950)
	June 15	99.310 [a]	0.393	Velocity-Area (FH950)
	July 16	99.166 [a]	0.067	Velocity-Area (FH950)
	July 20	99.152 [a]	0.049**	Velocity-Area (FH950)
	August 19	99.130 [a]	0.026	Velocity-Area (FlowMate)
	September 12	99.152 [a]	0.051	Velocity-Area (FlowMate)
WR-H1	June 1	98.738 [a]	0.416	Velocity-Area (FH950)
	June 8	98.702 [a]	0.269	Velocity-Area (FH950)
	July 16	98.404 [a]	No Flow	N/A†
	August 22	98.522 [a]	0.022	Velocity-Area (FlowMate)
	August 25	98.552 [a]	0.040	Velocity-Area (FlowMate)
	September 13	98.748 [a]	0.399	Velocity-Area (FlowMate)
	September 15	98.636 [a]	0.141	Velocity-Area (FlowMate)

** Stage values corrected during rating curve development, a = surveyed stage, b = pressure transducer corrected stage. See Appendix 3.*

*** Discharge calculated from average of two discharge measurements at WP-H1 on July 20 2013.*

† Flow was visibly absent in channel. No discharge measurement required.

Table 4.1-2. Summary of Discharge Measurements in the George Property Area in 2013

Hydrometric Station	Date Measured	Stage (m)*	Measured Discharge (m^3/s)	Method (Equipment Used)
KL-H1	June 4	98.962 [a]	0.784	Velocity-Area (FH950)
	June 23	98.953 [a]	0.777	Velocity-Area (FH950)
	July 12	98.682 [b]	0.126	Velocity-Area (FH950)
	August 17	98.551 [b]	0.031	Velocity-Area (FlowMate)
	September 17	98.717 [b]	0.150	Velocity-Area (FlowMate)
KL-H2	June 11	99.585 [a]	0.340	Velocity-Area (FH950)
	June 13	99.572 [a]	0.287	Velocity-Area (FH950)
	July 13	99.447 [a]	0.052	Velocity-Area (FH950)
	August 18	99.401 [b]	0.009	Velocity-Area (FlowMate)
	September 13	99.447 [b]	0.046	Velocity-Area (FlowMate)
LG-H1	June 11	97.759 [a]	10.98	Velocity-Area (FH950)
	June 13	97.730 [a]	9.59	Velocity-Area (FH950)
	July 13	97.383 [a]	2.04	Velocity-Area (FH950)
	August 23	97.250 [a]	0.825	Velocity-Area (FlowMate)
	September 11	97.350 [a]	1.67	Velocity-Area (FlowMate)
LY-H1	June 10	99.728 [a]	0.327	Velocity-Area (FH950)
	June 12	99.695 [a]	0.295	Velocity-Area (FH950)
	July 13	99.451 [a]	0.025	Velocity-Area (FH950)
	July 21	99.403 [a]	0.017	Velocity-Area (FH950)
	August 17	99.346 [a]	0.004	Velocity-Area (FlowMate)
	September 14	99.456 [b]	0.030	Velocity-Area (FlowMate)
MC-H1	June 10	98.530 [a]	0.347	Velocity-Area (FH950)
	June 13	98.482 [a]	0.223	Velocity-Area (FH950)
	July 12	98.292 [a]	0.016	Velocity-Area (FH950)
	July 21	98.267 [a]	0.005	Velocity-Area (FH950)
	August 23	98.250 [a]	0.003	Velocity-Area (FlowMate)
	September 14	98.331 [a]	0.048	Velocity-Area (FlowMate)
MC-H2	June 9	99.503 [a]	0.509	Velocity-Area (FH950)
	June 13	99.434 [b]	0.178	Velocity-Area (FH950)
	July 12	99.099 [a]	0.006	Velocity-Area (FH950)
	August 24	99.066 [a]	0.003	Velocity-Area (FlowMate)
	September 17	99.159 [a]	0.029	Velocity-Area (FlowMate)
REFQ-H1	June 12	98.892 [a]	0.277	Velocity-Area (FH950)
	June 13	98.882 [b]	0.237	Velocity-Area (FH950)
	July 12	98.714 [b]	0.024	Velocity-Area (FH950)
	July 21	98.671 [b]	0.013	Velocity-Area (FH950)
	August 18	98.649 [b]	0.004	Velocity-Area (FlowMate)
	September 18	98.800 [b]	0.101	Velocity-Area (FlowMate)

(continued)

Table 4.1-2. Summary of Discharge Measurements in the George Property Area in 2013 (completed)

Hydrometric Station	Date Measured	Pressure Transducer Stage (m)	Measured Discharge (m^3/s)	Method (Equipment Used)
SL-H1	June 9	99.546 [a]	0.642	Velocity-Area (FH950)
	June 12	99.438 [a]	0.419	Velocity-Area (FH950)
	July 13	99.216 [a]	0.090	Velocity-Area (FH950)
	August 17	99.104 [b]	0.016	Velocity-Area (FlowMate)
	September 17	99.148 [b]	0.081	Velocity-Area (FlowMate)

** Stage values corrected during rating curve development, a = surveyed stage, b = pressure transducer corrected stage. See Appendix 3.*

Two discharge measurements were taken during the freshet period at most of the hydrometric stations to capture the range of flow conditions observed. Discharge measurements were not conducted at the hydrometric stations GL-H3, REFB-H1 and WR-H1 during the August visit and at hydrometric stations EL-H1 and TIA-H1 during both the July and August visits as these streams were dry.

4.2 HYDROMETRIC STATION SURVEYS

4.2.1 Levelling Surveys

A minimum of one levelling survey was completed during each of the four 2013 field visits at every hydrometric station. A summary of the survey control points at each station are provided in the station information sheets (Appendix 1). Survey data from the eleven re-established stations were used to reference the 2013 stage data to existing benchmarks installed in previous years.

Frost heave in the near-surface permafrost layer created some issues with the stability of the reference benchmarks and pressure transducers at some hydrometric stations. Where possible, reference benchmarks were installed in bedrock in order to mitigate this instability. By comparing changes in benchmark elevations between field visits, some surveyed stage values were deemed inaccurate, therefore the pressure transducer stage was used to calaculate the water level at the time of the discharge measurement.

At the majority of stations the surveys confirmed that the pressure transducers measuring water level remained stationary and properly calibrated during the monitoring period. Despite efforts to reduce vertical movement of the transducers (Plate 4.2-1), at stations GL-H2, UM-H1, WR-H1, KL-H2, MC-H1, and REFB-H1 the transducers drifted vertically during the field season due to thawing of the streambed. In these cases, survey data were used to confirm the changes in elevation of the pressure transducers and to correct for the errors in the stage time series.

4.2.2 Channel Geometry Surveys

Channel geometry surveys conducted at each hydrometric monitoring location are provided in Appendix 4. Surveys of the monitored reaches provide a physical representation of the channel geometry. These data were used in the rating curve development to help define the point of zero flow, and the elevation of any transitions between high flow and low flow rating curves. Cross-sections of the channels at the installed pressure transducers also show the water levels associated with minimum, mean, and maximum daily discharges measured in 2013.

Plate 4.2-1. Station set-up at REFB-H1 in 2013. Rebar was used in an attempt to limit vertical drift of the transducer into the soft bed along the channel reach. June 6, 2013.

4.3 STAGE-DISCHARGE RATING CURVES

At each of the streamflow monitoring stations that were established in 2010-2012, the data collected before 2013 were combined with the data collected in 2013 unless historical measurements were deemed unreliable. At each of the new stations that were installed in 2013, discharge measurements during the 2013 open water season were used in the development of preliminary rating equations. Additional discharge measurements will continue to increase the range and robustness of the stage-discharge relations.

For stations where no substantial break points were observed, a single rating curve was fit to the full range of flows measured. A two stage (Low/High) rating curve was developed for stations where the monitored reach was confined to a fairly deep channel with steep banks during low to medium flow conditions; however, during high flow conditions the banks were overtopped and the stream was able to flood the flat tundra adjacent to the channel. Rating equations are summarized in Tables 4.3-1 and 4.3-2, and rating curves are provided in Appendix 5.

Table 4.3-1. Summary of 2013 Rating Equations for the Hydrometric Monitoring Stations in Goose Property Area

Hydrometric Station		Rating Equation $Q = C (h-a)^b$	Root Mean Square Deviation
GL-H1	Low Stage (h ≤ 98.93)	$Q = 0.05 (h - 98.42)^{1.66}$	28.6
	High Stage (h > 98.93)	$Q = 1.25 (h - 98.79)^{2.22}$	
GL-H2		$Q = 3.99 (h - 99.51)^{2.08}$	12.4 (base), 8.1(shift)*
GL-H3	Low Stage (h ≤ 99.77)	$Q = 1.36 (h - 99.58)^{2.16}$	23.2
	High Stage (h > 99.77)	$Q = 9.50 (h - 99.73)^{1.67}$	

(continued)

Table 4.3-1. Summary of 2013 Rating Equations for the Hydrometric Monitoring Stations in Goose Property Area (completed)

Hydrometric Station		Rating Equation $Q = C (h-a)^b$	Root Mean Square Deviation
PL-H1	Low Stage (h ≤ 98.72)	$Q = 2.24 (h - 98.48)^{1.21}$	14.7
	High Stage (h > 98.72)	$Q = 22.04 (h - 98.56)^{2.20}$	
PL-H2	Low Stage (h ≤ 99.51)	$Q = 4.74 (h - 99.43)^{1.59}$	8.6
	High Stage (h > 99.51)	$Q = 31.76 (h - 99.46)^{1.96}$	
GI-H1	Low Stage (h ≤ 99.67)	$Q = 2.19 (h - 99.45)^{1.68}$	21.2
	High Stage (h > 99.67)	$Q = 54.28 (h - 99.63)^{1.79}$	
EL-H1	Low Stage (h ≤ 99.32)	$Q = 0.06 (h - 99.12)^{1.81}$	17.6
	High Stage (h > 99.32)	$Q = 4.24 (h - 99.30)^{1.85}$	
WL-H1	Low Stage (h ≤ 98.52)	$Q = 2.22 (h - 98.22)^{1.49}$	16.6
	High Stage (h > 98.52)	$Q = 8.90 (h - 98.29)^{2.21}$	
REFB-H1	Low Stage (h ≤ 99.58)	$Q = 1.85 (h - 99.38)^{2.18}$	30.4
	High Stage (h > 99.58)	$Q = 13.07 (h - 99.53)^{1.85}$	
TIA-H1		$Q = 0.26 (h - 98.97)^{1.96}$	5.4
UM-H1	Low Stage (h ≤ 99.69)	$Q = 0.60 (h - 99.60)^{1.68}$	26.8
	High Stage (h > 99.69)	$Q = 2.68 (h - 99.64)^{1.82}$	
WP-H1	Low Stage (h ≤ 99.29)	$Q = 6.58 (h - 99.07)^{1.96}$	1.8
	High Stage (h > 99.29)	$Q = 5.18 (h - 99.01)^{2.17}$	
WR-H1	Low Stage (h ≤ 98.57)	$Q = 1.89 (h - 98.45)^{1.73}$	4.5
	High Stage (h > 98.57)	$Q = 6.00 (h - 98.49)^{2.17}$	

Q = discharge (m^3/s); h = recorded stage (m)
**Shift applied to base rating curve at GL-H2 to account for backwater effect at low flow.*

Table 4.3-2. Summary of 2013 Rating Equations for the Hydrometric Monitoring Stations in George Property Area

Hydrometric Station		Rating Equation $Q = C (h-a)^b$	Root Mean Square Deviation
KL-H1		$Q = 3.88 (h - 98.48)^{2.07}$	37.5
KL-H2		$Q = 5.48 (h - 99.37)^{1.78}$	9.4
LG-H1		$Q = 19.90 (h - 96.99)^{2.40}$	3.3
LY-H1	Low Stage (h ≤ 99.49)	$Q = 0.59 (h - 99.30)^{1.62}$	7.7
	High Stage (h > 99.49)	$Q = 2.61 (h - 99.36)^{2.05}$	
SL-H1		$Q = 2.23 (h - 98.98)^{2.12}$	19.1
MC-H1		$Q = 3.20 (h - 98.24)^{1.82}$	8.0
REFQ-H1	Low Stage (h ≤ 98.72)	$Q = 0.61 (h - 98.63)^{1.25}$	9.9
	High Stage (h > 98.72)	$Q = 4.05 (h - 98.63)^{2.02}$	

Q = discharge (m^3/s); h = recorded stage (m)

Also included in the table is the Root Mean Square Deviation (RMSD) which is used by the Aquarius® software as an overall measure of error of the stage-discharge relation (Equation 2).

$$RMSD = \sqrt{\frac{\sum_{i=1}^{n}\left(\frac{Q_m - Q_o}{Q_o}\right)^2}{n}} \qquad (2)$$

Where n is the number of rating points used to develop the stage-discharge relation, Q_o is the observed discharge during the manual discharge measurement, and Q_m is the discharge calculated by the developed rating equation.

The RMSD is a statistical parameter that describes how well the values predicted by the stage-discharge relation fit or represent the observed data. The departure from true values computed by this statistic combines both bias and lack of precision. The lower the RMSD, the better the estimated values provided by the rating relationship.

4.4 ANNUAL HYDROGRAPHS

The 2013 annual daily unit discharge hydrographs presented in Figures 4.4-1 and 4.4-2 show similar trends over the year at each of the monitored locations in the Project area. Daily discharge tables and individual hydrographs are provided in Appendix 6.

Based on the continuous time series of water level recorded at these sites, it is clear that the largest observed peak flow occurred during the freshet period from late May to early June.

Pressure transducers were installed at all stations as soon as it was possible at all sites given ice conditions in the streams and lakes. However, it is usually not possible to get the instrumentation installed prior to the initial melting, and so regional data were used to help determine the onset of freshet. To estimate the spring freshet peak, linear regression was used. Regression equations to estimate freshet peak flows in hydrometric stations within the Goose and George Property areas are summarized in Tables 4.3-3 and 4.3-4. To estimate the flows between the onset of spring flows (May 23rd in Goose Property and May 25th in George Property) and the estimated peak flows, a logarithmic growth function was used.

Regression equations (Tables 4.4-1 and 4.4-2) were developed to extend the recession limb of hydrographs until Oct 3rd (in Goose Property area) and September 16th (in George Property area). Beyond these dates, depending on the shape of the hydrograph, linear or logarithmic decay functions were used to extend the hydrographs to the freeze-up date (i.e., October 20th in Goose Property area and October 10th in George Property area). Reference stations are provided in the equations (e.g., EL-H1 for the rising limb and PL-H2 for the recession limb in the Goose Property area).

The 2013 discharge hydrographs (Appendix 6) demonstrate prominent high flows – one was driven by snowmelt and the others by rainfall. Discharge hydrographs are normalized into unit discharge hydrographs (Figures 4.4-1 and 4.4-2) to better demonstrate the temporal and spatial variations of runoff within the study area. Since the natural drainage divide between GL-H3, WL-H1, WR-H1, and EL-H1 watersheds is not clear, the unit discharge from these watersheds are summed and shown as one graph in Figure 4.4-1.

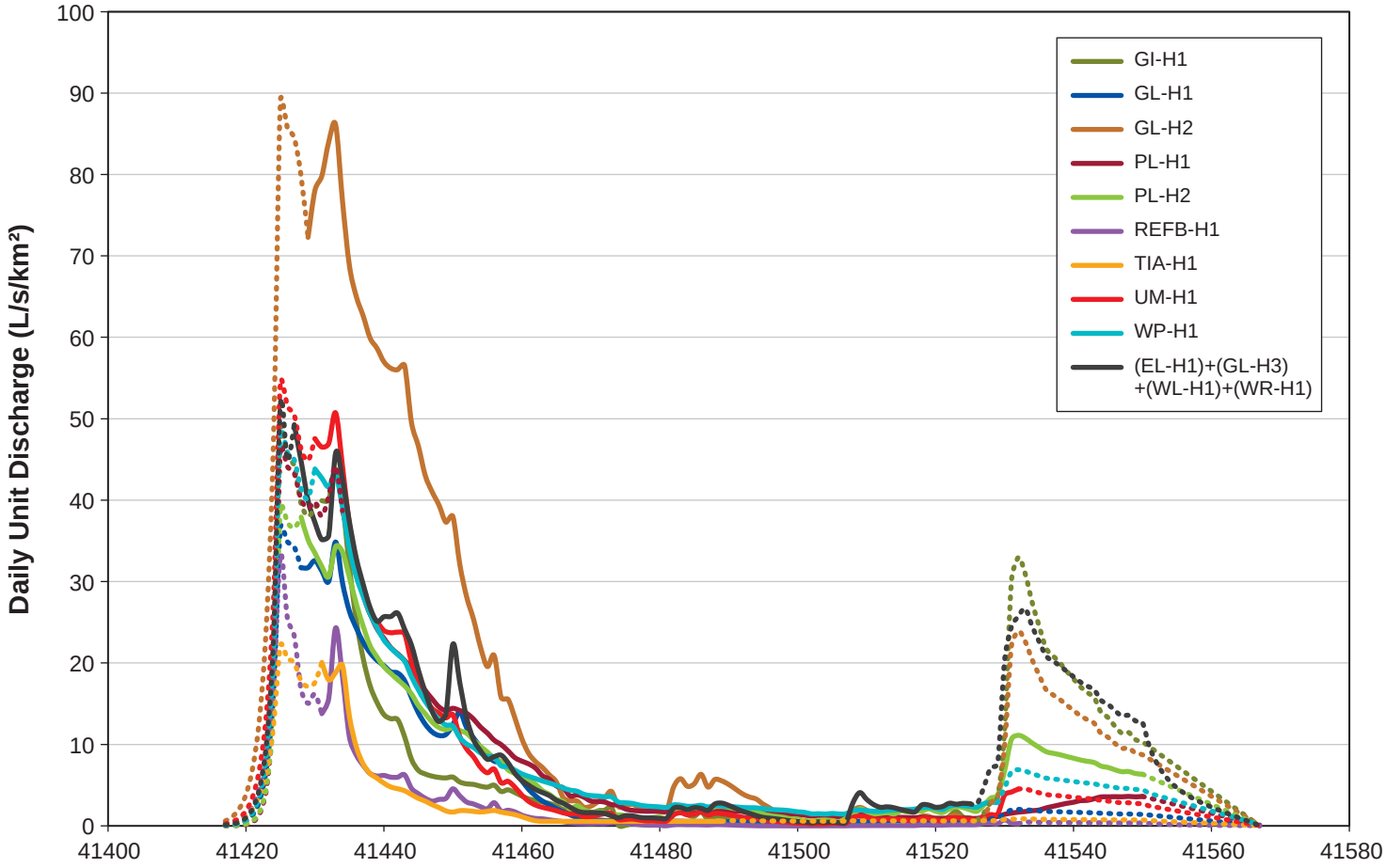


Figure 4.4-1

Sabina GOLD & SILVER CORP.

Annual Unit Hydrographs of Hydrometric Monitoring Stations in 2013 - Goose Property Area

Figure 4.4-1

Rescan Engineers & Scientists

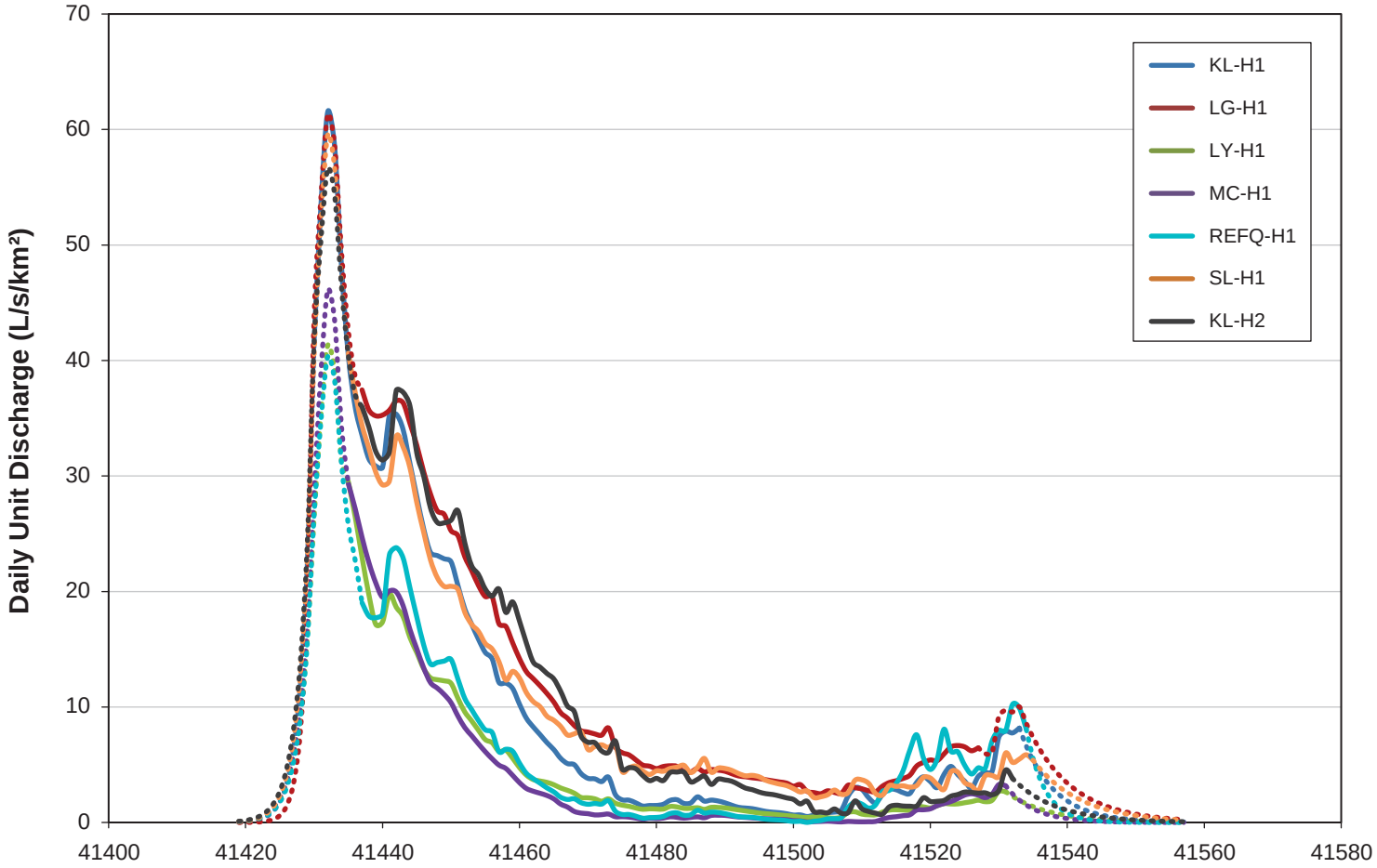


Figure 4.4-2

Sabina GOLD & SILVER CORP.

Annual Unit Hydrographs of Hydrometric Monitoring Stations in 2013 - George Property Area

Figure 4.4-2

Rescan Engineers & Scientists

Table 4.4-1. Regression Equations Used to Extend the Hydrographs for Stations in Goose Property Area

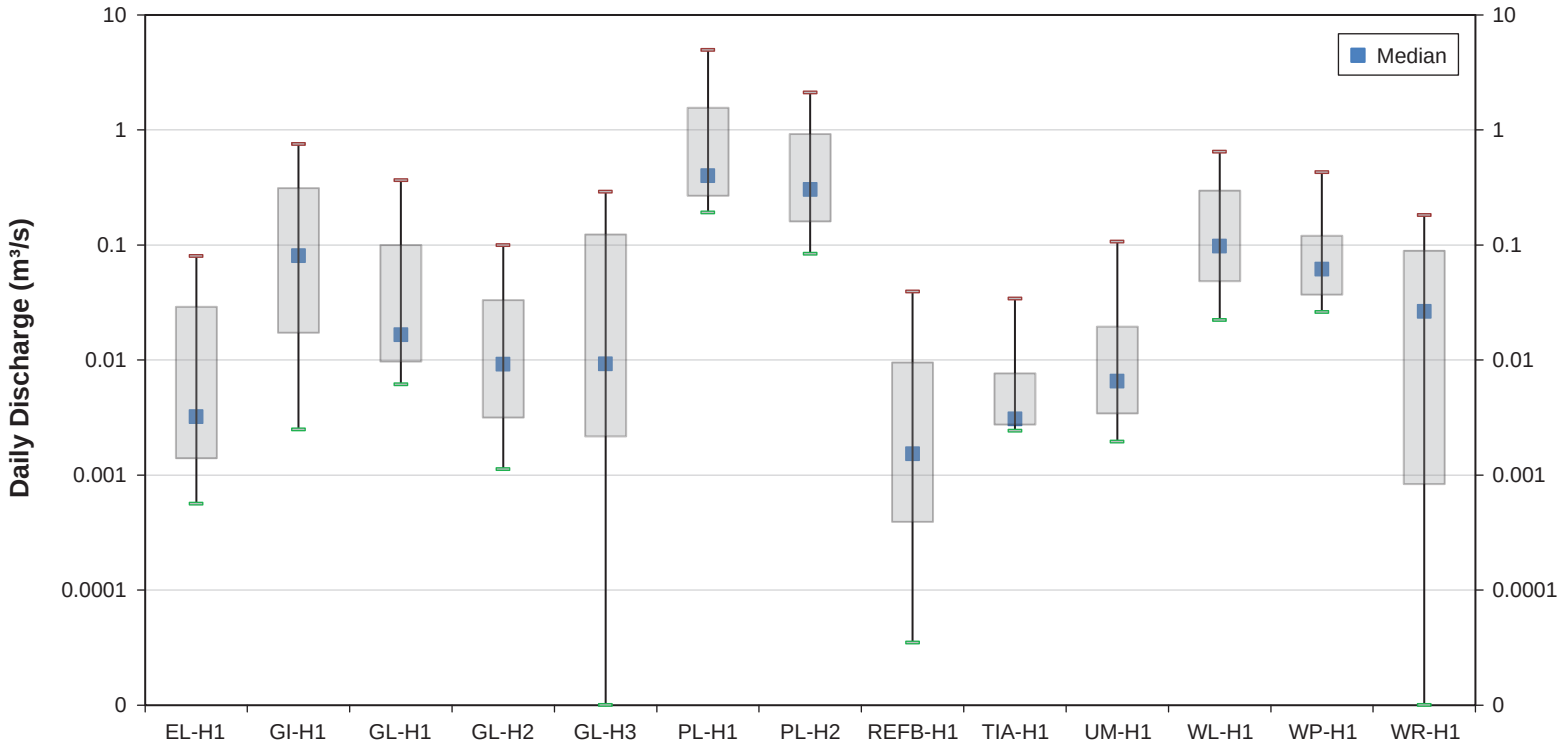
Hydrometric Station	Regression Equation for the Rising Limb	Regression Equation for the Recession Limb
EL-H1	n/a	$Q = 0.1342Q_{PL\text{-}H2}^{1.7452}$
GI-H1	$Q = 0.2953\ln(Q_{EL\text{-}H1}) + 1.9938$	$Q = 0.7029\ Q_{PL\text{-}H2}^{2.0692}$
GL-H1	$Q = 0.1047\ln(Q_{EL\text{-}H1}) + 0.8941$	$Q = 0.0335\ Q_{PL\text{-}H2}^{0.6447}$
GL-H2	$Q = 0.0187\ln(Q_{EL\text{-}H1}) + 0.1932$	$Q = 0.0327\ Q_{PL\text{-}H2}^{1.7941}$
GL-H3	$Q = 0.0734\ln(Q_{EL\text{-}H1}) + 0.6391$	$Q = 0.2236\ Q_{PL\text{-}H2}^{2.3537}$
PL-H1	$Q = 1.5283\ln(Q_{EL\text{-}H1}) + 12.91$	n/a
PL-H2	$Q = 0.6408\ln(Q_{EL\text{-}H1}) + 5.4158$	n/a
REFB-H1	$Q = 1.4222\ Q_{EL\text{-}H1} + 0.0232$	$Q = 0.0011\ln(Q_{PL\text{-}H2}) + 0.0023$
TIA-H1	$Q = 0.0254\ln(Q_{EL\text{-}H1}) + 0.1674$	$Q = 0.0028e^{22.258Q}$UM-H1
UM-H1	$Q = 0.0399\ln(Q_{EL\text{-}H1}) + 0.3126$	$Q = 0.0167\ Q_{PL\text{-}H2} + 0.0003$
WL-H1	$Q = 0.1523\ln(Q_{EL\text{-}H1}) + 1.4264$	$Q = 0.3322\ Q_{PL\text{-}H2} - 0.0028$
WP-H1	$Q = 0.1456\ln(Q_{EL\text{-}H1}) + 1.177$	$Q = 0.0893\ Q_{PL\text{-}H2} + 0.0204$
WR-H1	$Q = 2.6144\ Q_{EL\text{-}H1} + 0.0469$	$Q = 0.2183\ Q_{PL\text{-}H2} - 0.0042$

Table 4.4-2. Regression Equations Used to Extend the Hydrographs for Stations in George Property Area

Hydrometric Station	Regression Equation for the Rising Limb	Regression Equation for the Recession Limb
KL-H1	n/a	n/a
LG-H1	$Q = 9.9246\ Q_{KL\text{-}H1} + 1.8358$	$Q = 11.809\ Q_{KL\text{-}H1} + 0.3781$
LY-H1	$Q = 0.3291\ Q_{KL\text{-}H1} - 0.0515$	n/a
MC-H1	$Q = 0.3952\ Q_{KL\text{-}H1} - 0.0898$	n/a
REFQ-H1	$Q = 0.4188\ Q_{KL\text{-}H1} - 0.0306$	n/a
SL-H1	$Q = 0.5184\ Q_{KL\text{-}H1} + 0.0029$	n/a
KL-H2	$Q = 0.3039\ Q_{KL\text{-}H1} + 0.091$	n/a

The total monthly and annual volumetric water outflows for each of the drainages are presented in Tables 4.4-3 and 4.4-4. Outflows from each of the monitored drainages were generally found to be a function of drainage area. In the Goose Property area, the minimum volumetric outflows were observed at TIA-H1 (drainage area = 5.0 km^2) which had a total annual water output of 0.17 million cubic meters. The maximum annual volumetric output was 20.38 million cubic meters at PL-H1 (drainage area = 204.6 km^2). In the George Property area, the minimum volumetric outflows were observed at MC-H1 (drainage area = 10.8 km^2) which had a total annual water output of 0.64 million cubic meters. The maximum annual volumetric output was 35.83 million cubic meters at LG-H1 (drainage area = 271.1 km^2).

Variation of daily discharge at hydrometric stations within the Goose Property and George Property areas are shown in Figures 4.4-3 and 4.4-4. On average Goose Property stations show more flow variations than George Property stations.



Note: Boxes show the quartiles and whiskers show the deciles.

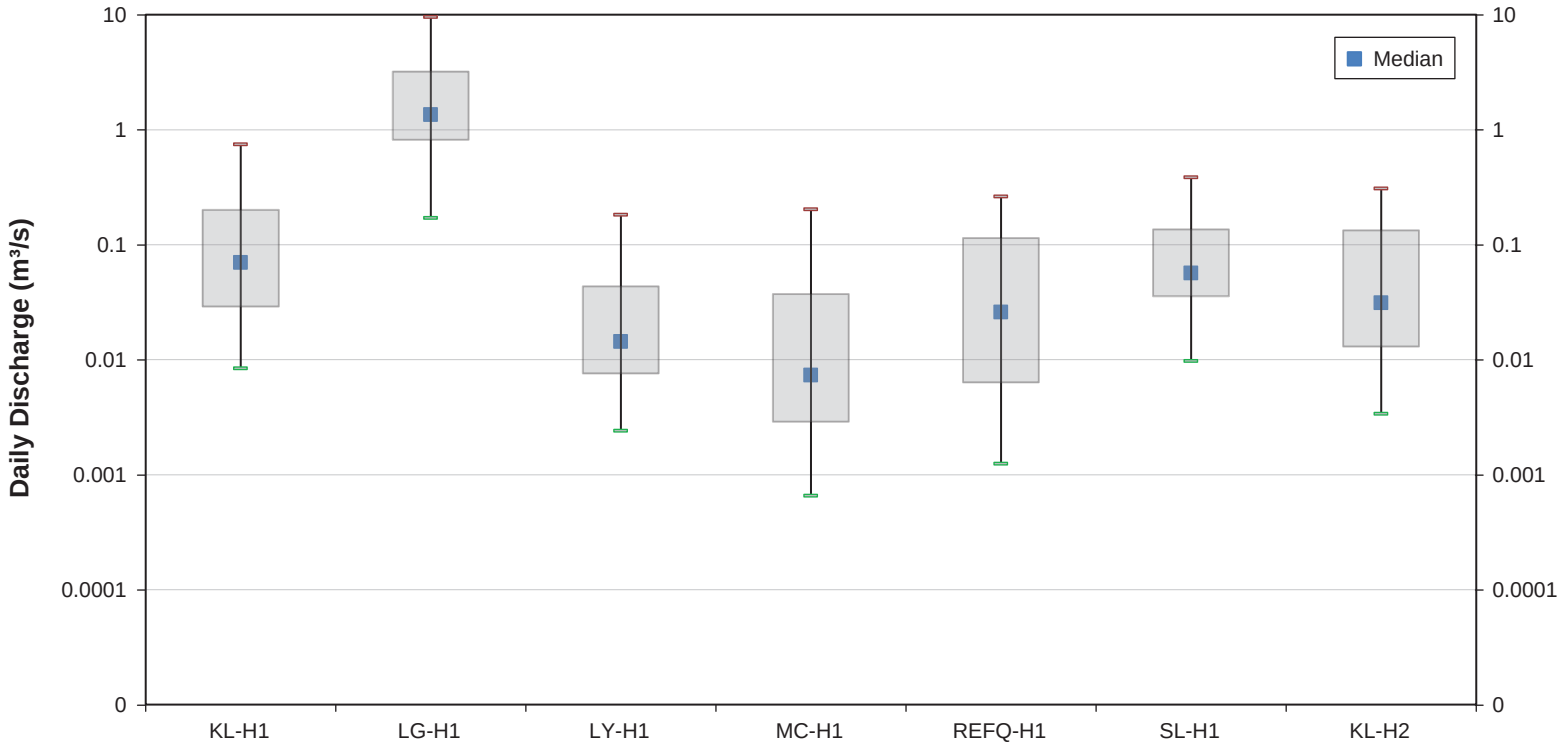
Figure 4.4-3

Sabina GOLD & SILVER CORP.

2013 Daily Discharge Percentiles for Hydrometric Stations within the Goose Property Area

Figure 4.4-3

Rescan Engineers & Scientists



Note: Boxes show the quartiles and whiskers show the deciles.

Figure 4.4-4

Sabina GOLD & SILVER CORP.

2013 Daily Discharge Percentiles for Hydrometric Stations within the George Property Area

Figure 4.4-4

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Table 4.4-3. 2013 Volumetric Water Yield in Millions of Cubic Meters (million m^3) for Hydrometric Stations in the Goose Property Area

Hydrometric Station	Jan-May	June	July	August	September	October	Nov-Dec	Total Annual
EL-H1	0.03	0.06	0.00	0.01	0.18	0.02	0.00	0.30
GI-H1	0.30	1.41	0.14	0.03	0.91	0.24	0.00	3.04
GL-H1	0.16	0.97	0.10	0.02	0.06	0.02	0.00	1.33
GL-H2	0.04	0.25	0.03	0.01	0.04	0.01	0.00	0.38
GL-H3	0.11	0.68	0.02	0.01	0.28	0.03	0.00	1.12
PL-H1	1.98	13.65	2.29	0.76	1.03	0.65	0.00	20.38
PL-H2	0.86	5.76	0.80	0.39	1.60	0.57	0.00	9.98
REFB-H1	0.04	0.12	0.01	0.00	0.00	0.00	0.00	0.18
TIA-H1	0.03	0.11	0.01	0.01	0.01	0.00	0.00	0.17
UM-H1	0.06	0.29	0.02	0.01	0.03	0.01	0.00	0.41
WL-H1	0.25	1.70	0.26	0.11	0.51	0.18	0.00	3.02
WP-H1	0.20	1.16	0.20	0.09	0.20	0.07	0.00	1.91
WR-H1	0.08	0.27	0.02	0.03	0.33	0.12	0.00	0.85

Note: Estimated values are italicized

Table 4.4-4. 2013 Volumetric Water Yield in Millions of Cubic Meters (million m^3) for Hydrometric Stations in the George Property Area

Hydrometric Station	Jan-May	June	July	August	September	October	Nov-Dec	Total Annual
KL-H1	0.01	1.92	0.33	0.10	0.22	0.00	0.00	2.58
KL-H2	0.01	0.78	0.24	0.05	0.05	0.00	0.00	1.12
LG-H1	0.06	23.02	6.44	2.50	3.70	0.11	0.00	35.83
LY-H1	0.01	0.51	0.08	0.02	0.03	0.00	0.00	0.66
MC-H1	0.01	0.55	0.05	0.01	0.03	0.00	0.00	0.64
REFQ-H1	0.01	0.72	0.09	0.04	0.16	0.00	0.00	1.03
SL-H1	0.01	1.00	0.27	0.12	0.11	0.00	0.00	1.51

Note: Estimated values are italicized

4.5 HYDROLOGIC INDICIES

4.5.1 Annual Runoff

For the gauged drainages in the Goose Property area, the estimated 2013 annual runoff ranged from 34 mm at TIA-H1 to 315 mm at WR-H1 (Table 4.5-1). Similar to the previous years, GL-H3 represented and outlier runoff value (621 mm). The discrepancy in annual runoff values is mainly due to the variable drainage divide among the GL-H3, WL-H1, WR-H1, and EL-H1 watersheds (Plate 4.5-1). Due to the low relief in this part of the study area, there are instances where small channels divide and follow different flow paths during high flows than they do under lower flow conditions. As a result of these branches, drainage areas are no longer static and become difficult to quantify. When these watersheds are considered as one integrated watershed, the annual runoff is estimated to be 137 mm.

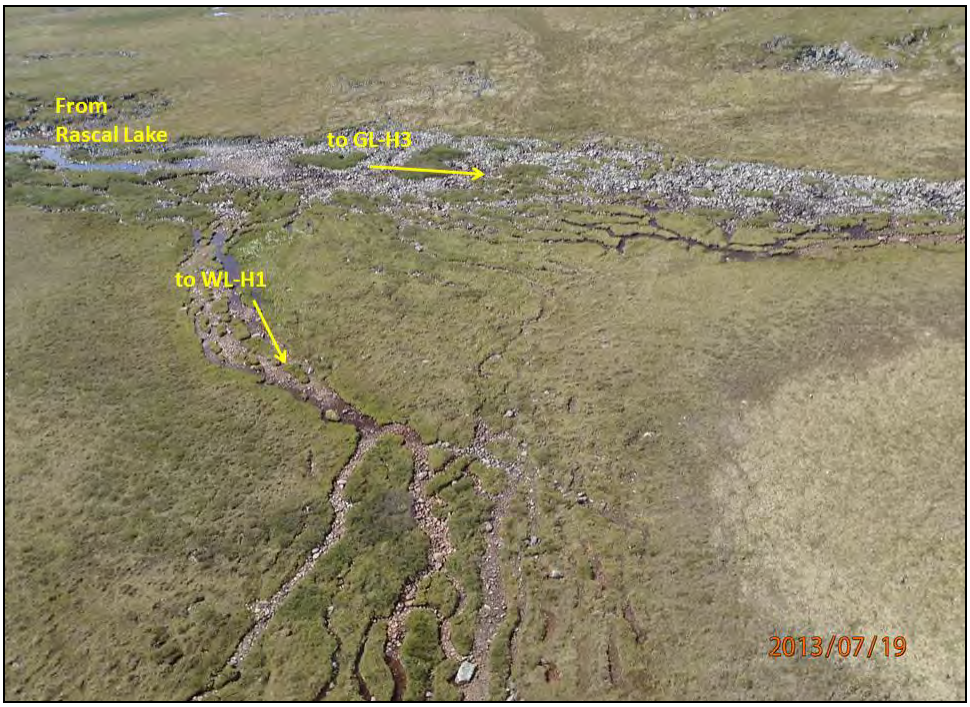

Plate 4.5-1. Channel division of the Rascal Lake outflow showing the division of the channel due to low relief. The indicated branches flow past different hydrometric stations before entering Goose Lake. July 19, 2013.

Table 4.5-1. 2013 Estimated Annual Runoff and Mean Annual Discharge in the Goose Property Area

Hydrometric Station	Drainage Area (km^2)	Previous Years Results		2013 Results			
		Annual Runoff 2011+ (mm)	Annual Runoff 2012+ (mm)	Annual Runoff (mm)	Jun-Sep Runoff (mm)	Mean Annual Discharge (m^3/s)	Mean Jun-Sep Discharge (m^3/s)
EL-H1	1.4	77	55	215*	178*	0.010	0.024
GI-H1	27.4	157	126	111	91	0.096	0.236
GL-H1	18.0	95	81	74	64	0.042	0.109
GL-H2	1.7	227	206	223*	191*	0.012	0.031
GL-H3	1.8	564	216	621*	545*	0.035	0.093
PL-H1	204.6	123	134	100	87	0.646	1.683
PL-H2	101.6	108	72	98	84	0.316	0.811
REFB-H1	5.3	56	40	34	25	0.006	0.013
TIA-H1	5.0	n/a	n/a	34	28	0.005	0.013
UM-H1	4.1	n/a	n/a	101	85	0.013	0.033
WL-H1	32.7	104	82	92*	79*	0.096	0.245
WP-H1	17.6	n/a	n/a	108	93	0.060	0.155
WR-H1	2.7	n/a	n/a	315*	243*	0.027	0.062
(GL-H3) + (WL-H1) + (WR-H1) + (EL-H1)	38.6	n/a	n/a	137	116	0.168	0.424

+: Updated watershed areas used to estimate the 2011 and 2012 annual runoff values.
**: Drainage divide is not fixed; therefore runoff values are uncertain.*

The lower than expected estimated runoff at TIA-H1 is most likely attributed to the subsurface flow at this hydrometric location. Likewise, the higher than expected runoff at GL-H2 is due to the variable drainage divide between this watershed and the Big Lake watershed. Part of the Big Lake watershed runoff overflows to the GL-H2 watershed during the open water season.

For the gauged drainages in the George Property area, the estimated 2013 annual runoff ranged from 59 mm at MC-H1 to 132 mm at LG-H1 (Table 4.5-2). Runoff values within George Property area show less spatial variations than those within the Goose Property area.

Table 4.5-2. 2013 Estimated Annual Runoff and Mean Annual Discharge in the George Property Area

		Previous Years Results		2013 Results			
Hydrometric Station	Drainage Area (km^2)	Annual Runoff 2011 (mm)	Annual Runoff 2012 (mm)	Annual Runoff (mm)	Jun-Sep Runoff (mm)	Mean Annual Discharge (m^3/s)	Mean Jun-Sep Discharge (m^3/s)
KL-H1	24.2	n/a	143	107	106	0.082	0.243
KL-H2	9.6	n/a	143	116	116	0.035	0.105
LG-H1	271.1	n/a	n/a	132	132	1.136	3.383
LY-H1	10.6	n/a	n/a	62	61	0.021	0.061
MC-H1	10.8	n/a	n/a	59	59	0.020	0.060
REFQ-H1	14.7	n/a	n/a	70	69	0.033	0.097
SL-H1	13.0	n/a	n/a	117	115	0.048	0.142

In the Arctic, the winter snowpack drives the annual runoff (Woo 1990). The 2012-2013 snowpack in the Canadian Arctic was 23% below the average of the last 66 years (Environment Canada 2013). The result of this below-average snowpack was a drier year with lower annual runoff in 2013 than in 2011 and 2012. This is evident at stations PL-H1 and KL-H1 that represent the majority of Goose Property and George Property area, respectively (Tables 4.5-1 and 4.5-2).

4.5.2 Mean Annual Discharge

Mean annual discharge (MAD) and the average discharge during the open water period from the beginning of June through September were calculated and provided in Tables 4.5-1 and 4.5-2.

For the gauged drainages in the Goose Property area, the average discharge during the open water season was the lowest at TIA-H1 (0.013 m^3/s) and the highest at PL-H1 (1.683 m^3/s; Table 4.5-1). For the gauged drainages in the George Property area, MAD was the lowest at MC-H1 (0.060 m^3/s) and the highest at LG-H1 (3.383 m^3/s; Table 4.5-2).

The MAD was much lower than the average discharge during the open water season, because a large portion of the year has zero flow conditions. In the Goose Property area, MAD was the lowest at TIA-H1 (0.005 m^3/s) and the highest at PL-H1 (0.646 m^3/s) (Table 4.5-1). In the George Property area, MAD was the lowest at MC-H1 (0.020 m^3/s) and the highest at LG-H1 (1.136 m^3/s) (Table 4.5-2).

4.5.3 Monthly Runoff Distribution

In all drainages, except EL-H1 and WR-H1, the maximum monthly runoff occurred in June (Tables 4.5-3 and 4.5-4; Figures 4.5-1 and 4.5-2). In these two watersheds, the maximum monthly runoff occurred in September. As previously mentioned, this exception may be attributed to the variable drainage divide among the watersheds to the south of Goose Lake.

Table 4.5-3. 2013 Runoff Distribution in the Goose Property Area

Hydrometric Station	Jan-May		June		July		August		September		October		Nov-Dec	
	(mm)	(%)*	(mm)	(%)*	(mm)	(%)*	(mm)	(%)*	(mm)	(%)*	(mm)	(%)*	(mm)	(%)*
EL-H1	22	10	39	18	2	1	7	3	129	60	16	7	0	0
GI-H1	11	10	51	46	5	5	1	1	33	30	9	8	0	0
GL-H1	9	12	54	73	6	8	1	2	3	5	1	2	0	0
GL-H2	24	11	145	65	16	7	5	2	26	12	8	3	0	0
GL-H3	60	10	375	60	12	2	4	1	154	25	16	3	0	0
PL-H1	10	10	67	67	11	11	4	4	5	5	3	3	0	0
PL-H2	8	9	57	58	8	8	4	4	16	16	6	6	0	0
REFB-H1	8	24	23	68	2	5	0	0	1	2	0	1	0	0
TIA-H1	6	18	22	65	2	6	2	5	2	5	1	2	0	0
UM-H1	14	14	71	70	5	5	2	2	7	6	2	2	0	0
WL-H1	8	8	52	56	8	9	3	4	16	17	6	6	0	0
WP-H1	11	10	66	61	11	10	5	5	11	10	4	4	0	0
WR-H1	28	9	101	32	7	2	13	4	123	39	44	14	0	0
(GL-H3) + (WL-H1) + (WR-H1) + (EL-H1)	12	9	70	51	8	6	4	3	34	25	9	7	0	0

** Monthly or a certain period runoff represented as a percentage of annual runoff.*

Table 4.5-4. 2013 Runoff Distribution in the George Property Area

Hydrometric Station	Jan- May		June		July		August		September		October		Nov-Dec	
	(mm)	(%)*	(mm)	(%)*	(mm)	(%)*	(mm)	(%)*	(mm)	(%)*	(mm)	(%)*	(mm)	(%)*
KL-H1	1	1	79	74	14	13	4	4	9	8	0	0	0	0
KL-H2	1	0	81	69	25	21	5	5	5	4	0	0	0	0
LG-H1	0	0	85	64	24	18	9	7	14	10	0	0	0	0
LY-H1	1	1	48	78	7	12	2	4	3	5	0	0	0	0
MC-H1	1	1	51	85	4	7	1	1	3	5	0	0	0	0
REFQ-H1	1	1	49	70	6	9	3	4	11	15	0	0	0	0
SL-H1	1	1	77	66	20	18	9	8	9	7	0	0	0	0

** Monthly or a certain period runoff represented as a percentage of annual runoff.*

Compared to previous years, the concentration of annual runoff in June was greater than 2011 but smaller than 2012. Using PL-H1 as a representative station, runoff values in June accounted for 45, 84, and 67% of the annual runoff in 2011, 2012, and 2013, respectively.

4.5.4 Annual Peak and Low Flow

For most hydrometric stations, except EL-H1 in Goose Property area and KL-H1 in George Property area, peak flows were estimated based on regression analysis. Such an analysis is more reliable for daily flows than instantaneous flows. Therefore, this report only presents the daily peak flows (Tables 4.5-5 and 4.5-6).

Peak flows for most basins in the Project area occurred in late May (in Goose Property area) or early June (in George Property area). The exception is EL-H1 where the peak flow was observed in September.

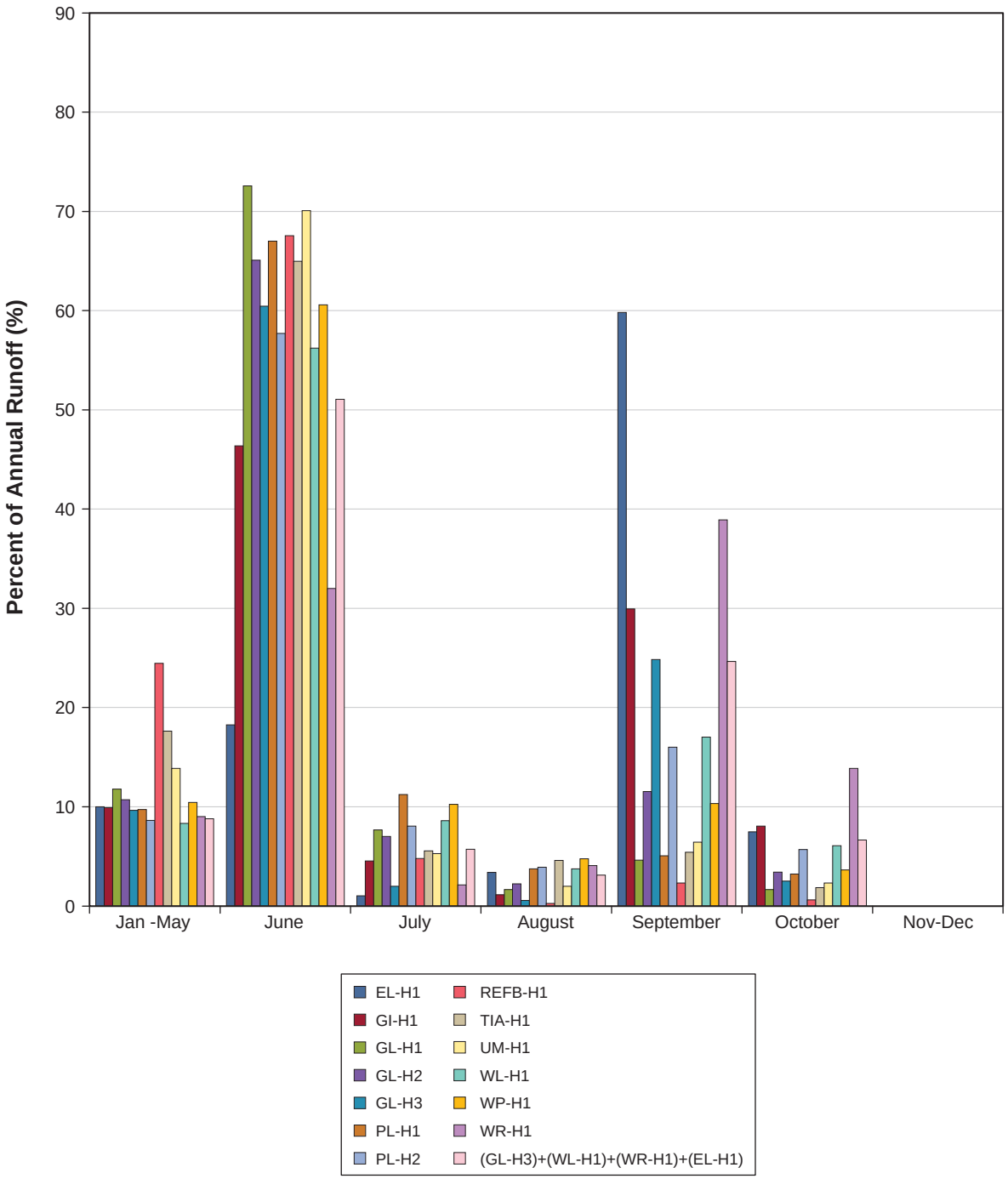

Figure 4.5-1

Monthly Runoff Distribution
Goose Property Area

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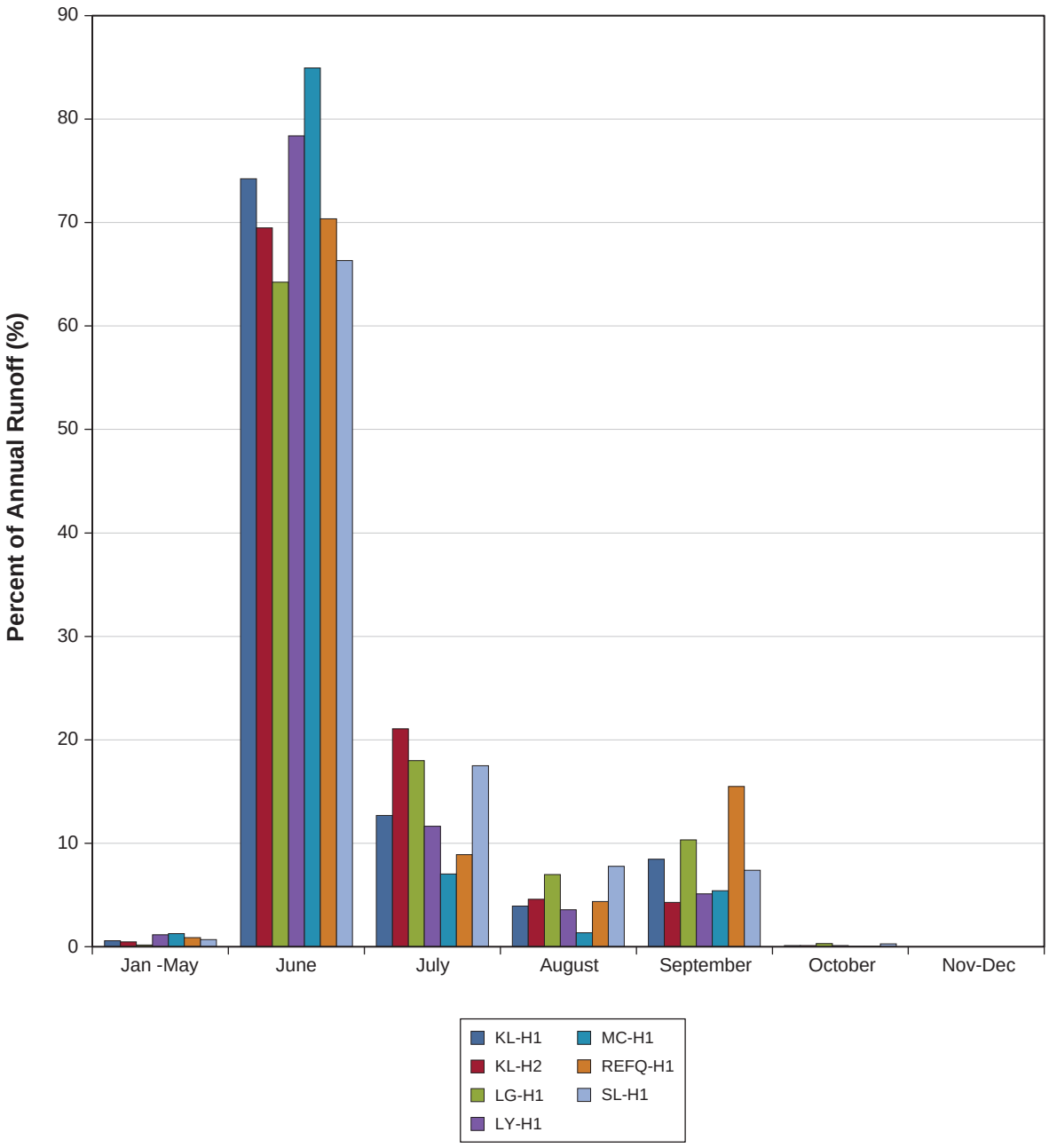

Figure 4.5-2

Monthly Runoff Distribution
George Property Area

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Table 4.5-5. Estimated 2013 Daily Peak Flows and Peak Unit Yields in the Goose Property Area

Hydrometric Station	Drainage Area (km^2)	Peak Daily Flow (m^3/s)	Peak Daily Unit Yield ($L/s/km^2$)	Date
EL-H1	1.4	0.17	118*	Sep 15
GI-H1	27.4	1.33	49	May 31
GL-H1	18	0.66	37	May 31
GL-H2	1.7	0.15	90*	May 31
GL-H3	1.8	0.49	274*	Jun 2
PL-H1	204.6	9.50	46	May 31
PL-H2	101.6	3.99	39	May 31
REFB-H1	5.3	0.18	33	May 31
TIA-H1	5	0.11	22	May 31
UM-H1	4.1	0.22	55	May 31
WL-H1	32.7	1.09	33*	Jun 2
WP-H1	17.6	0.85	48	May 31
WR-H1	2.7	0.33	121*	May 31

**: Drainage divide is not fixed; therefore unit yield values are uncertain.*

Table 4.5-6. Estimated 2013 Daily Peak Flows and Peak Unit Yields in the George Property Area

Hydrometric Station	Drainage Area (km^2)	Peak Daily Flow (m^3/s)	Peak Daily Unit Yield ($L/s/km^2$)	Date
KL-H1	24.2	1.49	62	Jun 7
KL-H2	9.6	0.54	57	Jun 7
LG-H1	271.1	16.62	61	Jun 7
LY-H1	10.6	0.44	41	Jun 7
MC-H1	10.8	0.50	46	Jun 7
REFQ-H1	14.7	0.59	40	Jun 7
SL-H1	13	0.77	60	Jun 7

In the Goose Property area, daily peak flows ranged from 0.11 m^3/s at TIA-H1 to 9.50 m^3/s at PL-H1 (Table 4.5-5). In the George Property area, daily peak flows ranged from 0.44 m^3/s at LY-H1 to 16.62 m^3/s at LG-H1 (Table 4.5-6).

Annual low flows are expected to reach zero in all the basins once freeze-up occurs, and zero flow conditions will last throughout the winter months (approximately October to May). The observed low flows are those that occurred during the 2013 period of record from early June to mid-September (Tables 4.5-7 and 4.5-8). Observed low flows for the majority of basins in the Project area occurred in August. Most streams except the streams monitored by the hydrometric stations PL-H1, PL-H2, WL-H1, WP-H1, KL-H1, LG-H1, and SL-H1 experienced zero or extreme low flow conditions during the open water period.

Table 4.5-7. 2013 Observed Daily Minimum Flows (June through September) in the Goose Property Area

Hydrometric Station	Drainage Area (km^2)	Daily minimum Flow (m^3/s)	Date
EL-H1	1.4	0	July 22-26
GI-H1	27.4	< 0.001	Aug 14-15
GL-H1	18.0	0.005	Aug 16-18
GL-H2	1.7	< 0.001	Aug 13-21
GL-H3	1.8	0	Aug 9-20
PL-H1	204.6	0.184	Sep 4
PL-H2	101.6	0.053	Aug 20
REFB-H1	5.3	0	Aug 8-22
TIA-H1	5.0	0.003*	July 7 to Aug 3*
UM-H1	4.1	0.001	Aug 16-18
WL-H1	32.7	0.013	Aug 20
WP-H1	17.6	0.025	Aug 16-18
WR-H1	2.7	0	Aug 9-20

** Flows were not recorded after August 3rd, but dry channel conditions were observed after this date.*

Table 4.5-8. 2013 Observed Daily Minimum Flows (June through September) in the George Property Area

Hydrometric Station	Drainage Area (km^2)	Daily minimum Flow (m^3/s)	Date
KL-H1	24.2	0.013	Aug 16
KL-H2	9.6	0.007	Aug 27
LG-H1	271.1	0.677	Aug 18
LY-H1	10.6	0.004	Aug 19-20
MC-H1	10.8	0.001	Aug 16-17 and Aug 20-25
REFQ-H1	14.7	0.000	Aug 16
SL-H1	13.0	0.028	Aug 17-19

5. Summary

5. Summary

The 2013 hydrology program included two networks that encompassed both the Goose and George Property areas. The network in the Goose Property area was comprised of 15 hydrometric stations (13 streamflow monitoring stations and 2 lake level stations) to monitor a total drainage area of 209.9 km^2, including a reference drainage area of 5.3 km^2. The network in the George Property area was comprised of 8 hydrometric stations to monitor a total drainage area of 301.8 km^2, including a reference drainage area of 14.7 km^2.

The hydrometric network was operated through the open water season from May 31, 2013 to October 3, 2013. During this time period, continuous time series water level (stage) data were collected at each station and more than 100 manual discharge measurements were completed. Based on the stage and discharge data collected, stage-discharge rating equations were determined and annual hydrographs produced.

The annual hydrographs show that basins within the Project area have an Arctic nival hydrologic regime characterized by snowmelt-driven high flows during the spring freshet and no flows during the winter. That is, all monitored streams can be considered either intermittent or ephemeral. In 2013 one prominent snowmelt-driven high flow event was observed in late May to early June in most basins. After this high flow, discharge steadily decreased throughout the Project area until mid-August. A rainfall-driven high flow occurred in early September.

Peak flows varied substantially between gauged streams. Daily peak flows in the Goose Property area ranged from 0.11 m^3/s at the hydrometric station TIA-H1 (Tailings Impoundment Area outflow) to 9.50 m^3/s at the station PL-H1 (Propeller Lake outflow). Daily peak flows in the George Property area ranged from 0.44 m^3/s at the hydrometric station LY-H1 (Lytle Lake outflow) to 16.62 m^3/s at the station LG-H1 (Long Lake outflow).

Volumetric outflows from each of the monitored drainages were generally found to be a function of drainage area. In the Goose Property area, the minimum volumetric outflows were observed at TIA-H1 (Tailings Impoundment Area outflow; drainage area = 5.0 km^2) which had a total annual water output of 0.17 million m^3. The maximum annual volumetric output was 20.38 million m^3 at PL-H1 (Propeller Lake outflow; drainage area = 204.6 km^2). In the George Property area, the minimum volumetric outflows were observed at MC-H1 (drainage area = 10.8 km^2) which had a total annual water output of 0.64 million m^3. The maximum annual volumetric output was 35.83 million m^3 at LG-H1 (drainage area = 271.1 km^2).

Regional data (Environment Canada 2013) show that 2013 was a drier year with a low snowpack compared to 2011 and 2012. Annual runoff was 100 mm at PL-H1, which represents the Goose Property area, and 107 mm at KL-H1, which represents the George Property area. Variable drainage divides between the sub-watersheds increased the uncertainty in runoff estimates for the smaller sub-watersheds.

In most drainages the maximum monthly runoff occurred in June (67% in PL-H1 and 74% in KL-H1 which represent the Goose and George Property areas, respectively). The exceptions are EL-H1 and WR-H1 where the maximum monthly runoff was in September. The percent of the total annual runoff in June was greater than that of 2011 and less than that of 2012.

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Appendix 1

Hydrometric Monitoring Station Information

Rescan™
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Appendix 1.1. Station Information Sheet for Hydrometric Station GL-H1

Site ID:	GL-H1	**Drainage Area (km²):**	18.0
Site Location:	Near the mouth of the southwestern inflow to Goose Lake		
UTM:	NAD 83, Zone 13W	430,772 E	7,270,016 N

Benchmarks	**Elevation (m)**	**Description**
BM 3	100.000	Bolt on left bank upstream of the station
BM 60	99.986	Bolt on left bank upstream of station
BM 61	99.979	Bolt on left bank upstream of station

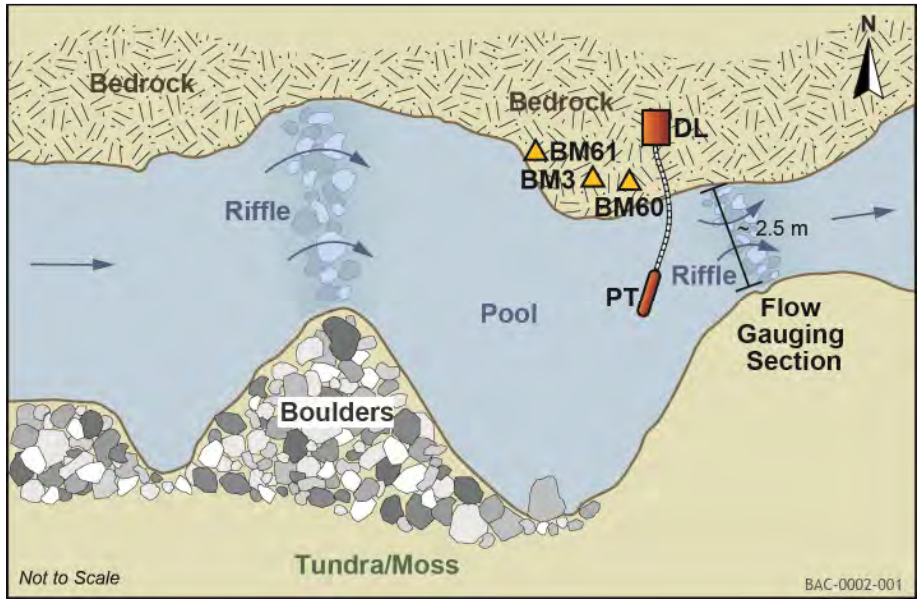
Transducer:	PS-98i	**Logger:**	ELF-2

Operating Periods:		
2010	June 10- Sep 16	Established June 16, 2010
2011	June 10- Sep 16	
2012	June 5 – Sep 7	
2013	June 2- Sep 12	Added BMs 60 and 61

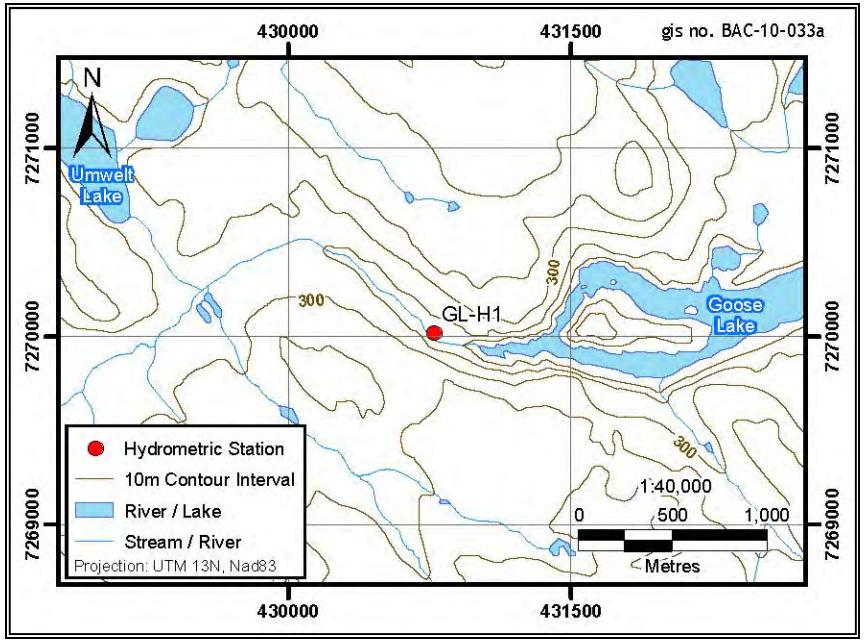
General Comments:

- Location previously established and monitored from 2007 to 2009 as D32 by Gartner Lee.
- Wadeable under all conditions
- Access by helicopter

General Site Information



Plan View of Hydrometric Station GL-H1



Site Map

Low angle view looking across the channel at low flow. The enclosure for the data logger can be seen on the left bank. August 20, 2013.

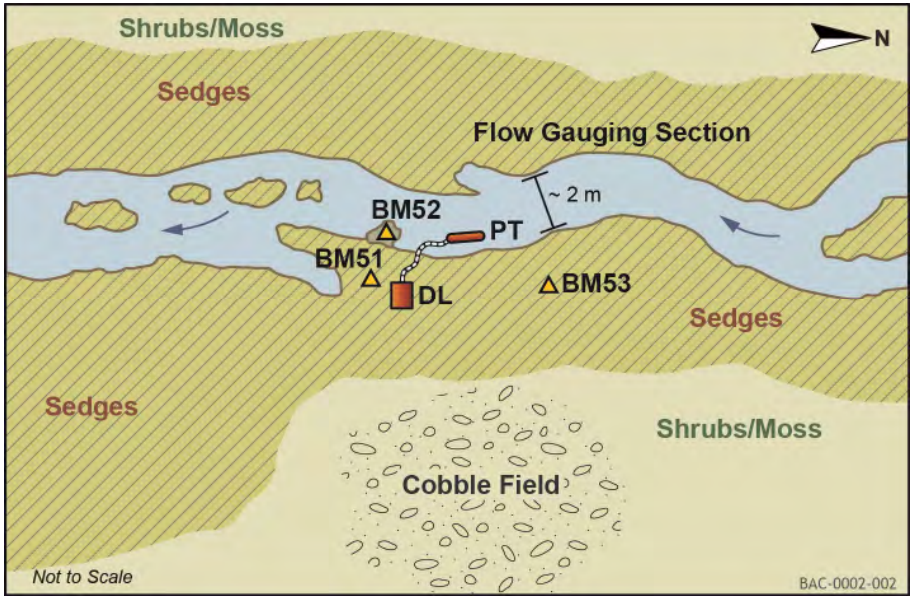
Site Photo

Appendix 1.2. Station Information Sheet for Hydrometric Station GL-H2

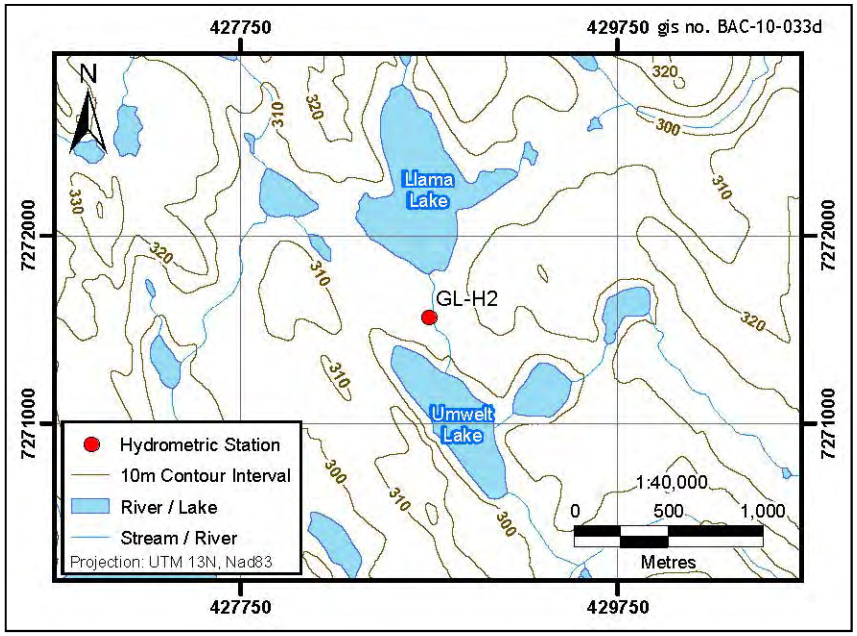
Site ID:	GL-H2	**Drainage Area (km²):**	1.7
Site Location:	Llama Lake outflow		
UTM:	NAD 83, Zone 13W	428,746 E	7,271,567 N
Benchmarks	**Elevation (m)**	**Description**	
BM 51 (BM 1)	100.000	Bolt at base of DL enclosure box	
BM 52 (BM 2)	99.746	Bolt in boulder embedded in LB	
BM 53 (BM 3)	99.781	Bolt in buried boulder ~5m upstream of station	
Transducer:	PS-98i	**Logger:**	ELF-2
Operating Periods:			
2010	July 6- Sept 29	Established June 16, 2010	
2011	June 10 – Sept 16		
2012	June 5 – Sept 7		
2013	June 3 – Sept 11		
General Comments:			

- Very low flow under most conditions.
- Can be waded under all conditions.
- Access by helicopter or on foot from UM-H1.

General Site Information



Plan View of Hydrometric Station GL-H2



Site Map

Low angle view looking downstream to the south along the monitored stream reach. September 11, 2013.

Site Photo

Appendix 1.3. Station Information Sheet for Hydrometric Station GL-H3

Site ID:	GL-H3	**Drainage Area (km^2):**	1.8
Site Location:	Gander Pond Outflow		
UTM:	NAD 83, Zone 13W	432,891 E	7,269,919 N

Benchmarks	**Elevation (m)**	**Description**
BM17	100.000	Bolt on right bank downstream of the station
BM18	100.141	Bolt on left bank downstream of the station
BM19	100.042	Bolt on left bank even with the station

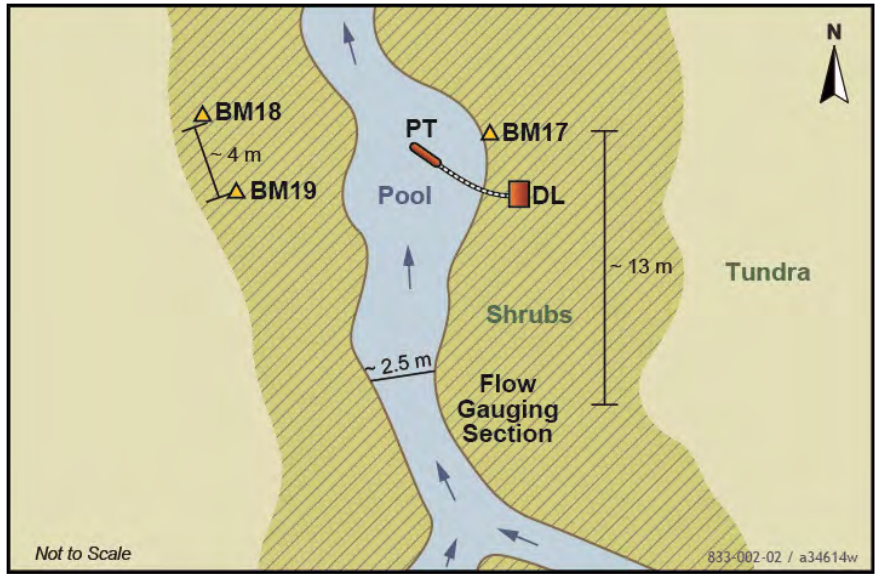
Transducer:	PS-98i	**Logger:**	ELF-2

Operating Periods:		
2011	June 14 - Sep 16	Established June 16, 2011
2012	June 7 - Sep 9	
2013	May 31- Sep 13	

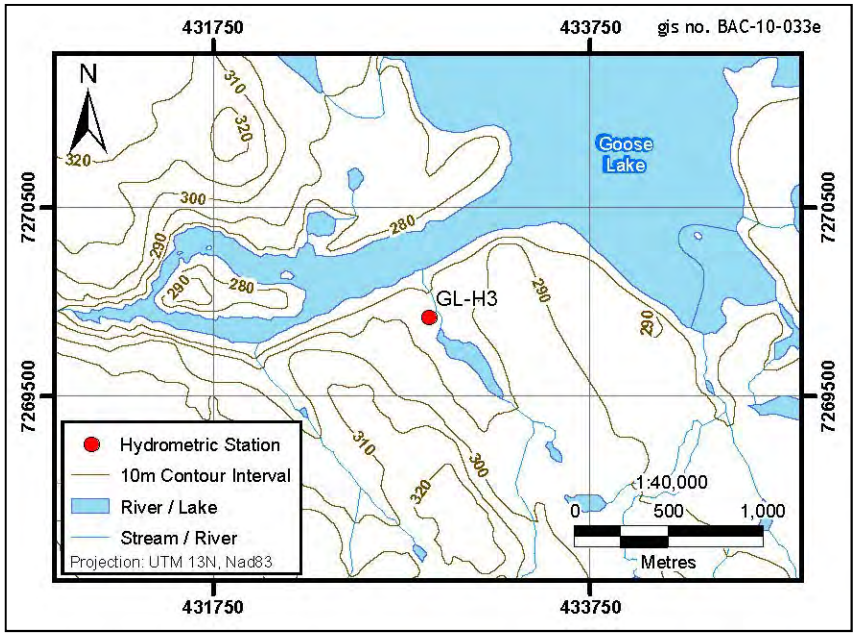
General Comments:

- Zero flow during summer low flow period
- Wadeable under all conditions
- Bench marks marked with rebar stakes for locating
- Access by helicopter or on foot from camp

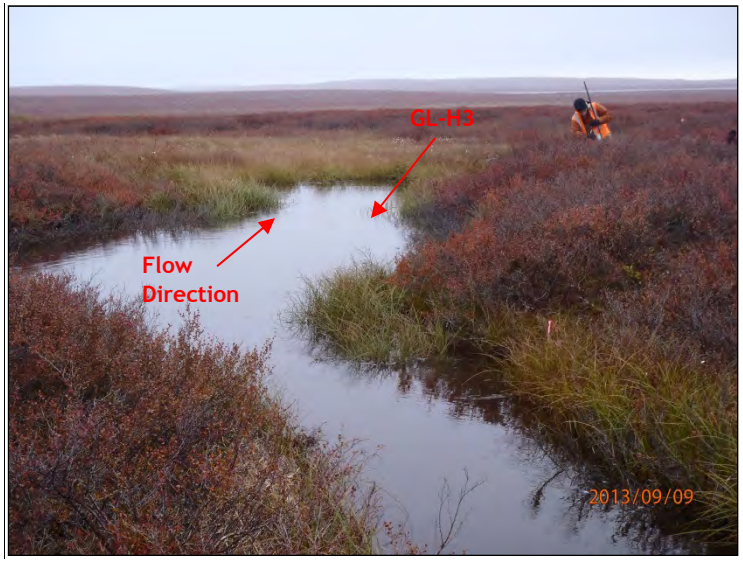
General Site Information



Plan View of Hydrometric Station GL-H3



Site Map



Low angle downstream view of the monitored stream reach. September 9, 2013.

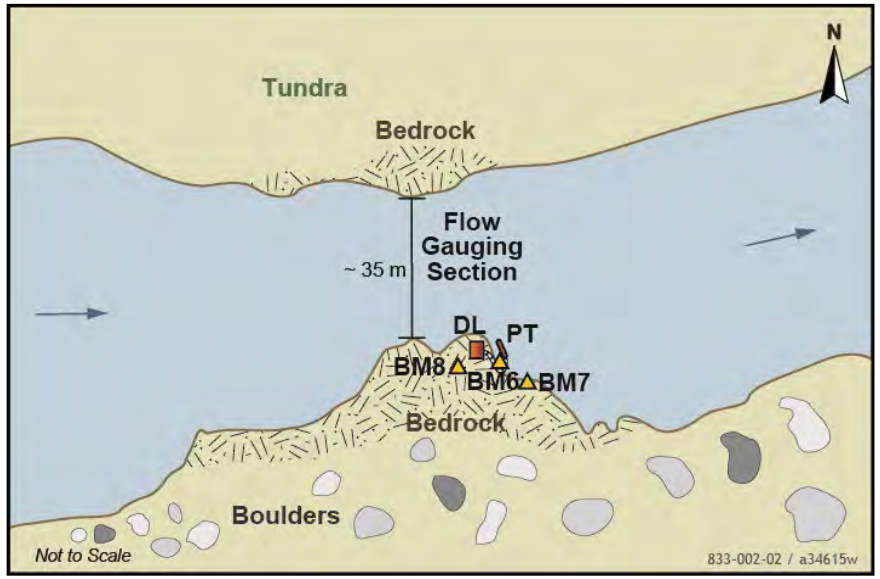
Site Photo

Appendix 1.4. Station Information Sheet for Hydrometric Station PL-H1

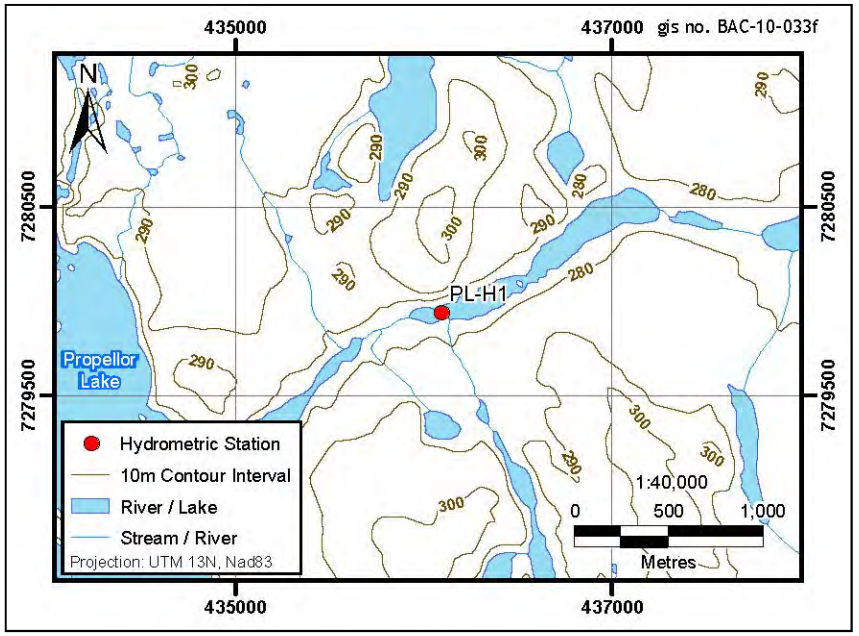
Site ID:	PL-H1	**Drainage Area (km²):**	204.4
Site Location:	Downstream from Propeller Lake outflow		
UTM:	NAD 83, Zone 13W	436,094 E	7,279,939 N
Benchmarks	**Elevation (m)**	**Description**	
BM8	100.000	Bolt upstream from station	
BM7	99.538	Bolt downstream from station	
BM6	99.601	Bolt near station	
Transducer:	PS-98i	**Logger:**	ELF-2
Operating Periods:			
2011	June14 - Sep 17	Established June 14, 2011	
2012	June 6 - Sep 8		
2013	June 8 - Oct 4		
General Comments:			

- Deep but relatively low velocity reach.
- Not wadeable under any conditions. Must walk 200m upstream to cross.
- Access by helicopter
- Under low flow conditions, manual flow measurement 400 m upstream of station.

General Site Information



Plan View of Hydrometric Station PL-H1



Site Map

Low angle view looking upstream towards station PL-H1 and the monitored reach. At low flow (Aug, Sep) manual measurement was taken 400 m further upstream. June 8, 2013.

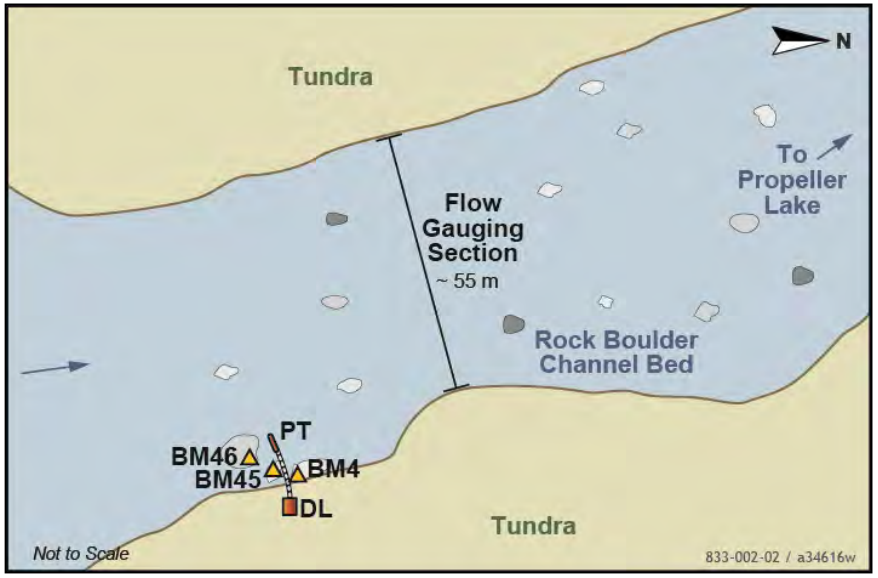
Site Photo

Appendix 1.5. Station Information Sheet for Hydrometric Station PL-H2

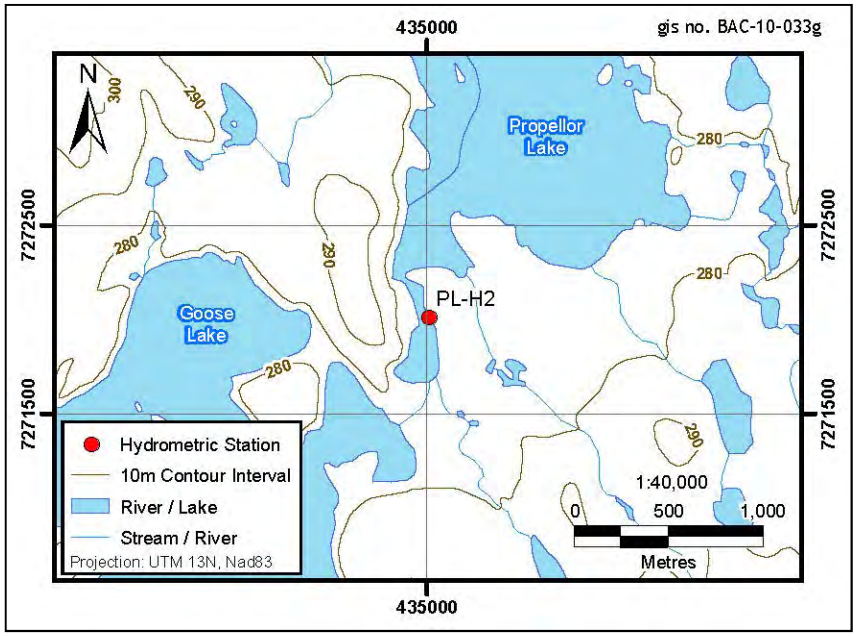
Site ID:	PL-H2	**Drainage Area (km^2):**	101.6
Site Location:	Between the outflow of Goose Lake and the inflow of Propeller Lake		
UTM:	NAD 83, Zone 13 W	435,007 E	7,272,014 N
Benchmarks	**Elevation (m)**	**Description**	
BM4	100.000	Bolt on in-stream boulder near the station	
BM45	99.852	Bolt on in-stream boulder near the station	
BM46	100.166	Bolt on in-stream boulder near the station	
Transducer:	PT-2X	**Logger:**	Self-Contained
Operating Periods:			
2011	June 11 - Sep 17	Established June 11, 2011	
2012	June 12 - Sep 13		
2013	June 2 - Oct 4		
General Comments:			

- Wide boulder strewn channel
- Low flow through boulders under all but freshet conditions where flow covers boulders
- Wadeable under all conditions
- Access by helicopter

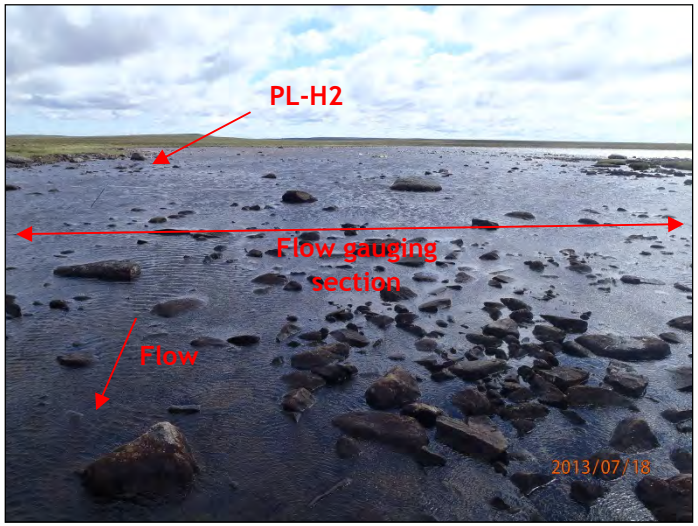
General Site Information



Plan View of Hydrometric Station PL-H2



Site Map



Low angle view looking upstream at the monitored reach under low flow conditions. Note the flow through boulders under these flow conditions. July 18, 2013.

Site Photo

Appendix 1.6. Station Information Sheet for Hydrometric Station GI-H1

Site ID:	GI-H1	Drainage Area (km^2):	27.4
Site Location:	Outflow of Giraffe Lake		
UTM:	NAD 83, Zone 13W	432,744 E	7,271,610 N

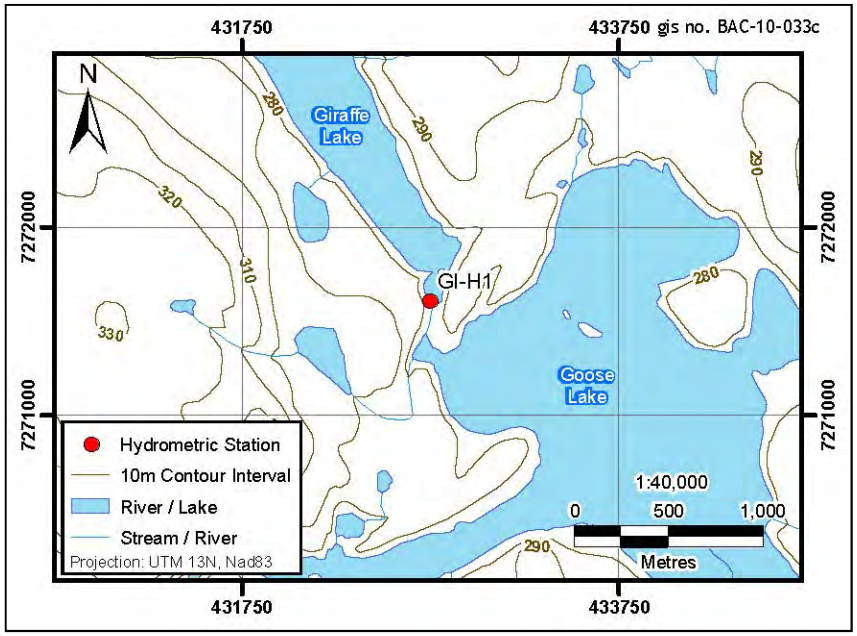
Benchmarks	Elevation (m)	Description
BM5	100.000	Bolt near station
BM47	99.920	Bolt downstream from station
BM49	100.034	Bolt downstream from station

Transducer:	PS-98i	Logger:	ELF2

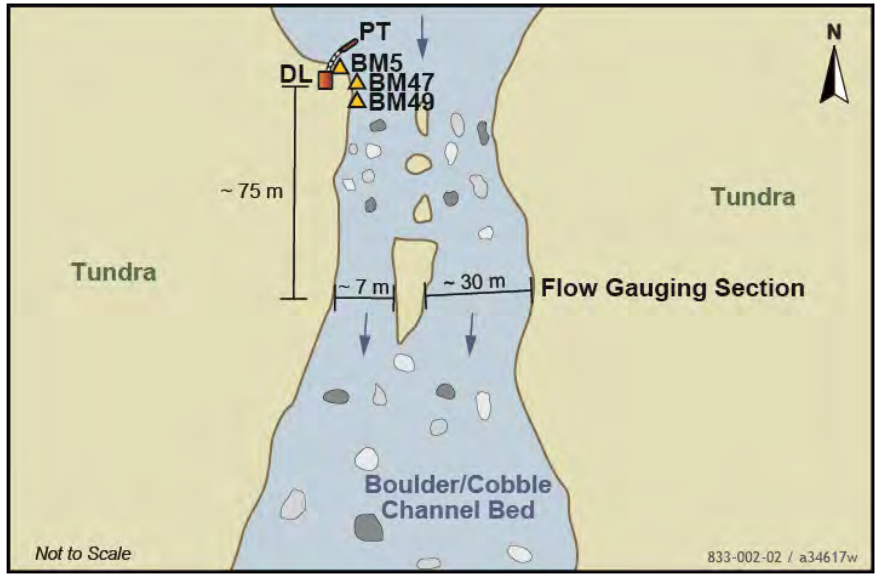
Operating Periods:		
2011	June 11 - Sep 16	Established June 16, 2011
2012	June 9 - Sep 14	
2013	June 5 - Sep 10	

General Comments:

- Wide boulder strewn channel. 2013 low flows measured 200m upstream.
- Relatively low flow, except at freshet
- Wadeable under all conditions
- Access by helicopter



Site Map



Plan View of Hydrometric Station GI-H1

Upstream view of Giraffe Lake outflow. Photograph was taken during summer low flow conditions and indicates the location of the pressure transducer at the lake outlet. July 17, 2013.

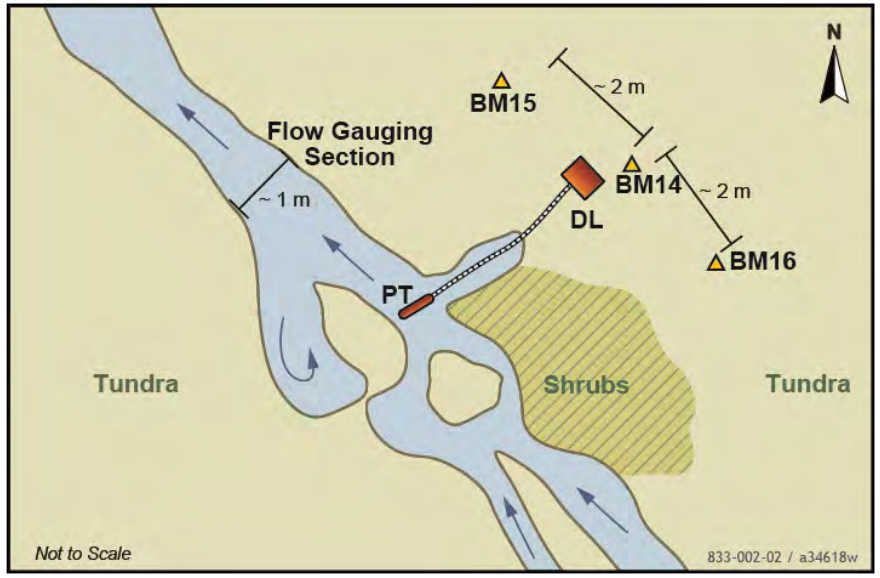
Site Photo

Appendix 1.7. Station Information Sheet for Hydrometric Station EL-H1

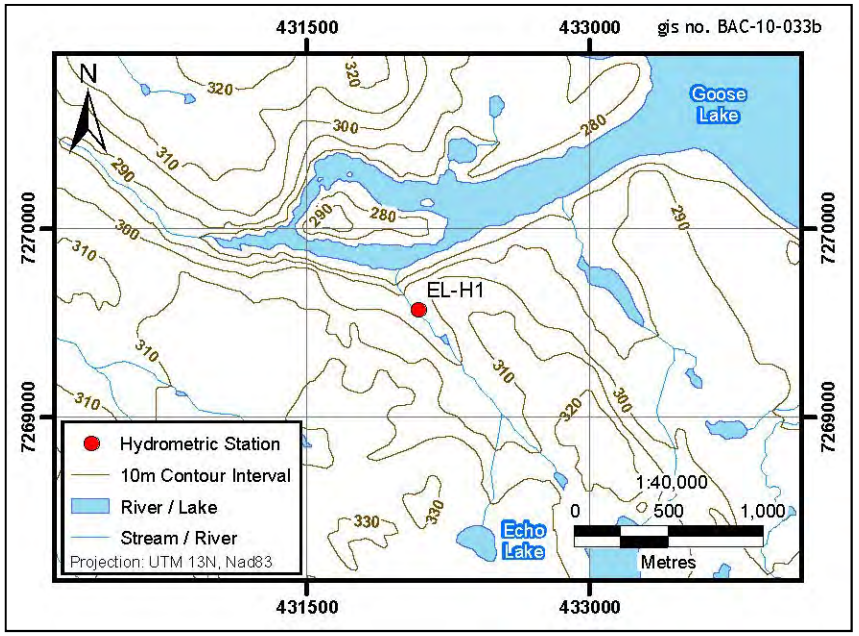
Site ID:	EL-H1	**Drainage Area (km²):**	1.4
Site Location:	Near the inflow to the West arm of Goose Lake		
UTM:	NAD 83, Zone 13W	432,091 E	7,269,573 N
Benchmarks	**Elevation (m)**	**Description**	
BM14	100.000	Bolt near the station	
BM15	99.926	Bolt 2m downstream from the station	
BM16	99.983	Bolt 2m upstream from the station	
Transducer:	PS-98i	**Logger:**	ELF-2
Operating Periods:			
2011	June 13 - Sep 16	Established June 13, 2011	
2012	June 6 - Sep 7		
2013	May 31 - Sep 13		
General Comments:			

- Ephemeral channel prone to flooding
- No flow during dry summer periods
- Wadeable under all conditions
- Access by helicopter

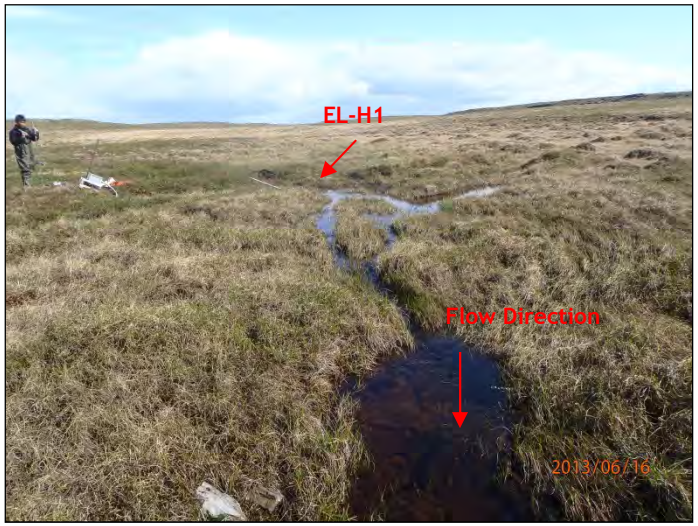
General Site Information



Plan View of Hydrometric Station EL-H1



Site Map



Upstream view of the monitored reach under moderate flow conditions. Due to the ephemeral nature of the channel, it is lined with grasses. June 16, 2013.

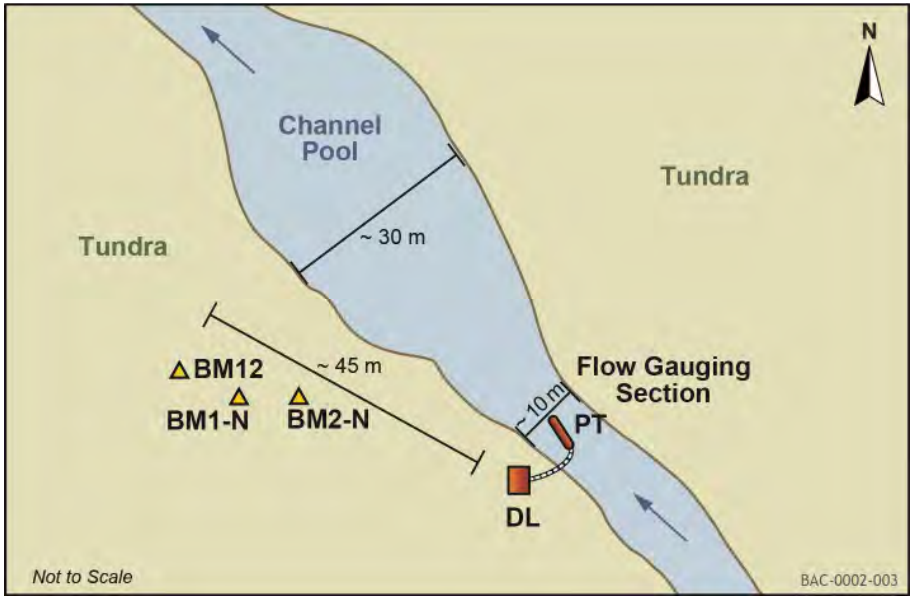
Site Photo

Appendix 1.8. Station Information Sheet for Hydrometric Station WL-H1

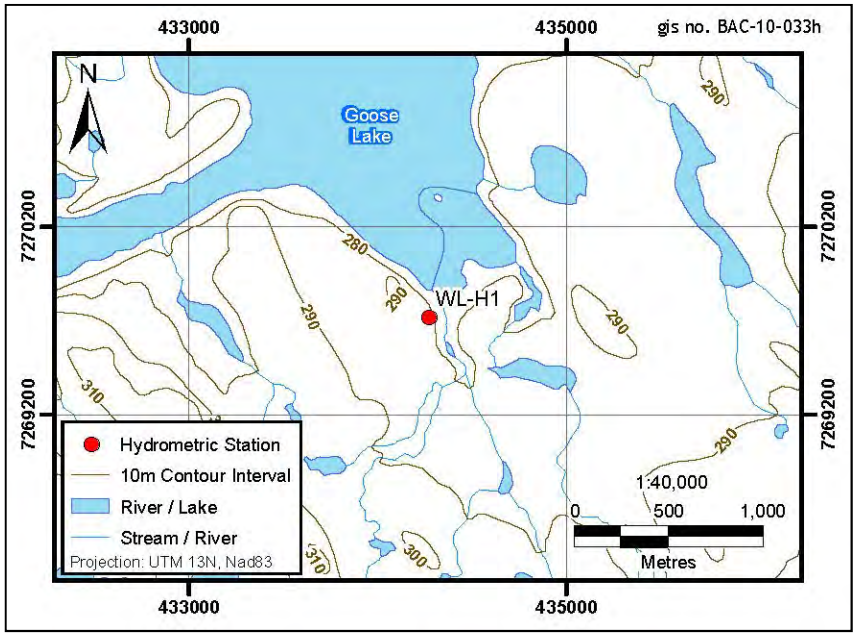
Site ID:	WL-H1	**Drainage Area (km²):**	32.7
Site Location:	Near the southern most inflow to Goose Lake		
UTM:	NAD 83, Zone 13W	434,269 E	7,269,719 N
Benchmarks	**Elevation (m)**	**Description**	
BM12	100.00	Bolt in rock ~45m northwest of the station	
BM1-N	99.529	Bolt in rock 2m from BM 12	
BM2-N	99.222	Bolt in rock 2m from BM1-N	
Transducer:	PS-98i	**Logger:**	ELF-2
Operating Periods:			
2011	June 10 - Sep 17	Established June 10, 2011	
2012	June 7 – Sep 14		
2013	June 1- Sep 15	Installed BMs 1-N and 2-N	
General Comments:			

- Relatively deep channel
- During lowest flows, preferable to measure discharge 50m upstream
- Wadeable under most conditions
- Access by helicopter

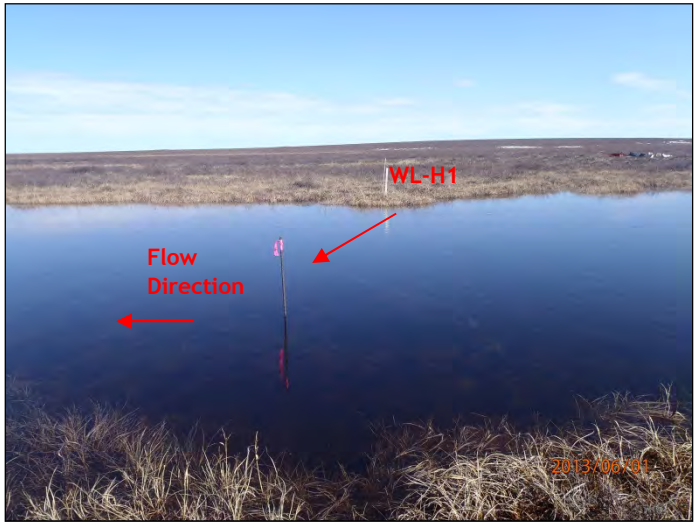
General Site Information



Plan View of Hydrometric Station WL-H1



Site Map



Looking across the channel at the monitored reach. High flows on this date resulted in flooded grass near the banks. June 1, 2013.

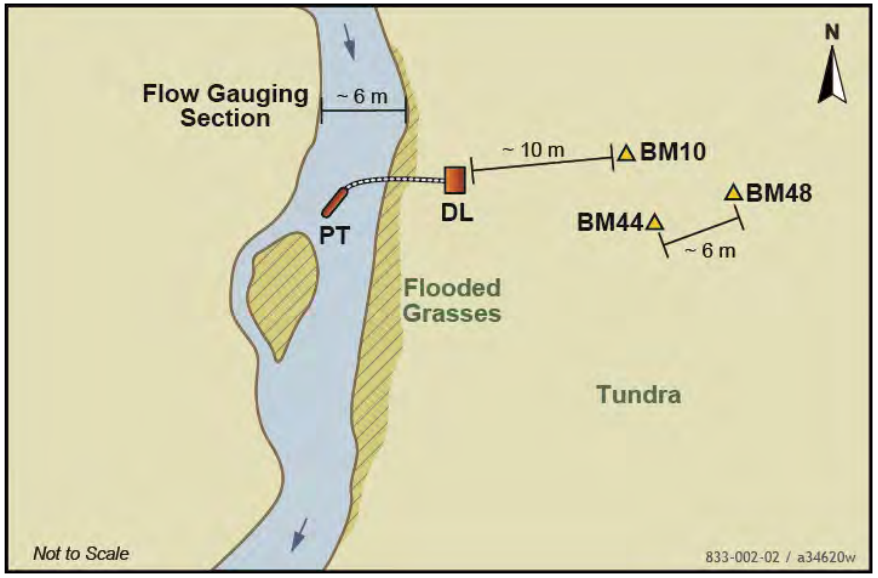
Site Photo

Appendix 1.9. Station Information Sheet for Hydrometric Station REFB-H1

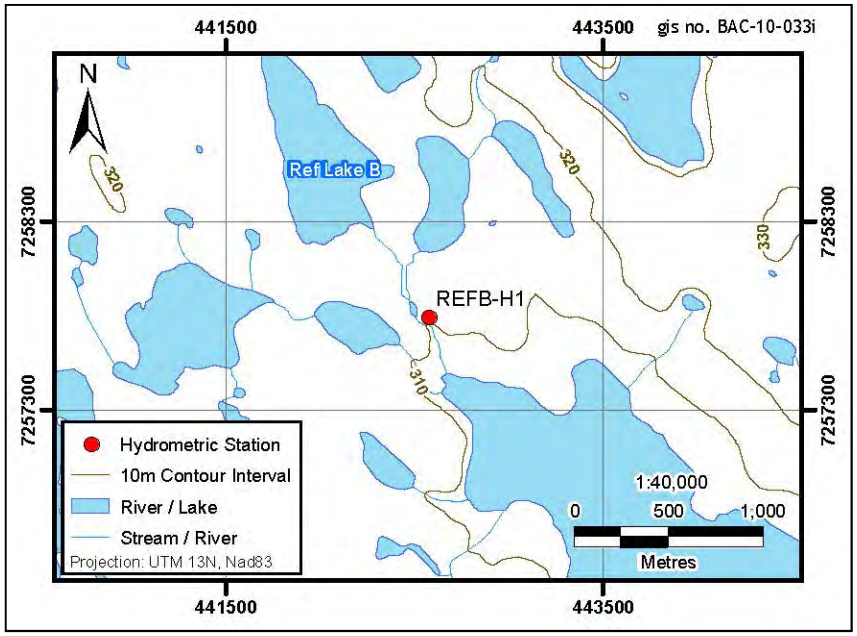
Site ID:	REFB-H1	**Drainage Area (km²):**	5.3
Site Location:	Near the outflow of Reference Lake B		
UTM:	NAD 83, Zone 13W	442,573 E	7,257,794 N
Benchmarks	**Elevation (m)**	**Description**	
BM10	100.000	Bolt ~10m west of the data logger	
BM44	99.972	Bolt ~5m south of BM10	
BM48	100.111	Bolt ~ 6m west of BM44	
Transducer:	PS-98i	**Logger:**	ELF-2
Operating Periods:			
2011	June 13 - Sep 17	Established June 13, 2011	
2012	June 9 – Sep 13		
2013	June 6 – Sep 16		
General Comments:			

- Ephemeral stream
- Soft bed (becomes very muddy following spring thaw)
- Wadeable under all conditions
- Access by helicopter

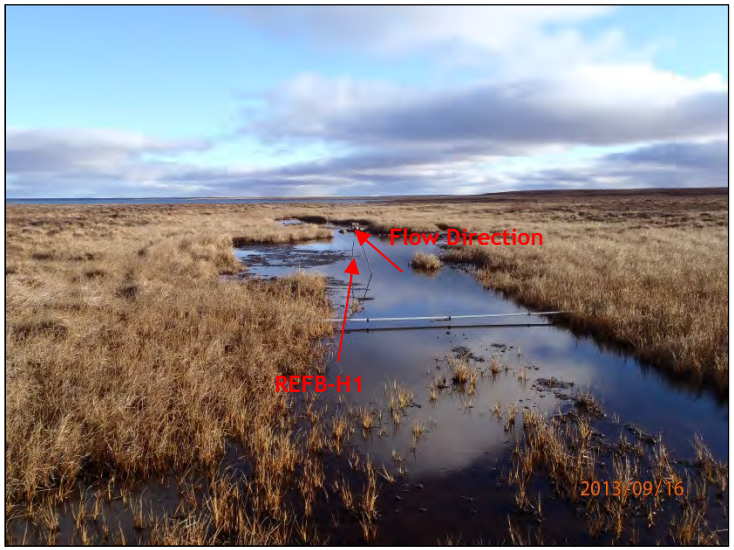
General Site Information



Plan View of Hydrometric Station REFB-H1



Site Map



Looking downstream at the monitored reach under moderate flow conditions. September 16, 2013.

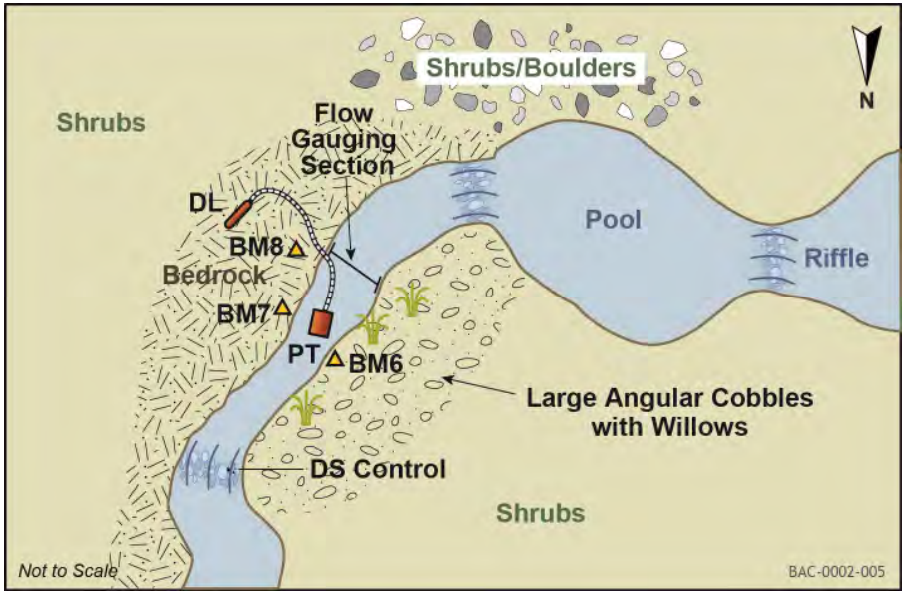
Site Photo

Appendix 1.10. Station Information Sheet for Hydrometric Station TIA-H1

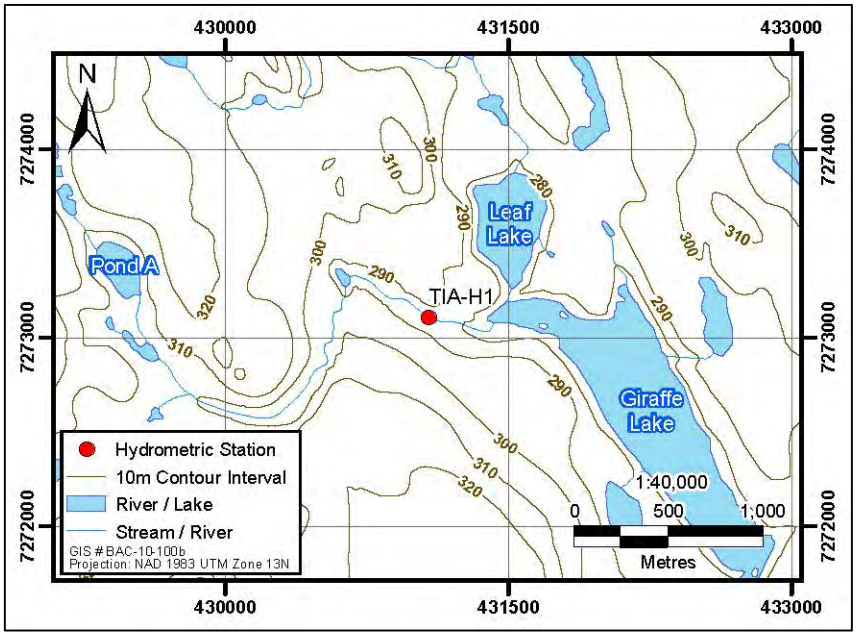
Site ID:	TIA-H1	**Drainage Area (km²):**	5.0
Site Location:	On the proposed TIA outflow channel near the DS boundary		
UTM:	NAD 83, Zone 13W	431, 074 E	7,273105 N
Benchmarks	**Elevation (m)**	**Description**	
BM 6	100.000	Bolt in bedrock left bank DS of station	
BM 7	100.075	Bolt in bedrock in line with station	
BM 8	100.063	Bolt in bedrock US of station	
Transducer:	PT2X	**Logger:**	Self-Contained
Operating Period:			
2013	June 5 – Sep 12	Established on June 5, 2013	
General Comments:			

- Very boulder channel with significant (near 100%) subsurface low flows
- Significant above surface flow only at freshet and in late season.
- Wadeable under all conditions
- Access by helicopter

General Site Information



Plan View of Hydrometric Station TIA-H1



Site Map

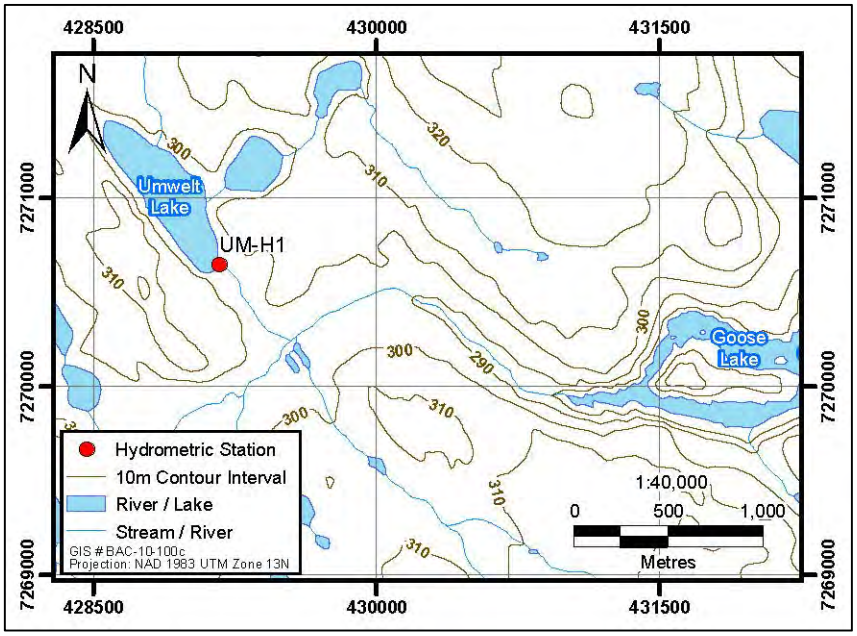
Low angle view looking downstream towards the station. Under moderate flow conditions. Much of the flow has retreated into the subsurface. June 16, 2013

Site Photo

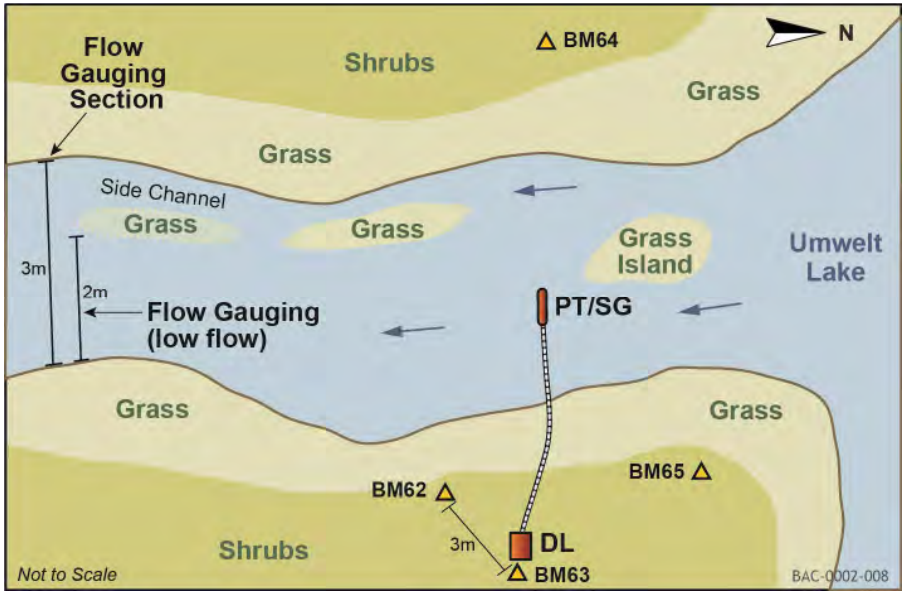
Appendix 1.11. Station Information Sheet for Hydrometric Station UM-H1

Site ID:	UM-H1	**Drainage Area (km²):**	4.1
Site Location:	At the outflow of Umwelt Lake		
UTM:	NAD 83, Zone 13W	429,166 E	7,270,648 N
Benchmarks	**Elevation (m)**	**Description**	
BM 62	100.000	Bolt on left bank 3m downstream of station	
BM 63	101.359	Rebar on station set-up	
BM 64	101.111	Rebar on right bank in line with station	
BM 65	100.747	Rebar on left bank upstream of station	
Transducer:	PT-2X	**Logger:**	Self-contained
Operating Period:			
2013	June 3 - Sep 16	Established on June 3, 2013	
General Comments:			

- Shallow and moderately wide channel with side channels US and DS of station
- Wadeable under all conditions
- Cobble bed with shallow grass banks (gradient = 1%)
- Access by helicopter or on foot from GL-H2.

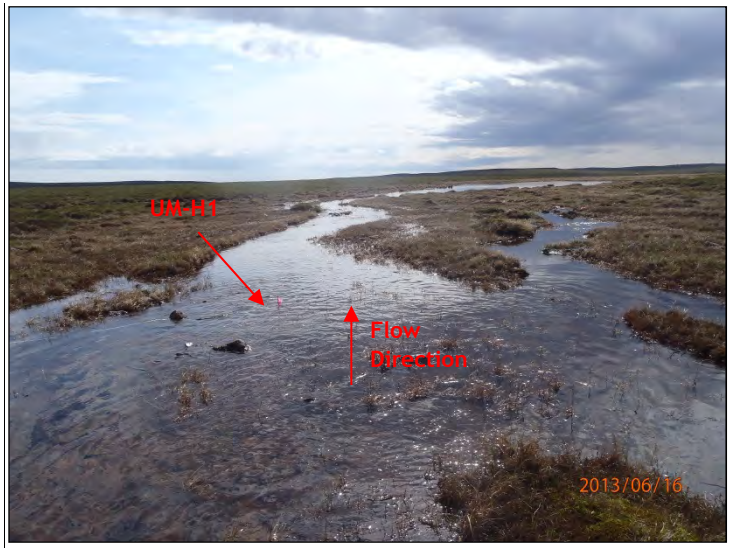


Site Map



Plan View of Hydrometric Station UM-H1

General Site Information



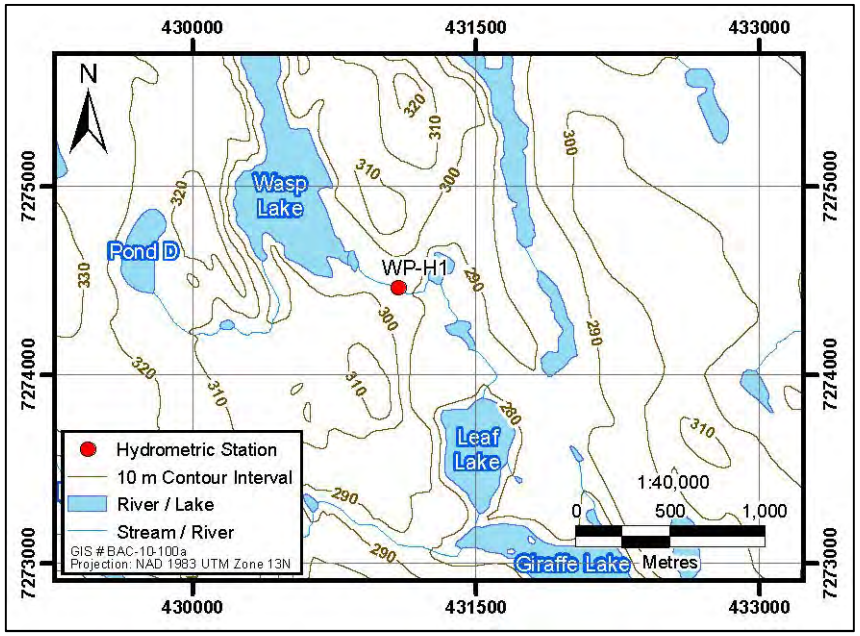
Low angle oblique view looking downstream at the channel section under high flow conditions. The station is shown on the left bank. June 16, 2013.

Site Photo

Appendix 1.12. Station Information Sheet for Hydrometric Station WP-H1

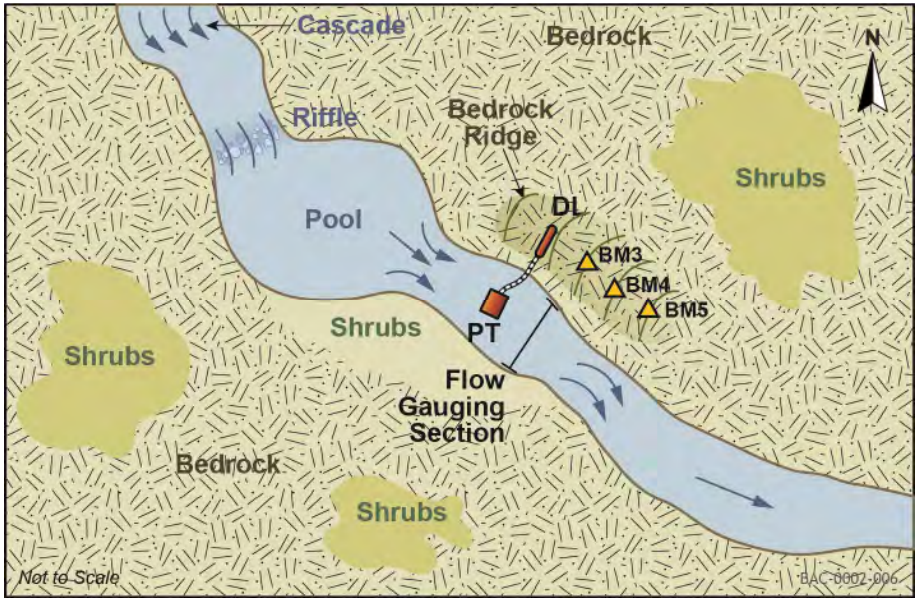
Site ID:	WP-H1	**Drainage Area (km²):**	17.6
Site Location:	Wasp Lake Outflow		
UTM:	NAD 83, Zone 13W	431,087N	7,274,467E
Benchmarks	**Elevation (m)**	**Description**	
BM 3	100.000	Bolt in bedrock on left bank 3m DS of station	
BM 4	99.949	Bolt in bedrock on left bank 4m DS of station	
BM 5	99.741	Bolt in bedrock on left bank 5m DS of station	
Transducer:	PT-2X	**Logger:**	Self-contained
Operating Period:			
2013	June 5 – Sep 12	Established on June 5, 2013	
General Comments:			

- Narrow, well confined channel with stable control.
- Pool-riffle morphology with bedrock banks and a cascade 15m DS.
- Wadeable under all conditions.
- Access by helicopter.



Site Map

General Site Information



Plan View of Hydrometric Station WP-H1

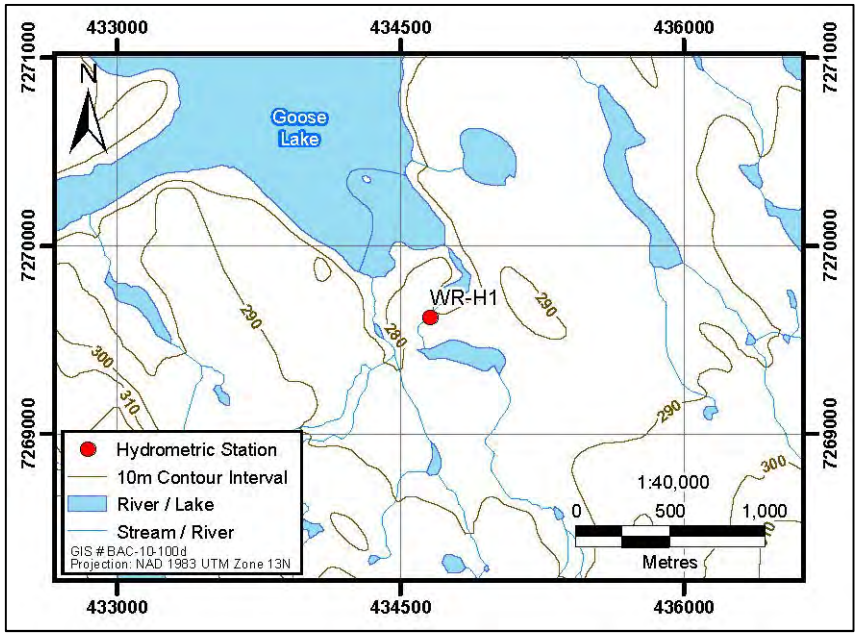
Low angle oblique view looking downstream at the channel section under low flow conditions. The station is shown on the left bank. August 19, 2013.

Site Photo

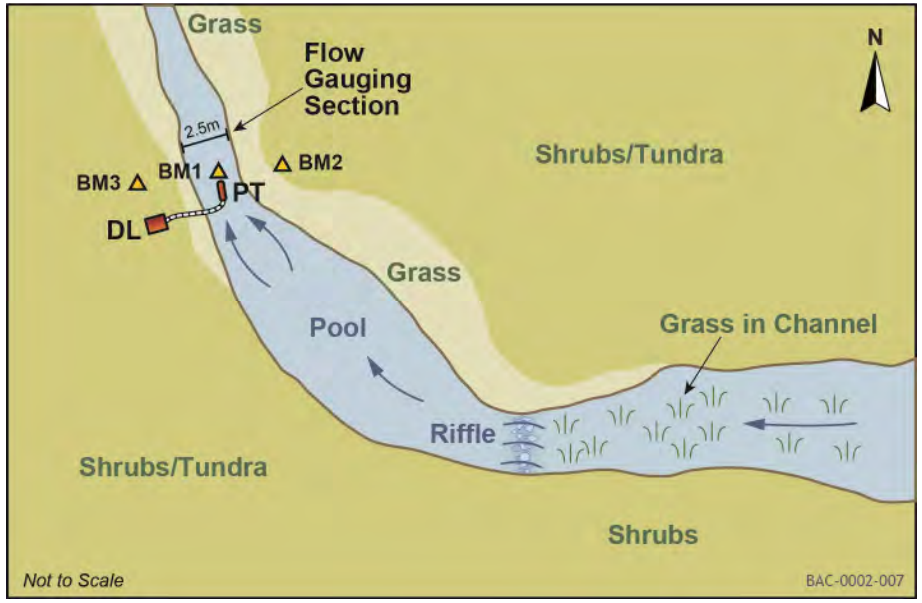
Appendix 1.13. Station Information Sheet for Hydrometric Station WR-H1

Site ID:	WR-H1	**Drainage Area (km²):**	2.7
Site Location:	Proposed WRSA B Outflow channel		
UTM:	NAD 83, Zone 13W	434,688E	7,269,634N
Benchmarks	**Elevation (m)**	**Description**	
BM 3	100.000	Rebar on right bank in line with station	
BM 1	99.727	Rebar in stream at PT location	
BM 2	99.586	Rebar on left bank in line with station	
Transducer:	PS98i	**Logger:**	ELF-2
Operating Period:			
2013	June 1 – Sep 15	Established on June 11, 2013	
General Comments:			

- Narrow and deep ephemeral channel with grass banks.
- Wadeable under all conditions
- Gravel bed with grass controls both US and DS of station
- Access by foot from Goose Camp

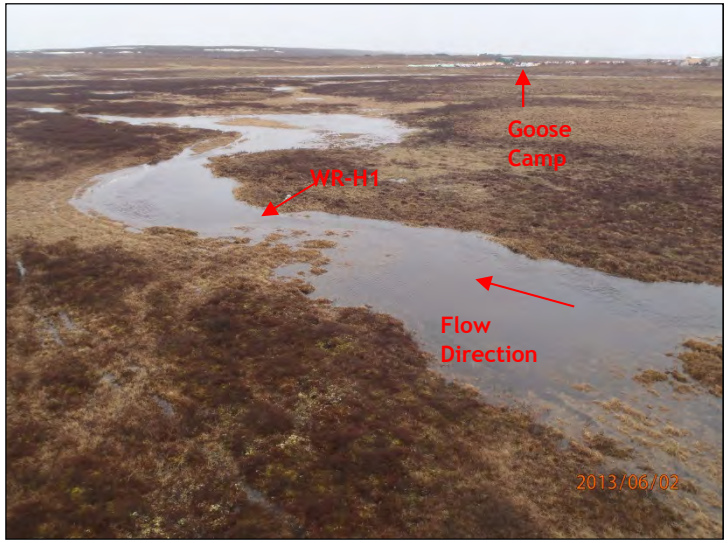


Site Map



Plan View of Hydrometric Station WR-H1

General Site Information



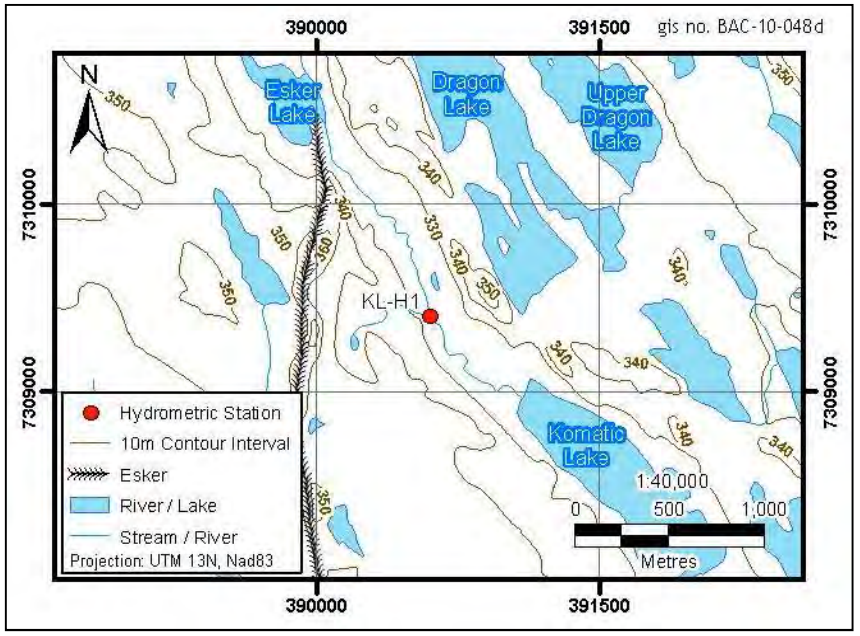
High angle oblique view of the monitored reach under high flow conditions. There is significant flow through neighbouring grasses on this date. June 2, 2013.

Site Photo

Appendix 1.14. Station Information Sheet for Hydrometric Station KL-H1

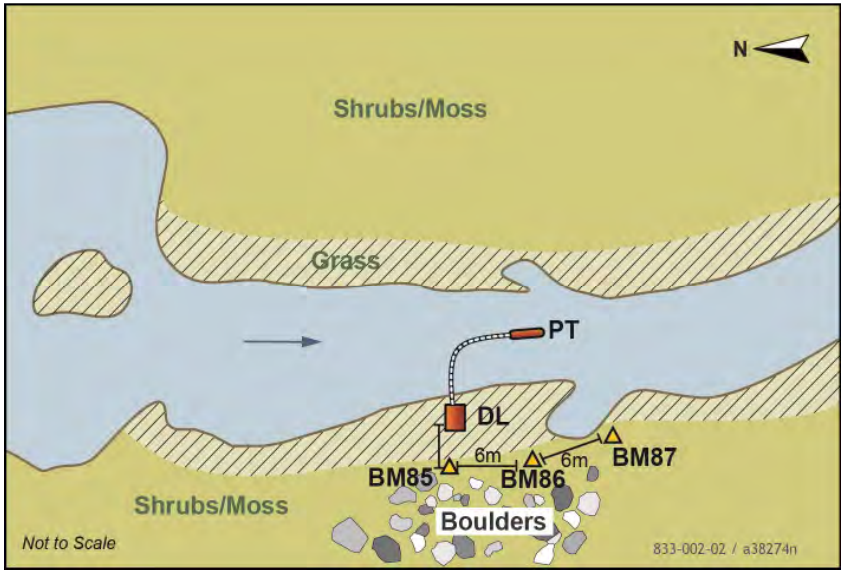
Site ID:	KL-H1	**Drainage Area (km²):**	24.2
Site Location:	On the Channel between Esker Pond and Komatic Lake		
UTM:	NAD 83, Zone 13W	390,592E	7,309,400N
Benchmarks	**Elevation (m)**	**Description**	
BM 85	100.000	Bolt in rock 5m behind station	
BM 86	100.126	Bolt in rock 6m downstream of station	
BM 87	99.627	Bolt in rock 6m downstream of BM 86	
Transducer:	PT-2X	**Logger:**	Self-contained
Operating Period:			
2012	June 10 – Sep 12	Established on June 10, 2012	
2013	June 4 – Sep 17		
General Comments:			

- Narrow, deep channel with swift flows at high water.
- Can be waded under all conditions.
- Pool-riffle morphology with large, deep pool downstream of station.
- Access by helicopter.

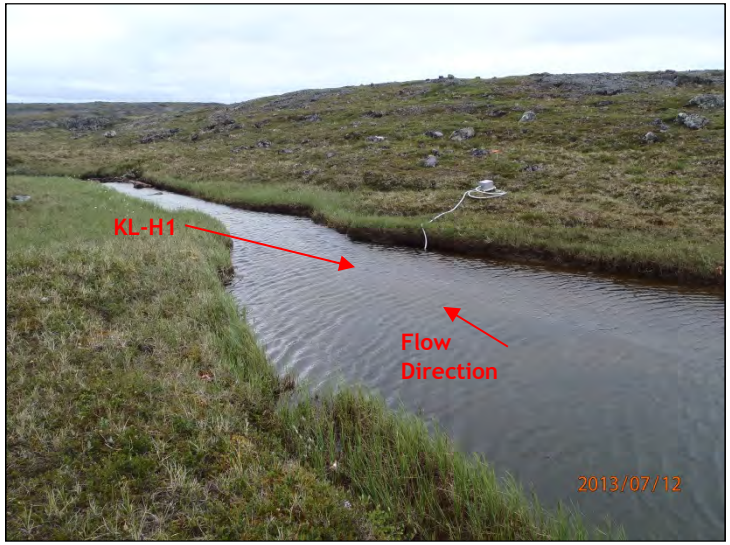


Site Map

General Site Information



Plan View of Hydrometric Station KL-H1



Low angle view looking downstream at the channel section under low flow conditions. The station is shown on the right bank. July 7, 2013.

Site Photo

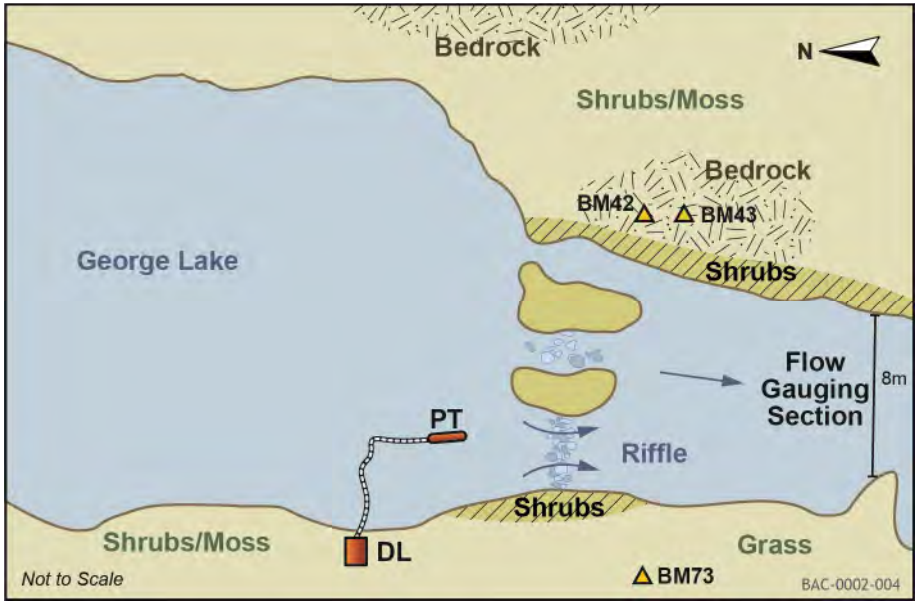
Appendix 1.15. Station Information Sheet for Hydrometric Station KL-H2

Site ID:	KL-H2	**Drainage Area (km²):**	9.8
Site Location:	George Lake outflow		
UTM:	NAD 83, Zone 13W	386,687E	7,314,673N
Benchmarks	**Elevation (m)**	**Description**	
BM 73	100.000	Bolt in rock 15m downstream of station	
BM 42	100.617	Bolt in bedrock on left bank	
BM 43	100.460	Bolt in bedrock on left bank	
Transducer:	PT-2X	**Logger:**	Self-contained
Operating Period:			
2012	June 10 – Sep 12	Established on June 10, 2012	
2013	June 11 – Sep 14	Installed BMs 42 and 43	

General Comments:

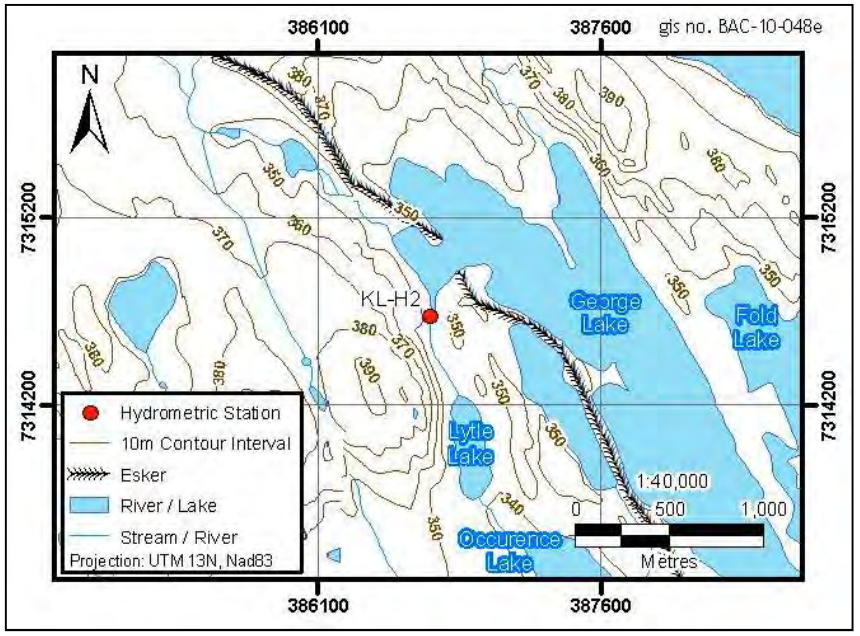
- Transducer installed in lake with flow gauging section immediately downstream of outlet.
- Can be waded under all conditions.
- Cobble bed with water flowing mainly deep in loose cobbles at low water
- Access by helicopter

General Site Information

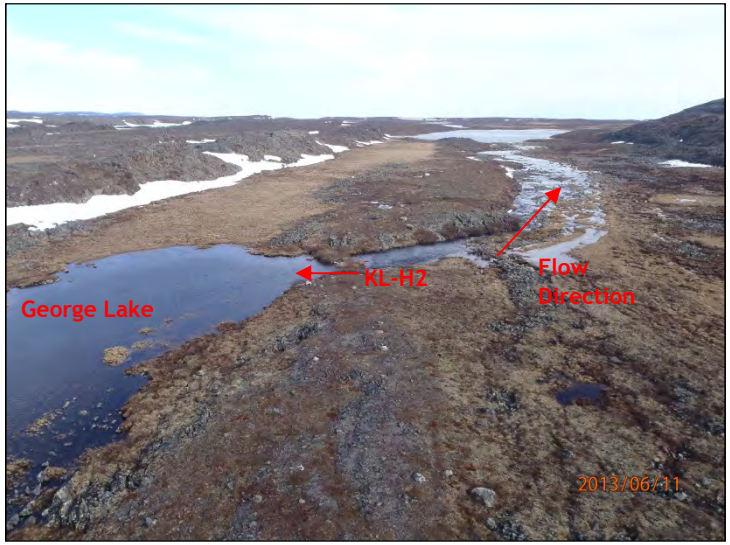


Plan View of Hydrometric Station KL-H2

Site Map



Site Photo

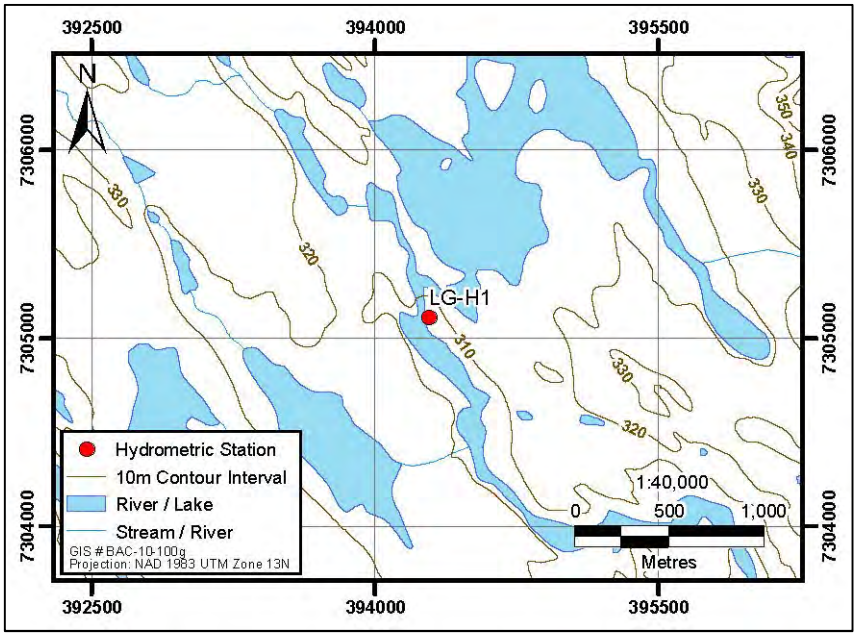


High angle oblique view looking downstream (south) of the outlet of George Lake and KL-H2. The station is indicated on the right bank.

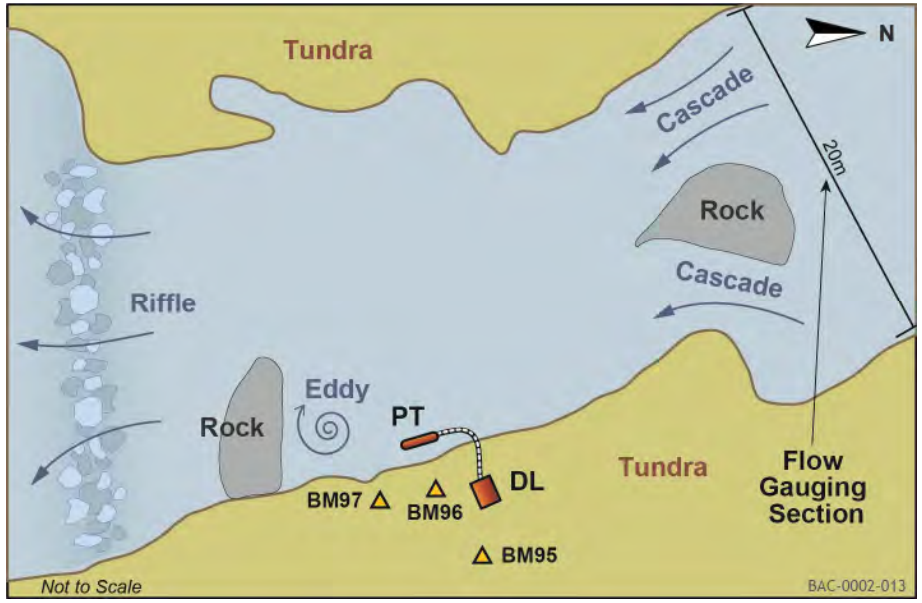
Appendix 1.16. Station Information Sheet for Hydrometric Station LG-H1

Site ID:	LG-H1	**Drainage Area (km²):**	271.3
Site Location:	Long Lake outflow		
UTM:	NAD 83, Zone 13W	394,281E	7,305,112N
Benchmarks	**Elevation (m)**	**Description**	
BM 95	100.000	Bolt in bedrock near the station	
BM 96	99.677	Bolt in bedrock on left bank	
BM 97	99.758	Bolt in bedrock on left bank	
Transducer:	PT-2X	**Logger:**	Self-contained
Operating Period:			
2013	June 11 – Sep 9	Station installed June 11, 2013	
General Comments:			

- Wide, high energy channel with cascade upstream.
- Can be waded under most conditions. At peak flows, can be waded above US cascade or a DS. May not be possible to wade at highest flows.
- Cobble bed with bedrock banks and wide boulder fan DS of station.
- Access by helicopter



Site Map



Plan View of Hydrometric Station LG-H1

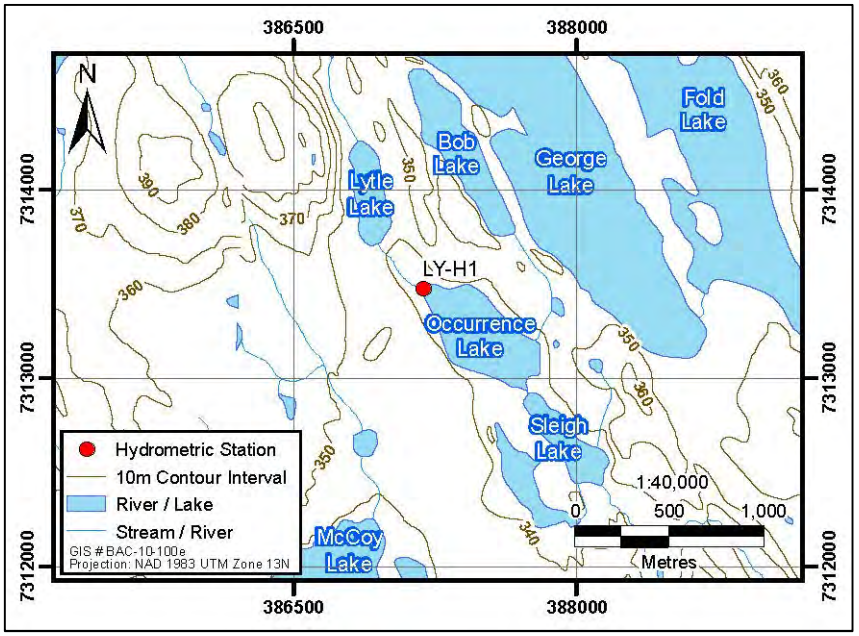
High angle oblique view looking upstream at the station under high flow conditions. June 13, 2013.

Site Photo

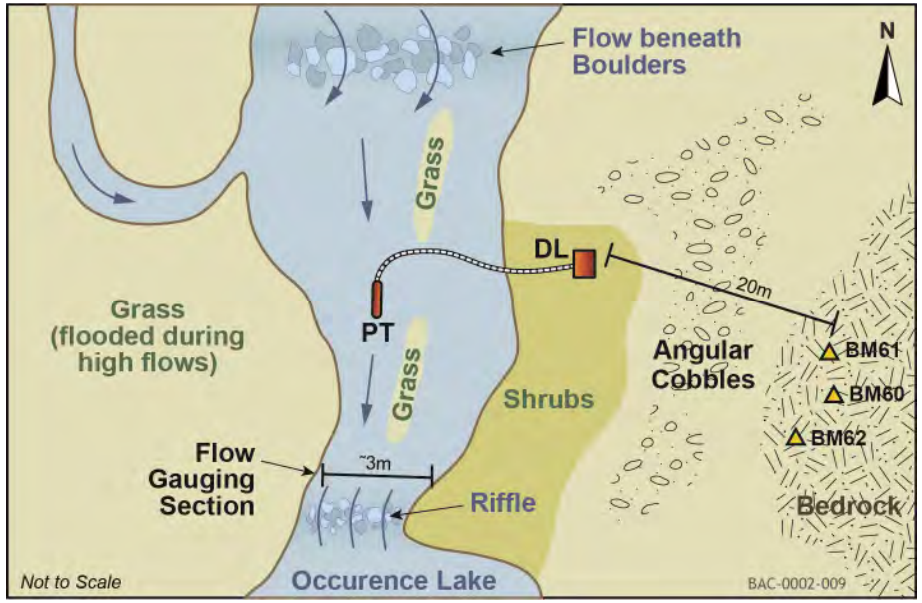
Appendix 1.17. Station Information Sheet for Hydrometric Station LY-H1

Site ID:	LY-H1	**Drainage Area (km²):**	10.6
Site Location:	Lytle Lake outflow		
UTM:	NAD 83, Zone 13W	387,183E	7,313,489N
Benchmarks	**Elevation (m)**	**Description**	
BM 60	100.000	Bolt in bedrock 20m E of the station	
BM 61	99.850	Bolt in bedrock 1m N of BM 60	
BM 62	99.941	Bolt in bedrock 1m S of BM 60	
Transducer:	PT-2X	**Logger:**	Self-contained
Operating Period:			
2013	June 10 – Sep 14	Station installed June 10, 2013	
General Comments:			

- Low velocity stream with significant flow through grass.
- Can be waded under all conditions.
- Angular cobble bed with significant subsurface flow upstream.
- Access by helicopter

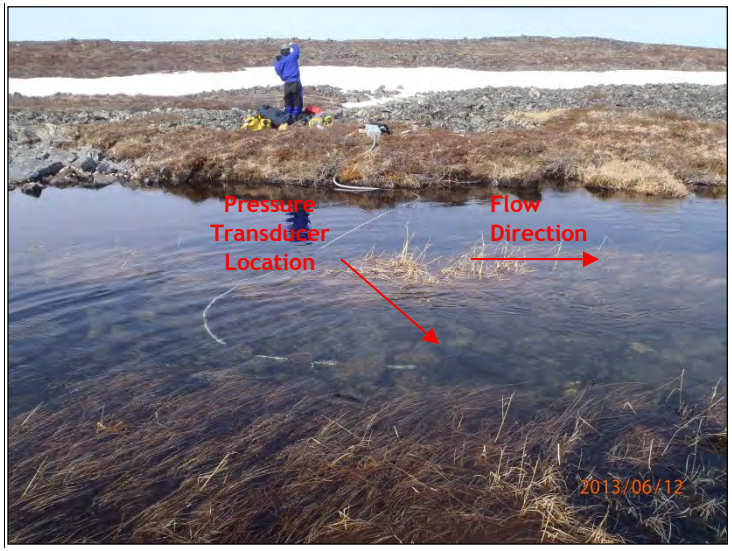


Site Map



Plan View of Hydrometric Station LY-H1

General Site Information



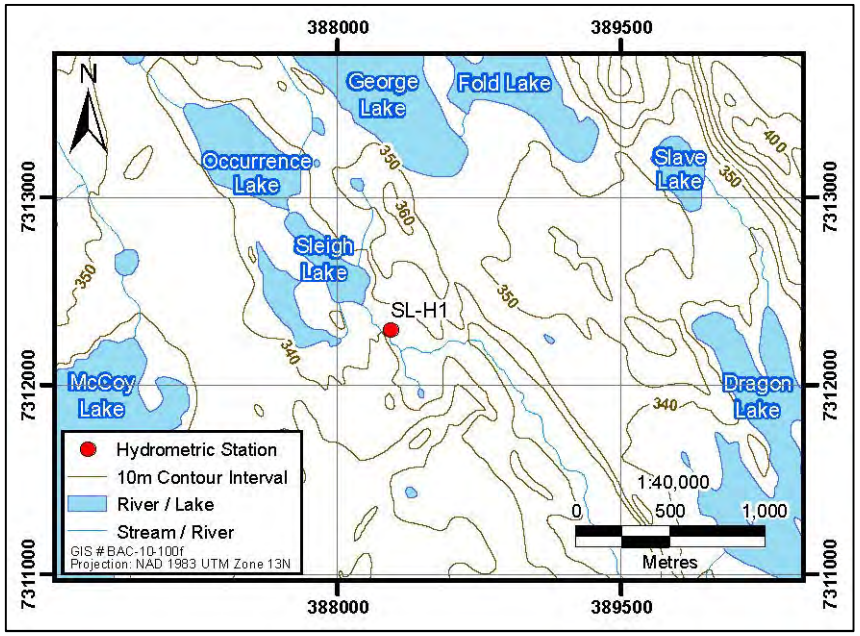
Low angle view looking across the channel from the right bank under high flow conditions. Note the large amount of grass under the flowing water. June 12, 2013.

Site Photo

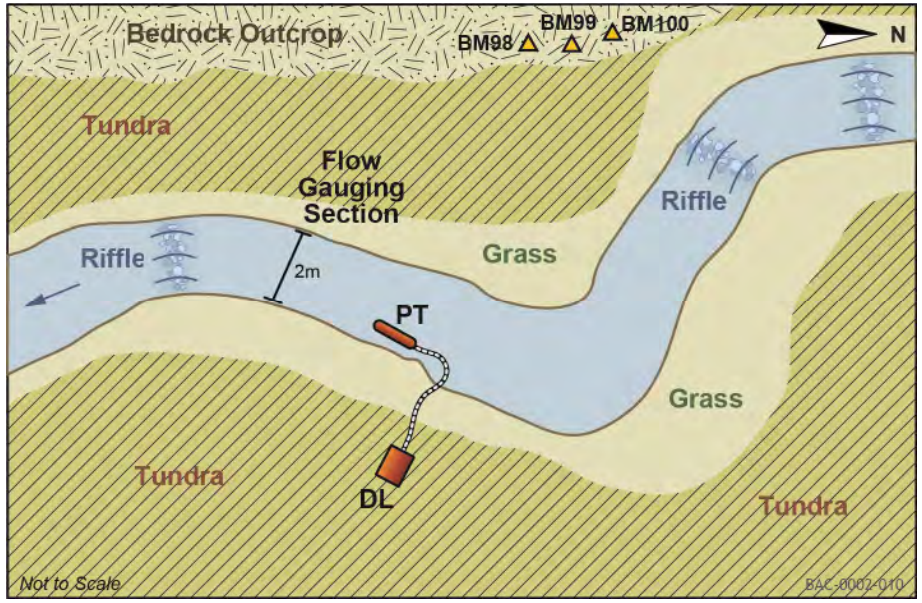
Appendix 1.18. Station Information Sheet for Hydrometric Station SL-H1

Site ID:	SL-H1	**Drainage Area (km²):**	13.0
Site Location:	Sleigh Lake outflow		
UTM:	NAD 83, Zone 13W	388,274E	7,312,296N
Benchmarks	**Elevation (m)**	**Description**	
BM 98	100.000	Bolt in bedrock 30m W of the station	
BM 99	99.915	Bolt in bedrock 2m N of BM 98	
BM 100	100.030	Bolt in bedrock 4m N of BM 98	
Transducer:	PT-2X	**Logger:**	Self-contained
Operating Period:			
2013	June 9 – Sep 17	Station installed June 9, 2013	
General Comments:			

- Narrow, relatively deep channel with swift flows at high water.
- Can be waded under all conditions.
- Pool-riffle morphology with long riffle section 40m US of station.
- Access by helicopter

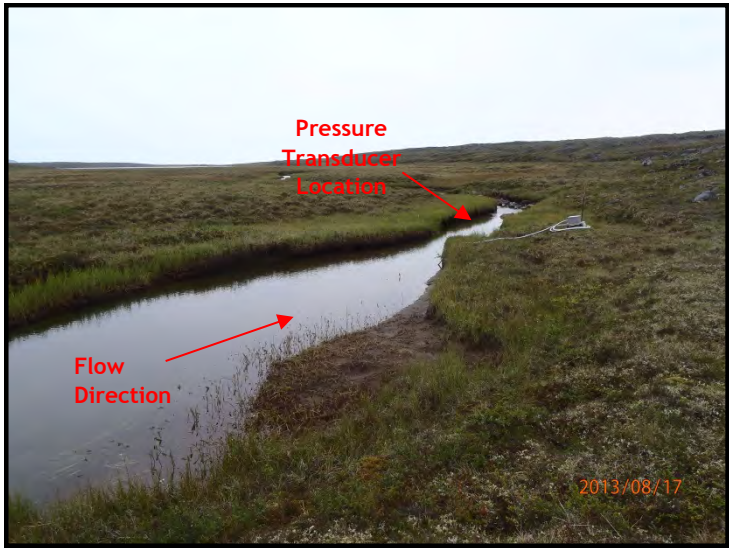


Site Map



General Site Information

Plan View of Hydrometric Station SL-H1



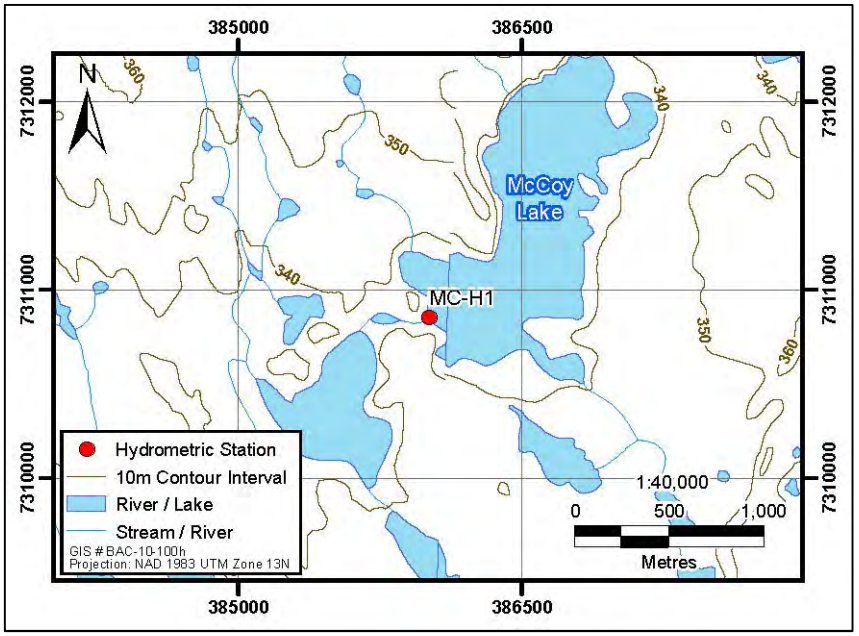
Low angle view looking downstream at the monitored reach under low flow conditions. The station can be seen on the right bank. August 17, 2013.

Site Photo

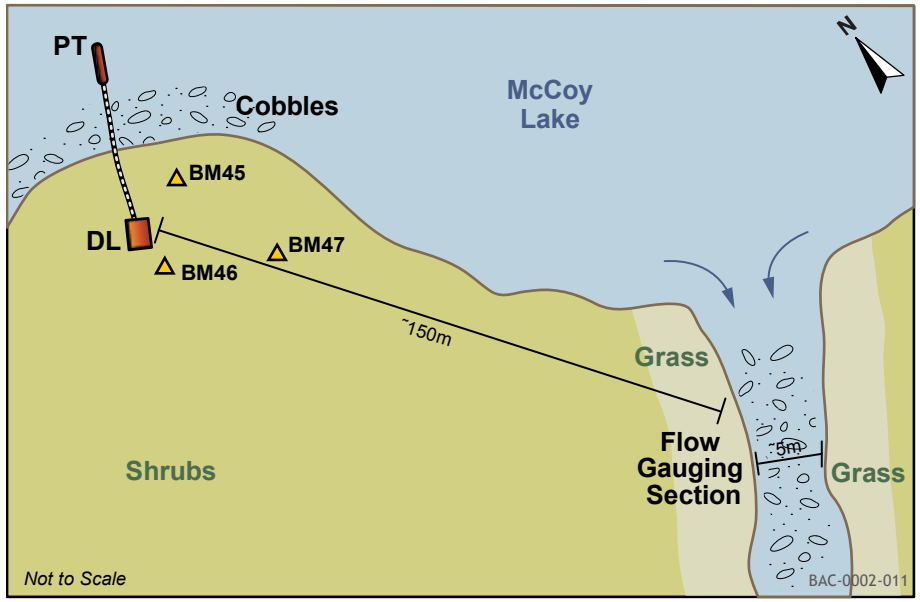
Appendix 1.19. Station Information Sheet for Hydrometric Station MC-H1

Site ID:	MC-H1	**Drainage Area (km²):**	10.6
Site Location:	McCoy Lake Outflow		
UTM:	NAD 83, Zone 13W	385,983E	7,310,949N
Benchmarks	**Elevation (m)**	**Description**	
BM 45	100.000	Bolt in rock 3m N of the station	
BM 46	99.859	Bolt in rock 1m S of station	
BM 47	99.319	Bolt in rock 5m W of station	
Transducer:	PT-2X	**Logger:**	Self-contained
Operating Period:			
2013	June 13 – Sep 14	Station installed June 13, 2013	
General Comments:			

- Station located in McCoy with discharge on nearby outflow channel.
- Wadeable under all conditions.
- Outflow channel is wide an boulder with many grass islands.
- Access by helicopter



Site Map



General Site Information

Plan View of Hydrometric Station MC-H1

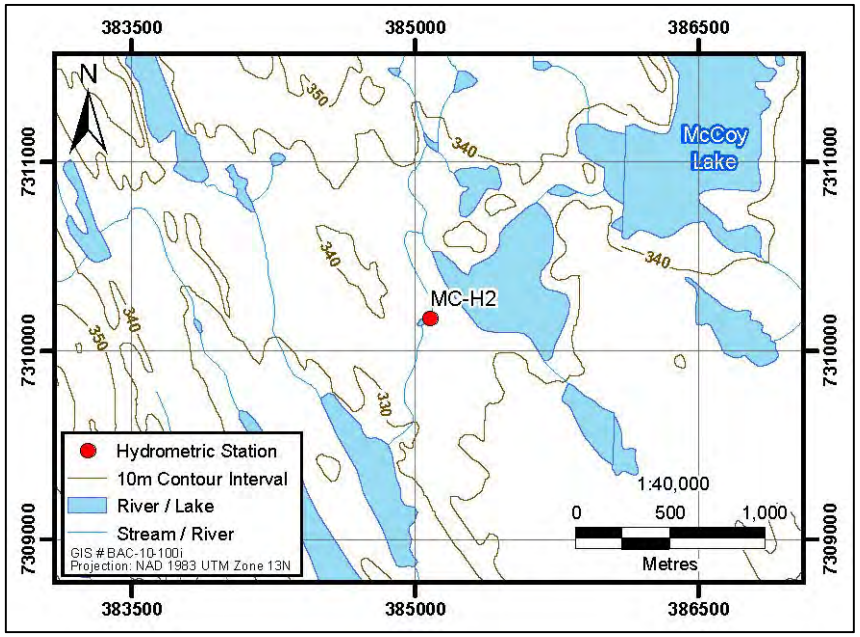
View of McCoy Lake looking E towards the outflow channel. June 12, 2013.

Site Photo

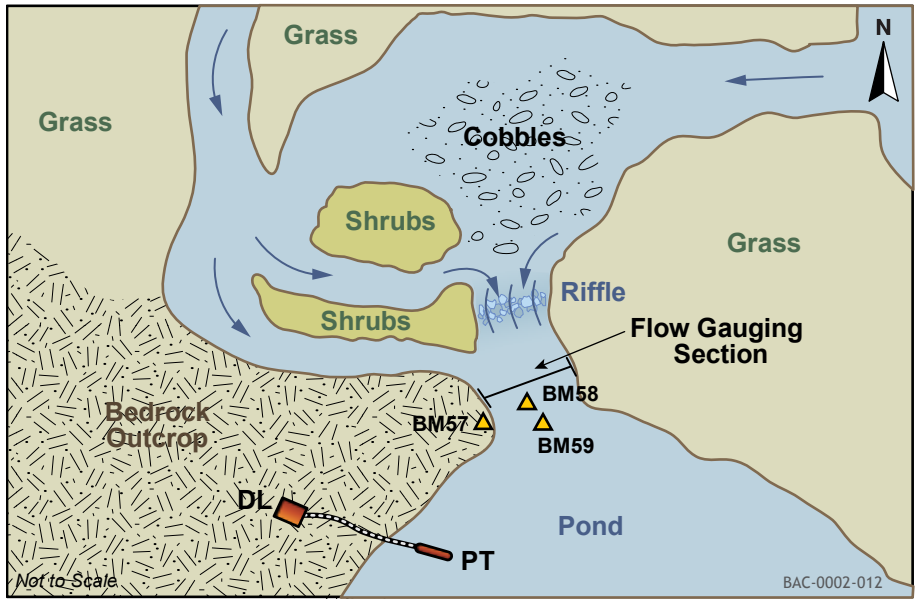
Appendix 1.20. Station Information Sheet for Hydrometric Station MC-H2

Site ID:	MC-H2	**Drainage Area (km²):**	10.6
Site Location:	McCoy watershed outflow		
UTM:	NAD 83, Zone 13W	385,076E	7,310,203N
Benchmarks	**Elevation (m)**	**Description**	
BM 57	100.000	Bolt in bedrock 20m N of the station	
BM 58	99.958	Bolt in rock mid-channel	
BM 59	100.019	Bolt in rock mid-channel	
Transducer:	PT-2X	**Logger:**	Self-contained
Operating Period:			
2013	June 9 – Sep 17	Station installed June 9, 2013	
General Comments:			

- Wide, braided stream with significant subsurface flow upstream and downstream of the station; difficult flow measurement conditions.
- Can be waded under all conditions.
- Station installed in small pond.
- Access by helicopter .

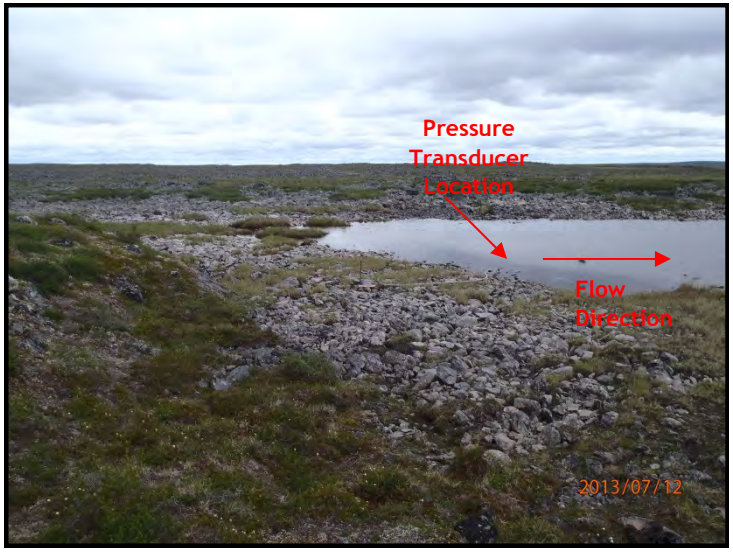


Site Map



General Site Information

Plan View of Hydrometric Station MC-H2



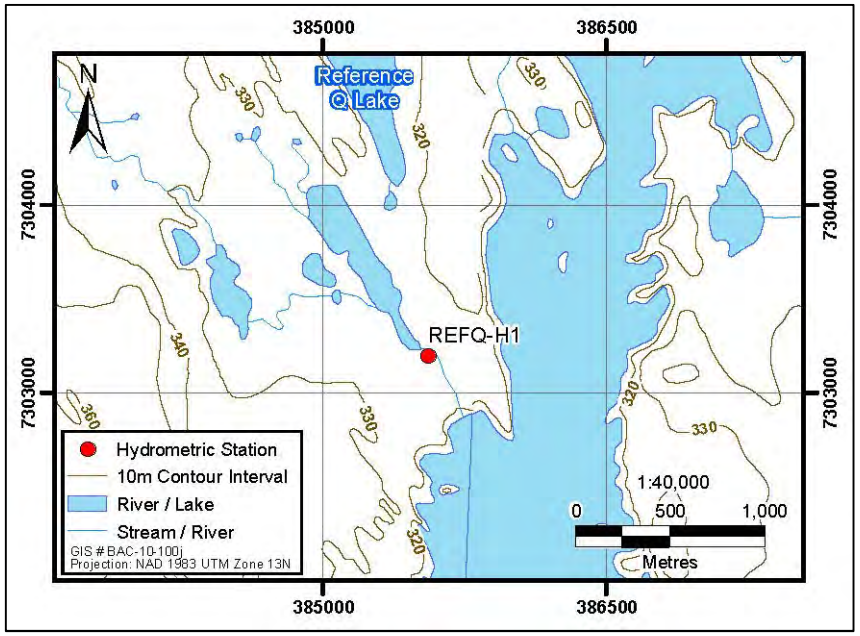
Low angle view looking at the station under mid-flow conditions. The pond in which the transducer is located is fed by subsurface flow in the summer months. July 12, 2013.

Site Photo

Appendix 1.21. Station Information Sheet for Hydrometric Station REFQ-H1

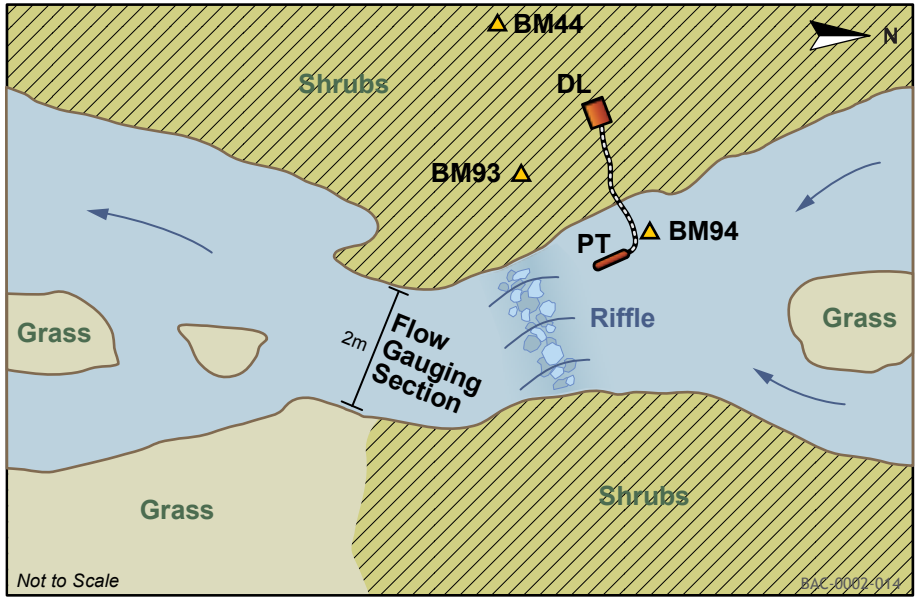
Site ID:	REFQ-H1	**Drainage Area (km^2):**	14.7
Site Location:	Reference Q Lake outflow		
UTM:	NAD 83, Zone 13W	385,552E	7,303,202N
Benchmarks	**Elevation (m)**	**Description**	
BM 44	100.000	Bolt in rock 30m W of station	
BM 93	99.425	Bolt in rock 5m SW of station	
BM 94	99.124	Bolt in rock near PT location	
Transducer:	PS98i	**Logger:**	ELF-2
Operating Period:			
2013	June 12 – Sep 17	Station installed June 12, 2013	
General Comments:			

- Narrow and shallow channel with cobble bed. Braided upstream and downstream of the station.
- Wadeable under all conditions.
- Station installed in small pool upstream of riffle.
- Access by helicopter



Site Map

General Site Information



Plan View of Hydrometric Station REFQ-H1

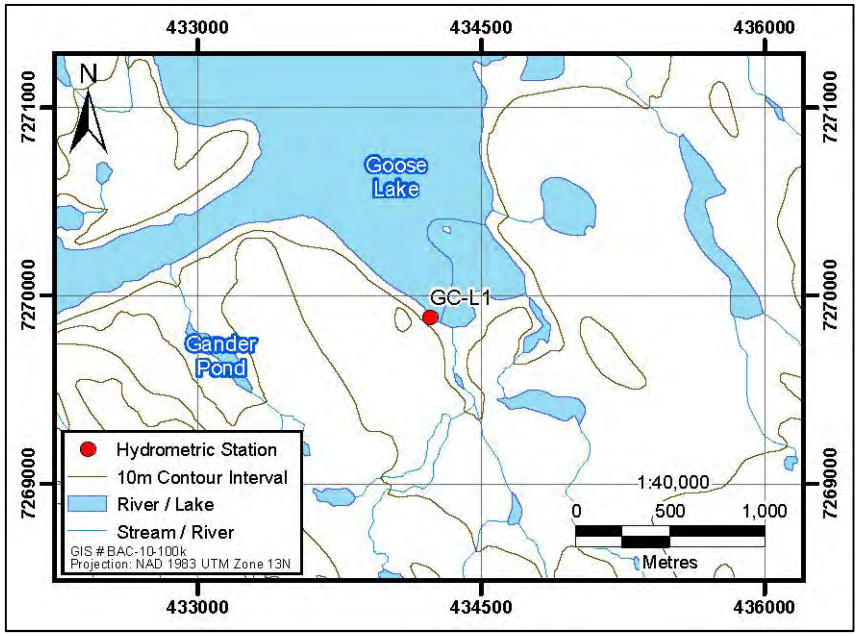
Low angle view looking downstream at the station under high flow conditions. The flow gauging section can be seen in the background. June 12, 2013.

Site Photo

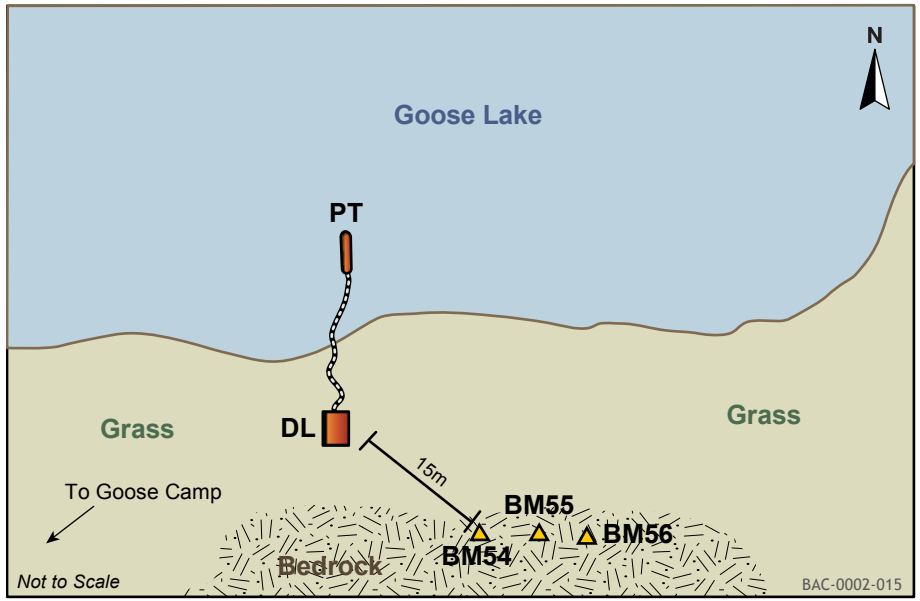
Appendix 1.22. Station Information Sheet for Hydrometric Station GC-L1

Site ID:	GC-L1	**Drainage Area (km²):**	N/A
Site Location:	In Goose Lake near Goose Camp		
UTM:	NAD 83, Zone 13W	434,227E	7,269,886N
Benchmarks	**Elevation (m)**	**Description**	
BM 54	100.000	Bolt in bedrock outcrop 15m from station	
BM 55	99.551	Bolt in bedrock outcrop 17m from station	
BM 56	99.518	Bolt in bedrock outcrop 18m from station	
Transducer:	PT2X	**Logger:**	Self-contained
Operating Period:			
2013	June 7 – Oct 4	Established on June 7, 2013	
General Comments:			

- Lake level monitoring station near Goose Camp.
- Under strong North winds, large waves observed near the PT.
- Cobble lake bed at station location.
- Access by foot from Goose Camp.

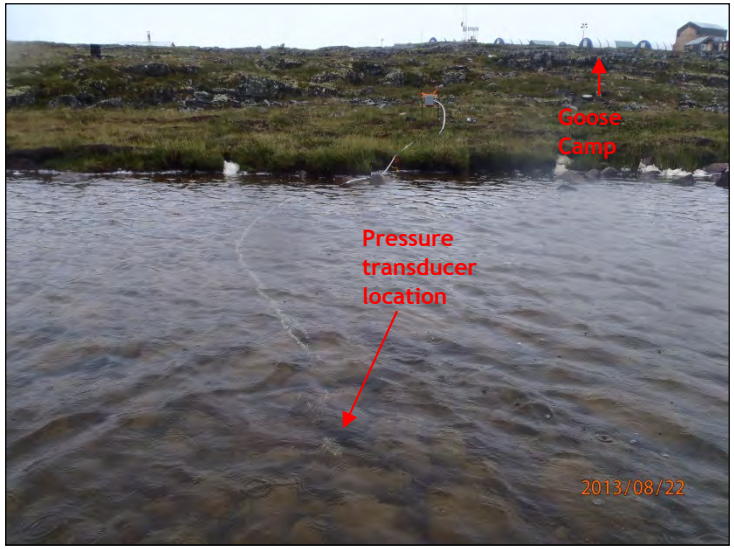


Site Map



General Site Information

Plan View of Hydrometric Station GC-L1



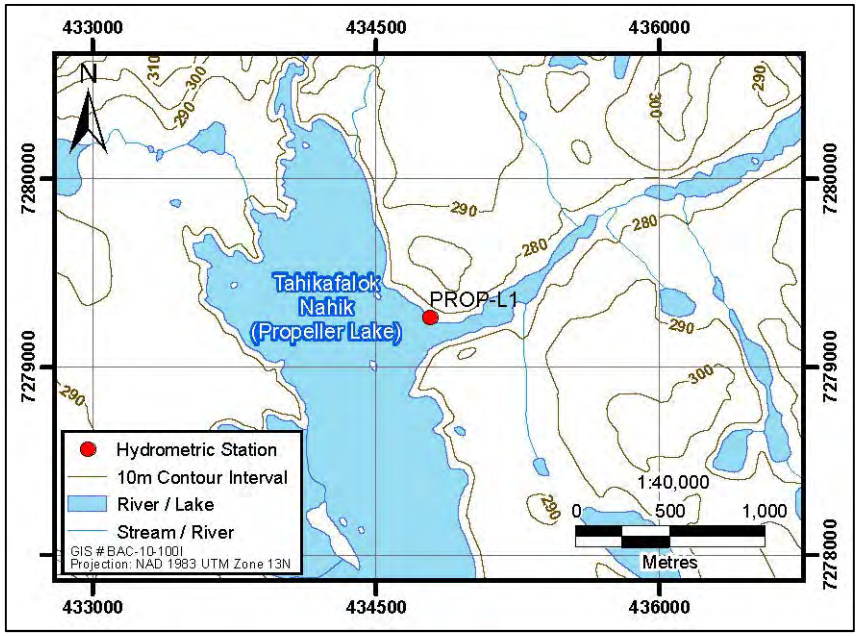
View of the lake level monitoring station looking towards Goose Camp. August 22, 2013.

Site Photo

Appendix 1.23. Station Information Sheet for Hydrometric Station PROP-L1

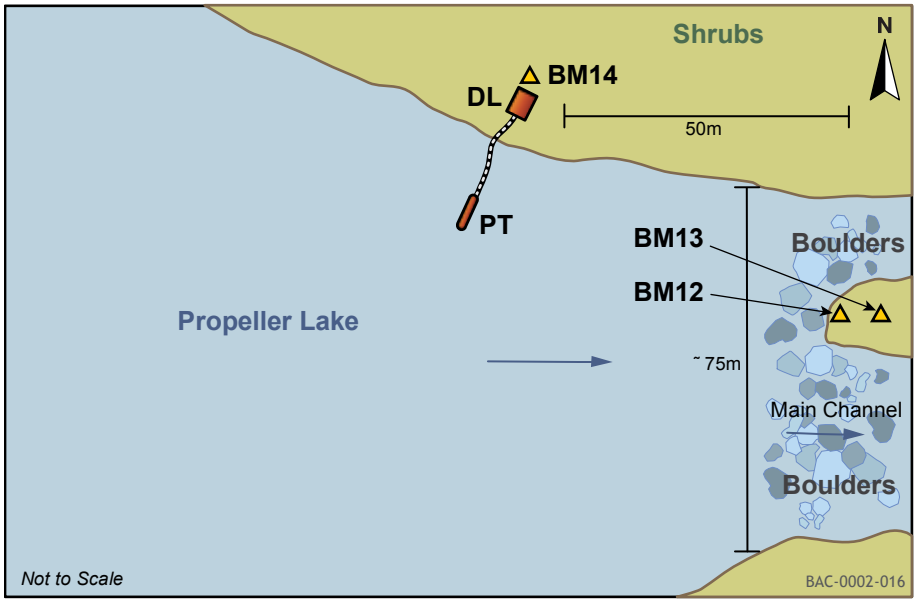
Site ID:	PROP-L1	**Drainage Area (km²):**	N/A
Site Location:	In Propeller Lake near the outflow		
UTM:	NAD 83, Zone 13W	434,782E	7,279,265N
Benchmarks	**Elevation (m)**	**Description**	
BM 12	100.000	Painted rock at lake outlet	
BM 13	100.121	Painted rock at lake outlet	
BM 14	100.460	Station rebar	
Transducer:	PT2X	**Logger:**	Self-contained
Operating Period:			
2013	Sep 9 - Oct 4	Established on Sep 9, 2013	
General Comments:			

- Lake level monitoring station near in Propeller Lake.
- Propeller Lake is very shallow near the outlet
- Cobble lake bed at station location
- Access by helicopter

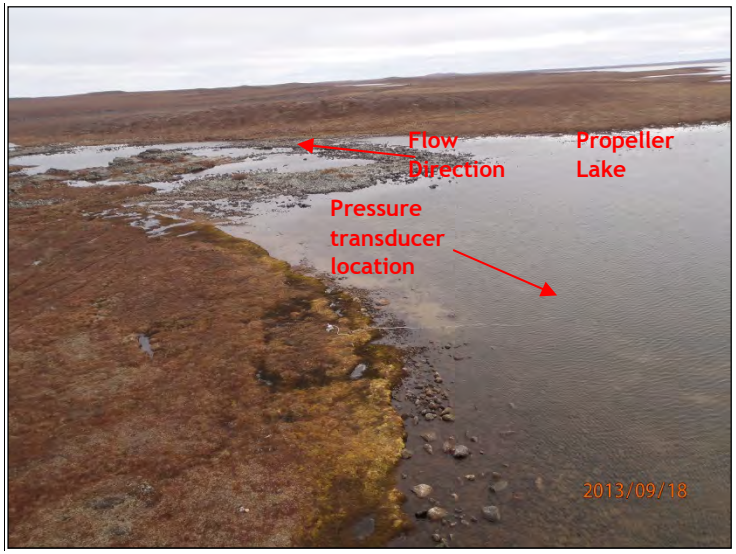


Site Map

General Site Information



Plan View of Hydrometric Station PROP-L1

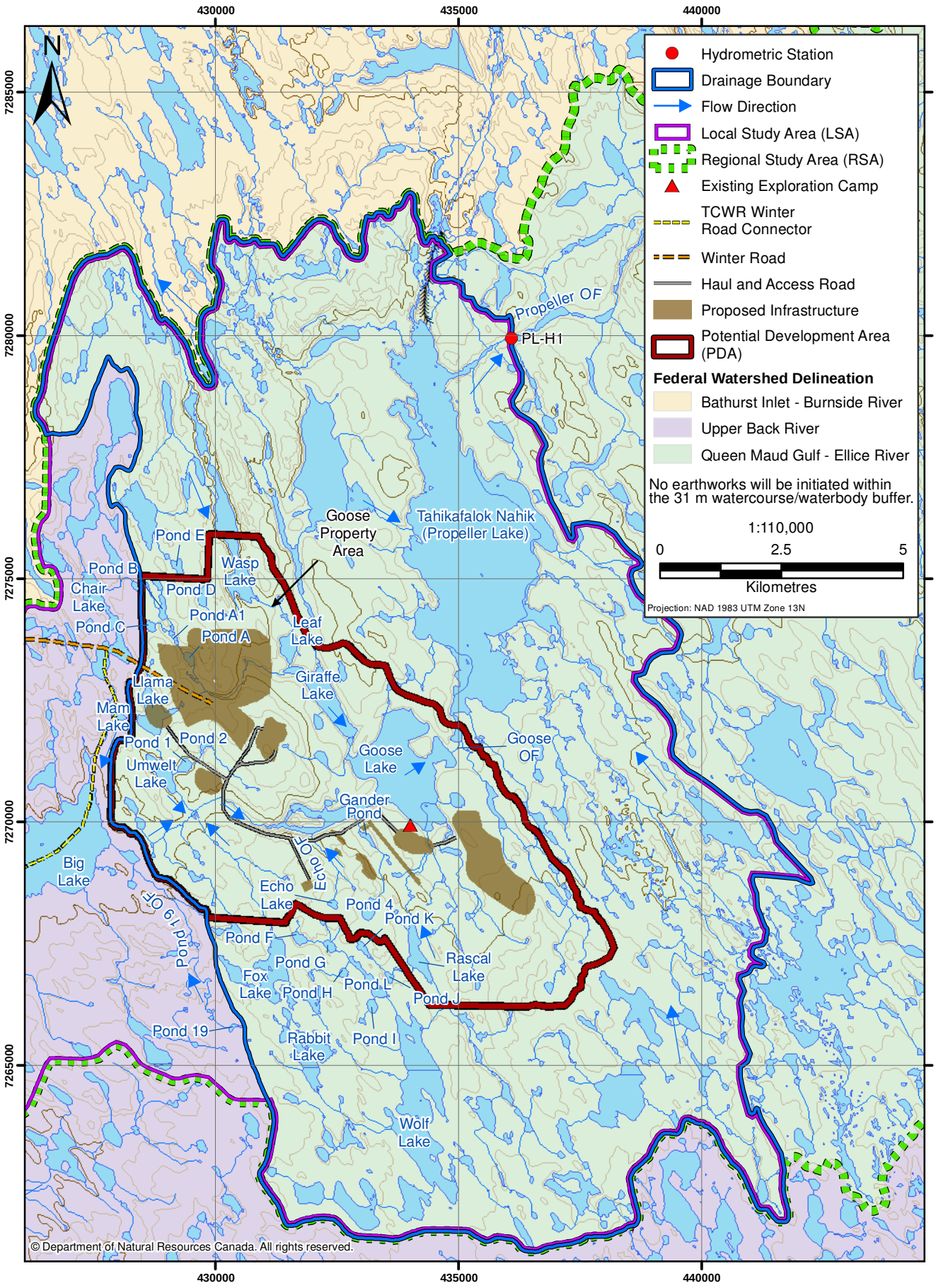


High angle oblique view of the monitored station looking towards the lake outlet. September 18, 2013.

Site Photo

Appendix 2
Drainage Area Maps

Rescan™
an ERM company

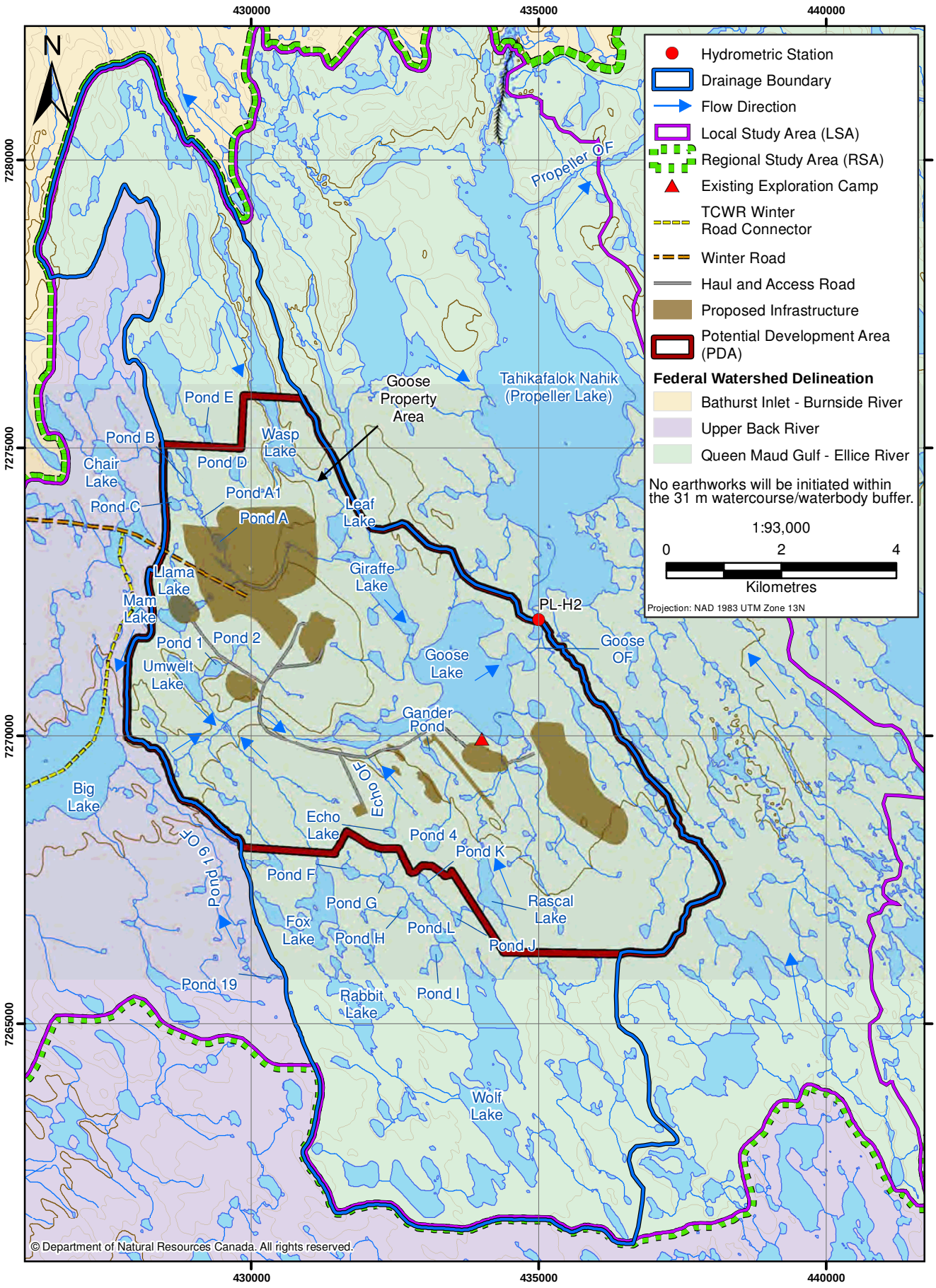


Sabina GOLD & SILVER CORP

Drainage Boundary for PL-H1 Hydrometric Monitoring Station

Figure A2-1

Rescan an ERM company

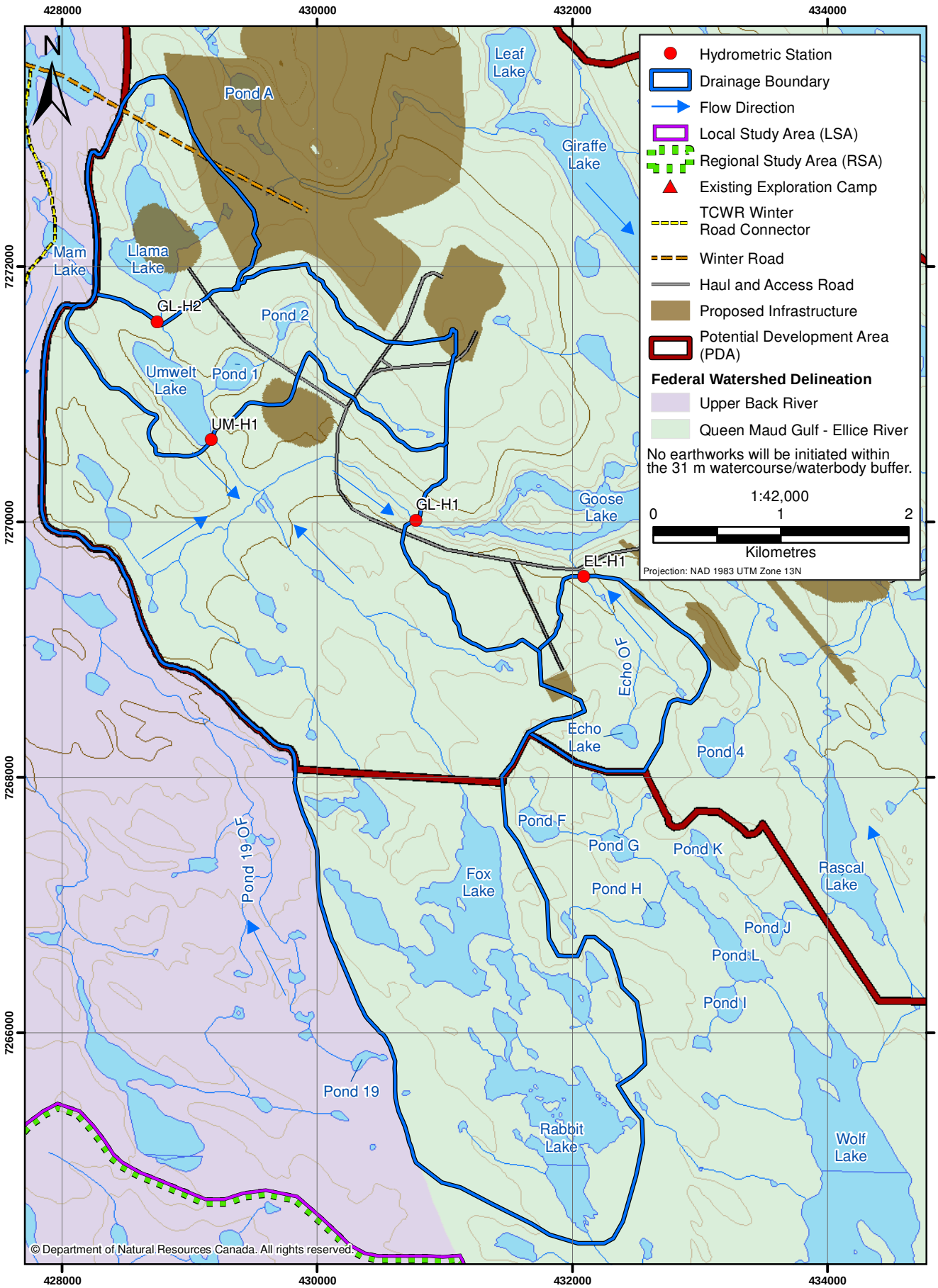


Drainage Boundary for PL-H2 Hydrometric Monitoring Station

Figure A2-2

Sabina GOLD & SILVER CORP.

Rescan an ERM company

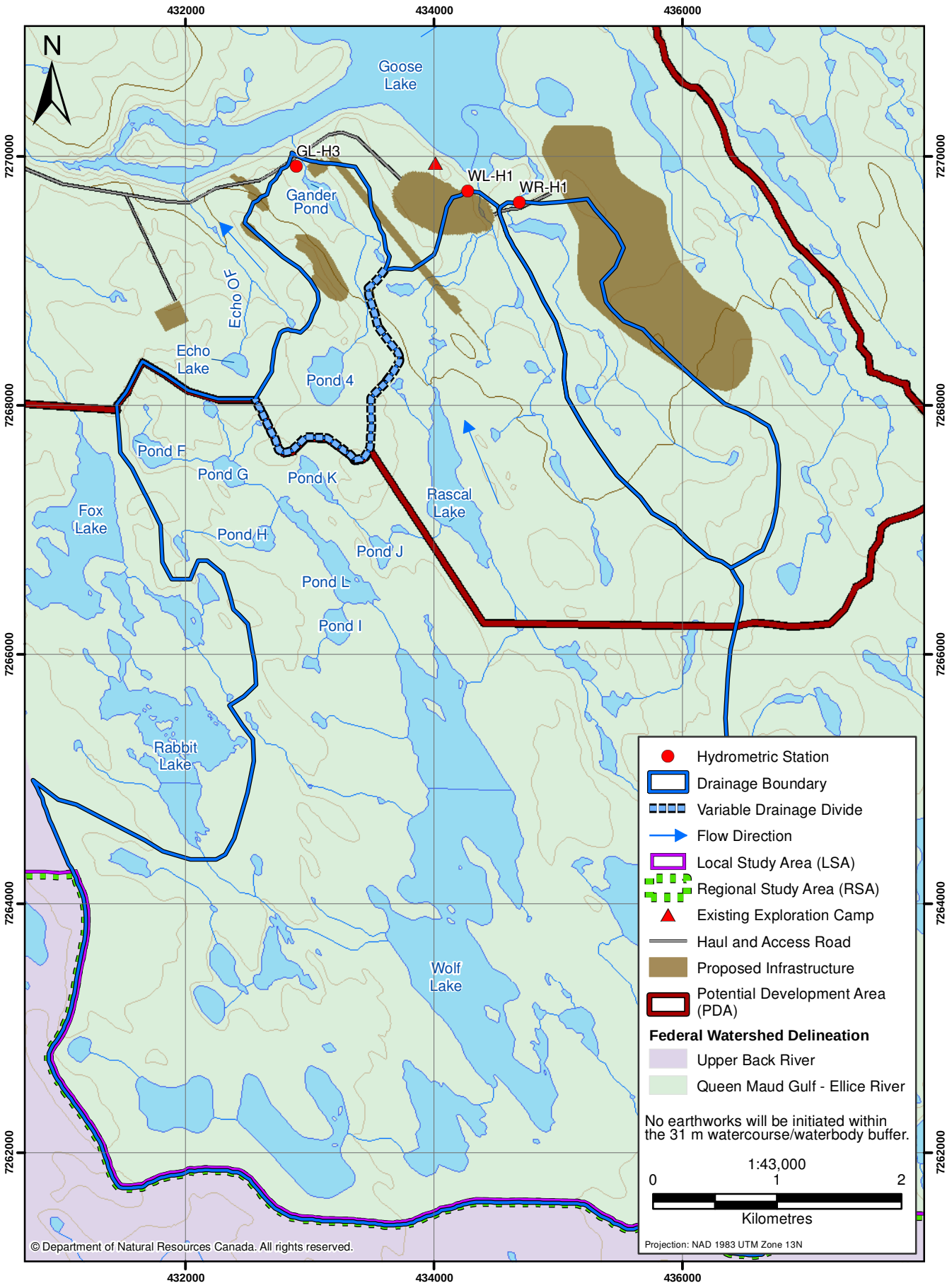


Sabina GOLD & SILVER CORP.

Drainage Boundaries for GL-H1, GL-H2, EL-H1 and UM-H1 Hydrometric Monitoring Stations

Figure A2-3

Rescan an ERM company

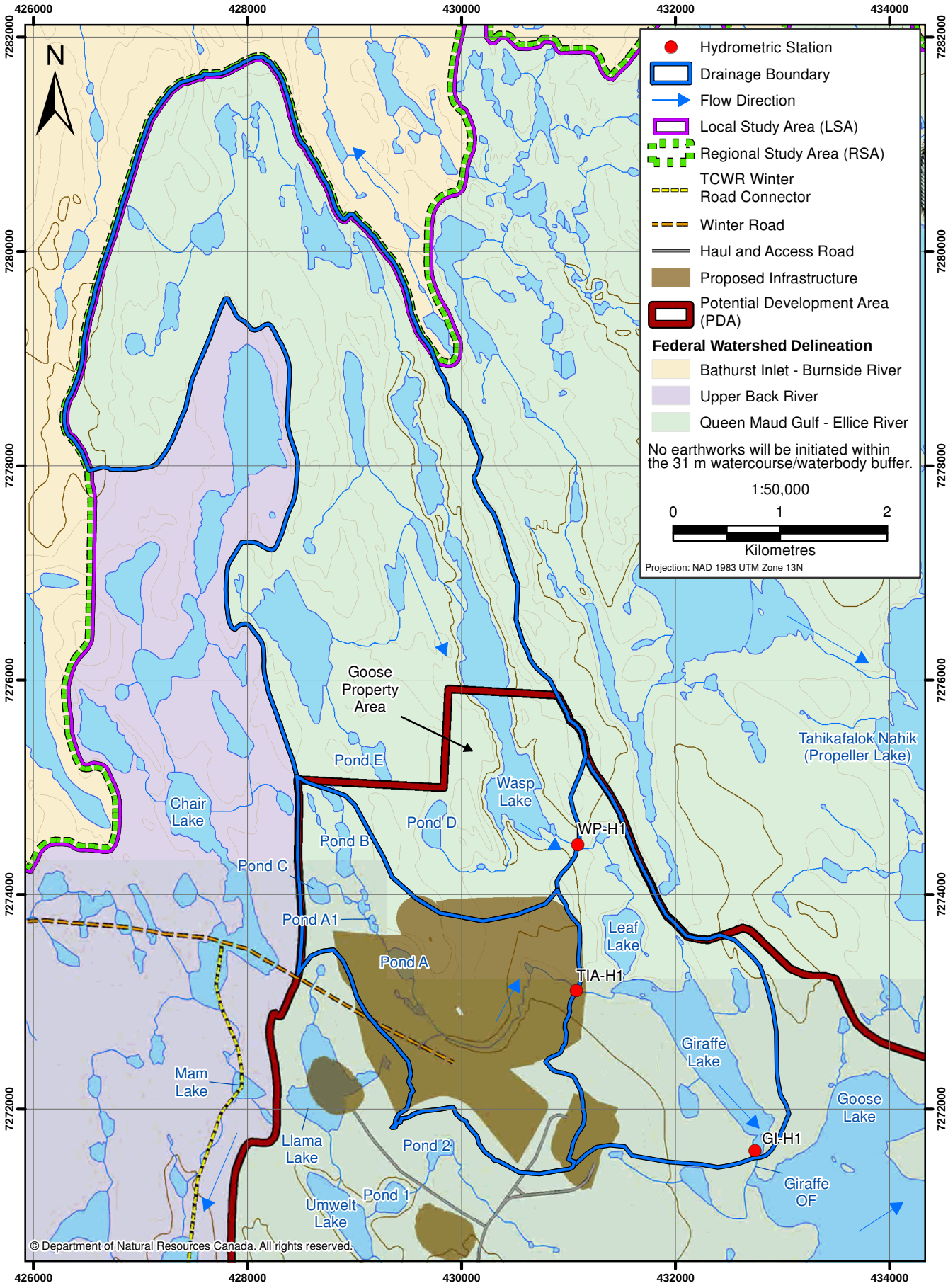


Sabina GOLD & SILVER CORP.

Drainage Boundaries for GL-H3, WL-H1 and WR-H1 Hydrometric Monitoring Stations

Figure A2-4

Rescan an ERM company

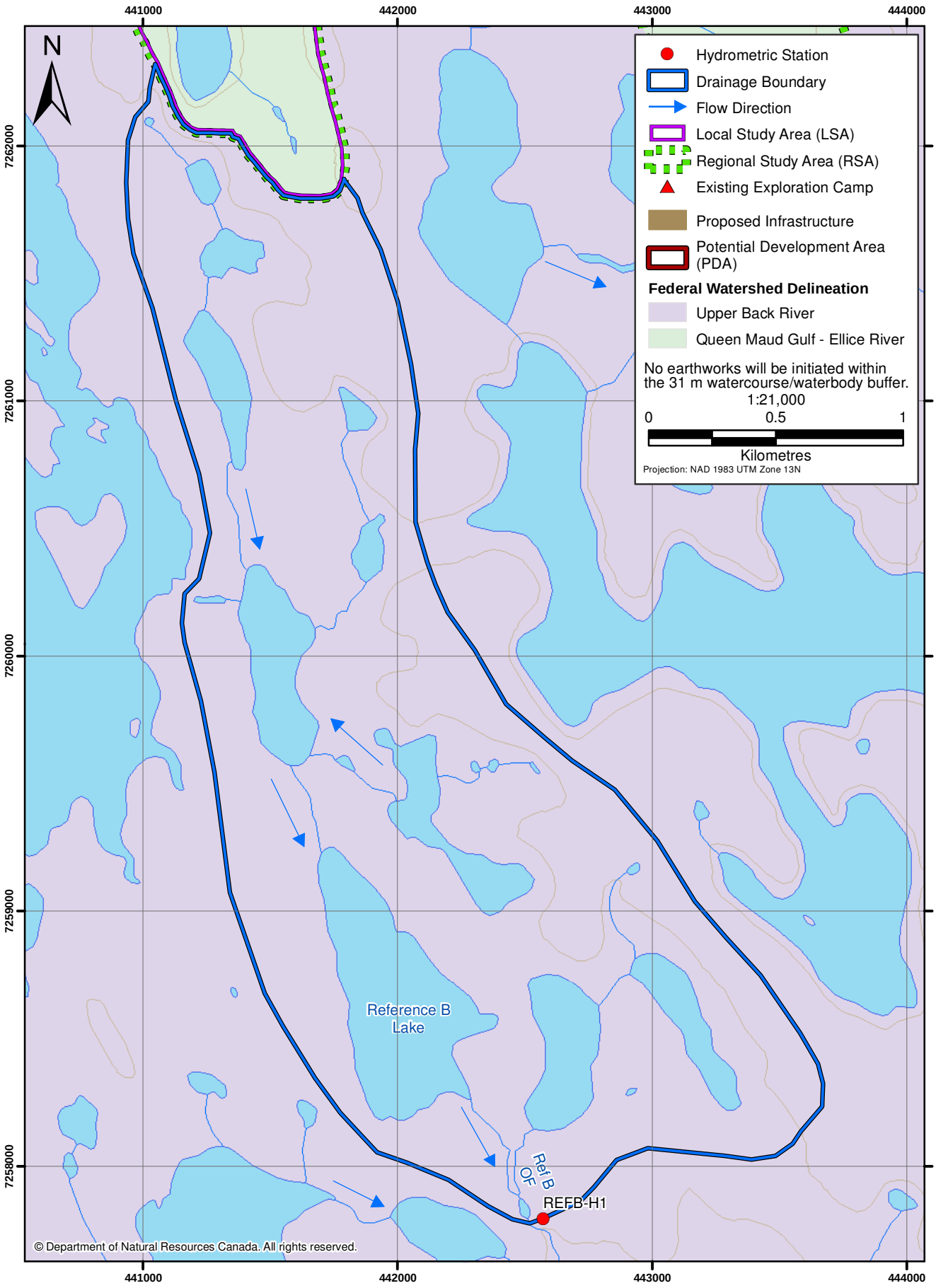


Sabina

Drainage Boundaries for GI-H1, WP-H1 and TIA-H1 Hydrometric Monitoring Stations

Figure A2-5

Rescan an ERM company

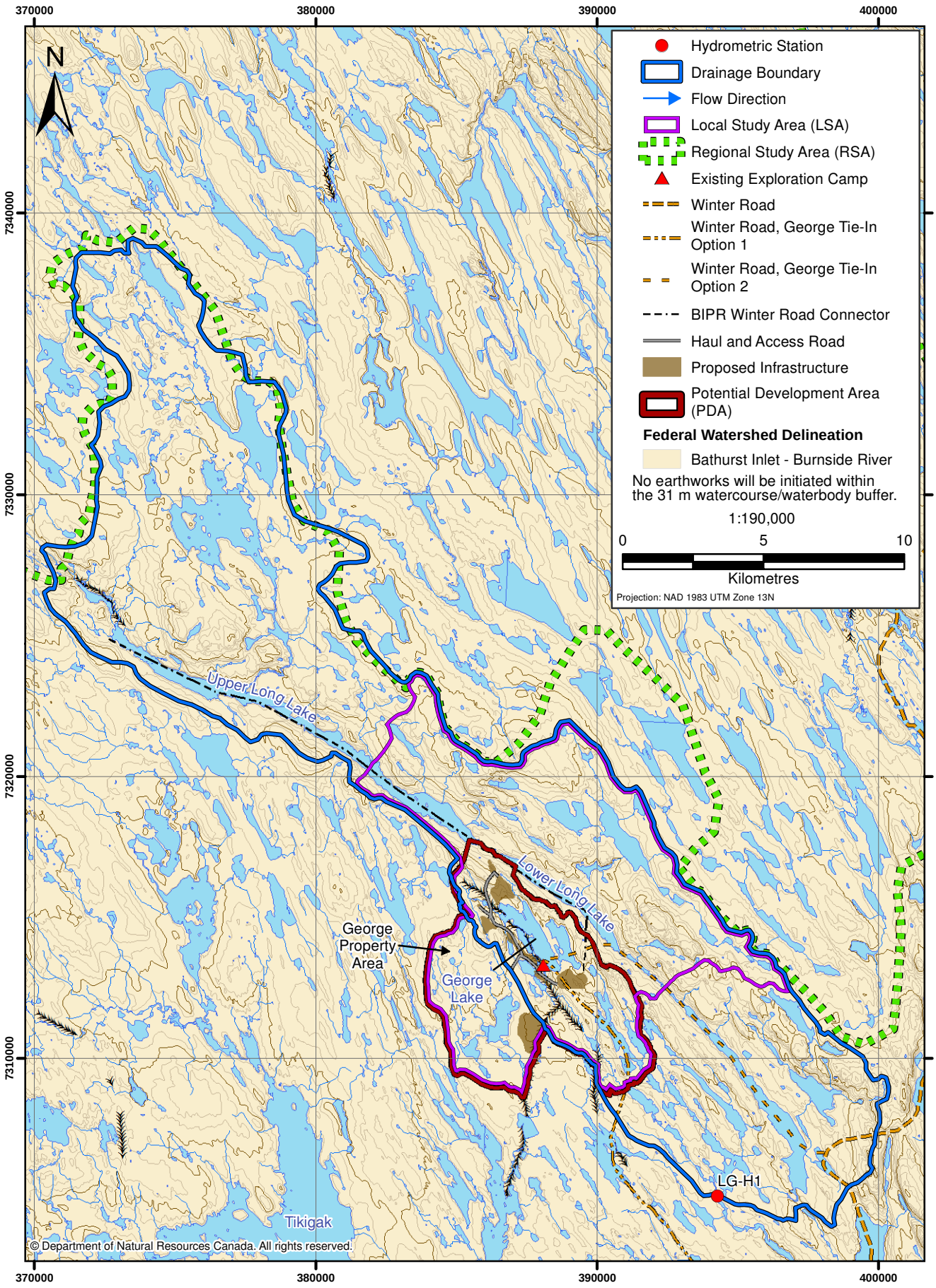


Sabina GOLD & SILVER CORP.

Drainage Boundary for REFB-H1 Hydrometric Monitoring Station

Figure A2-6

Rescan an ERM company

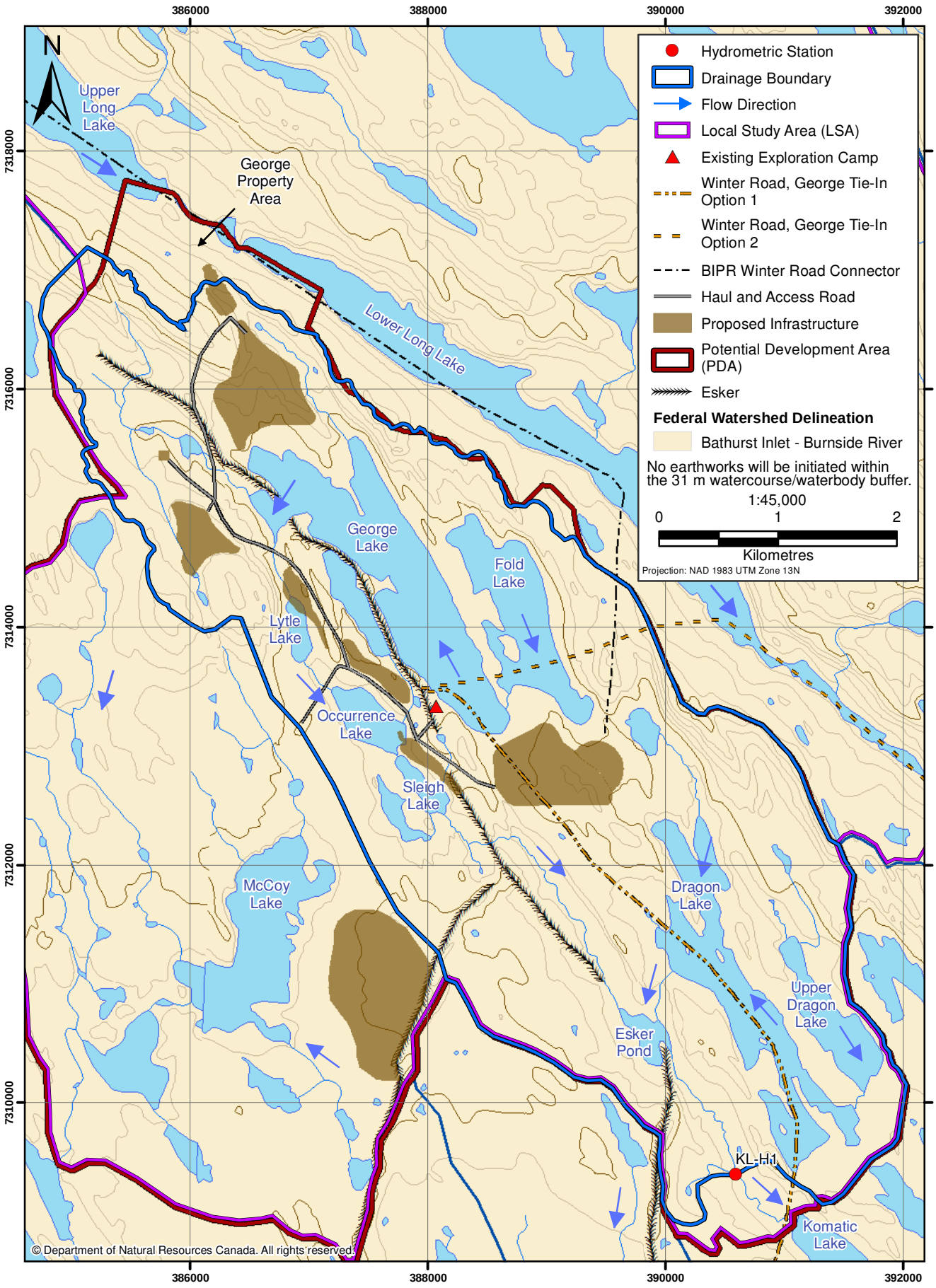


Sabina

Drainage Boundary for LG-H1 Hydrometric Monitoring Station

Figure A2-7

Rescan an ERM company

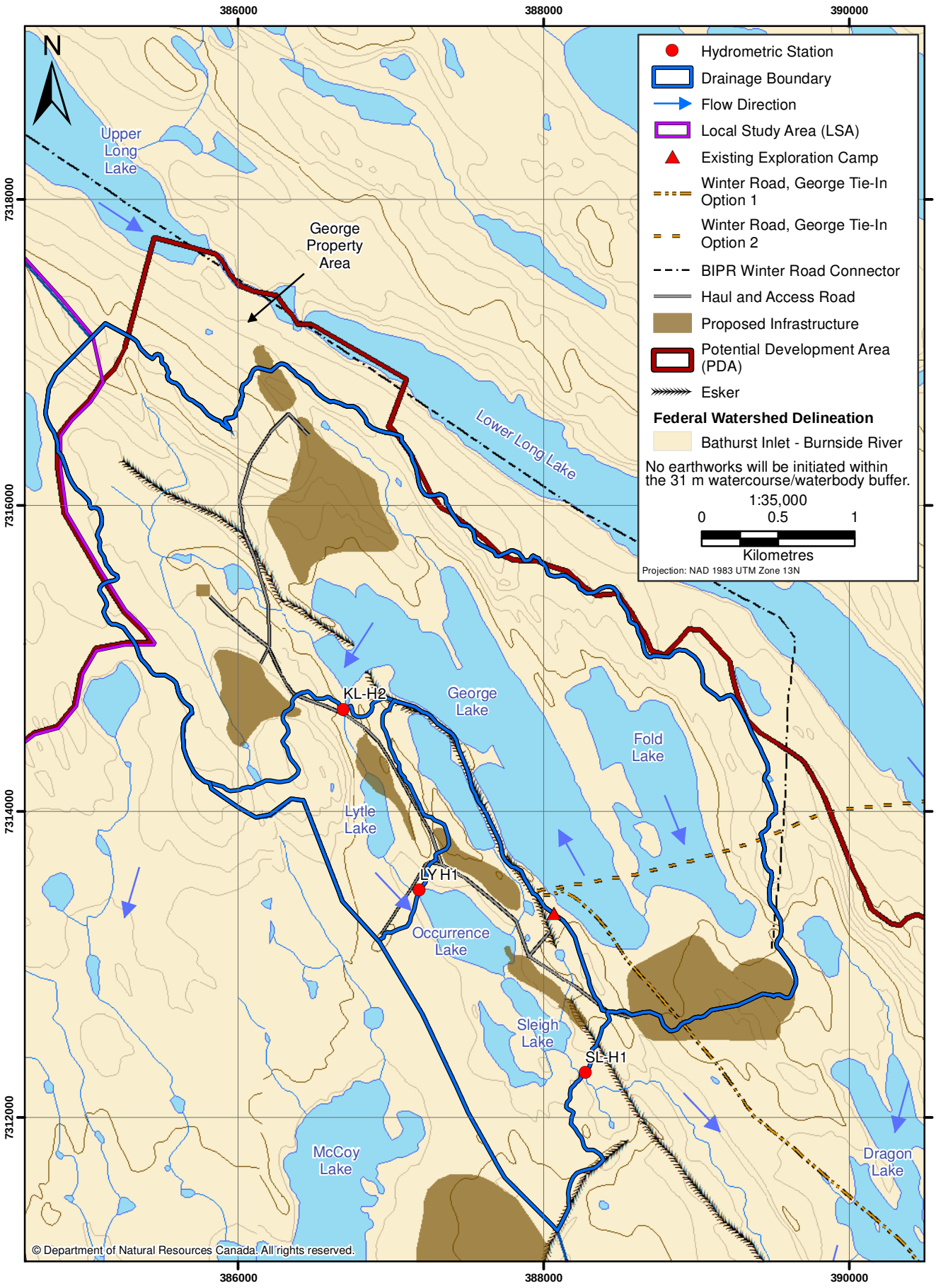


Sabina GOLD & SILVER CORP.

Drainage Boundary for KL-H1 Hydrometric Monitoring Station

Figure A2-8

Rescan an ERM company

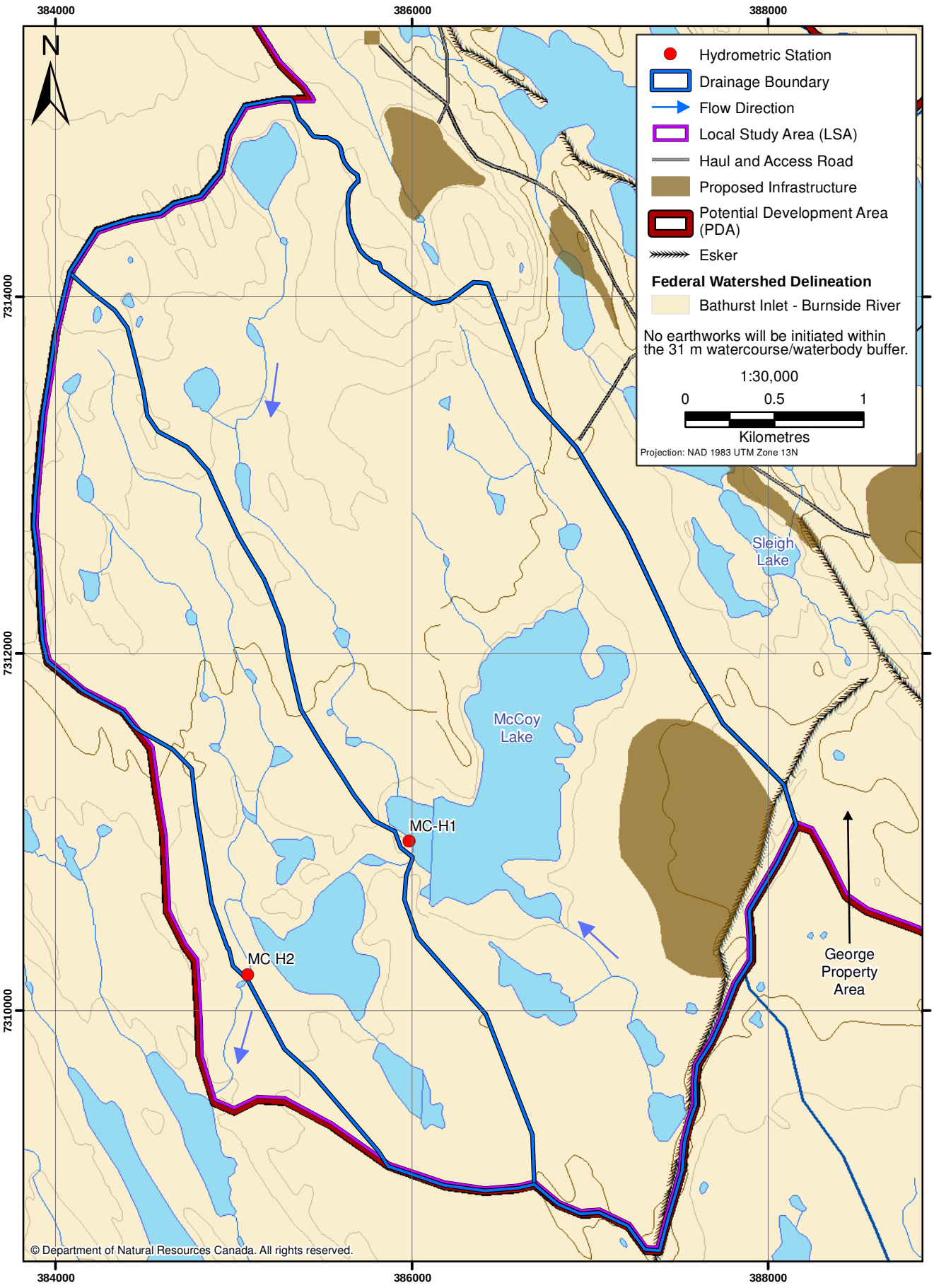


Sabina GOLD & SILVER CORP.

Drainage Boundaries for KL-H2, LY-H1 and SL-H1 Hydrometric Monitoring Stations

Figure A2-9

Rescan an ERM company

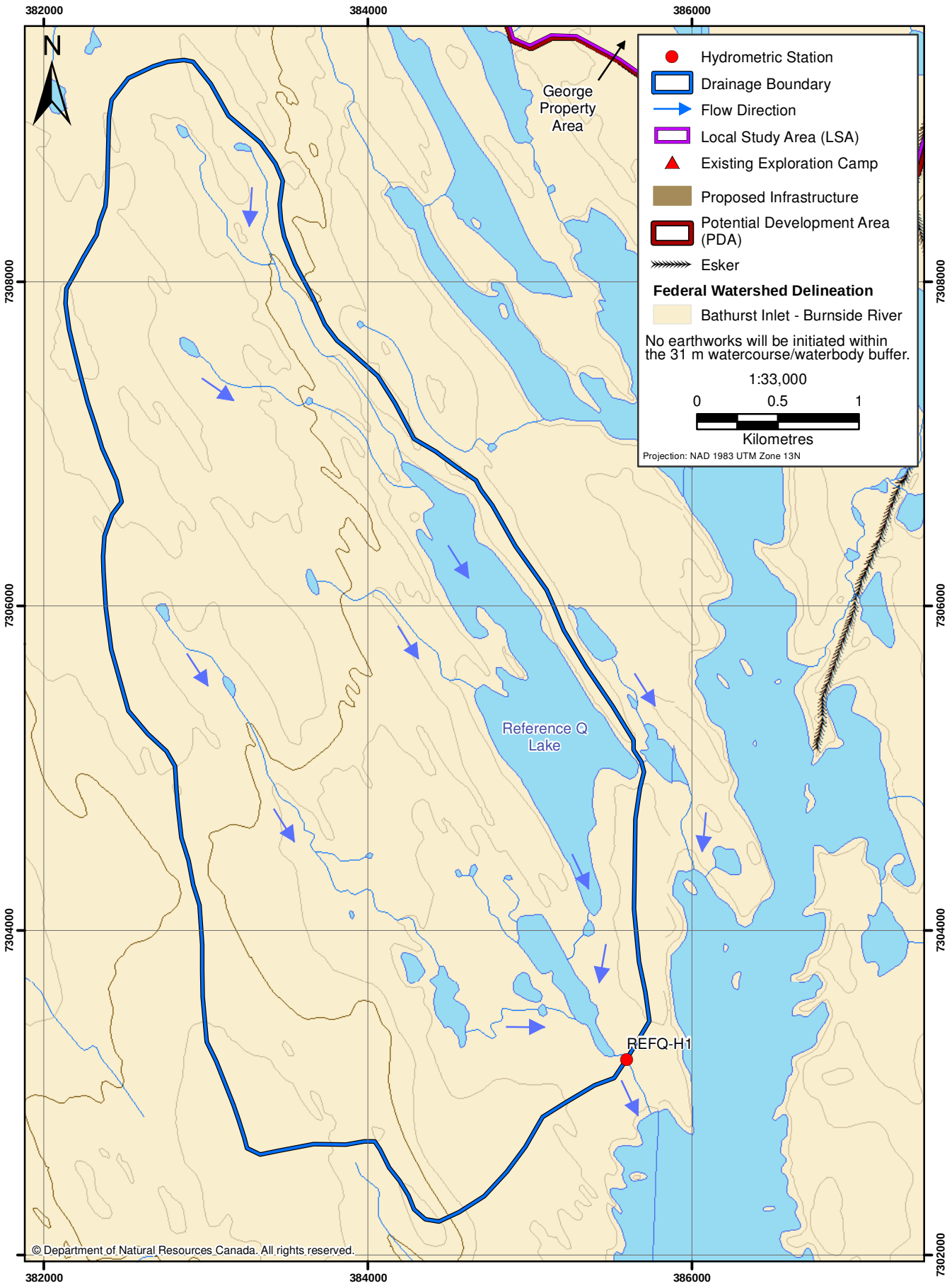


Sabina GOLD & SILVER CORP.

Drainage Boundaries for MC-H1 and MC-H2 Hydrometric Monitoring Stations

Figure A2-10

Rescan an ERM company



Sabina GOLD & SILVER CORP.

Drainage Boundary for REFQ-H1 Hydrometric Monitoring Station

Figure A2-11

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Appendix 3
Discharge Measurements

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Appendix 3. Manual Stage and Discharge Measurements, Site GL-H1

Site Information				
Project Name	Back River			
Station Identification	GL-H1			
Stream Name	Goose Neck			
Date Monitored	2-Jun-13			
Time at Site (24 hr)	**Start Time:**	12:00:00 PM	**End Time:**	
Personnel	Eli H., Jeff			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	430772	7270016		
Weather Conditions	Cloudy, cool			

Transducer Information			
PT Model	ELF-2	**Serial #**	2818014
Gain	3.5103	**Offset**	-0.1826
Status	OK	**Battery**	100%
# of Records	1	**Memory Free**	
Date Serviced		**Crest Gauges**	Notes

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 3	1.861	101.861		100.000	BM 3
BM 60			1.877	99.984	BM 60
BM 61			1.882	99.979	BM 61
PT			3.291	98.570	
WL			2.350	**99.511**	
BM 5			1.331	100.530	
TBM	1.875	101.868	1.868	99.993	
WL			2.360	**99.508**	
PT			3.295	98.573	
BM 61			1.889	99.979	BM 61
BM 60			1.882	99.986	BM 60
BM 3			1.870	99.998	BM 3

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 60	99.985	99.985	0.000	
BM 61	99.979	99.979	0.000	
PT	98.572	98.572	0.000	

Summary	
Stage (m)	99.510
Discharge (m^3/s)	0.549
Pressure Transducer Reading (m)	0.880
Pressure Transducer Elevation (m)	98.629

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	14:20	**End**	14:50	**Location**	20m Upstream of PT	
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950	
Flow Meter Type	Electromagnetic			**Instrument Serial #**		130881001502	
Stage (m)	**Start**	**Reading**	0.88	**Time**	14:20		
	End	**Reading**		**Time**	14:50		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	1.00	0.00	0.0	0.01	0			0.000	0.0
	1.20	0.12	0.2	0.04	0.16			0.006	1.0
	1.60	0.16	0.4	0.06	0.23			0.015	2.7
	2.00	0.30	0.4	0.17	0.17			0.028	5.1
	2.70	0.16	0.7	0.08	0.23			0.018	3.4
	3.00	0.27	0.3	0.08	0.19			0.015	2.8
	3.30	0.49	0.3	0.15	0.21			0.031	5.6
	3.60	0.44	0.3	0.12	0.2			0.024	4.4
	3.85	0.45	0.3	0.11	0.17			0.019	3.5
	4.10	0.41	0.3	0.10	0.19			0.019	3.5
	4.35	0.54	0.3	0.14	0.18			0.024	4.4
	4.60	0.56	0.3	0.14	0.2			0.028	5.1
	4.85	0.53	0.3	0.16	0.22			0.035	6.4
	5.20	0.54	0.4	0.16	0.19			0.031	5.6
	5.45	0.51	0.3	0.13	0.2			0.026	4.6
	5.70	0.54	0.3	0.14	0.2			0.027	4.9
	5.95	0.59	0.3	0.15	0.19			0.028	5.1
	6.20	0.53	0.3	0.25	0.17			0.043	7.8
	6.90	0.14	0.7	0.11	0.13			0.015	2.7
	7.80	0.20	0.9	0.17	0.14			0.024	4.3
	8.60	0.36	0.8	0.25	0.12			0.030	5.5
	9.20	0.35	0.6	0.25	0.11			0.027	4.9
	10.00	0.35	0.8	0.35	0.05			0.018	3.2
	11.20	0.00	1.2	0.00	0			0.000	0.0
	11.75	0.34	0.6	0.17	0.08			0.014	2.5
	12.20	0.22	0.4	0.07	0.07			0.005	0.9
LB	12.40	0.00	0.2	0.02	0			0.000	0.0
Total Q								**0.549**	**100.0**

General Notes

- High water flowing through blueberry bushes

Appendix 3. Manual Stage and Discharge Measurements, Site GL-H1

Site Information				
Project Name	Back River			
Station Identification	GL-H1			
Stream Name	Goose Neck			
Date Monitored	15-Jul-13			
Time at Site (24 hr)	**Start Time:**	12:30:00 PM	**End Time:**	
Personnel	Eli H., Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	430772	7270016		
Weather Conditions	Mix sun + cloud			

Transducer Information			
PT Model	ELF-2	**Serial #**	2818014
Gain	3.5103	**Offset**	-0.1826
Status	OK	**Battery**	100%
# of Records	6182	**Memory Free**	29446
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 3	0.918	100.918		100.000	BM 3
BM 60			0.932	99.986	BM 60
BM 61			0.939	99.979	BM 61
PT			2.345	98.573	
WL			2.014	**98.904**	0.330
TBM	1.712	100.868	1.762	99.156	
WL			1.966	**98.902**	
PT			2.298	98.570	
BM 61			0.889	99.979	BM 61
BM 60			0.882	99.986	BM 60
BM 3			0.867	100.001	BM 3
DSWS			1.977	98.891	
USWL1			1.953	98.915	top of pool

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 60	99.985	99.986	0.001	
BM 61	99.979	99.979	0.000	
PT	98.572	98.572	0.000	

Summary	
Stage (m)	98.903
Discharge (m^3/s)	0.0130
Pressure Transducer Reading (m)	0.308
Pressure Transducer Elevation (m)	98.595

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	11:45	**End**		**Location**	1m DS of PT
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950
Flow Meter Type	Electromagnetic			**Instrument Serial #**		130881001502
Stage (m)	**Start**	**Reading**	0.308	**Time**	11:45	
	End	**Reading**		**Time**	0:00	

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	0.75	0.00	0.0	0.00	0			0.000	0.0
	0.85	0.09	0.1	0.01	0.04			0.000	2.1
	0.90	0.13	0.1	0.01	0.04			0.000	2.6
	0.98	0.14	0.1	0.01	0.05			0.001	4.3
	1.06	0.14	0.1	0.01	0.04			0.000	3.4
	1.14	0.12	0.1	0.01	0.05			0.000	3.7
	1.22	0.18	0.1	0.01	0.04			0.001	4.4
	1.30	0.22	0.1	0.02	0.04			0.001	5.4
	1.38	0.22	0.1	0.02	0.04			0.001	5.4
	1.46	0.36	0.1	0.03	0.04			0.001	8.9
	1.54	0.37	0.1	0.03	0.05			0.001	10.0
	1.60	0.22	0.1	0.01	0.06			0.001	4.1
	1.62	0.38	0.0	0.01	0.05			0.001	4.4
	1.66	0.22	0.0	0.01	0.06			0.001	4.1
	1.70	0.40	0.0	0.02	0.05			0.001	6.2
	1.74	0.22	0.0	0.01	0.06			0.001	4.1
	1.78	0.22	0.0	0.01	0.07			0.001	7.1
	1.86	0.08	0.1	0.01	0.08			0.001	3.9
	1.94	0.11	0.1	0.01	0.09			0.001	4.6
	1.98	0.12	0.0	0.00	0.1			0.000	3.7
	2.02	0.14	0.0	0.01	0.12			0.001	7.8
RB	2.10	0.00	0.1	0.01	0			0.000	0.0
Total Q								**0.013**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site GL-H1

Site Information				
Project Name	Back River			
Station Identification	GL-H1			
Stream Name	Goose Neck			
Date Monitored	13-Aug-13			
Time at Site (24 hr)	Start Time:	12:40:00 PM	End Time:	
Personnel	Eli H., Mark W.			
Station Cordinates	Easting	Northing	Elevation	
	430772	7270016		
Weather Conditions	Sunny, light breeze			

Transducer Information			
PT Model	ELF-2	Serial #	2818014
Gain	3.5103	Offset	-0.1826
Status	Stopped, restore	Battery	100%
# of Records	6687	Memory Free	
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 3	2.351	102.351		100.000	BM 3
BM 60			2.366	99.985	BM 60
BM 61			2.372	99.979	BM 61
PT			3.778	98.573	
WL			3.649	**98.702**	
TBM	1.741	102.269	1.823	100.528	
WL			3.567	**98.702**	
PT			3.698	98.571	0.140
BM 61			2.291	99.978	BM 61
BM 60			2.283	99.986	BM 60
BM 3			2.269	100.000	BM 3

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 60	99.985	99.986	0.001	
BM 61	99.979	99.979	-0.001	
PT	98.572	98.572	0.000	

Summary	
Stage (m)	98.702
Discharge (m^3/s)	0.00693
Pressure Transducer Reading (m)	0.109
Pressure Transducer Elevation (m)	98.593

Discharge Measurement - Mid-Section Method							
Time (24 hr)	Start	12:45	End	13:15	Location	~20m DS of station	
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate	
Flow Meter Type	Electromagnetic			Instrument Serial #			
Stage (m)	Start	Reading	0.109	Time	12:45		
	End	Reading		Time	13:15		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	0.25	0.00	0.0	0.01	0			0.000	0.0
	0.50	0.04	0.3	0.01	-0.03			0.000	-3.0
	0.60	0.08	0.1	0.01	-0.01			0.000	-1.2
	0.70	0.10	0.1	0.01	0.03			0.000	4.3
	0.80	0.12	0.1	0.01	0.06			0.001	7.8
	0.85	0.12	0.0	0.01	0.08			0.000	6.9
	0.90	0.14	0.1	0.01	0.1			0.001	10.1
	0.95	0.14	0.0	0.01	0.11			0.001	11.1
	1.00	0.16	0.1	0.01	0.12			0.001	13.9
	1.05	0.14	0.1	0.01	0.11			0.001	11.1
	1.10	0.11	0.1	0.01	0.1			0.001	7.9
	1.15	0.09	0.0	0.00	0.11			0.000	7.1
	1.20	0.09	0.1	0.00	0.1			0.000	6.5
	1.25	0.10	0.1	0.01	0.1			0.001	7.2
	1.30	0.10	0.1	0.01	0.08			0.000	5.8
	1.35	0.12	0.1	0.01	0.07			0.000	6.1
	1.40	0.13	0.0	0.01	0.02			0.000	2.8
	1.50	0.05	0.1	0.01	-0.03			0.000	-2.2
	1.60	0.05	0.1	0.01	-0.03			0.000	-2.2
	1.70	0.12	0.1	0.01	0			0.000	0.0
	1.80	0.11	0.1	0.01	0.01			0.000	1.6
	1.90	0.08	0.1	0.01	0.01			0.000	1.2
	2.00	0.04	0.1	0.00	-0.04			0.000	-2.7
	2.13	0.03	0.1	0.00	-0.01			0.000	-0.3
RB	2.14	0.00	0.0	0.00	0			0.000	0.0
Total Q								**0.007**	**100.0**

General Notes
Error upon starting logger: "low battery error before completion"
Data stopped 18/7/2013 at 23:40.
Current battery @ 100%, relaunched at 12:40 and seems to be working OK.

Appendix 3. Manual Stage and Discharge Measurements, Site GL-H1

Site Information				
Project Name	Back River			
Station Identification	GL-H1			
Stream Name	Goose Neck			
Date Monitored	12-Sep-13			
Time at Site (24 hr)	Start Time:	9:10:00 AM	End Time:	
Personnel	Eli Heyman, Robert M.			
Station Cordinates	Easting	Northing	Elevation	
	430772	7270016		
Weather Conditions	Light Rain			

Transducer Information			
PT Model	Elf 2	Serial #	2818014
Gain	3.5101	Offset	-0.1826
Status	active	Battery	100%
# of Records	321	Memory Free	30887
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM3	1.080	101.080		100.000	
BM 60			1.094	99.986	
BM 61			1.101	99.979	
WL			2.138	98.942	
PT			2.510	**98.570**	
TBM	1.869	101.037	1.912	99.168	
PT			2.465	**98.572**	
WL			2.092	98.945	
BM 61			1.058	99.979	
BM 60			1.051	99.986	
BM3			1.036	100.001	
DS WL			2.098	98.939	
US WL			2.061	98.976	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 60		99.986		
BM 61		99.979		
PT		98.571		

Summary	
Stage (m)	98.944
Discharge (m^3/s)	0.0171
Pressure Transducer Reading (m)	0.324
Pressure Transducer Elevation (m)	98.620

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	9:15	End	9:46	Location	1m downstream of PT			
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate			
Flow Meter Type	Electomagnetic			Instrument Serial #					
Stage (m)	Start	Reading	0.322	Time	9:15				
	End	Reading	0.324	Time	9:46				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	0.40	0.00	0.0	0.01	0			0.000	0.0
	0.65	0.04	0.3	0.01	0.01			0.000	0.4
	0.75	0.03	0.1	0.00	0.01			0.000	0.2
	0.85	0.06	0.1	0.00	0.02			0.000	0.6
	0.91	0.07	0.1	0.00	0.06			0.000	1.5
	0.97	0.08	0.1	0.00	0.07			0.000	2.0
	1.03	0.12	0.1	0.01	0.06			0.000	2.5
	1.09	0.07	0.1	0.00	0.07			0.000	1.7
	1.15	0.20	0.1	0.01	0.07			0.001	4.9
	1.21	0.23	0.1	0.01	0.07			0.001	5.7
	1.27	0.18	0.1	0.01	0.07			0.001	4.4
	1.33	0.18	0.1	0.01	0.08			0.001	5.1
	1.39	0.21	0.1	0.01	0.09			0.001	6.6
	1.45	0.23	0.1	0.01	0.08			0.001	6.5
	1.51	0.05	0.1	0.00	0.11			0.000	1.9
	1.57	0.08	0.1	0.00	0.11			0.001	3.1
	1.63	0.10	0.1	0.01	0.12			0.001	4.2
	1.69	0.12	0.1	0.01	0.12			0.001	5.1
	1.75	0.14	0.1	0.01	0.13			0.001	5.9
	1.80	0.16	0.1	0.01	0.16			0.001	7.5
	1.85	0.18	0.1	0.01	0.16			0.001	8.4
	1.90	0.19	0.0	0.01	0.17			0.002	9.5
	1.95	0.20	0.1	0.01	0.18			0.002	9.5
	1.99	0.04	0.0	0.00	0.17			0.001	3.0
RB	2.10	0.00	0.1	0.00	0			0.000	0.0
Total Q								**0.017**	**100.0**

General Notes
Logger stopped at 10:12

Appendix 3. Manual Stage and Discharge Measurements, Site GL-H2

Site Information				
Project Name	Back River			
Station Identification	GL-H2			
Stream Name	Llama Lake Outflow			
Date Monitored	3-Jun-13			
Time at Site (24 hr)	**Start Time:**	12:02:00 PM	**End Time:**	
Personnel	Eli H., Jeff			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	428746	7271567		
Weather Conditions	Sunny			

Transducer Information			
PT Model	ELF-2	**Serial #**	2818013
Gain	3.5113	**Offset**	0.0115
Status	OK	**Battery**	100%
# of Records	1	**Memory Free**	32530
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 51	1.372	101.372		100.000	
BM 52			1.612	99.760	
BM 53			1.582	99.790	
PT			2.047	99.325	
WL			1.696	**99.676**	
SG			1.695	99.677	
TBM	1.657	101.385	1.644	99.728	
SG			1.709	99.676	
WL			1.707	**99.678**	
PT			2.061	99.324	
BM 53			1.598	99.787	
BM 52			1.626	99.759	
BM 51			1.387	99.998	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 52	99.746	99.760	0.014	
BM 53	99.792	99.789	-0.004	
PT	99.427	99.325	-0.103	

Summary	
Stage (m)	99.677
Discharge (m^3/s)	0.119
Pressure Transducer Reading (m)	0.371
Pressure Transducer Elevation (m)	99.306

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	12:56	**End**	13:32	**Location**	20m US of PT	
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950	
Flow Meter Type	Electromagnetic			**Instrument Serial #**		130881001502	
Stage (m)	**Start**	**Reading**	0.371	**Time**	12:56		
	End	**Reading**	0.373	**Time**	13:32		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	2.80	0.00	0.0	0.01	0			0.000	0.0
Grass	3.00	0.08	0.2	0.08	0.01			0.001	0.7
Grass	4.80	0.10	1.8	0.18	0.01			0.002	1.5
Grass	6.50	0.13	1.7	0.15	0.01			0.001	1.3
Grass	7.10	0.06	0.6	0.02	-0.01			0.000	-0.2
Eddy	7.30	0.18	0.2	0.03	-0.05			-0.001	-1.1
Eddy	7.40	0.19	0.1	0.02	-0.04			-0.001	-0.6
Eddy	7.50	0.21	0.1	0.02	-0.02			0.000	-0.4
	7.60	0.22	0.1	0.02	0.04			0.001	0.7
	7.70	0.22	0.1	0.03	0.07			0.002	1.6
	7.85	0.22	0.1	0.03	0.19			0.006	5.3
	8.00	0.22	0.2	0.03	0.26			0.007	6.0
	8.10	0.24	0.1	0.02	0.3			0.007	6.1
	8.20	0.23	0.1	0.02	0.35			0.008	6.8
	8.30	0.24	0.1	0.02	0.33			0.008	6.7
	8.40	0.25	0.1	0.02	0.32			0.008	6.7
	8.50	0.26	0.1	0.03	0.28			0.009	7.7
	8.65	0.27	0.2	0.03	0.28			0.009	8.0
	8.75	0.24	0.1	0.02	0.35			0.008	7.1
	8.85	0.26	0.1	0.03	0.34			0.009	7.4
	8.95	0.26	0.1	0.03	0.35			0.009	7.7
	9.05	0.26	0.1	0.03	0.3			0.010	8.2
	9.20	0.28	0.1	0.04	0.22			0.008	6.5
	9.30	0.29	0.1	0.03	0.16			0.005	3.9
	9.40	0.30	0.1	0.04	0.06			0.002	1.9
	9.55	0.12	0.2	0.02	-0.01			0.000	-0.2
LB main channel	9.70	0.00	0.1	0.00	0			0.000	0.0
RB side channel	15.00	0.00	0.0	0.00	0			0.000	0.0
Grass	15.70	0.08	0.7	0.06	0.02			0.001	0.9
LB side channel	16.40	0.00	0.7	0.03	0			0.000	0.0
Total Q								**0.119**	**100.0**

General Notes

Added BM tags: numbers have changed from 1,2,3 to 51,52,53 but no elevation. Added SG near BM 52. May have moved PT slightly @ 13:35. Lots of flow over flooded grass.

Appendix 3. Manual Stage and Discharge Measurements, Site GL-H2

Site Information				
Project Name	Back River			
Station Identification	GL-H2			
Stream Name	Llama Lake Outflow			
Date Monitored	15-Jul-13			
Time at Site (24 hr)	**Start Time:**	6:40:00 AM	**End Time:**	8:15:00 AM
Personnel	Eli H., Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	428746	7271567		
Weather Conditions	Cloudy, misty			

Transducer Information			
PT Model	ELF-2	**Serial #**	2818013
Gain	3.5113	**Offset**	0.0115
Status	OK	**Battery**	100%
# of Records	6014	**Memory Free**	29529
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 51	1.162	101.162		100.000	
BM 52			1.420	99.742	
BM 53			1.389	99.773	
PT			1.862	99.300	depth: 0.248
WL			1.616	**99.546**	
SG			1.503	99.659	
TBM	1.453	101.113	1.502	99.660	
SG			1.456	99.657	
WL			1.568	**99.545**	
PT			1.814	99.299	
BM 53			1.341	99.772	
BM 52			1.372	99.741	
BM 51			1.113	100.000	
DSWL			1.571	99.542	
DSWL2			1.585	99.528	
USWL			1.565	99.548	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 52	99.746	99.742	-0.004	
BM 53	99.792	99.773	-0.019	
PT	99.427	99.300	-0.127	

Summary	
Stage (m)	99.546
Discharge (m^3/s)	0.005
Pressure Transducer Reading (m)	0.271
Pressure Transducer Elevation (m)	99.275

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	6:50	**End**	7:35	**Location**	15m US of PT	
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950	
Flow Meter Type	Electromagnetic			**Instrument Serial #**		130881001502	
Stage (m)	**Start**	**Reading**	0.276	**Time**	6:50		
	End	**Reading**	0.271	**Time**	7:35	Staff Gauge: 0.113	

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	0.50	0.00	0.0	0.00	0			0.000	0.0
	0.60	0.08	0.1	0.01	0			0.000	0.0
	0.70	0.14	0.1	0.01	0			0.000	0.0
	0.78	0.18	0.1	0.01	0.01			0.000	2.8
	0.86	0.19	0.1	0.02	0.03			0.000	8.8
	0.94	0.13	0.1	0.01	0.04			0.000	8.0
	1.02	0.10	0.1	0.01	0.04			0.000	6.2
	1.10	0.09	0.1	0.01	0.03			0.000	4.2
	1.18	0.08	0.1	0.01	0.03			0.000	3.7
	1.26	0.12	0.1	0.01	0.03			0.000	5.6
	1.34	0.12	0.1	0.01	0.01			0.000	1.9
	1.42	0.07	0.1	0.01	0.03			0.000	3.2
	1.50	0.07	0.1	0.01	0.05			0.000	5.4
	1.58	0.08	0.1	0.01	0.04			0.000	4.9
	1.66	0.08	0.1	0.01	0.05			0.000	6.2
	1.74	0.10	0.1	0.01	0.05			0.000	7.7
	1.82	0.08	0.1	0.01	0.06			0.000	7.4
	1.90	0.09	0.1	0.01	0.05			0.000	6.9
	1.98	0.10	0.1	0.01	0.06			0.000	9.3
	2.06	0.10	0.1	0.01	0.05			0.000	5.8
	2.10	0.08	0.0	0.00	0.03			0.000	2.1
RB	2.15	0.00	0.0	0.00	0			0.000	0.0
Total Q								**0.005**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site GL-H2

Site Information				
Project Name	Back River			
Station Identification	GL-H2			
Stream Name	Llama Lake Outflow			
Date Monitored	20-Aug-13			
Time at Site (24 hr)	**Start Time:**	9:50:00 AM	**End Time:**	1:00:00 PM
Personnel	Eli H., Mark W.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	428746	7271567		
Weather Conditions	Mix sun and cloud			

Transducer Information			
PT Model	ELF-2	**Serial #**	2818013
Gain	3.5113	**Offset**	0.0115
Status	OK	**Battery**	100%
# of Records	11216	**Memory Free**	26122
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 51	1.109	101.109		100.000	
BM 52			1.367	99.742	
BM 53			1.342	99.767	
PT			1.815	99.294	0.240
WL			1.573	**99.536**	
SG			1.451	99.658	
TBM	1.512	101.059	1.562	99.547	
SG			1.401	99.658	
WL			1.523	**99.536**	
PT			1.765	99.294	
BM 53			1.292	99.767	
BM 52			1.317	99.742	
BM 51			1.059	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 52	99.746	99.742	-0.004	
BM 53	99.792	99.767	-0.025	
PT	99.427	99.294	-0.133	

Summary	
Stage (m)	99.536
Discharge (m^3/s)	0.000
Pressure Transducer Reading (m)	0.268
Pressure Transducer Elevation (m)	99.268

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	6:50	**End**	7:35	**Location**	15m US of PT	
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-mate	
Flow Meter Type	Electromagnetic			**Instrument Serial #**			
Stage (m)	**Start**	**Reading**	0.192	**Time**	10:10	Staff Gauge : 0.124	
	End	**Reading**	0.268	**Time**	11:00	Staff Gauge : 0.124	

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.20	0.00	0.0	0.00	0			0.000	0.0
	0.25	0.08	0.1	0.00	-0.01			0.000	-8.9
	0.30	0.07	0.1	0.00	0			0.000	0.0
	0.33	0.06	0.0	0.00	0.02			0.000	9.4
	0.37	0.06	0.0	0.00	0			0.000	0.0
	0.41	0.07	0.0	0.00	0.02			0.000	12.5
	0.45	0.08	0.0	0.00	0.02			0.000	14.3
	0.49	0.10	0.0	0.00	0.01			0.000	7.8
	0.52	0.09	0.0	0.00	0.02			0.000	16.1
	0.57	0.09	0.0	0.00	0.01			0.000	9.0
	0.61	0.10	0.0	0.00	0.02			0.000	17.8
	0.65	0.10	0.0	0.00	0.01			0.000	8.9
	0.69	0.10	0.0	0.00	0.01			0.000	7.8
	0.72	0.08	0.0	0.00	0.01			0.000	6.2
	0.76	0.07	0.0	0.00	0			0.000	0.0
	0.80	0.08	0.0	0.00	0.01			0.000	10.7
	0.88	0.09	0.1	0.01	0.01			0.000	16.1
	0.96	0.06	0.1	0.00	0			0.000	0.0
	1.04	0.08	0.1	0.01	0			0.000	0.0
	1.12	0.06	0.1	0.00	0			0.000	0.0
	1.20	0.08	0.1	0.01	0			0.000	0.0
	1.28	0.08	0.1	0.01	0			0.000	0.0
	1.36	0.09	0.1	0.01	0			0.000	0.0
	1.44	0.12	0.1	0.01	0			0.000	0.0
	1.52	0.15	0.1	0.01	0			0.000	0.0
	1.60	0.12	0.1	0.01	0			0.000	0.0
	1.68	0.10	0.1	0.01	0			0.000	0.0
	1.76	0.08	0.1	0.01	-0.01			0.000	-14.3
	1.84	0.05	0.1	0.00	-0.02			0.000	-13.4
LB	1.88	0.00	0.0	0.00	0			0.000	0.0
Total Q								**0.0004**	**100.0**

General Notes

RTR @ 10:08 = 0.192. Depth measured with rod = 0.24 off by 5cm.

Tried unclogging new tube, screwed in connection. Readings seem to have stabilised at 0.268.

Noted issue with widely fluctuating readings beginning on July 16 (last visit July 15). Wakes found in logger box, possible cause.

Dried out box, replaced dessicant. Will check back to see if readings stabilise.

Appendix 3. Manual Stage and Discharge Measurements, Site GL-H2

Site Information				
Project Name	Back River			
Station Identification	GL-H2			
Stream Name	Llama Lake Outflow			
Date Monitored	11-Sep-13			
Time at Site (24 hr)	**Start Time:**	2:33:00 PM	**End Time:**	4:00:00 PM
Personnel	Eli H., Robert M.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	428746	7271567		
Weather Conditions	Mix sun and cloud			

Transducer Information			
PT Model	ELF-2	**Serial #**	2818013
Gain	3.5113	**Offset**	0.0115
Status	OK	**Battery**	100%
# of Records	14412	**Memory Free**	24458
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 51	1.161	101.161		100.000	
BM 52			1.411	99.750	
BM 53			1.391	99.770	
PT			1.867	99.294	0.250
WL			1.621	**99.540**	
SG			1.497	99.664	
TBM	1.500	101.136	1.525	99.636	
SG			1.471	99.665	
WL			1.593	**99.543**	
PT			1.841	99.295	
BM 53			1.366	99.770	
BM 52			1.387	99.749	
BM 51			1.135	100.001	
BM 54			0.693	100.443	New rebar

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 52	99.746	99.750	0.004	
BM 53	99.792	99.770	-0.022	
PT	99.427	99.295	-0.133	

Summary	
Stage (m)	99.542
Discharge (m^3/s)	0.001
Pressure Transducer Reading (m)	0.279
Pressure Transducer Elevation (m)	99.263

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	6:50	**End**	7:35	**Location**	15m US of PT			
Method	Velocity-area (Mid-section)				**Instrument Model**	Flo-mate			
Flow Meter Type	Electromagnetic				**Instrument Serial #**				
Stage (m)	**Start**	**Reading**	0.192	**Time**	10:10	Staff Gauge : 0.124			
	End	**Reading**	0.268	**Time**	11:00	Staff Gauge : 0.124			

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	0.30	0.00	0.0	0.00	0			0.000	0.0
	0.35	0.05	0.1	0.00	-0.01			0.000	-2.8
	0.43	0.06	0.1	0.00	0			0.000	0.0
	0.51	0.06	0.1	0.00	0			0.000	0.0
	0.59	0.03	0.1	0.00	0			0.000	0.0
	0.67	0.03	0.1	0.00	0.01			0.000	2.1
	0.75	0.12	0.1	0.01	0.01			0.000	8.3
	0.83	0.12	0.1	0.01	0			0.000	0.0
	0.91	0.12	0.1	0.01	0.01			0.000	8.3
	0.99	0.12	0.1	0.01	0.02			0.000	16.6
	1.07	0.12	0.1	0.01	0.01			0.000	8.3
	1.15	0.10	0.1	0.01	0			0.000	0.0
	1.23	0.10	0.1	0.01	0.01			0.000	6.9
	1.31	0.16	0.1	0.01	0			0.000	0.0
	1.39	0.15	0.1	0.01	0.01			0.000	10.4
	1.47	0.14	0.1	0.01	0.01			0.000	9.7
	1.55	0.08	0.1	0.01	0.01			0.000	5.5
	1.63	0.06	0.1	0.00	0.01			0.000	4.1
	1.71	0.06	0.1	0.00	0.02			0.000	8.3
	1.79	0.07	0.1	0.01	0.02			0.000	9.7
	1.87	0.10	0.1	0.01	0.01			0.000	4.7
	1.90	0.00	0.0	0.00	0			0.000	0.0
LB									
Total Q								**0.001**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site GL-H3

Site Information				
Project Name	Back River			
Station Identification	GL-H3			
Stream Name	Inflow to GL			
Date Monitored	31-May-13			
Time at Site (24 hr)	**Start Time:**	3:00:00 PM	**End Time:**	4:45:00 PM
Personnel	Eli H., Jeff			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	432891	7269919		
Weather Conditions	Above 10C	Sunny		

Transducer Information			
PT Model	ELF-2	**Serial #**	2818016
Gain	3.5338	**Offset**	-0.0121
Status	Active	**Battery**	97%
# of Records		**Memory Free**	32534
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 17	1.748	101.748		100.000	BM 17
BM 18			1.652	100.096	BM 18
BM 19			1.749	99.999	BM 19
PT			2.920	98.828	
WL			1.936	**99.812**	**Corrected to 99.862**
SG			1.637	100.111	
TBM	1.832	101.822	1.758	99.990	
SG			1.712	100.110	
WL			2.013	**99.809**	**Corrected to 99.862**
PT			2.996	98.826	
BM 19			1.825	99.997	BM 19
BM 18			1.728	100.094	BM 18
BM 17			1.824	99.998	BM 17

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 18	100.137	100.095	-0.042	
BM 19	100.042	99.998	-0.044	
PT	98.827	98.827	0.000	

Summary		
Stage (m)	99.811	Corrected to 99.862m
Discharge (m^3/s)	0.214	
Pressure Transducer Reading (m)	1.023	
Pressure Transducer Elevation (m)	98.788	

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	15:04	**End**	16:04	**Location**	10m US of PT	
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950	
Flow Meter Type	Electromagnetic			**Instrument Serial #**		130881001502	
Stage (m)	**Start**	**Reading**	1.022	**Time**	15:04		
	End	**Reading**	1.023	**Time**	16:04		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RWE	0.00	0.00	0.0	0.00	0			0.000	0.0
	0.10	0.04	0.1	0.00	0			0.000	0.0
	0.20	0.12	0.1	0.02	0.01			0.000	0.1
	0.40	0.26	0.2	0.05	0.01			0.001	0.2
	0.60	0.23	0.2	0.03	0.07			0.002	1.1
	0.70	0.25	0.1	0.03	0.15			0.004	1.8
	0.80	0.29	0.1	0.03	0.27			0.008	3.7
	0.90	0.34	0.1	0.03	0.31			0.011	4.9
	1.00	0.40	0.1	0.04	0.38			0.015	7.1
	1.10	0.44	0.1	0.04	0.39			0.017	8.0
	1.20	0.44	0.1	0.04	0.4			0.018	8.2
	1.30	0.42	0.1	0.03	0.38			0.012	5.6
	1.35	0.45	0.1	0.02	0.36			0.008	3.8
	1.40	0.46	0.0	0.02	0.4			0.009	4.3
	1.45	0.45	0.1	0.02	0.42			0.009	4.4
	1.50	0.53	0.1	0.03	0.42			0.011	5.2
	1.55	0.52	0.1	0.03	0.44			0.011	5.4
	1.60	0.51	0.1	0.03	0.47			0.012	5.6
	1.65	0.49	0.0	0.02	0.47			0.012	5.4
	1.70	0.48	0.1	0.02	0.5			0.012	5.6
	1.75	0.47	0.1	0.02	0.48			0.011	5.3
	1.80	0.46	0.1	0.02	0.46			0.011	4.9
	1.85	0.44	0.1	0.02	0.33			0.007	3.4
	1.90	0.44	0.0	0.03	0.27			0.009	4.2
	2.00	0.38	0.1	0.08	0.04			0.003	1.4
In eddy and grass	2.30	0.25	0.3	0.08	0.01			0.001	0.4
In eddy and grass	2.60	0.23	0.3	0.05	0			0.000	0.0
LB	2.75	0.00	0.2	0.00	0			0.000	0.0
Total Q								**0.214**	**100.0**

General Notes

Stage elevation adjusted to 99.862 in rating curve based on PT record.

Appendix 3. Manual Stage and Discharge Measurements, Site GL-H3

Site Information				
Project Name	Back River			
Station Identification	GL-H3			
Stream Name	Inflow to GL			
Date Monitored	15-Jul-13			
Time at Site (24 hr)	**Start Time:**	1:30:00 PM	**End Time:**	
Personnel	Eli H., Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	432891	7269919		
Weather Conditions	Above Zero	Partly Cloudy		

Transducer Information			
PT Model	ELF-2	**Serial #**	7110581
Gain	3.5338	**Offset**	-0.0121
Status	O.k.	**Battery**	96%
# of Records	6470	**Memory Free**	29299
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 17	1.814	101.814		100.000	BM 17
BM 18			1.658	100.156	BM 18
BM 19			1.752	100.062	BM 19
PT			2.938	98.876	Depth: 0.748
WL			2.194	**99.620**	**Corrected to 99.618**
SG			1.671	100.143	
TBM	1.590	101.733	1.671	100.143	
SG			1.590	100.143	
WL			2.111	**99.622**	**Corrected to 99.618**
PT			2.875	98.858	
BM 19			1.671	100.062	BM 19
BM 18			1.577	100.156	BM 18
BM 17			1.733	100.000	BM 17

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 18	100.137	100.156	0.019	
BM 19	100.042	100.062	0.020	
PT	98.902	98.867	-0.035	

Summary		
Stage (m)	99.621	Corrected to 99.618
Discharge (m^3/s)	0.001	
Pressure Transducer Reading (m)	0.779	
Pressure Transducer Elevation (m)	98.842	

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	13:30	**End**	13:50	**Location**	10m US of PT	
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950	
Flow Meter Type	Electromagnetic			**Instrument Serial #**		130881001502	
Stage (m)	**Start**	**Reading**	0.778	**Time**	13:30		
	End	**Reading**	0.779	**Time**	13:50		

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	0.35	0.00	0.0	0.00	0			0.000	0.0
	0.40	0.04	0.1	0.00	0.01			0.000	1.4
	0.45	0.07	0.1	0.00	0.01			0.000	2.5
	0.50	0.08	0.1	0.00	0.03			0.000	8.6
	0.55	0.08	0.1	0.00	0.03			0.000	8.6
	0.60	0.08	0.0	0.00	0.06			0.000	17.3
	0.65	0.08	0.1	0.00	0.07			0.000	20.2
	0.70	0.08	0.0	0.00	0.06			0.000	17.3
	0.75	0.08	0.1	0.00	0.04			0.000	11.5
	0.80	0.06	0.1	0.00	0.04			0.000	8.6
	0.85	0.06	0.0	0.00	0.02			0.000	3.0
	0.87	0.05	0.0	0.00	0.01			0.000	0.9
RB	0.90	0.00	0.0	0.00	0			0.000	0.0
Total Q								**0.001**	**100.0**

General Notes

Stage elevation adjusted to 99.618 in rating curve based on PT record.

Appendix 3. Manual Stage and Discharge Measurements, Site GL-H3

Site Information				
Project Name	Back River			
Station Identification	GL-H3			
Stream Name	Inflow to GL			
Date Monitored	16-Aug-13			
Time at Site (24 hr)	**Start Time:**	1:30:00 PM	**End Time:**	3:00:00 PM
Personnel	Eli H., Mark W.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	432891	7269919		
Weather Conditions	Above Zero	Partly Cloudy		

Transducer Information			
PT Model	PS98i	**Serial #**	2818016
Gain	3.52168	**Offset**	0
Status	O.k.	**Battery**	96%
# of Records	11079	**Memory Free**	26995
Date Serviced	n/a	**Crest Gauges**	No

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 17	1.731	101.731		100.000	BM 17
BM 18			1.584	100.147	BM 18
BM 19			1.680	100.051	BM 19
PT			2.846	98.885	Error (0.710)
WL			2.150	**99.581**	
TBM	1.723	101.668	1.786	99.945	
WL			2.090	**99.578**	
PT			2.712	98.956	Checked, good
BM 19			1.618	100.050	BM 19
BM 18			1.521	100.147	BM 18
BM 17			1.668	100.000	BM 17

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 18	100.137	100.147	0.010	
BM 19	100.042	100.051	0.008	
PT	98.902	98.956	0.054	

Summary	
Stage (m)	99.580
Discharge (m^3/s)	0.000
Pressure Transducer Reading (m)	0.741
Pressure Transducer Elevation (m)	98.839

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**		**End**		**Location**	
Method	Velocity-area (Mid-section)			**Instrument Model**		
Flow Meter Type	Swoffer			**Instrument Serial #**		
Stage (m)	**Start**	**Reading**		**Time**		
	End	**Reading**		**Time**		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
Total Q								**0.000**	**0.0**

General Notes

Hard to find PT due to murky water. Very small trickle through grass (not measurable) on this date.

Appendix 3. Manual Stage and Discharge Measurements, Site GL-H3

Site Information				
Project Name	Back River			
Station Identification	GL-H3			
Stream Name	Gander Pond Outflow			
Date Monitored	9-Sep-13			
Time at Site (24 hr)	**Start Time:**	2:00:00 PM	**End Time:**	
Personnel	Eli H., Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	432891	7269919		
Weather Conditions	Below Zero	Snow		

Transducer Information			
PT Model	ELF-2	**Serial #**	7110581
Gain	3.5338	**Offset**	-0.0121
Status	O.k.	**Battery**	96%
# of Records	6470	**Memory Free**	29299
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 17	1.879	101.879		100.000	BM 17
BM 18			1.737	100.142	BM 18
BM 19			1.828	100.051	BM 19
PT			3.012	98.867	Depth: 0.798
WL			2.212	**99.667**	**Corrected to 99.659**
SG				101.879	
TBM	1.809	101.800	1.888	99.991	
SG				101.800	
WL			2.136	**99.664**	**Corrected to 99.659**
PT				101.800	
BM 19			1.752	100.048	BM 19
BM 18			1.658	100.142	BM 18
BM 17			1.801	99.999	BM 17
BM 20			0.579	101.221	new rebar LB
BM 21			0.767	101.033	new rebar RB

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 18	100.137	100.142	0.005	
BM 19	100.042	100.050	0.007	
PT	98.902	98.867	-0.035	

Summary		
Stage (m)	99.666	Corrected to 99.659m
Discharge (m^3/s)	0.007	
Pressure Transducer Reading (m)	0.820	
Pressure Transducer Elevation (m)	98.846	

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	14:20	**End**	15:00	**Location**	10m US of PT			
Method	Velocity-area (Mid-section)				**Instrument Model**	Flo-Mate			
Flow Meter Type	Electromagnetic				**Instrument Serial #**	3747			
Stage (m)	**Start**	**Reading**	0.814	**Time**	14:20				
	End	**Reading**	0.816	**Time**	15:00				

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	0.30	0.00	0.0	0.00	0			0.000	0.0
	0.35	0.06	0.1	0.00	0			0.000	0.0
	0.42	0.10	0.1	0.01	0			0.000	0.0
	0.49	0.22	0.1	0.02	0			0.000	0.0
	0.56	0.30	0.1	0.02	0			0.000	0.0
	0.60	0.33	0.0	0.02	0.01			0.000	2.7
	0.67	0.34	0.1	0.03	0.01			0.000	3.8
	0.75	0.32	0.1	0.02	0.02			0.000	6.2
	0.80	0.24	0.1	0.01	0.02			0.000	3.6
	0.85	0.24	0.0	0.01	0.04			0.000	7.1
	0.90	0.26	0.1	0.01	0.03			0.000	5.8
	0.95	0.28	0.0	0.01	0.03			0.000	6.3
	1.00	0.29	0.1	0.01	0.03			0.000	6.5
	1.05	0.30	0.1	0.02	0.02			0.000	4.5
	1.10	0.30	0.1	0.02	0.02			0.000	4.5
	1.15	0.30	0.1	0.02	0.02			0.000	4.5
	1.20	0.30	0.1	0.02	0.02			0.000	4.5
	1.25	0.30	0.1	0.02	0.02			0.000	4.5
	1.30	0.28	0.1	0.02	0.02			0.000	5.0
	1.37	0.28	0.1	0.02	0.03			0.001	8.8
	1.44	0.26	0.1	0.02	0.03			0.001	8.1
	1.51	0.22	0.1	0.02	0.03			0.000	6.9
	1.58	0.16	0.1	0.01	0.02			0.000	3.3
	1.65	0.16	0.1	0.01	0.01			0.000	1.7
	1.72	0.16	0.1	0.01	0.01			0.000	1.4
	1.77	0.08	0.1	0.00	0.01			0.000	0.5
LB	1.80	0.00	0.0	0.00	0			0.000	0.0
Total Q								**0.007**	**100.0**

General Notes

Stage elevation adjusted to 99.659 in rating curve based on PT record.

Appendix 3. Manual Stage and Discharge Measurement, Site PL-H1

Site Information				
Project Name	Back River			
Station Identification	PL-H1			
Stream Name	Propeller Outflow			
Date Monitored	8-Jun-13			
Time at Site (24 hr)	Start Time:	1:18:00 PM	End Time:	
Personnel	Eli H., Byeong K.			
Station Cordinates	Easting	Northing	Elevation	
	436094	7279939		
Weather Conditions	Cloudy, rainy, mistly, windy			

Transducer Information			
PT Model	125	Serial #	2718019
Gain	3.5179	Offset	-0.02195
Status	OK	Battery	100%
# of Records	24	Memory Free	32518
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 8	0.996	100.996		100.000	
BM 7			1.458	99.538	
BM 6			1.396	99.600	
WL			1.815	**99.181**	
PT			2.260	98.736	
TP	1.312	100.935	1.373	99.623	
PT			2.196	98.739	
WL			1.752	**99.183**	
BM 6			1.333	99.602	
BM 7			1.398	99.537	
BM 8			0.933	100.002	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 8	100	100.001	0.001	
BM 7	99.539	99.538	-0.002	
BM 6	99.603	99.601	-0.002	
PT	98.512	99.182	0.670	

Discharge Measurement ADCP								
Time (24 hr)	Start	11:30	End	13:00	Location	In line with station		
Method	Velocity-area (ADCP)				Water Temp (ADCP)(°C)	4		
Flow Meter Type	ADCP				Water Temp (Therm) (°C)			
Instrument Model	SteamPro				Mean Discharge Q (m^3/s)	7.8		
Instrument Serial#					Error (Std Dev in m^3/s)	0.27		
Stage (m) Start	Reading	0.446	Time	11:30	Mean % of Q Measured	61.5		
Stage (m) End	Reading	0.446	Time	13:00				
File Location	N:\833 Sabina\833-002 Back River\833-002-02 WaterResources-Hydrology\Data and Documentation\Flow Measurement							

Transect #	Discharge Q (m^3/s)						% Q Measured	% Bad	
	Top	Mid	Bottom	Left	Right	Total Q		Ensembles	Bins
1	1.061	4.642	1.698	0.008	0.079	7.488	61.993	14	2
2	1.186	4.744	1.784	0.015	0.126	7.854	60.402	17	2
3	1.138	4.474	1.713	-0.003	0.031	7.354	60.838	14	2
4	1.226	4.768	1.985	0.011	0.039	8.029	59.385	18	2
5	1.151	4.840	1.972	0.009	0.082	8.055	60.087	22	3
6	1.107	5.061	1.645	0.003	0.157	7.973	63.477	18	2
7	1.063	5.045	1.678	0.012	0.054	7.852	64.251	12	2
Mean	**1.13**	**4.80**	**1.78**	**0.01**	**0.08**	**7.80**	**61.49**	**16.43**	**2.14**

General Notes

Moved ~ 2m ds due to boulders near bank.
-Large bad ensembles due to bouldery bottom of channel (boulder of section of bed RB to LB)
-First transect record as negative - did addional transects because first was skewing values.

Summary			
Stage (m)	99.182		
Discharge (m^3/s)	7.801		
Pressure Transducer Reading (m)	0.446		
Pressure Transducer Elevation (m)	98.736		

Appendix 3. Manual Stage and Discharge Measurement, Site PL-H1

Site Information				
Project Name	Back River			
Station Identification	PL-H1			
Stream Name	Propeller Outflow			
Date Monitored	19-Jul-13			
Time at Site (24 hr)	**Start Time:**	12:55:00 PM	**End Time:**	
Personnel	Eli H., Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	436094	7279939		
Weather Conditions	Mix sun + cloud			

Transducer Information			
PT Model	ELF-2	**Serial #**	2718019
Gain	3.5179	**Offset**	-0.02195
Status	OK	**Battery**	100%
# of Records	5928	**Memory Free**	29532
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 8	1.128	101.128		100.000	
BM 7			1.590	99.538	
BM 6			1.527	99.601	
PT			2.388	98.740	
WL			2.401	**98.727**	error
TP	1.353	101.043	1.438	99.690	
WL			2.328	**98.715**	use this one
PT			2.306	98.737	
BM 6			1.443	99.600	
BM 7			1.508	99.535	
BM 8			1.045	99.998	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 7	99.539	99.537	-0.003	
BM 6	99.603	99.601	-0.002	
PT	98.512	98.739	0.226	

Summary	
Stage (m)	98.715
Discharge (m^3/s)	0.493
Pressure Transducer Reading (m)	0.127
Pressure Transducer Elevation (m)	98.588

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	14:20	**End**	15:00	**Location**	400m Upstream of PT at bedrock constriction. Same location as Aug/Sep 2012	
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950	
Flow Meter Type	Electromagnetic			**Instrument Serial #**		130881001502	
Stage (m)	**Start**	**Reading**	0.127	**Time**	14:20		
	End	**Reading**		**Time**	15:00		

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	2.10	0.00	0.0	0.07	0	0	0.00	0.000	0.0
	2.35	0.59	0.3	0.12	0.19	0	0	0.022	4.5
	2.50	0.62	0.2	0.11	0.14	0	0	0.015	3.1
	2.70	0.60	0.2	0.12	0.16	0	0	0.019	3.9
	2.90	0.60	0.2	0.12	0.2	0.00	0.00	0.024	4.9
	3.10	0.62	0.2	0.12	0.21	0.00	0.00	0.026	5.3
	3.30	0.64	0.2	0.13	0.26	0.00	0.00	0.033	6.8
	3.50	0.87	0.2	0.17	0	0.28	0.20	0.042	8.5
	3.70	0.76	0.2	0.15	0	0.25	0.15	0.030	6.2
	3.90	0.78	0.2	0.16	0	0.27	0.14	0.032	6.5
	4.10	0.72	0.2	0.14	0.2	0.00	0.00	0.029	5.8
	4.30	0.67	0.2	0.17	0.28	0.00	0.00	0.047	9.5
	4.60	0.30	0.3	0.06	0.4	0.00	0.00	0.024	4.9
	4.70	0.26	0.1	0.04	0.38	0.00	0.00	0.015	3.0
	4.90	0.36	0.2	0.09	0.3	0.00	0.00	0.027	5.5
	5.20	0.28	0.3	0.08	0.21	0.00	0.00	0.018	3.6
	5.50	0.32	0.3	0.10	0.2	0.00	0.00	0.019	3.9
	5.80	0.25	0.3	0.08	0.26	0.00	0.00	0.020	4.0
	6.10	0.21	0.3	0.07	0.25	0.00	0.00	0.018	3.7
	6.50	0.15	0.4	0.06	0.25	0.00	0.00	0.015	3.0
	6.90	0.16	0.4	0.06	0.21	0.00	0.00	0.012	2.4
	7.20	0.16	0.3	0.06	0.08	0.00	0.00	0.005	1.0
Rock	7.70	0.00	0.5	0.00	0	0.00	0.00	0.000	0.0
	8.05	0.05	0.4	0.02	0.04	0.00	0.00	0.001	0.1
RB	8.30	0.00	0.3	0.01	0	0.00	0.00	0.000	0.0
Total Q	**2.30**							**0.493**	100.0

General Notes

PT almost out of water upon arrival. RTR: 0.1275, 0.126 (should be near 0). After PT was moved (13:35), the realtime readings = 0.335, 0.335, 0.335. Actual depth measured: 0.197 (13:51). At 15:20, 0.337, 0.336, depth measured 0.198

Appendix 3. Manual Stage and Discharge Measurement, Site PL-H1

Site Information

Project Name	Back River			
Station Identification	PL-H1			
Stream Name	Propeller Outflow			
Date Monitored	20-Jul-13			
Time at Site (24 hr)	**Start Time:**	1:30:00 PM	**End Time:**	
Personnel	Eli H., Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	436094	7279939		
Weather Conditions	Mix sun + cloud			

Transducer Information

PT Model	ELF-2	**Serial #**	2718019
Gain	3.5179	**Offset**	-0.02195
Status	OK	**Battery**	100%
# of Records	5928	**Memory Free**	29532
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 8	1.007	101.007		100.000	
BM 7			1.468	99.539	
BM 6			1.405	99.602	
PT			2.509	98.498	0.220
WL	2.236	100.954	2.289	**98.718**	
TP			2.288	98.666	
WL			2.237	**98.717**	
PT			2.456	98.498	
BM 6			1.353	99.601	
BM 7			1.546	99.408	
BM 8			0.954	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 7	99.539	99.474	-0.066	
BM 6	99.603	99.602	-0.001	
PT	98.498	98.498	0.000	New PT Elevation

Summary

Stage (m)	98.718
Discharge (m^3/s)	n/a
Pressure Transducer Reading (m)	0.238
Pressure Transducer Elevation (m)	98.480

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**		**End**		**Location**	
Method				**Instrument Model**		
Flow Meter Type				**Instrument Serial #**		
Stage (m)	**Start**	**Reading**		**Time**		
	End	**Reading**		**Time**		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
Total Q								0.000	0.0

General Notes

Replaced logger due to unstable readings noted on 19/07/13. Logger re-started at 13:00

Appendix 3. Manual Stage and Discharge Measurement, Site PL-H1

Site Information				
Project Name	Back River			
Station Identification	PL-H1			
Stream Name	Propeller Outflow			
Date Monitored	21-Aug-13			
Time at Site (24 hr)	**Start Time:**	7:40:00 AM	**End Time:**	11:15:00 AM
Personnel	Eli H., Mark W.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	436094	7279939		
Weather Conditions	Cloudy			

Transducer Information			
PT Model	ELF-2	**Serial #**	2809015
Gain	3.51	**Offset**	0.0111
Status	OK	**Battery**	98%
# of Records	4576	**Memory Free**	30247
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 8	1.055	101.055		100.000	
BM 7			1.519	99.536	
BM 6			1.456	99.599	
PT			2.562	98.493	0.120
WL			2.552	**98.503**	error
SG			2.187	98.868	
TP	1.872	101.008	1.919	99.136	
SG			2.140	98.868	
WL			2.396	**98.612**	Checked, ok
PT			2.516	98.492	
BM 6			1.409	99.599	
BM 7			1.473	99.535	
BM 8			1.009	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 7	99.539	99.536	-0.003	
BM 6	99.603	99.599	-0.004	
PT	98.498	98.493	-0.005	

Summary	
Stage (m)	98.612
Discharge (m^3/s)	0.208
Pressure Transducer Reading (m)	0.132
Pressure Transducer Elevation (m)	98.480

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	10:30	**End**	11:15	**Location**	~400m US of station at bedrock constriction	
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-mate	
Flow Meter Type	Electromagnetic			**Instrument Serial #**			
Stage (m)	**Start**	**Reading**	0.132	**Time**	10:30		
	End	**Reading**	0.133	**Time**	11:15		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	0.20	0.00	0.0	0.00	0			0.000	0.0
	0.30	0.09	0.1	0.01	0.03			0.000	0.1
	0.40	0.60	0.1	0.06	0			0.000	0.0
	0.50	0.62	0.1	0.06	0.1			0.006	3.0
	0.60	0.59	0.1	0.06	0.14			0.008	4.0
	0.70	0.56	0.1	0.06	0.17			0.010	4.6
	0.80	0.61	0.1	0.08	0.17			0.013	6.2
	0.95	0.56	0.2	0.08	0.17			0.014	6.9
	1.10	0.52	0.2	0.08	0.21			0.016	7.9
	1.25	0.52	0.2	0.08	0.23			0.018	8.6
	1.40	0.49	0.2	0.07	0.23			0.017	8.1
	1.55	0.47	0.2	0.07	0.25			0.018	8.5
	1.70	0.49	0.2	0.07	0.24			0.018	8.5
	1.85	0.40	0.2	0.06	0.25			0.015	7.2
	2.00	0.42	0.2	0.06	0.22			0.014	6.7
	2.15	0.34	0.2	0.05	0.22			0.011	5.4
	2.30	0.32	0.2	0.06	0.19			0.011	5.1
	2.50	0.26	0.2	0.05	0.12			0.006	3.0
	2.70	0.06	0.2	0.01	0.17			0.002	1.0
	2.90	0.07	0.2	0.02	0.21			0.004	1.8
	3.20	0.04	0.3	0.01	0.17			0.002	0.9
	3.45	0.10	0.3	0.03	0.11			0.003	1.3
	3.70	0.08	0.3	0.02	0.13			0.003	1.4
	4.00	0.06	0.3	0.01	0.01			0.000	0.0
Rocks	4.02	0.00	0.0	0.00	0			0.000	0.0
Rocks	4.65	0.00	0.6	0.00	0			0.000	0.0
	4.75	0.04	0.1	0.00	0.04			0.000	0.1
RB	4.85	0.00	0.1	0.00	0			0.000	0.0
Total Q								**0.208**	100.0

General Notes

Appendix 3. Manual Stage and Discharge Measurement, Site PL-H1

Site Information				
Project Name	Back River			
Station Identification	PL-H1			
Stream Name	Propeller Outflow			
Date Monitored	13-Sep-13			
Time at Site (24 hr)	**Start Time:**	7:15:00 AM	**End Time:**	
Personnel	Eli H., Robert			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	436094	7279939		
Weather Conditions	Cloudy, recent rain			

Transducer Information			
PT Model	ELF-2	**Serial #**	2809015
Gain	3.51	**Offset**	0.0111
Status	ok	**Battery**	100%
# of Records	7886	**Memory Free**	28590
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 8	0.895	100.895		100.000	
BM 7			1.358	99.537	
BM 6			1.294	99.601	
PT			2.401	98.494	0.17
WL			2.227	**98.668**	
SG			2.024	98.871	bottom hole
TP	1.863	100.999	1.759	99.136	
SG			2.131	98.868	
WL			2.333	**98.666**	
PT			2.504	98.495	
BM 6			1.401	99.598	
BM 7			1.462	99.537	
BM 8			1.001	99.998	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 7	99.539	99.537	-0.002	
BM 6	99.603	99.600	-0.003	
PT	98.498	98.495	-0.004	

Summary	
Stage (m)	98.666
Discharge (m^3/s)	0.304
Pressure Transducer Reading (m)	0.184
Pressure Transducer Elevation (m)	98.482

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	8:10	**End**	8:15	**Location**	400m upstream of station	
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-mate	
Flow Meter Type	Electromagnetic			**Instrument Serial #**			
Stage (m)	**Start**	**Reading**	0.184	**Time**	8:10	**SG**	0.209
	End	**Reading**	0.19	**Time**	8:50	**SG**	0.212

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	0.00	0.00	0.0	0.00	0			0.000	0.0
Rocks	0.20	0.03	0.2	0.01	0.04			0.000	0.1
Rocks	0.50	0.06	0.3	0.02	0.03			0.001	0.2
	0.80	0.06	0.3	0.02	0.11			0.002	0.7
	1.10	0.06	0.3	0.02	0.12			0.002	0.7
	1.40	0.14	0.3	0.04	0.19			0.007	2.2
	1.60	0.16	0.2	0.03	0.15			0.005	1.6
	1.80	0.19	0.2	0.04	0.24			0.009	3.0
	2.00	0.07	0.2	0.01	0.21			0.003	1.0
	2.20	0.11	0.2	0.02	0.31			0.007	2.2
	2.40	0.08	0.2	0.02	0.32			0.005	1.7
	2.60	0.10	0.2	0.02	0.26			0.005	1.7
	2.80	0.31	0.2	0.06	0.28			0.017	5.7
	3.00	0.31	0.2	0.06	0.32			0.020	6.5
	3.20	0.24	0.2	0.05	0.46			0.022	7.3
	3.40	0.27	0.2	0.05	0.45			0.024	8.0
	3.60	0.32	0.2	0.05	0.41			0.020	6.5
	3.70	0.50	0.1	0.05	0.35			0.018	5.8
	3.80	0.52	0.1	0.05	0.31			0.016	5.3
	3.90	0.54	0.1	0.05	0.33			0.018	5.9
	4.00	0.52	0.1	0.08	0.29			0.023	7.4
	4.20	0.52	0.2	0.09	0.27			0.025	8.1
	4.35	0.46	0.1	0.07	0.24			0.017	5.4
	4.50	0.57	0.2	0.09	0.22			0.019	6.2
	4.65	0.56	0.2	0.09	0.15			0.013	4.3
	4.81	0.56	0.2	0.07	0.12			0.008	2.8
LB	4.90	0.00	0.1	0.03	0			0.000	0.0
								0.000	0.0
Total Q								**0.304**	100.0

General Notes

Did not demobilize station. Left in for Merle to demob at end of September.

Appendix 3. Manual Stage and Discharge Measurements, Site PL-H2

Site Information				
Project Name	Back River			
Station Identification	PL-H2			
Stream Name	Goose Lake Outflow			
Date Monitored	2-Jun-13			
Time at Site (24 hr)	**Start Time:**	8:00:00 AM	**End Time:**	
Personnel	Eli H.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	435007	7272014		
Weather Conditions	Cloudy, Rain/Shower			

Transducer Information			
PT Model	PT2X	**Serial #**	21221023
Gain	1.005618	**Offset**	0.009
Status		**Battery**	
# of Records		**Memory Free**	
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 4	1.411	101.411		100.000	
BM 45			1.569	99.842	
BM 46			1.263	100.148	
PT			2.017	99.394	0.400
WL			1.605	**99.806**	
SG			1.550	99.861	
TBM	1.176	101.295	1.292	100.119	
SG			1.434	99.861	
WL			1.490	**99.805**	
PT			1.900	99.395	
BM 46			1.147	100.148	
BM 45			1.452	99.843	
BM 4			1.294	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 45	99.869	99.843	-0.026	
BM 46	100.177	100.148	-0.029	
PT	99.395	99.395	0.000	

Summary	
Stage (m)	99.806
Discharge (m^3/s)	4.014
Pressure Transducer Reading (m)	0.439
Pressure Transducer Elevation (m)	99.367

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	9:20	**End**	10:20	**Location**	15m Downstream of PT		
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950		
Flow Meter Type	Electromagnetic			**Instrument Serial #**		130881001502		
Stage (m)	**Start**	**Reading**	0.438	**SG**	0.065	**Time**	9:00	
	End	**Reading**	0.439	**SG**	0.065	**Time**	10:20	

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	2.80	0.00	0.0	0.00	0			0.000	0.0
	2.90	0.06	0.1	0.09	0			0.000	0.0
	5.70	0.12	2.8	0.19	0.01			0.002	0.0
	6.10	0.30	0.4	0.75	0.06			0.045	1.1
	10.70	0.16	4.6	0.58	0.07			0.041	1.0
	13.40	0.15	2.7	0.40	0.1			0.040	1.0
	16.00	0.18	2.6	0.50	0.16			0.081	2.0
	19.00	0.31	3.0	0.93	0.22			0.205	5.1
	22.00	0.32	3.0	0.88	0.31			0.273	6.8
	24.50	0.33	2.5	0.83	0.41			0.338	8.4
	27.00	0.32	2.5	0.80	0.46			0.368	9.2
	29.50	0.39	2.5	0.98	0.36			0.351	8.7
	32.00	0.38	2.5	0.95	0.28			0.266	6.6
	34.50	0.44	2.5	1.10	0.22			0.242	6.0
	37.00	0.36	2.5	0.81	0.3			0.243	6.1
	39.00	0.39	2.0	0.88	0.37			0.325	8.1
	41.50	0.26	2.5	0.65	0.43			0.280	7.0
	44.00	0.30	2.5	0.75	0.43			0.323	8.0
	46.50	0.27	2.5	0.68	0.28			0.189	4.7
	49.00	0.18	2.5	0.45	0.26			0.117	2.9
	51.50	0.19	2.5	0.48	0.22			0.105	2.6
	54.00	0.13	2.5	0.33	0.22			0.072	1.8
	56.50	0.18	2.5	0.40	0.27			0.107	2.7
	58.40	0.20	1.9	0.25	0.02			0.005	0.1
LB	59.00	0.00	0.6	0.06	0			0.000	0.0
Total Q								**4.014**	100.0

Appendix 3. Manual Stage and Discharge Measurements, Site PL-H2

Site Information				
Project Name	Back River			
Station Identification	PL-H2			
Stream Name	Goose Lake Outflow			
Date Monitored	16-Jun-13			
Time at Site (24 hr)	**Start Time:**	12:00:00 PM	**End Time:**	
Personnel	Eli H., Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	435007	7272014		
Weather Conditions	Sun and cloud			

Transducer Information			
PT Model	PT2X	**Serial #**	21221023
Gain	1.005618	**Offset**	0.009
Status	Active	**Battery**	3.0V
# of Records	2035	**Memory Free**	522104
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 4	1.516	101.516		100.000	
BM 45			1.661	99.855	error, don't use
BM 46			1.351	100.165	
PT			2.106	99.410	depth: 0.300
WL			1.812	**99.704**	
TBM	1.465	101.318	1.663	99.853	
SG			1.453	99.865	(sleeve near arrow)
WL			1.616	**99.702**	
PT			1.907	99.411	
BM 46			1.153	100.165	
BM 45			1.467	99.851	Good
BM 4			1.316	100.002	
SG2			1.456	99.862	end of bolt

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 45	99.869	99.851	-0.018	
BM 46	100.177	100.165	-0.012	
PT	99.3945	99.411	0.016	

Summary	
Stage (m)	99.703
Discharge (m^3/s)	1.874
Pressure Transducer Reading (m)	0.330
Pressure Transducer Elevation (m)	99.373

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	12:15	**End**	13:10	**Location**		
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950	
Flow Meter Type	Electromagnetic			**Instrument Serial #**			
Stage (m)	**Start**	**Reading**	0.33	**Time**	12:15		
	End	**Reading**	0.33	**Time**	13:10		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	1.40	0.00	0.0	0.01	0			0.000	0.0
	1.60	0.11	0.2	0.03	0.02			0.001	0.0
	2.00	0.15	0.4	0.14	0.05			0.007	0.4
	3.50	0.14	1.5	0.20	0.06			0.012	0.7
	4.90	0.07	1.4	0.07	0.03			0.002	0.1
Rock Pile	5.40	0.00	0.5	0.00	0			0.000	0.0
	6.50	0.03	1.1	0.05	0.05			0.003	0.1
	9.00	0.06	2.5	0.15	0.06			0.009	0.5
	11.50	0.08	2.5	0.20	0.03			0.006	0.3
	14.00	0.19	2.5	0.48	0.11			0.052	2.8
	16.50	0.14	2.5	0.35	0.23			0.081	4.3
	19.00	0.23	2.5	0.58	0.23			0.132	7.1
	21.50	0.30	2.5	0.60	0.16			0.096	5.1
	23.00	0.30	1.5	0.38	0.21			0.079	4.2
	24.00	0.27	1.0	0.47	0.32			0.151	8.1
	26.50	0.26	2.5	0.78	0.31			0.242	12.9
	30.00	0.26	3.5	0.78	0.25			0.195	10.4
	32.50	0.24	2.5	0.60	0.2			0.120	6.4
	35.00	0.24	2.5	0.60	0.29			0.174	9.3
	37.50	0.24	2.5	0.60	0.27			0.162	8.6
	40.00	0.26	2.5	0.65	0.17			0.111	5.9
	42.50	0.18	2.5	0.45	0.17			0.077	4.1
	45.00	0.12	2.5	0.30	0.13			0.039	2.1
	47.50	0.12	2.5	0.30	0.09			0.027	1.4
	50.00	0.06	2.5	0.15	0.06			0.009	0.5
	52.50	0.12	2.5	0.24	0.13			0.031	1.7
	54.00	0.23	1.5	0.25	0.2			0.051	2.7
	54.70	0.22	0.7	0.11	0.06			0.007	0.4
LB	55.00	0.00	0.3	0.03	0			0.000	0.0
Total Q								**1.874**	100.0

Appendix 3. Manual Stage and Discharge Measurements, Site PL-H2

Site Information				
Project Name	Back River			
Station Identification	PL-H2			
Stream Name	Goose Lake Outflow			
Date Monitored	18-Jul-13			
Time at Site (24 hr)	**Start Time:**	11:34:00 AM	**End Time:**	
Personnel	Eli H., Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	435007	7272014		
Weather Conditions	sun, partly cloudy, windy			

Transducer Information			
PT Model	PT2X	**Serial #**	21221023
Gain	1.005618	**Offset**	0.009
Status	Active	**Battery**	2.9V
# of Records	6641	**Memory Free**	517499
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 4	1.181	101.181		100.000	
BM 45			1.334	99.847	
BM 46			1.008	100.173	
PT			1.779	99.402	0.121
SG			1.319	99.862	
WL			1.660	**99.521**	
TBM	1.583	101.100	1.664	99.517	
WL			1.581	**99.519**	
SG			1.239	99.861	end of bolt
PT			1.698	99.402	
BM 46			0.928	100.172	
BM 45			1.254	99.846	
BM 4			1.100	100.000	
SG2			1.237	99.863	Near black arrow
DSWL			1.725	99.375	
USWL			1.558	99.542	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 45	99.869	99.847	-0.023	
BM 46	100.177	100.173	-0.005	
PT	99.3945	99.402	0.008	

Summary	
Stage (m)	99.520
Discharge (m^3/s)	0.181
Pressure Transducer Reading (m)	0.153
Pressure Transducer Elevation (m)	99.367

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	11:45	**End**	12:20	**Location**				
Method	Velocity-area (Mid-section)			**Instrument Model**	FH950				
Flow Meter Type	Electromagnetic			**Instrument Serial #**					
Stage (m)	**Start**	**Reading**		**SG**	0.332	**Time**	11:45		
	End	**Reading**	0.153	**SG**	0.332	**Time**	12:20		

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	27.00	0.00	0.0	0.01	0			0.000	0.0
	27.50	0.05	0.5	0.03	0.02			0.001	0.3
Rock	28.00	0.00	0.5	0.00	0			0.000	0.0
	28.70	0.06	0.7	0.06	0			0.000	0.0
	30.00	0.06	1.3	0.10	0.02			0.002	1.1
	32.00	0.08	2.0	0.14	0.06			0.008	4.6
	33.50	0.08	1.5	0.12	0.06			0.007	4.0
	35.00	0.12	1.5	0.18	0.11			0.020	10.9
	36.50	0.15	1.5	0.23	0.1			0.023	12.4
	38.00	0.12	1.5	0.18	0.06			0.011	6.0
	39.50	0.10	1.5	0.15	0.1			0.015	8.3
	41.00	0.13	1.5	0.20	0.09			0.018	9.7
Behind rock	42.50	0.08	1.5	0.12	0			0.000	0.0
	44.00	0.11	1.5	0.17	0.04			0.007	3.6
	45.50	0.12	1.5	0.18	0.04			0.007	4.0
	47.00	0.14	1.5	0.21	0.05			0.011	5.8
	48.50	0.12	1.5	0.18	0.06			0.011	6.0
	50.00	0.10	1.5	0.15	0.08			0.012	6.6
	51.50	0.11	1.5	0.17	0.07			0.012	6.4
	53.00	0.08	1.5	0.12	0.03			0.004	2.0
	54.50	0.10	1.5	0.15	0.05			0.008	4.1
	56.00	0.06	1.5	0.09	0.02			0.002	1.0
	57.50	0.09	1.5	0.10	0.04			0.004	2.3
	58.30	0.09	0.8	0.05	0.03			0.001	0.8
Rock	58.60	0.00	0.3	0.00	0			0.000	0.0
Rock	59.20	0.00	0.9	0.00	0			0.000	0.0
	59.40	0.08	0.2	0.02	0.02			0.000	0.2
RB	59.60	0.00	0.2	0.01	0.00			0.000	0.0
Total Q								**0.181**	100.0

Appendix 3. Manual Stage and Discharge Measurements, Site PL-H2

Site Information				
Project Name	Back River			
Station Identification	PL-H2			
Stream Name	Goose Lake Outflow			
Date Monitored	22-Aug-13			
Time at Site (24 hr)	**Start Time:**	7:00:00 AM	**End Time:**	9:30:00 AM
Personnel	Eli H., Mark W.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	435007	7272014	266	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PT2X	**Serial #**	21221023
Gain	1.005618	**Offset**	0.009
Status	Active	**Battery**	3.0V
# of Records	11648	**Memory Free**	512491
Date Serviced		**Crest Gauges**	No

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 4	1.287	101.287		100.000	
BM 45			1.441	99.846	
BM 46			1.116	100.171	
PT			1.887	99.400	0.110
SG			1.422	99.865	
WL			1.771	**99.516**	
TBM	1.409	101.258	1.438	99.849	
WL			1.741	**99.517**	
SG			1.393	99.865	end of bolt
PT			1.859	99.399	
BM 46			1.089	100.169	
BM 45			1.413	99.845	
BM 4			1.260	99.998	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 45	99.869	99.846	-0.023	
BM 46	100.177	100.170	-0.007	
PT	99.3945	99.400	0.005	

Stage (m)	99.517
Discharge (m^3/s)	0.104
Pressure Transducer Reading (m)	0.149
Pressure Transducer Elevation (m)	99.368

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	6:15	**End**	7:00	**Location**	15m Downstream of PT	
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000	
Flow Meter Type	Flo-Mate			**Instrument Serial #**			
Stage (m)	**Start**	**Reading**	0.146	**Time**	7:15		
	End	**Reading**	0.148	**Time**	8:00		

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	-1.00	0.00	0.0	0.02	0			0.000	0.0
	-0.25	0.06	0.8	0.03	0.02			0.001	0.6
Rocks	0.00	0.00	0.3	0.00	0			0.000	0.0
	0.50	0.06	0.5	0.04	0.01			0.000	0.4
Rocks	1.30	0.00	0.8	0.00	0			0.000	0.0
	1.70	0.04	0.4	0.01	0.01			0.000	0.1
Rocks	2.00	0.00	0.3	0.00	0			0.000	0.0
Rocks	4.50	0.00	2.5	0.00	0			0.000	0.0
	4.60	0.03	0.1	0.02	0.03			0.001	0.6
	6.00	0.08	1.4	0.12	0.04			0.005	4.5
	7.50	0.09	1.5	0.14	0.05			0.007	6.5
	9.00	0.10	1.5	0.09	0.08			0.007	6.9
Rocks	9.30	0.00	0.3	0.00	0			0.000	0.0
Behind rock	10.00	0.13	0.7	0.14	0.03			0.004	4.1
	11.50	0.11	1.5	0.17	0.08			0.013	12.7
	13.00	0.08	1.5	0.10	0.08			0.008	7.7
	14.00	0.13	1.0	0.13	0.09			0.012	11.2
	15.00	0.12	1.0	0.12	0.06			0.007	6.9
behind rock	16.00	0.04	1.0	0.04	-0.03			-0.001	-1.2
	17.00	0.05	1.0	0.06	0.01			0.001	0.6
	18.50	0.12	1.5	0.18	0			0.000	0.0
	20.00	0.14	1.5	0.21	0.02			0.004	4.0
	21.50	0.16	1.5	0.20	0.04			0.008	7.7
	22.50	0.15	1.0	0.15	0.05			0.008	7.2
	23.50	0.14	1.0	0.14	0.01			0.001	1.3
	24.50	0.12	1.0	0.15	0.01			0.002	1.4
	26.00	0.10	1.5	0.15	0.05			0.008	7.2
	27.50	0.06	1.5	0.13	0.04			0.005	4.8
Total Q (this sheet)								**0.099**	95.3

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site PL-H2

Site Information				
Project Name	Back River			
Station Identification	PL-H2			
Stream Name	Goose Lake Outflow			
Date Monitored	22-Aug-13			
Time at Site (24 hr)	Start Time:	7:00:00 AM	End Time:	9:30:00 AM
Personnel	Eli H., Mark W.			
Station Cordinates	Easting	Northing	Elevation	
	435007	7272014	266	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PT2X	Serial #	21221023
Gain	1.005618	Offset	0.009
Status	Active	Battery	3.0V
# of Records	11648	Memory Free	512491
Date Serviced		Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 4	1.287	101.287		100.000	
BM 45			1.441	99.846	
BM 46			1.116	100.171	
PT			1.887	99.400	0.110
SG			1.422	99.865	
WL			1.771	**99.516**	
TBM	1.409	101.258	1.438	99.849	
WL			1.741	**99.517**	
SG			1.393	99.865	end of bolt
PT			1.859	99.399	
BM 46			1.089	100.169	
BM 45			1.413	99.845	
BM 4			1.260	99.998	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 45	99.869	99.846	-0.023	
BM 46	100.177	100.170	-0.007	
PT	99.3945	99.400	0.005	

Stage (m)	99.517
Discharge (m^3/s)	0.104
Pressure Transducer Reading (m)	0.149
Pressure Transducer Elevation (m)	99.368

Discharge Measurement - Mid-Section Method

Time (24 hr)	Start	6:15	End	7:00	Location	15m Downstream of PT			
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			Instrument Serial #					
Stage (m)	Start	Reading	0.146	Time	7:15				
	End	Reading	0.148	Time	8:00				

cont'd	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
Rocks	28.50	0.00	0.0	0.00	0			0.000	0.0
Rocks	30.10	0.00	1.6	0.00	0			0.000	0.0
	30.20	0.04	0.1	0.02	0.03			0.000	0.5
	30.90	0.10	0.7	0.05	0.06			0.003	2.6
Rocks	31.10	0.00	0.2	0.00	0			0.000	0.0
Rocks	31.80	0.00	0.7	0.00	0			0.000	0.0
	32.00	0.06	0.2	0.01	0.02			0.000	0.3
	32.30	0.00	0.3	0.00	0			0.000	0.0
	35.90	0.00	3.6	0.00	0			0.000	0.0
	36.20	0.04	0.3	0.01	-0.02			0.000	-0.3
Rocks	36.60	0.00	0.4	0.00	0			0.000	0.0
Rocks	38.70	0.00	2.1	0.00	0			0.000	0.0
	38.90	0.03	0.2	0.02	0			0.000	0.0
Rocks	39.70	0.00	0.8	0.00	0			0.000	0.0
Rocks	40.40	0.00	0.7	0.00	0			0.000	0.0
	40.60	0.06	0.2	0.03	0.02			0.001	0.5
	41.30	0.10	0.7	0.06	0.02			0.001	1.2
LB	41.80	0.00	0.5	0.00	0			0.000	0.0
Total Q								**0.104**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site PL-H2

Site Information				
Project Name	Back River			
Station Identification	PL-H2			
Stream Name	Goose Lake Outflow			
Date Monitored	15-Sep-13			
Time at Site (24 hr)	**Start Time:**	8:00:00 AM	**End Time:**	9:30:00 AM
Personnel	Eli H., Robert M., Jem M.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	435007	7272014	266m	
Weather Conditions	High Cloud			

Transducer Information			
PT Model	PT2X	**Serial #**	21221023
Gain	1.005618	**Offset**	0.009
Status	Active	**Battery**	2.9V
# of Records	15115	**Memory Free**	509024
Date Serviced		**Crest Gauges**	No

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 4	1.401	101.401		100.000	
BM 45			1.559	99.842	
BM 46			1.232	100.169	
PT			2.004	99.397	0.110
SG			1.534	99.867	
WL			1.764	**99.637**	
TBM	1.698	101.376	1.723	99.678	
WL			1.739	**99.637**	
SG			1.509	99.867	end of bolt
PT			1.979	99.397	
BM 46			1.208	100.168	
BM 45			1.536	99.840	
BM 4			1.376	100.000	
US WL			1.74	99.636	
BM 47			1.362	100.014	
BM 48			0.463	100.913	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 45	99.869	99.841	-0.028	
BM 46	100.177	100.169	-0.009	
PT	99.3945	99.397	0.002	

Stage (m)	99.637
Discharge (m^3/s)	1.026
Pressure Transducer Reading (m)	0.276
Pressure Transducer Elevation (m)	99.361

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	8:07	**End**	8:53	**Location**	15m Downstream of PT		
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000		
Flow Meter Type	Flo-Mate			**Instrument Serial #**				
Stage (m)	**Start**	**Reading**	0.146	**Time**	8:07			
	End	**Reading**	0.148	**Time**	8:00			

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	1.00	0.00	0.0	0.01	0			0.000	0.0
	1.20	0.06	0.2	0.03	0.01			0.000	0.0
	1.90	0.14	0.7	0.09	0.06			0.005	0.5
	2.50	0.08	0.6	0.06	0.02			0.001	0.1
	3.40	0.08	0.9	0.06	0.02			0.001	0.1
	4.00	0.00	0.6	0.00	0			0.000	0.0
Rocks	6.40	0.00	2.4	0.00	0			0.000	0.0
Rocks	6.60	0.03	0.2	0.02	0.01			0.000	0.0
	8.00	0.06	1.4	0.10	0.04			0.004	0.4
	10.00	0.10	2.0	0.20	0.07			0.014	1.4
	12.00	0.12	2.0	0.24	0.11			0.026	2.6
	14.00	0.10	2.0	0.20	0.08			0.016	1.6
	16.00	0.12	2.0	0.24	0.14			0.034	3.3
Behind Rock	18.00	0.19	2.0	0.22	0.08			0.017	1.7
	18.30	0.08	0.3	0.08	0.24			0.019	1.9
	20.00	0.18	1.7	0.24	0.18			0.044	4.3
	21.00	0.24	1.0	0.22	0.16			0.035	3.4
Behind Rock	21.80	0.26	0.8	0.16	0.06			0.009	0.9
	22.20	0.22	0.4	0.24	0.14			0.034	3.3
	24.00	0.16	1.8	0.26	0.22			0.058	5.7
	25.50	0.18	1.5	0.27	0.22			0.059	5.8
	27.00	0.21	1.5	0.32	0.15			0.047	4.6
	28.50	0.22	1.5	0.33	0.15			0.050	4.8
	30.00	0.12	1.5	0.18	0.11			0.020	1.9
	31.50	0.25	1.5	0.38	0.11			0.041	4.0
	33.00	0.24	1.5	0.36	0.13			0.047	4.6
	34.50	0.22	1.5	0.22	0.23			0.051	4.9
Rocks	35.00	0.00	0.5	0.00	0			0.000	0.0
Total Q (this sheet)								**0.633**	61.7

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site PL-H2

Site Information				
Project Name	Back River			
Station Identification	PL-H2			
Stream Name	Goose Lake Outflow			
Date Monitored	15-Sep-13			
Time at Site (24 hr)	Start Time:	8:00:00 AM	End Time:	9:30:00 AM
Personnel	Eli H., Robert M., Jem M.			
Station Cordinates	Easting	Northing	Elevation	
	435007	7272014	266m	
Weather Conditions	High Cloud			

Transducer Information			
PT Model	PT2X	Serial #	21221023
Gain	1.005618	Offset	0.009
Status	Active	Battery	2.9V
# of Records	15115	Memory Free	509024
Date Serviced		Crest Gauges	No

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 4	1.401	101.401		100.000	
BM 45			1.559	99.842	
BM 46			1.232	100.169	
PT			2.004	99.397	0.110
SG			1.534	99.867	
WL			1.764	**99.637**	
TBM	1.698	101.376	1.723	99.678	
WL			1.739	**99.637**	
SG			1.509	99.867	end of bolt
PT			1.979	99.397	
BM 46			1.208	100.168	
BM 45			1.536	99.840	
BM 4			1.376	100.000	
US WL			1.74	99.636	
BM 47			1.362	100.014	
BM 48			0.463	100.913	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 45	99.869	99.841	-0.028	
BM 46	100.177	100.169	-0.009	
PT	99.3945	99.397	0.002	

Stage (m)	99.637
Discharge (m^3/s)	1.026
Pressure Transducer Reading (m)	0.276
Pressure Transducer Elevation (m)	99.361

Discharge Measurement - Mid-Section Method

Time (24 hr)	Start	8:07	End	8:53	Location	15m Downstream of PT		
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000		
Flow Meter Ty	Flo-Mate			Instrument Serial #				
Stage (m)	Start	Reading	0.146	Time	8:07			
	End	Reading	0.148	Time	8:00			

cont'd	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
	36.00	0.23	0.0	0.35	0.18			0.062	6.0
	38.00	0.15	2.0	0.30	0.19			0.057	5.6
	40.00	0.21	2.0	0.42	0.16			0.067	6.5
	42.00	0.15	2.0	0.30	0.15			0.045	4.4
	44.00	0.09	2.0	0.18	0.09			0.016	1.6
	46.00	0.10	2.0	0.20	0.1			0.020	1.9
	48.00	0.10	2.0	0.20	0.1			0.020	1.9
	50.00	0.08	2.0	0.16	0.08			0.013	1.2
	52.00	0.12	2.0	0.24	0.12			0.029	2.8
	54.00	0.16	2.0	0.24	0.16			0.038	3.7
	55.00	0.13	1.0	0.10	0.13			0.013	1.2
	55.50	0.18	0.5	0.07	0.18			0.013	1.3
LB	55.80	0.00	0.3	0.00	0			0.000	0.0
Total Q								1.026	100.0

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site GI-H1

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	5-Jun-13			
Time at Site (24 hr)	**Start Time:**	1:50:00 PM	**End Time:**	
Personnel	Eli H, Jeff A.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	432744	7271610		
Weather Conditions	Sunny			

Transducer Information			
PT Model	ELF-2	**Serial #**	2718023
Gain	3.5117	**Offset**	0.0122
Status	Active	**Battery**	4.6V
# of Records	1	**Memory Free**	65203
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 5	1.331	101.331		100.000	BM 5
BM 47			1.426	99.905	BM 47
BM 49			1.323	100.008	BM 49
PT			2.178	99.153	
WL			1.598	**99.733**	
TBM	1.420	101.399	1.352	99.979	
WL			1.669	**99.730**	
PT			2.247	99.152	
BM 49			1.391	100.008	BM 49
BM 47			1.494	99.905	BM 47
BM 5			1.400	99.999	BM 5

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 47	99.924	99.905	0.019	
BM 49	100.023	100.008	0.015	
PT	99.153	99.153	0.001	

Summary	
Stage (m)	99.732
Discharge (m^3/s)	1.034
Pressure Transducer Reading (m)	0.600
Pressure Transducer Elevation (m)	99.132

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	14:00	**End**	15:20	**Location**	50m DS of PT	
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950	
Flow Meter Type	Electromagnetic			**Instrument Serial #**		130881001502	
Stage (m)	**Start**	**Reading**	0.688	**Time**	14:00		
	End	**Reading**	0.600	**Time**	15:20		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
	1.50	0.00	0.0	0.00	0			0.000	0.0
	1.60	0.04	0.1	0.01	0.02			0.000	0.0
	1.90	0.16	0.3	0.06	0.1			0.006	0.5
	2.30	0.14	0.4	0.06	0.14			0.008	0.8
	2.70	0.12	0.4	0.05	0.12			0.006	0.6
	3.10	0.15	0.4	0.06	0.2			0.012	1.2
	3.50	0.09	0.4	0.04	0.13			0.005	0.5
	3.90	0.12	0.4	0.05	0.16			0.008	0.8
	4.35	0.25	0.5	0.10	0.21			0.021	2.0
	4.70	0.30	0.4	0.11	0.19			0.020	1.9
	5.05	0.10	0.4	0.04	0.2			0.007	0.7
	5.40	0.22	0.4	0.08	0.3			0.023	2.2
	5.75	0.28	0.4	0.08	0.34			0.029	2.8
	6.00	0.31	0.3	0.09	0.33			0.028	2.7
	6.30	0.32	0.3	0.10	0.38			0.036	3.5
	6.60	0.20	0.3	0.06	0.39			0.023	2.3
	6.90	0.22	0.3	0.07	0.28			0.018	1.8
	7.20	0.26	0.3	0.08	0.4			0.031	3.0
	7.50	0.32	0.3	0.10	0.44			0.042	4.1
	7.80	0.29	0.3	0.09	0.25			0.022	2.1
	8.10	0.21	0.3	0.06	0.34			0.021	2.1
	8.40	0.18	0.3	0.06	0.33			0.019	1.9
	8.75	0.10	0.4	0.03	0.07			0.002	0.2
	8.90	0.00	0.2	0.01	0			0.000	0.0
Q (this table)								**0.388**	**37.5**

General Notes

Total Q is the sum of both channels, shown on the next page.

Appendix 3. Manual Stage and Discharge Measurements, Site GI-H1

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	5-Jun-13			
Time at Site (24 hr)	**Start Time:**	1:50:00 PM	**End Time:**	
Personnel	Eli H, Jeff A.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	432744	7271610		
Weather Conditions	Sunny			

Transducer Information			
PT Model	ELF-2	**Serial #**	2718023
Gain	3.5117	**Offset**	0.0122
Status	Active	**Battery**	4.6V
# of Records	1	**Memory Free**	65203
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 5	1.331	101.331		100.000	BM 5
BM 47			1.426	99.905	BM 47
BM 49			1.323	100.008	BM 49
PT			2.178	99.153	
WL			1.598	**99.733**	
TBM	1.420	101.399	1.352	99.979	
WL			1.669	**99.730**	
PT			2.247	99.152	
BM 49			1.391	100.008	BM 49
BM 47			1.494	99.905	BM 47
BM 5			1.400	99.999	BM 5

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 47	99.924	99.905	0.019	
BM 49	100.023	100.008	0.015	
PT	99.153	99.153	0.001	

Summary	
Stage (m)	99.732
Discharge (m^3/s)	1.034
Pressure Transducer Reading (m)	0.600
Pressure Transducer Elevation (m)	99.132

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	14:00	**End**	15:20	**Location**	50m DS of PT	
Method	Velocity-area (Mid-section)			**Instrument Model**	FH950		
Flow Meter Type	Electromagnetic			**Instrument Serial #**	130881001502		
Stage (m)	**Start**	**Reading**	0.688	**Time**	14:00		
	End	**Reading**	0.600	**Time**	15:20		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	1.30	0.00	0.0	0.01	0			0.000	0.0
	1.40	0.11	0.1	0.02	0			0.000	0.0
	1.70	0.32	0.3	0.18	0.13			0.023	2.2
	2.50	0.14	0.8	0.16	0.1			0.016	1.6
	4.00	0.10	1.5	0.15	0.11			0.017	1.6
	5.50	0.07	1.5	0.08	0.2			0.016	1.6
	6.30	0.00	0.8	0.00	0.01			0.000	0.0
	7.40	0.16	1.1	0.18	0.02			0.004	0.3
	8.50	0.22	1.1	0.28	0.03			0.008	0.8
	9.90	0.24	1.4	0.36	0.15			0.054	5.2
	11.50	0.22	1.6	0.34	0.18			0.061	5.9
	13.00	0.30	1.5	0.38	0.2			0.075	7.3
	14.00	0.14	1.0	0.14	0.18			0.025	2.4
	15.00	0.24	1.0	0.30	0.22			0.066	6.4
	16.50	0.24	1.5	0.36	0.15			0.054	5.2
	18.00	0.28	1.5	0.42	0.15			0.063	6.1
	19.50	0.19	1.5	0.29	0.23			0.066	6.3
	21.00	0.22	1.5	0.33	0.13			0.043	4.2
	22.50	0.29	1.5	0.44	0.11			0.048	4.6
	24.00	0.13	1.5	0.20	0.02			0.004	0.4
	25.50	0.06	1.5	0.12	0.03			0.004	0.3
	28.00	0.08	2.5	0.11	0			0.000	0.0
LB	28.20	0.00	0.2	0.01	0			0.000	0.0
Total Q								**1.034**	**100.0**

General Notes

Total Q is the sum of both channels, shown on this page.

Appendix 3. Manual Stage and Discharge Measurements, Site GI-H1

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	17-Jul-13			
Time at Site (24 hr)	**Start Time:**	11:55:00 AM	**End Time:**	
Personnel	Eli H., Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	432744	7271610		
Weather Conditions	Cloudy, Windy			

Transducer Information			
PT Model	ELF-2	**Serial #**	2718023
Gain	3.5117	**Offset**	0.0122
Status	OK	**Battery**	100%
# of Records	6032	**Memory Free**	29510
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 5	1.453	101.453		100.000	
BM 47			1.539	99.914	
BM 49			1.411	100.042	
PT			2.261	99.192	0.41+_0.01
WL			1.857	**99.596**	**Corrected to 99.568**
TBM	1.394	101.387	1.460	99.993	
WL			1.793	**99.594**	**Corrected to 99.568**
PT			2.198	99.189	
BM 49			1.347	100.040	
BM 47			1.473	99.914	
BM 5			1.389	99.998	
WL-1			1.785	99.602	at outlet
WL-2			1.829	99.558	20m DS

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 47	99.924	99.914	0.010	
BM 49	100.023	100.041	-0.018	
PT	99.153	99.191	-0.038	

Summary			
Surveyed Stage (m)	99.595	**Corrected:**	99.568
Discharge (m^3/s)	0.070		
Pressure Transducer Reading (m)	0.436		
Pressure Transducer Elevation (m)	99.159		

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	12:00	**End**	13:20	**Location**	75m DS of PT			
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950			
Flow Meter Type	Electromagnetic			**Instrument Serial #**					
Stage (m)	**Start**	**Reading**	0.435	**Time**	12:00				
	End	**Reading**	0.437	**Time**	13:20				

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB channel #1	5.70	0.00	0.0	0.00	0			0.000	0.0
	5.80	0.10	0.1	0.04	0.03			0.001	1.5
	6.40	0.12	0.6	0.05	0.04			0.002	2.9
	6.65	0.10	0.3	0.03	0.03			0.001	1.3
	7.00	0.12	0.4	0.04	0.07			0.003	3.9
	7.30	0.06	0.3	0.02	0.09			0.002	2.3
	7.60	0.24	0.3	0.07	0.04			0.003	4.1
	7.90	0.12	0.3	0.03	0.18			0.005	7.0
	8.05	0.20	0.2	0.04	0.13			0.005	7.5
	8.30	0.20	0.3	0.05	0.15			0.008	11.9
	8.60	0.06	0.3	0.02	0.14			0.003	3.6
Rock	8.90	0.08	0.3	0.02	0.13			0.003	4.1
	9.15	0.12	0.3	0.03	0.01			0.000	0.4
Rock	9.40	0.00	0.3	0.00	0			0.000	0.0
	9.55	0.05	0.2	0.01	0.19			0.002	3.4
	9.90	0.05	0.4	0.01	0.08			0.001	1.6
LB channel #2	10.10	0.00	0.2	0.00	0			0.000	0.0
RB channel #2	2.80	0.00	0.0	0.01	0			0.000	0.0
	2.90	0.14	0.1	0.04	0.04			0.001	2.0
Rock	3.30	0.00	0.4	0.00	0			0.000	0.0
	3.65	0.10	0.4	0.04	0.02			0.001	1.0
	4.00	0.15	0.4	0.05	0.02			0.001	1.4
	4.30	0.07	0.3	0.02	0.05			0.001	1.5
Rock	4.60	0.00	0.3	0.00	0			0.000	0.0
Rock	10.10	0.00	5.5	0.00	0			0.000	0.0
	10.65	0.06	0.6	0.04	0.05			0.002	3.0
	11.50	0.06	0.9	0.06	0.07			0.004	5.6
	12.50	0.06	1.0	0.06	0.02			0.001	1.7
	13.50	0.07	1.0	0.07	0.01			0.001	1.0
	14.50	0.12	1.0	0.12	0.04			0.005	6.9
	15.50	0.12	1.0	0.12	0.01			0.001	1.7
	16.50	0.10	1.0	0.10	0.03			0.003	4.3

Appendix 3. Manual Stage and Discharge Measurements, Site GI-H1

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	17-Jul-13			
Time at Site (24 hr)	**Start Time:**	11:55:00 AM	**End Time:**	
Personnel	Eli H., Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	432744	7271610		
Weather Conditions	Cloudy, Windy			

Transducer Information			
PT Model	ELF-2	**Serial #**	2718023
Gain	3.5117	**Offset**	0.0122
Status	OK	**Battery**	100%
# of Records	6032	**Memory Free**	29510
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 5	1.453	101.453		100.000	
BM 47			1.539	99.914	
BM 49			1.411	100.042	
PT			2.261	99.192	0.41+_0.01
WL			1.857	**99.596**	**Corrected to 99.568**
TBM	1.394	101.387	1.460	99.993	
WL			1.793	**99.594**	**Corrected to 99.568**
PT			2.198	99.189	
BM 49			1.347	100.040	
BM 47			1.473	99.914	
BM 5			1.389	99.998	
WL-1			1.785	99.602	at outlet
WL-2			1.829	99.558	20m DS

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 47	99.924	99.914	0.010	
BM 49	100.023	100.041	-0.018	
PT	99.153	99.191	-0.038	

Summary			
Surveyed Stage (m)	99.595	**Corrected:**	99.568
Discharge (m^3/s)	0.070		
Pressure Transducer Reading (m)	0.436		
Pressure Transducer Elevation (m)	99.159		

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	12:00	**End**	13:20	**Location**	75m DS of PT
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950
Flow Meter Type	Electromagnetic			**Instrument Serial #**		
Stage (m)	**Start**	**Reading**	0.435	**Time**	12:00	
	End	**Reading**	0.437	**Time**	13:20	

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
	17.50	0.14	1.0	0.14	0.01			0.001	2.0
	18.50	0.09	1.0	0.09	0.04			0.004	5.4
	19.60	0.11	1.1	0.11	0.02			0.002	3.2
	20.50	0.06	0.9	0.07	0.03			0.002	3.1
	22.00	0.06	1.5	0.09	-0.01			-0.001	-1.3
	23.50	0.14	1.5	0.15	0			0.000	0.0
	24.10	0.08	0.6	0.06	0.02			0.001	1.7
LB channel #2	25.00	0.00	0.9	0.04	0			0.000	0.0
Total Q								**0.070**	**100.0**

General Notes

Distance from middle of PT to top of pipe = 1.6cm

Stage value adjusted to 99.568 on rating curve to fit PT record.

Appendix 3. Manual Stage and Discharge Measurements, Site GI-H1

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	19-Aug-13			
Time at Site (24 hr)	**Start Time:**	6:50:00 AM	**End Time:**	
Personnel	Eli H., Mark W.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	432744	7271610		
Weather Conditions				

Transducer Information			
PT Model	ELF-2	**Serial #**	2718023
Gain	3.5117	**Offset**	0.0122
Status		**Battery**	
# of Records		**Memory Free**	
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 5	1.432	101.432		100.000	
BM 47			1.520	99.912	
BM 49			1.401	100.031	
PT			2.239	99.193	0.290
WL			1.931	**99.501**	Error, don't use
TBM	1.620	101.393	1.659	99.773	
WL			1.920	**99.473**	Checked, good
PT			2.200	99.193	
BM 49			1.362	100.031	
BM 47			1.479	99.914	
BM 5			1.393	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 47	99.924	99.913	0.011	
BM 49	100.023	100.031	-0.008	
PT	99.153	99.193	-0.040	

Summary			
Surveyed Stage (m)	99.473	**Corrected:**	99.440
Discharge (m^3/s)	0.050		
Pressure Transducer Reading (m)	0.308		
Pressure Transducer Elevation (m)	99.165		

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	7:45	**End**	8:20	**Location**	Upstream of station between Griff and DS pond
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-mate
Flow Meter Type	Electromagnetic			**Instrument Serial #**		
Stage (m)	**Start**	**Reading**	0.308	**Time**	7:45	
	End	**Reading**	0.309	**Time**	8:20	

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	0.30	0.00	0.0	0.00	0			0.000	0.0
	0.35	0.03	0.1	0.00	0.01			0.000	0.1
	0.50	0.05	0.2	0.01	0.05			0.000	0.9
	0.70	0.06	0.2	0.01	0.15			0.002	3.6
	0.90	0.09	0.2	0.02	0.22			0.004	7.9
	1.10	0.07	0.2	0.01	0.26			0.004	7.3
	1.30	0.06	0.2	0.01	0.35			0.004	8.4
	1.50	0.08	0.2	0.01	0.34			0.004	8.2
	1.60	0.07	0.1	0.01	0.27			0.002	3.8
	1.70	0.07	0.1	0.01	0.27			0.002	3.8
	1.80	0.08	0.1	0.01	0.25			0.002	4.0
	1.90	0.10	0.1	0.01	0.27			0.003	5.4
	2.00	0.10	0.1	0.01	0.23			0.002	4.6
	2.10	0.10	0.1	0.01	0.22			0.002	4.4
	2.20	0.09	0.1	0.01	0.21			0.002	3.8
	2.30	0.08	0.1	0.01	0.25			0.003	6.0
	2.50	0.08	0.2	0.02	0.28			0.004	9.0
	2.70	0.07	0.2	0.01	0.29			0.004	8.1
	2.90	0.06	0.2	0.01	0.15			0.002	3.6
	3.10	0.04	0.2	0.01	0.1			0.001	1.6
	3.30	0.04	0.2	0.01	0.11			0.001	1.8
	3.50	0.04	0.2	0.01	0.12			0.001	1.7
	3.65	0.05	0.2	0.01	0.12			0.001	1.8
	3.80	0.03	0.2	0.00	0.03			0.000	0.2
RB	3.85	0.00	0.1	0.00	0			0.000	0.0
Q (this table)								**0.050**	**100.0**

General Notes

Could not download logger on this date due to issue with cable, returned aug 25 to download.
Stage value adjusted to 99.440 on rating curve to fit PT record.

Appendix 3. Manual Stage and Discharge Measurements, Site GI-H1

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	19-Aug-13			
Time at Site (24 hr)	Start Time:	6:50:00 AM	End Time:	
Personnel	Eli H., Mark W.			
Station Cordinates	Easting	Northing	Elevation	
	432744	7271610		
Weather Conditions				

Transducer Information			
PT Model	ELF-2	Serial #	2718023
Gain	3.5117	Offset	0.0122
Status		Battery	
# of Records		Memory Free	
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 5	1.432	101.432		100.000	
BM 47			1.520	99.912	
BM 49			1.401	100.031	
PT			2.239	99.193	0.290
WL			1.931	**99.501**	Error, don't use
TBM	1.620	101.393	1.659	99.773	
WL			1.920	**99.473**	Checked, good
PT			2.200	99.193	
BM 49			1.362	100.031	
BM 47			1.479	99.914	
BM 5			1.393	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 47	99.924	99.913	0.011	
BM 49	100.023	100.031	-0.008	
PT	99.153	99.193	-0.040	

Summary			
Surveyed Stage (m)	99.473	Corrected:	99.440
Discharge (m^3/s)	0.050		
Pressure Transducer Reading (m)	0.308		
Pressure Transducer Elevation (m)	99.165		

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	7:45	End	8:20	Location	Upstream of station between Griff and DS pond			
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate			
Flow Meter Type	Electromagnetic			Instrument Serial #					
Stage (m)	Start	Reading	0.308	Time	7:45				
	End	Reading	0.309	Time	8:20				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.26	0.00	0.0	0.00	0			0.000	0.0
	0.30	0.05	0.0	0.00	-0.02			0.000	-19.1
	0.35	0.05	0.1	0.00	0			0.000	0.0
	0.40	0.06	0.1	0.00	0.02			0.000	25.5
	0.45	0.05	0.1	0.00	0.02			0.000	21.3
	0.50	0.06	0.1	0.00	0.02			0.000	25.5
	0.55	0.06	0.1	0.00	0.02			0.000	25.5
	0.60	0.06	0.0	0.00	0			0.000	0.0
	0.70	0.04	0.1	0.00	-0.01			0.000	-17.0
	0.80	0.03	0.1	0.00	0.01			0.000	12.8
	0.90	0.03	0.1	0.00	-0.02			0.000	-25.5
	1.00	0.03	0.1	0.00	0.01			0.000	12.8
	1.10	0.03	0.1	0.00	0.03			0.000	38.3
LB	1.20	0.00	0.1	0.00	0			0.000	0.0
Q (this table)	0.27							0.000	100.0

General Notes
Small side-channel with very little flow

Appendix 3. Manual Stage and Discharge Measurements, Site GI-H1

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	10-Sep-13			
Time at Site (24 hr)	**Start Time:**	11:40:00 AM	**End Time:**	
Personnel	Eli H., Robert M.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	432744	7271610		
Weather Conditions				

Transducer Information			
PT Model	ELF-2	**Serial #**	2718023
Gain	3.5117	**Offset**	0.0122
Status	OK	**Battery**	100%
# of Records	13951	**Memory Free**	25502
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 5	1.431	101.431		100.000	
BM 47			1.511	99.920	
BM 49			1.394	100.037	
BM 50			1.128	100.303	
PT			2.241	99.190	0.400
WL			1.849	**99.582**	(+/- 0.01) waves
TBM	1.690	101.405	1.716	99.715	
WL			1.819	**99.586**	(+/- 0.01) waves
PT			2.213	99.192	
BM 50			1.099	100.306	
BM 49			1.368	100.037	
BM 47			1.483	99.922	
BM 5			1.403	100.002	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 47	99.924	99.921	0.003	
BM 49	100.023	100.037	-0.014	
PT	99.153	99.191	-0.038	

Summary			
Surveyed Stage (m)	99.584	**Corrected:**	99.547
Discharge (m^3/s)	0.105		
Pressure Transducer Reading (m)	0.415		
Pressure Transducer Elevation (m)	99.169		

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	12:40	**End**	13:30	**Location**	Upstream of station between Griff and DS pond		
Method	Velocity-area (Mid-section)				**Instrument Model**	Flo-mate		
Flow Meter Type	Electromagnetic				**Instrument Serial #**			
Stage (m)	**Start**	**Reading**	0.308		**Time**	12:40		
	End	**Reading**	0.309		**Time**	13:30		

Channel 1	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB Chan #1	0.80	0.03	0.0	0.00	0.03			0.000	0.0
	0.89	0.03	0.1	0.00	0.04			0.000	0.1
	1.00	0.03	0.1	0.00	0.02			0.000	0.1
Rock	1.10	0.00	0.1	0.00	0			0.000	0.0
	1.20	0.06	0.1	0.01	0.06			0.000	0.3
	1.30	0.07	0.1	0.01	0.07			0.000	0.5
	1.40	0.08	0.1	0.01	0.11			0.001	0.8
	1.50	0.08	0.1	0.01	0.07			0.001	0.5
	1.60	0.07	0.1	0.01	0.04			0.000	0.3
	1.70	0.06	0.1	0.01	0			0.000	0.0
	1.80	0.04	0.1	0.00	0.08			0.000	0.3
	1.90	0.05	0.1	0.01	0.12			0.001	0.6
	2.00	0.04	0.1	0.00	0.1			0.000	0.4
	2.10	0.03	0.1	0.00	0.08			0.000	0.2
	2.20	0.03	0.1	0.00	0.11			0.000	0.3
	2.30	0.02	0.1	0.00	0.11			0.000	0.3
LB Chan #1	2.45	0.00	0.2	0.00	0			0.000	0.0
RB Chan # 3	0.70	0.00	0.0	0.00	0			0.000	0.0
	0.80	0.03	0.1	0.00	0.01			0.000	0.0
	0.95	0.04	0.2	0.01	0.05			0.000	0.3
	1.10	0.04	0.2	0.01	0.06			0.000	0.3
	1.25	0.06	0.2	0.01	0.1			0.001	0.9
	1.40	0.06	0.2	0.01	0.15			0.001	1.3
	1.55	0.07	0.2	0.01	0.14			0.001	1.2
	1.65	0.06	0.1	0.01	0.13			0.001	0.9
	1.80	0.05	0.2	0.01	0.06			0.000	0.4
	1.95	0.04	0.2	0.01	0.06			0.000	0.3
	2.10	0.03	0.2	0.00	0.06			0.000	0.2
LB Chan #3	2.20	0.00	0.1	0.00	0			0.000	0.0
Q (this table)								**0.011**	**10.6**

General Notes

Measurement split between three channels. Total discharge is the sum of all three channels.
Installed BM 50 = rebar on bank. Flow measurement caried out at same location as August, on upstream end of the pond.
Stage values adjusted to 99.547 m in rating curve based on fit to PT record.

Appendix 3. Manual Stage and Discharge Measurements, Site GI-H1

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	10-Sep-13			
Time at Site (24 hr)	**Start Time:**	11:40:00 AM	**End Time:**	
Personnel	Eli H., Robert M.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	432744	7271610		
Weather Conditions				

Transducer Information			
PT Model	ELF-2	**Serial #**	2718023
Gain	3.5117	**Offset**	0.0122
Status	OK	**Battery**	100%
# of Records	13951	**Memory Free**	25502
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 5	1.431	101.431		100.000	
BM 47			1.511	99.920	
BM 49			1.394	100.037	
BM 50			1.128	100.303	
PT			2.241	99.190	0.400
WL			1.849	**99.582**	(+/- 0.01) waves
TBM	1.690	101.405	1.716	99.715	
WL			1.819	**99.586**	(+/- 0.01) waves
PT			2.213	99.192	
BM 50			1.099	100.306	
BM 49			1.368	100.037	
BM 47			1.483	99.922	
BM 5			1.403	100.002	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 47	99.924	99.921	0.003	
BM 49	100.023	100.037	-0.014	
PT	99.153	99.191	-0.038	

Summary			
Surveyed Stage (m)	99.584	**Corrected:**	99.547
Discharge (m^3/s)	0.105		
Pressure Transducer Reading (m)	0.415		
Pressure Transducer Elevation (m)	99.169		

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	12:40	**End**	13:30	**Location**	Upstream of station between Griff and DS pond			
Method	Velocity-area (Mid-section)			**Instrument Model**	Flo-mate				
Flow Meter Type	Electromagnetic			**Instrument Serial #**					
Stage (m)	**Start**	**Reading**	0.308	**Time**	12:40				
	End	**Reading**	0.309	**Time**	13:30				

Channel 2	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB Chan #2	1.00	0.00	0.0	0.00	0			0.000	0.0
	1.20	0.02	0.2	0.00	0.03			0.000	0.1
Sand	1.40	0.00	0.2	0.00	0			0.000	0.0
Sand	2.00	0.00	0.6	0.00	0			0.000	0.0
	2.20	0.03	0.2	0.01	0.1			0.001	0.7
	2.50	0.08	0.3	0.02	0.13			0.003	2.5
	2.70	0.09	0.2	0.02	0.2			0.004	3.4
	2.90	0.08	0.2	0.02	0.18			0.003	2.7
	3.10	0.01	0.2	0.00	0.2			0.000	0.4
Behind Rock	3.30	0.01	0.2	0.00	0.09			0.000	0.1
Behind Rock	3.40	0.04	0.1	0.01	0.01			0.000	0.0
Rock	3.55	0.00	0.2	0.00	0			0.000	0.0
	3.60	0.20	0.1	0.02	0.27			0.004	3.8
	3.70	0.21	0.1	0.02	0.15			0.003	3.0
	3.80	0.18	0.1	0.03	0.2			0.005	5.1
	4.00	0.16	0.2	0.03	0.29			0.009	8.8
	4.20	0.17	0.2	0.03	0.29			0.010	9.4
	4.40	0.17	0.2	0.03	0.28			0.010	9.0
	4.60	0.16	0.2	0.03	0.25			0.008	7.6
	4.80	0.18	0.2	0.04	0.22			0.008	7.5
Behind Rock	5.00	0.20	0.2	0.04	0.05			0.002	1.9
Behind Rock	5.20	0.20	0.2	0.04	0.09			0.004	3.4
	5.40	0.20	0.2	0.04	0.23			0.009	8.7
	5.60	0.18	0.2	0.04	0.15			0.005	5.1
	5.80	0.16	0.2	0.03	0.1			0.003	3.0
	6.00	0.12	0.2	0.03	0.09			0.003	2.6
	6.30	0.06	0.3	0.02	0.02			0.000	0.3
	6.60	0.03	0.3	0.01	0			0.000	0.0
LB Chan #2	6.70	0.00	0.1	0.00	0			0.000	0.0
Q (this table)				**0.69**				**0.094**	**89.4**

General Notes

Measurement split between three channels. Total discharge is the sum of all three channels.
Installed BM 50 = rebar on bank. Flow measurement caried out at same location as August, on upstream end of the pond.
Stage values adjusted to 99.547 m in rating curve based on fit to PT record.

Appendix 3. Manual Stage and Discharge Measurements, Site EL-H1

Site Information				
Project Name	Back River			
Station Identification	EL-H1			
Stream Name	Echo Lake Outflow			
Date Monitored	31-May-13			
Time at Site (24 hr)	**Start Time:**	12:00 PM	**End Time:**	2:00 PM
Personnel	E. Heyman, Jeff			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	432,091	7,269,573	293	
Weather Conditions	Sunny			

Transducer Information			
PT Model	ELF-2	**Serial #**	2714003
Gain	3.5058	**Offset**	-0.1901
Status	LOGGING	**Battery**	100%
# of Records	1	**Memory Free**	
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 14	1.346	101.346		100.000	BM 14
BM 15			1.420	99.926	BM 15
BM 16			1.390	99.956	BM 16
PT			2.313	99.033	
WL			1.933	**99.413**	
TBM	1.634	101.272	1.708	99.638	
WL			1.857	**99.415**	
PT			2.242	99.030	
BM 16			1.315	99.957	BM 16
BM 15			1.346	99.926	BM15
BM 14			1.272	100.000	BM 14

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 15	99.926	99.926	0.000	
BM 16	99.992	99.957	0.035	
PT	99.032	99.032	0.001	

Summary	
Stage (m)	99.414
Discharge (m^3/s)	0.078
Pressure Transducer Reading (m)	0.413
Pressure Transducer Elevation (m)	99.001

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	12:40	**End**	13:20	**Location**	100m DS of station			
Method	Velocity-area (Mid-section)				**Instrument Model**	FH950			
Flow Meter Type	Electromagnetic				**Instrument Serial #**				
Stage (m)	**Start**	**Reading**	0.404		**Time**	12:40			
	End	**Reading**	0.412		**Time**	13:20			

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	0.00	0.00	0.0	0.00	0			0.000	0.0
Grass	0.15	0.04	0.2	0.01	0.01			0.000	0.1
	0.30	0.12	0.2	0.01	-0.02			0.000	-0.3
	0.35	0.16	0.1	0.01	0.02			0.000	0.3
	0.45	0.10	0.1	0.01	0.3			0.003	3.9
	0.55	0.20	0.1	0.02	0.38			0.008	9.8
	0.65	0.14	0.1	0.01	0.22			0.003	4.0
	0.75	0.15	0.1	0.02	0.23			0.003	4.4
	0.85	0.20	0.1	0.02	0.21			0.004	5.4
	0.95	0.22	0.1	0.02	0.19			0.004	5.4
	1.05	0.22	0.1	0.02	0.29			0.005	6.1
	1.10	0.20	0.1	0.01	0.35			0.004	4.5
	1.15	0.21	0.0	0.01	0.58			0.006	7.8
	1.20	0.22	0.1	0.01	0.53			0.006	7.5
	1.25	0.22	0.1	0.01	0.38			0.004	5.4
	1.30	0.14	0.1	0.01	0.64			0.004	5.8
	1.35	0.12	0.1	0.01	0.74			0.004	5.7
	1.40	0.11	0.0	0.01	0.7			0.004	4.9
	1.45	0.12	0.1	0.01	0.73			0.004	5.6
	1.50	0.11	0.1	0.01	0.64			0.004	4.5
	1.55	0.12	0.1	0.01	0.65			0.004	5.0
Edge grass	1.60	0.10	0.1	0.01	0.44			0.003	4.2
Edge grass	1.70	0.09	0.1	0.01	0			0.000	0.0
LB	1.90	0.00	0.2	0.01	0			0.000	0.0
Total Q								**0.078**	**100.0**

General Notes
Water flowing over grass around station. Side-channel hydrology connected upstream of PT

Appendix 3. Manual Stage and Discharge Measurements, Site EL-H1

Site Information				
Project Name	Back River			
Station Identification	EL-H1			
Stream Name	Echo Lake Outflow			
Date Monitored	16-Jun-13			
Time at Site (24 hr)	**Start Time:**	1:45 PM	**End Time:**	
Personnel	E. Heyman, Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	432,091	7,269,573	293m	
Weather Conditions	Sunny			

Transducer Information			
PT Model	ELF-2	**Serial #**	2714003
Gain	3.5058	**Offset**	-0.1901
Status	OK	**Battery**	100%
# of Records	2313	**Memory Free**	31373
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 14	0.968	100.968		100.000	BM 14
BM 15			1.038	99.930	BM 15
BM 16			1.007	99.961	BM 16
PT			1.936	99.032	Depth: 0.278
WL			1.661	**99.307**	
TBM	1.240	101.028	1.180	99.788	
WL			1.721	**99.307**	
PT			1.999	99.029	
BM 16			1.067	99.961	BM 16
BM 15			1.098	99.930	BM15
BM 14			1.028	100.000	BM 14
PT (before move)				98.998	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 15	99.926	99.930	-0.004	
BM 16	99.992	99.961	0.031	
PT	99.032	99.031	0.001	

Summary			
Surveyed Stage (m)	99.307	**Corrrected:**	99.324
Discharge (m^3/s)	0.004		
Pressure Transducer Reading (m)	0.301		
Pressure Transducer Elevation (m)	99.006		

Discharge Measurement - Mid-Section Method						
Time (24 hr)	**Start**		**End**		**Location**	100m DS of station
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950
Flow Meter Type	Electromagnetic			**Instrument Serial #**		
Stage (m)	**Start**	**Reading**		**Time**		
	End	**Reading**		**Time**		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	0.06	0.00	0.0	0.00	0			0.000	0.0
	0.10	0.07	0.0	0.00	0			0.000	0.0
	0.15	0.08	0.1	0.00	0			0.000	0.0
	0.20	0.05	0.1	0.00	-0.01			0.000	-0.7
	0.25	0.05	0.1	0.00	0			0.000	0.0
	0.30	0.05	0.1	0.00	0			0.000	0.0
	0.35	0.05	0.1	0.00	0			0.000	0.0
	0.40	0.05	0.1	0.00	0.01			0.000	0.7
	0.45	0.10	0.1	0.01	0.02			0.000	2.9
	0.50	0.10	0.1	0.01	0.01			0.000	1.4
	0.55	0.10	0.1	0.01	0.07			0.000	10.0
	0.60	0.10	0.0	0.01	0.07			0.000	10.0
	0.65	0.10	0.1	0.01	0.09			0.000	12.9
	0.70	0.08	0.0	0.00	0.12			0.000	13.7
	0.75	0.07	0.1	0.00	0.17			0.001	17.0
	0.80	0.06	0.1	0.00	0.17			0.001	14.6
	0.85	0.06	0.0	0.00	0.14			0.000	12.0
	0.90	0.05	0.1	0.00	0.02			0.000	1.4
	0.95	0.05	0.0	0.00	0.03			0.000	2.1
	1.00	0.05	0.1	0.00	0.02			0.000	1.4
	1.05	0.04	0.1	0.00	0.01			0.000	0.6
LB	1.10	0.00	0.1	0.00	0			0.000	0.0
Total Q								**0.004**	**100.0**

General Notes
PT was moved from 98.998 to 99.031 (0.306 to 0.278 depth) @ 14:00.

Appendix 3. Manual Stage and Discharge Measurements, Site EL-H1

Site Information					
Project Name	Back River				
Station Identification	EL-H1				
Stream Name	Echo Lake Outflow				
Date Monitored	17-Jul-13				
Time at Site (24 hr)	**Start Time:**	2:21 PM	**End Time:**		
Personnel	E. Heyman, Byeong K.				
Station Cordinates	**Easting**	**Northing**	**Elevation**		
	432,091	7,269,573	293		
Weather Conditions	Windy, cloudy				
Transducer Information					
PT Model	ELF-2	**Serial #**		2714003	
Gain	3.5058	**Offset**		-0.1901	
Status	OK	**Battery**		100%	
# of Records	6780	**Memory Free**		29144	
Date Serviced		**Crest Gauges**			

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 14	1.267	101.267		100.000	BM 14
BM 15			1.341	99.926	BM 15
BM 16			1.283	99.984	BM 16
PT			2.202	99.065	Depth: 0.138
WL			**2.061**	**99.206**	
TBM	1.643	101.200	1.710	99.557	
WL			**1.996**	**99.204**	
PT			2.138	99.062	
BM 16			1.218	99.982	BM 16
BM 15			1.276	99.924	BM15
BM 14			1.201	99.999	BM 14
a-value			1.990	99.210	Approximately zero flow

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 15	99.926	99.925	0.001	
BM 16	99.992	99.983	0.009	
PT	98.968	99.064	-0.096	

Summary

Stage (m)	99.205
Discharge (m^3/s)	0.000
Pressure Transducer Reading (m)	0.164
Pressure Transducer Elevation (m)	99.041

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**		**End**		**Location**	100m DS of station
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950
Flow Meter Type	Electromagnetic			**Instrument Serial #**		
Stage (m)	**Start**	**Reading**	0.164	**Time**	14:24	
	End	**Reading**		**Time**		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
Total Q								**0.000**	**0.0**

General Notes

No flow on this date. PT in pool hydrologically disconnected from adjacent pool. Surveyed approx. a value location

Appendix 3. Manual Stage and Discharge Measurements, Site EL-H1

Site Information					
Project Name	Back River				
Station Identification	EL-H1				
Stream Name	Echo Lake Outflow				
Date Monitored	16-Aug-13				
Time at Site (24 hr)	Start Time:	6:00 AM	End Time:	6:30 AM	
Personnel	Eli H., Mark W.				
Station Cordinates	Easting		Elevation		
	432,091	7,269,573	293m		
Weather Conditions	Cloudy, cool				
Transducer Information					
PT Model	ELF-2	Serial #	2714003		
Gain	3.5058	Offset	-0.1901		
Status	ok	Battery	100%		
# of Records	11051	Memory Free	26998		
Date Serviced		Crest Gauges			

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 14	1.397	101.397		100.000	BM 14
BM 15			1.463	99.934	BM 15
BM 16			1.423	99.974	BM 16
PT			2.328	99.069	
WL			2.178	**99.219**	
TBM	2.033	101.280	2.150	99.247	
WL			2.060	**99.220**	
PT			2.212	99.068	
BM 16			1.308	99.972	BM 16
BM 15			1.349	99.931	BM15
BM 14			1.282	99.998	BM 14

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 15	99.926	99.933	-0.007	
BM 16	99.992	99.973	0.019	
PT	98.968	99.069	-0.100	

Summary

Stage (m)	99.220
Discharge (m^3/s)	0.000
Pressure Transducer Reading (m)	0.169
Pressure Transducer Elevation (m)	99.051

Discharge Measurement - Mid-Section Method

Time (24 hr)	Start		End		Location				
Method				Instrument Model					
Flow Meter Type				Instrument Serial #					
Stage (m)	Start	Reading		Time					
	End	Reading		Time					
	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
Total Q								0.000	0.0

General Notes

No flow today

Appendix 3. Manual Stage and Discharge Measurements, Site EL-H1

Site Information				
Project Name	Back River			
Station Identification	EL-H1			
Stream Name	Echo Lake Outflow			
Date Monitored	13-Sep-13			
Time at Site (24 hr)	**Start Time:**	6:57 AM	**End Time:**	8:30 AM
Personnel	E. Heyman, Robert M.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	432,091	7,269,573	293	
Weather Conditions	Cloudy, recent rain			

Transducer Information			
PT Model	ELF-2	**Serial #**	2714003
Gain	3.5058	**Offset**	-0.1901
Status	OK	**Battery**	100%
# of Records	14945	**Memory Free**	0
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 14	1.146	101.146		100.000	
BM 15			1.213	99.933	
BM 16			1.188	99.958	
PT			2.080	99.066	Depth: 0.300
WL			1.780	**99.366**	
TBM	1.772	101.111	1.807	99.339	
WL			1.743	**99.368**	
PT			2.046	99.065	
BM 16			1.153	99.958	
BM 15			1.181	99.930	
BM 14			1.112	99.999	
BM17			0.678	100.433	
BM 18			1.123	99.988	
US WL			1.271	99.840	
DSWL			1.759	99.352	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 15	99.926	99.932	-0.005	
BM 16	99.992	99.958	0.034	
PT	98.968	99.066	-0.097	

Summary	
Stage (m)	99.367
Discharge (m^3/s)	0.016
Pressure Transducer Reading (m)	0.324
Pressure Transducer Elevation (m)	99.043

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	7:00	**End**	8:00	**Location**	100m DS of station	
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate	
Flow Meter Type	Electromagnetic			**Instrument Serial #**			
Stage (m)	**Start**	**Reading**	0.324	**Time**	7:00		
	End	**Reading**	0.335	**Time**	8:00		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.35	0.00	0.0	0.00	0			0.000	0.0
	0.40	0.05	0.1	0.00	-0.01			0.000	-0.2
	0.46	0.08	0.1	0.00	-0.02			0.000	-0.6
	0.51	0.08	0.1	0.00	0.25			0.001	6.9
	0.57	0.10	0.1	0.01	0.32			0.002	13.1
	0.64	0.07	0.1	0.00	0.29			0.001	8.3
	0.70	0.06	0.1	0.00	0.23			0.001	5.2
	0.76	0.07	0.1	0.00	0.19			0.001	4.6
	0.81	0.06	0.1	0.00	0.11			0.000	2.3
	0.87	0.05	0.1	0.00	0.19			0.001	3.6
	0.93	0.06	0.1	0.00	0.25			0.001	5.7
	0.99	0.08	0.1	0.00	0.18			0.001	5.4
	1.05	0.12	0.1	0.01	0.08			0.001	3.6
	1.11	0.09	0.1	0.01	0.08			0.000	2.7
	1.17	0.08	0.1	0.00	0.21			0.001	6.3
	1.23	0.13	0.1	0.01	0.14			0.001	6.9
	1.29	0.14	0.1	0.01	0.14			0.001	7.4
	1.35	0.14	0.1	0.01	0.17			0.001	9.0
	1.41	0.05	0.1	0.00	0.2			0.001	3.8
	1.47	0.04	0.1	0.00	0.17			0.000	2.6
	1.53	0.03	0.1	0.00	0.14			0.000	1.6
Grass	1.59	0.04	0.1	0.00	0.11			0.000	1.7
	1.65	0.03	0.1	0.00	0			0.000	0.0
LB	1.70	0.00	0.1	0.00	0			0.000	0.0
Total Q								**0.016**	**100.0**

General Notes

Logger time siginificantly different than computer time, Terra 4 converted data after dowload. Installed 2 new rebar BMs (17 on RB and 18 on LB). Logger stopped beore discharge.

Appendix 3. Manual Stage and Discharge Measurements, Site WL-H1

Site Information				
Project Name	Back River			
Station Identification	WL-H1			
Stream Name	Wolf Outflow			
Date Monitored	1-Jun-13			
Time at Site (24 hr)	**Start Time:**	8:00:00 AM	**End Time:**	
Personnel	Eli H, Jeff A			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	434269	7269719		
Weather Conditions	Sunny			

Transducer Information			
PT Model	ELF-2	**Serial #**	2809027
Gain	3.5035	**Offset**	0.0138
Status	Active	**Battery**	100%
# of Records	1	**Memory Free**	32655
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 12	0.550	100.550		100.000	
BM 1-N			1.018	99.532	NEW
BM 2-N			1.326	99.224	NEW
PT			2.843	97.707	WSE = 98.644
WL			1.913	**98.637**	
SG			1.432	99.118	WSE = 98.642
TBM	1.288	100.484	1.354	99.196	
SG			1.367	99.117	
WL			1.846	**98.638**	
PT			2.777	97.707	
BM 2-N			1.260	99.224	
BM 1-N			0.951	99.533	
BM 12			0.484	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 1-N	99.533	99.533	0.000	
BM 2-N	99.224	99.224	0.000	
PT	97.808	97.707	-0.101	

Summary	
Stage (m)	98.638
Discharge (m^3/s)	0.742
Pressure Transducer Reading (m)	0.972
Pressure Transducer Elevation (m)	97.666

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	9:23	**End**	10:17	**Location**	55m U/S of PT	
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950	
Flow Meter Type	Electromagnetic			**Instrument Serial #**		06591	
Stage (m)	**Start**	**Reading**		**Time**			
	End	**Reading**	0.971	**Time**	10:17		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.70	0.00	0.0	0.02	0.00	0.00	0.00	0.000	0.0
Some grass	0.90	0.16	0.2	0.04	-0.01	0.00	0.00	0.000	-0.1
Edge grass	1.20	0.24	0.3	0.06	0.02	0.00	0.00	0.001	0.2
Edge	1.40	0.30	0.2	0.08	0.00	0.00	0.00	0.000	0.0
	1.70	0.37	0.3	0.11	0.04	0.00	0.00	0.004	0.6
	2.00	0.50	0.3	0.15	0.10	0.00	0.00	0.015	2.0
	2.30	0.61	0.3	0.18	0.18	0.00	0.00	0.033	4.4
	2.60	0.58	0.3	0.17	0.19	0.00	0.00	0.033	4.5
	2.90	0.59	0.3	0.18	0.21	0.00	0.00	0.037	5.0
	3.20	0.60	0.3	0.18	0.23	0.00	0.00	0.041	5.6
	3.50	0.62	0.3	0.16	0.21	0.00	0.00	0.033	4.4
	3.70	0.64	0.2	0.16	0.20	0.00	0.00	0.032	4.3
	4.00	0.67	0.3	0.20	0.22	0.00	0.00	0.044	6.0
	4.30	0.68	0.3	0.20	0.18	0.00	0.00	0.037	4.9
	4.60	0.70	0.3	0.21	0.19	0.00	0.00	0.040	5.4
	4.90	0.72	0.3	0.22	0.22	0.00	0.00	0.048	6.4
	5.20	0.76	0.3	0.23	0.00	0.26	0.22	0.055	7.4
	5.50	0.76	0.3	0.23	0.00	0.26	0.23	0.056	7.5
	5.80	0.82	0.3	0.25	0.00	0.23	0.22	0.055	7.5
	6.10	0.88	0.3	0.26	0.00	0.21	0.21	0.055	7.5
	6.40	0.88	0.3	0.26	0.00	0.20	0.19	0.051	6.9
	6.70	0.73	0.3	0.22	0.20	0.00	0.00	0.044	5.9
	7.00	0.47	0.3	0.12	0.14	0.00	0.00	0.016	2.2
	7.20	0.38	0.2	0.08	0.15	0.00	0.00	0.011	1.5
	7.40	0.13	0.2	0.02	0.01	0.00	0.00	0.000	0.0
LB	7.50	0.00	0.1	0.01	0	0.00	0.00	0.000	0.0
Total Q								**0.742**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site WL-H1

Site Information				
Project Name	Back River			
Station Identification	WL-H1			
Stream Name	Wolf Outflow			
Date Monitored	16-Jul-13			
Time at Site (24 hr)	Start Time:	11:50:00 AM	End Time:	
Personnel	Eli H., Byeong K.			
Station Cordinates	Easting	Northing	Elevation	
	434269	7269719		
Weather Conditions	Partly cloudy, windy			

Transducer Information			
PT Model	ELF-2	Serial #	2809027
Gain	3.5035	Offset	0.0138
Status	Okay	Battery	100%
# of Records	6498	Memory Free	29287
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 12	0.050	100.050		100.000	
BM 1			0.523	99.527	
BM 2			0.829	99.221	
PT			2.350	97.700	
WL			1.742	**98.308**	
TBM	0.728	100.095	0.683	99.367	
SG			1.013	99.082	
WL			1.789	**98.306**	
PT			2.397	97.698	
BM 2			0.874	99.221	
BM 1			0.569	99.526	
BM 12			0.098	99.997	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 1	99.533	99.527	-0.006	
BM 2	99.224	99.221	-0.003	
PT	97.808	97.699	-0.109	

Summary			
Surveyed Stage (m)	98.307	Corrected:	98.309
Discharge (m^3/s)	0.0724		
Pressure Transducer Reading (m)	0.643		
Pressure Transducer Elevation (m)	97.664		

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	13:05	End	13:38	Location	55m U/S of PT			
Method	Velocity-area (Mid-section)			Instrument Model		FH950			
Flow Meter Type	Electromagnetic			Instrument Serial #		06591			
Stage (m)	Start	Reading	0.644	Time	13:05				
	End	Reading	0.644	Time	13:38				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	1.70	0.00	0.0	0.01	0.00			0.000	0.0
	1.75	0.24	0.1	0.04	0.00			0.000	0.0
	2.00	0.26	0.3	0.07	0.00			0.000	0.0
	2.25	0.29	0.3	0.07	0.00			0.000	0.0
	2.50	0.34	0.3	0.09	0.02			0.002	2.3
	2.75	0.34	0.3	0.09	0.03			0.003	3.5
	3.00	0.36	0.3	0.09	0.03			0.003	3.7
	3.25	0.36	0.3	0.09	0.04			0.004	5.0
	3.50	0.40	0.3	0.10	0.02			0.002	2.8
	3.75	0.42	0.3	0.11	0.04			0.004	5.8
	4.00	0.47	0.3	0.12	0.04			0.005	6.5
	4.25	0.42	0.3	0.11	0.06			0.006	8.7
	4.50	0.50	0.3	0.13	0.06			0.008	10.4
	4.75	0.50	0.3	0.13	0.05			0.006	8.6
	5.00	0.41	0.3	0.10	0.05			0.005	7.1
	5.25	0.43	0.3	0.11	0.06			0.006	8.9
	5.50	0.38	0.3	0.10	0.06			0.006	7.9
	5.75	0.38	0.3	0.10	0.04			0.004	5.3
	6.00	0.39	0.3	0.10	0.04			0.004	5.4
	6.25	0.34	0.3	0.09	0.03			0.003	3.5
	6.50	0.36	0.3	0.09	0.03			0.003	3.7
	6.75	0.30	0.3	0.05	0.01			0.001	0.7
	6.85	0.06	0.1	0.01	0.02			0.000	0.2
RB	6.95	0.00	0.1	0.00	0.00			0.000	0.0
Total Q								**0.072**	**100.0**

General Notes

Stage value adjusted to 98.309 in rating curve based on fit to PT record.

Appendix 3. Manual Stage and Discharge Measurements, Site WL-H1

Site Information				
Project Name	Back River			
Station Identification	WL-H1			
Stream Name	Wolf Outflow			
Date Monitored	18-Aug-13			
Time at Site (24 hr)	Start Time:	1:30:00 PM	End Time:	2:15:00 PM
Personnel	Eli H., Mark W.			
Station Cordinates	Easting	Northing	Elevation	
	434269	7269719		
Weather Conditions	Sunny			

Transducer Information			
PT Model	ELF-2	Serial #	2809027
Gain	3.5035	Offset	0.0138
Status		Battery	
# of Records		Memory Free	
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 12	0.240	100.240		100.000	
BM 1			0.713	99.527	
BM 2			1.020	99.220	
PT			2.546	97.694	error
WL			1.988	**98.252**	
SG			1.983	98.257	
TBM	1.952	100.209	1.983	98.257	
SG			1.952	98.257	
WL			1.957	**98.252**	
PT			2.510	97.699	0.560, checked & good
BM 2			0.990	99.219	
BM 1			0.681	99.528	
BM 12			0.209	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 1	99.533	99.528	-0.005	
BM 2	99.224	99.220	-0.004	
PT	97.808	97.699	-0.109	

Summary		
Surveyed Stage (m)	98.252	Corrected:
Discharge (m^3/s)	0.0077	
Pressure Transducer Reading (m)	0.580	
Pressure Transducer Elevation (m)	97.672	

Discharge Measurement - Mid-Section Method

Time (24 hr)	Start	14:16	End	14:50	Location	~50m US of PT after right turn of channel	
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate	
Flow Meter Type	Electromagnetic			Instrument Serial #			
Stage (m)	Start	Reading	0.581	Time	14:16		
	End	Reading	0.58	Time	14:50		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	2.05	0.00	0.0	0.00	0.00			0.000	0.0
	2.10	0.10	0.1	0.01	0.03			0.000	3.9
	2.25	0.12	0.2	0.01	0.02			0.000	3.6
	2.33	0.12	0.1	0.01	0.06			0.001	7.0
	2.40	0.04	0.1	0.00	0.08			0.000	3.5
	2.50	0.11	0.1	0.01	0.05			0.001	7.2
	2.60	0.14	0.1	0.01	0.06			0.001	10.9
	2.70	0.10	0.1	0.01	0.12			0.001	15.6
	2.80	0.10	0.1	0.01	0.08			0.001	10.4
	2.90	0.08	0.1	0.01	0.04			0.000	4.2
	3.00	0.10	0.1	0.01	0.02			0.000	2.6
	3.10	0.10	0.1	0.01	0.03			0.000	3.9
	3.20	0.08	0.1	0.01	0.01			0.000	1.0
	3.30	0.04	0.1	0.00	-0.01			0.000	-0.5
	3.40	0.06	0.1	0.01	-0.01			0.000	-0.8
	3.50	0.08	0.1	0.01	-0.01			0.000	-1.6
	3.70	0.10	0.2	0.02	-0.02			0.000	-5.2
	3.90	0.14	0.2	0.02	-0.02			0.000	-5.5
	4.00	0.14	0.1	0.01	0.00			0.000	0.0
	4.10	0.17	0.1	0.02	0.04			0.001	8.9
	4.20	0.12	0.1	0.01	0.10			0.001	11.7
	4.25	0.16	0.0	0.01	0.05			0.000	5.2
	4.30	0.12	0.0	0.01	0.10			0.001	11.7
	4.40	0.14	0.1	0.01	0.06			0.001	10.9
	4.50	0.18	0.1	0.02	-0.01			0.000	-2.3
	4.60	0.18	0.1	0.02	-0.02			0.000	-4.7
	4.70	0.08	0.1	0.00	-0.03			0.000	-1.9
RB	4.72	0.00	0.0	0.00	0.00			0.000	0.0
Total Q								**0.008**	**100.0**

General Notes

Stage value adjusted to 98.246 in rating curve based on fit to PT record.

Appendix 3. Manual Stage and Discharge Measurements, Site WL-H1

Site Information				
Project Name	Back River			
Station Identification	WL-H1			
Stream Name	Wolf Outflow			
Date Monitored	13-Sep-13			
Time at Site (24 hr)	Start Time:	2:00:00 PM	End Time:	3:00:00 PM
Personnel	Eli H, Robert M			
Station Cordinates	Easting	Northing	Elevation	
	434269	7269719		
Weather Conditions	Light Sleet, Strong Wind			

Transducer Information			
PT Model	ELF-2	Serial #	2809027
Gain	3.5035	Offset	0.0138
Status		Battery	
# of Records		Memory Free	
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM#	Established Elevation (m)	Mean Elevation (this date) (m)		Difference (m)	Notes

Summary			
Surveyed Stage (m)	98.494	Corrected:	98.496
Discharge (m^3/s)	0.257		
Pressure Transducer Reading (m)	0.830		
Pressure Transducer Elevation (m)	97.664		

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	14:00	End	14:40	Location	50m upstream of station			
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate			
Flow Meter Type	Electromagnetic			Instrument Serial #					
Stage (m)	Start	Reading	19:55	Time	14:00				
	End	Reading	19:55	Time	14:40				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	0.60	0.00	0.0	0.01	0.00			0.000	0.0
	0.65	0.37	0.1	0.03	-0.01			0.000	-0.1
	0.75	0.35	0.1	0.06	-0.01			-0.001	-0.2
	1.00	0.48	0.3	0.12	0.00			0.000	0.0
	1.25	0.43	0.3	0.11	0.01			0.001	0.4
	1.50	0.47	0.3	0.12	0.00			0.000	0.0
	1.75	0.50	0.3	0.13	0.02			0.003	1.0
	2.00	0.51	0.3	0.13	0.06			0.008	3.0
	2.25	0.56	0.3	0.14	0.07			0.010	3.8
	2.50	0.58	0.3	0.15	0.07			0.010	4.0
	2.75	0.63	0.3	0.16	0.10			0.016	6.1
	3.00	0.66	0.3	0.17	0.11			0.018	7.1
	3.25	0.68	0.3	0.17	0.14			0.024	9.3
	3.50	0.69	0.3	0.17	0.14			0.024	9.4
	3.75	0.71	0.3	0.18	0.14			0.025	9.7
	4.00	0.60	0.3	0.15	0.16			0.024	9.3
	4.25	0.57	0.3	0.14	0.13			0.019	7.2
	4.50	0.56	0.3	0.14	0.10			0.014	5.5
	4.75	0.54	0.3	0.14	0.11			0.015	5.8
	5.00	0.52	0.3	0.13	0.12			0.016	6.1
	5.25	0.48	0.3	0.12	0.11			0.013	5.1
	5.50	0.47	0.3	0.11	0.11			0.012	4.5
	5.70	0.45	0.2	0.09	0.08			0.007	2.8
	5.90	0.10	0.2	0.04	0.02			0.001	0.3
Grass	6.50	0.06	0.6	0.03	0.00			0.000	0.0
	6.80	0.08	0.3	0.02	0.00			0.000	0.0
RB	6.90	0.00	0.1	0.00	0.00			0.000	0.0
Total Q								0.257	100.0

General Notes

No Survey on this date, wl marked with nails to be surveyed upon return.
Stage value adjusted to 98.496 m in rating curve based on fit to PT record.

Appendix 3. Manual Stage and Discharge Measurements, Site WL-H1

Site Information					
Project Name	Back River				
Station Identification	WL-H1				
Stream Name	Wolf Outflow				
Date Monitored	15-Sep-13				
Time at Site (24 hr)	**Start Time:**	1:00:00 PM	**End Time:**		
Personnel	Eli H, Robert M				
Station Cordinates	**Easting**	**Northing**	**Elevation**		
	434269	7269719			
Weather Conditions	Cloud				
Transducer Information					
PT Model	ELF-2	**Serial #**		2809027	
Gain	3.5035	**Offset**		0.0138	
Status	ok	**Battery**		100%	
# of Records	15299	**Memory Free**		24885	
Date Serviced		**Crest Gauges**			

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 12	0.346	100.346		100.000	
BM 1			0.820	99.526	
BM 2			1.126	99.220	
PT			2.648	97.698	
WL			1.891	**98.455**	
TBM	0.259	100.322	0.283	100.063	
WL			1.858	**98.464**	
PT			2.621	97.701	
BM 2			1.099	99.223	
BM 1			0.792	99.530	
BM 12			0.319	100.003	
WL Sept 13			1.827	98.495	#1, nails in stream
WL Sept 13			1.83	98.492	#2
BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**		**Difference (m)**	**Notes**
BM 1	99.533	99.528		-0.004	
BM 2	99.224	99.222		-0.002	
PT	97.808	97.700		-0.109	

Summary	
Surveyed Stage (m)	98.460
Discharge (m^3/s)	n/a
Pressure Transducer Reading (m)	0.796
Pressure Transducer Elevation (m)	97.664

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**		**End**		**Location**				
Method				**Instrument Model**					
Flow Meter Type				**Instrument Serial #**					
Stage (m)	**Start**	**Reading**		**Time**					
	End	**Reading**		**Time**					
	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
Total Q								**0.000**	**0.0**

General Notes

No flow measurement performed on this day.

Appendix 3. Manual Stage and Discharge Measurements, Site REFB-H1

Site Information				
Project Name	Back River			
Station Identification	REFB-H1			
Stream Name	Reference Lake B outflow			
Date Monitored	6-Jun-13			
Time at Site (24 hr)	Start Time:	1:30:00 PM	End Time:	
Personnel	Eli H., Byeong K.			
Station Cordinates	Easting	Northing	Elevation	
	442573	7257794		
Weather Conditions	Cloudy			

Transducer Information			
PT Model	ELF2	Serial #	2809011
Gain	3.5144	Offset	0.0137
Status	Active	Battery	100%
# of Records	1	Memory Free	32534
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 10	1.283	101.283		100.000	BM 10
BM 44			1.281	100.002	BM 44
BM 48			1.157	100.126	BM 48
PT			1.929	99.354	0.222
WL			1.707	**99.576**	
TBM	1.258	101.212	1.329	99.954	
WL			1.635	**99.577**	
PT			1.858	99.354	
BM 48			1.086	100.126	BM 48
BM 44			1.211	100.001	BM 44
BM 10			1.212	100.000	BM 10

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 44	99.962	100.002	0.039	
BM 48	100.118	100.126	0.008	
PT	99.354	99.354	0.000	

Summary	
Stage (m)	99.577
Discharge (m^3/s)	0.055
Pressure Transducer Reading (m)	0.253
Pressure Transducer Elevation (m)	99.324

Discharge Measurement - Mid-Section Method							
Time (24 hr)	Start	16:25	End		Location	6m US of PT	
Method	Velocity-area (Mid-section)			Instrument Model		FH0950	
Flow Meter Type	Electromagnetic			Instrument Serial #			
Stage (m)	Start	Reading	0.253	Time	16:25		
	End	Reading		Time			

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	1.50	0.00	0.0	0.05	0			0.0000	0.0
	2.30	0.12	0.8	0.09	0.01			0.0009	1.6
	3.00	0.11	0.7	0.06	0			0.0000	0.0
	3.40	0.12	0.4	0.03	0.01			0.0003	0.6
	3.55	0.14	0.2	0.02	0.09			0.0019	3.4
	3.70	0.12	0.2	0.02	0.15			0.0027	4.9
	3.85	0.13	0.2	0.02	0.14			0.0027	4.9
	4.00	0.13	0.2	0.02	0.15			0.0029	5.3
	4.15	0.13	0.2	0.02	0.15			0.0029	5.3
	4.30	0.14	0.1	0.02	0.12			0.0025	4.5
	4.45	0.16	0.2	0.02	0.14			0.0034	6.1
	4.60	0.14	0.1	0.02	0.1			0.0021	3.8
	4.75	0.14	0.2	0.02	0.07			0.0015	2.7
	4.90	0.15	0.2	0.02	0.09			0.0020	3.7
	5.05	0.15	0.1	0.02	0.08			0.0018	3.2
	5.20	0.15	0.2	0.02	0.07			0.0016	2.8
	5.35	0.14	0.1	0.02	0.08			0.0017	3.0
	5.50	0.15	0.2	0.02	0.11			0.0025	4.5
	5.65	0.18	0.2	0.03	0.12			0.0032	5.8
	5.80	0.21	0.1	0.03	0.11			0.0029	5.2
	5.90	0.20	0.1	0.02	0.11			0.0022	4.0
	6.00	0.20	0.1	0.02	0.11			0.0022	4.0
	6.10	0.20	0.1	0.03	0.13			0.0033	5.9
	6.25	0.18	0.2	0.03	0.13			0.0035	6.3
	6.40	0.16	0.2	0.02	0.01			0.0002	0.4
Grass	6.50	0.14	0.1	0.03	0.01			0.0003	0.5
	6.80	0.12	0.3	0.10	0.02			0.0019	3.5
	8.10	0.10	1.3	0.15	0.01			0.0015	2.6
	9.70	0.06	1.6	0.09	0.01			0.0009	1.6
RB	11.00	0.00	1.3	0.04	0			0.0000	0.0
Total Q								**0.055**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site REFB-H1

Site Information				
Project Name	Back River			
Station Identification	REFB-H1			
Stream Name	Reference Lake B outflow			
Date Monitored	19-Jul-13			
Time at Site (24 hr)	Start Time:	6:50:00 AM	End Time:	
Personnel	Eli H., Byeong K.			
Station Cordinates	Easting	Northing	Elevation	
	442573	7257794		
Weather Conditions	Sunny, windless			

Transducer Information			
PT Model	ELF2	Serial #	2809011
Gain	3.5144	Offset	0.0137
Status	Active	Battery	100%
# of Records	6137	Memory Free	29468
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 10	1.510	101.510		100.000	BM 10
BM 44			1.540	99.970	BM 44
BM 48			1.402	100.108	BM 48
PT			2.167	99.343	0.080
WL			2.083	**99.427**	
TBM	1.421	101.437	1.494	100.016	
WL			2.012	**99.425**	
PT			2.096	99.341	
BM 48			1.330	100.107	BM 48
BM 44			1.467	99.970	BM 44
BM 10			1.438	99.999	BM 10

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 44	99.962	99.970	0.008	
BM 48	100.118	100.108	-0.010	
PT	99.354	99.341	-0.013	

Summary	
Stage (m)	99.426
Discharge (m^3/s)	0.00139
Pressure Transducer Reading (m)	0.108
Pressure Transducer Elevation (m)	99.318

Discharge Measurement - Mid-Section Method							
Time (24 hr)	Start	6:50	End		Location	20m US of PT , only flowing branch	
Method	Velocity-area (Mid-section)			Instrument Model		FH0950	
Flow Meter Type	Electromagnetic			Instrument Serial #			
Stage (m)	Start	Reading	0.108	Time	6:50		
	End	Reading		Time			

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.45	0.00	0.0	0.00	0			0.0000	0.0
	0.50	0.05	0.1	0.00	0.01			0.0000	1.8
	0.55	0.07	0.1	0.00	0.01			0.0000	2.5
	0.60	0.08	0.0	0.00	0.01			0.0000	2.9
	0.65	0.10	0.1	0.01	0.01			0.0001	3.6
	0.70	0.12	0.0	0.01	0			0.0000	0.0
	0.75	0.12	0.1	0.01	0			0.0000	0.0
	0.80	0.12	0.1	0.01	0.01			0.0001	4.3
	0.85	0.12	0.0	0.01	0.01			0.0001	4.3
	0.90	0.11	0.1	0.01	0			0.0000	0.0
	0.95	0.12	0.0	0.01	0			0.0000	0.0
	1.00	0.11	0.1	0.01	0			0.0000	0.0
	1.05	0.12	0.1	0.01	0			0.0000	0.0
	1.10	0.12	0.1	0.01	0			0.0000	0.0
	1.15	0.13	0.0	0.01	0			0.0000	0.0
	1.20	0.13	0.1	0.01	0.01			0.0001	4.7
	1.25	0.14	0.1	0.01	0.01			0.0001	5.1
	1.30	0.13	0.1	0.01	0.03			0.0002	14.1
	1.35	0.13	0.1	0.01	0.02			0.0001	9.4
	1.40	0.12	0.0	0.01	0.02			0.0001	8.7
	1.45	0.12	0.1	0.01	0.02			0.0001	8.7
	1.50	0.12	0.1	0.01	0.02			0.0001	8.7
	1.55	0.12	0.1	0.01	0.02			0.0001	8.7
	1.60	0.12	0.1	0.01	0.02			0.0001	8.7
	1.65	0.11	0.0	0.01	0.01			0.0001	4.0
	1.70	0.04	0.1	0.00	0			0.0000	0.0
LB	1.75	0.00	0.1	0.00	0			0.0000	0.0
Total Q								**0.001**	**100.0**

General Notes
Very low flow on this date

Appendix 3. Manual Stage and Discharge Measurements, Site REFB-H1

Site Information				
Project Name	Back River			
Station Identification	REFB-H1			
Stream Name	Reference Lake B outflow			
Date Monitored	21-Aug-13			
Time at Site (24 hr)	**Start Time:**	2:00:00 PM	**End Time:**	
Personnel	Eli H., Mark W.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	442573	7257794		
Weather Conditions	Cloudy			

Transducer Information			
PT Model	ELF2	**Serial #**	2809011
Gain	3.5144	**Offset**	0.0137
Status	OK	**Battery**	100%
# of Records	10932	**Memory Free**	27070
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 10	1.149	101.149		100.000	BM 10
BM 44			1.179	99.970	BM 44
BM 48			1.040	100.109	BM 48
PT			1.823	99.326	
WL			1.824	**99.325**	Near PT level
TBM	0.661	101.100	0.710	100.439	
WL			1.773	**99.327**	
PT			1.773	99.327	
BM 48			0.990	100.110	BM 48
BM 44			1.127	99.973	BM 44
BM 10			1.097	100.003	BM 10

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 44	99.962	99.972	0.010	
BM 48	100.118	100.110	-0.008	
PT	99.354	99.327	-0.027	

Summary	
Stage (m)	99.326
Discharge (m^3/s)	0.000
Pressure Transducer Reading (m)	0.030
Pressure Transducer Elevation (m)	99.296

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**		**End**		**Location**	
Method				**Instrument Model**		
Flow Meter Type				**Instrument Serial #**		
Stage (m)	**Start**	**Reading**		**Time**		
	End	**Reading**		**Time**		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
Total Q								**0.000**	**0.0**

General Notes

No discharge on this date due to dry conditions

Appendix 3. Manual Stage and Discharge Measurements, Site REFB-H1

Site Information				
Project Name	Back River			
Station Identification	REFB-H1			
Stream Name	Reference Lake B outflow			
Date Monitored	16-Sep-13			
Time at Site (24 hr)	Start Time:	2:30:00 PM	End Time:	4:00:00 AM
Personnel	Eli H., Robert M.			
Station Cordinates	Easting	Northing	Elevation	
	442573	7257794		
Weather Conditions	Mix of Sun and Cloud			

Transducer Information			
PT Model	ELF2	Serial #	2809011
Gain	3.5144	Offset	0.0137
Status	ok	Battery	100%
# of Records	14679	Memory Free	25196
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 10	1.021	101.021		100.000	
BM 44			1.048	99.973	
BM 48			0.913	100.108	
BM 49			0.182	100.839	
PT			1.698	99.323	
WL			1.608	**99.413**	
TBM	1.061	101.101	0.981	100.040	
WL			1.689	**99.412**	
PT			1.778	99.323	
BM 49			0.261	100.840	
BM 48			0.992	100.109	
BM 44			1.126	99.975	
BM10			1.101	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 44	99.962	99.974	0.012	
BM 48	100.118	100.109	-0.010	
PT	99.354	99.323	-0.031	

Summary	
Stage (m)	99.413
Discharge (m^3/s)	0.00159
Pressure Transducer Reading (m)	0.122
Pressure Transducer Elevation (m)	99.291

Discharge Measurement - Mid-Section Method

Time (24 hr)	Start	14:34	End	15:00	Location	at PT	
Method	Velocity-area (Mid-section)			Instrument Model		FloMate	
Flow Meter Type	Electromagnetic			Instrument Serial #			
Stage (m)	Start	Reading	0.121	Time	14:34		
	End	Reading	0.121	Time	15:00		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	0.50	0.00	0.0	0.00	0			0.0000	0.0
	0.60	0.04	0.1	0.00	-0.01			0.0000	-2.5
	0.70	0.04	0.1	0.00	-0.01			0.0000	-2.5
	0.80	0.05	0.1	0.01	0			0.0000	0.0
	1.00	0.03	0.2	0.01	0.01			0.0001	3.8
	1.20	0.04	0.2	0.01	0			0.0000	0.0
	1.40	0.04	0.2	0.01	0.01			0.0001	5.0
	1.60	0.06	0.2	0.01	0.02			0.0002	15.1
	1.80	0.05	0.2	0.01	0.01			0.0001	6.3
	2.00	0.04	0.2	0.01	0.01			0.0001	3.8
	2.10	0.04	0.1	0.01	0			0.0000	0.0
	2.30	0.06	0.2	0.01	0			0.0000	0.0
	2.50	0.08	0.2	0.01	0.01			0.0001	8.8
	2.65	0.08	0.2	0.01	0.01			0.0001	7.6
	2.80	0.08	0.2	0.01	0.02			0.0002	15.1
	2.95	0.09	0.2	0.01	0.03			0.0003	21.3
	3.05	0.09	0.1	0.01	0.02			0.0002	11.3
	3.15	0.06	0.1	0.01	0.01			0.0001	3.8
	3.25	0.05	0.1	0.01	0.01			0.0001	3.1
	3.35	0.03	0.1	0.00	0			0.0000	0.0
RB	3.40	0.00	0.0	0.00	0			0.0000	0.0
Total Q								0.0016	100.0

General Notes

Very low flow on this date

Lots of mud

Appendix 3. Manual Stage and Discharge Measurements, Site TIA-H1

Site Information				
Project Name	Back River			
Station Identification	TIA-H1			
Stream Name	TIA-Outflow			
Date Monitored	5-Jun-13			
Time at Site (24 hr)	**Start Time:**	10:00:00 AM	**End Time:**	
Personnel	Eli H, Jeff A			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	0431069	7273106	285	
Weather Conditions	Clear, sunny, light wind (20C)			

Transducer Information			
PT Model	PT2X	**Serial #**	0021302033
Gain	1	**Offset**	0
Status	Active	**Battery**	3.2V
# of Records	2	**Memory Free**	524,137
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 6	1.111	101.111		100.000	
BM 7			1.039	100.072	
BM 8			1.052	100.059	
PT			2.019	99.092	0.557
WL				**99.647**	
SG			1.412	99.699	-0.052
TBM	0.965	101.062	1.014	100.097	
SG			1.363	99.699	-0.052
WL				**99.647**	
PT			1.971	99.091	
BM 8			1.003	100.059	
BM 7			0.990	100.072	
BM 6			1.063	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 7	100.072	100.072	0.000	
BM 8	100.059	100.059	0.000	
PT	99.092	99.092	0.000	

Summary	
Stage (m)	99.647 From SG
Discharge (m^3/s)	0.122
Pressure Transducer Reading (m)	0.584
Pressure Transducer Elevation (m)	99.063

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	11:50	**End**		**Location**	4m US of PT	
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950	
Flow Meter Type	Electromagnetic			**Instrument Serial #**		130881001502	
Stage (m)	**Start**	**Reading**		**Time**	11:50	SG	0.052
	End	**Reading**		**Time**			

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
	0.95	0.00	0.0	0.00	0.00			0.00	0.0
	1.00	0.04	0.1	0.00	0.07			0.00	0.1
	1.07	0.24	0.1	0.02	0.19			0.00	2.8
	1.15	0.37	0.1	0.03	0.35			0.01	8.0
	1.22	0.39	0.1	0.03	0.42			0.01	10.1
	1.30	0.34	0.1	0.02	0.48			0.01	9.4
	1.36	0.33	0.1	0.01	0.52			0.01	4.9
	1.37	0.34	0.0	0.02	0.00			0.00	0.0
	1.45	0.32	0.1	0.02	0.41			0.01	7.0
	1.50	0.31	0.1	0.01	0.38			0.00	3.4
	1.52	0.31	0.0	0.02	0.30			0.00	3.8
	1.60	0.34	0.1	0.03	0.30			0.01	6.3
	1.67	0.41	0.1	0.03	0.26			0.01	6.6
	1.75	0.30	0.1	0.00	0.32			0.00	1.2
	1.70	0.35	0.1	0.01	0.22			0.00	2.2
	1.82	0.29	0.1	0.03	0.46			0.01	11.0
	1.90	0.28	0.1	0.02	0.51			0.01	8.8
	1.97	0.26	0.1	0.02	0.39			0.01	6.2
	2.05	0.25	0.1	0.02	0.30			0.01	4.6
	2.12	0.23	0.1	0.02	0.16			0.00	3.0
	2.25	0.34	0.1	0.03	0.03			0.00	0.8
	2.30	0.34	0.0	0.03	-0.01			0.00	-0.2
	2.40	0.00	0.1	0.02	0.00			0.00	0.0
Total Q								**0.122**	**100.0**

General Notes

Small bedrock canyon. Large angular cobble bed. Bedrock outcrop on RB.

Appendix 3. Manual Stage and Discharge Measurements, Site TIA-H1

Site Information				
Project Name	Back River			
Station Identification	TIA-H1			
Stream Name	TIA-Outflow			
Date Monitored	16-Jun-13			
Time at Site (24 hr)	Start Time:	8:30:00 AM	End Time:	
Personnel	Eli H, Byeong K.			
Station Cordinates	Easting	Northing	Elevation	
	0431069	7273106	285	
Weather Conditions	Sun, scattered cloud			

Transducer Information			
PT Model	PT2X	Serial #	21302033
Gain	1	Offset	0
Status	Active	Battery	3.1V
# of Records	1563	Memory Free	522,576
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 6					
BM 7					
BM 8					
PT					
WL					
SG					
TBM					
SG					
WL					
PT					
BM 8					
BM 7					
BM 6					

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 7				
BM 8				
PT				

Summary	
Stage (m)	99.699 From June 5 SG
Discharge (m^3/s)	0.024
Pressure Transducer Reading (m)	0.204
Pressure Transducer Elevation (m)	99.495

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	8:40	End	9:20	Location	30m DS of PT			
Method	Velocity-area (Mid-section)				Instrument Model	FH950			
Flow Meter Type	Electromagnetic				Instrument Serial #	130881001502			
Stage (m)	Start	Reading	0.204	Time	8:40	SG	0.43		
	End	Reading	0.204	Time	9:20				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.30	0.00	0.0	0.01	0.00			0.000	0.0
	0.55	0.08	0.3	0.01	0.02			0.000	1.2
	0.65	0.06	0.1	0.01	0.02			0.000	0.5
	0.75	0.06	0.1	0.01	0.04			0.000	1.0
	0.85	0.09	0.1	0.01	0.07			0.000	2.0
	0.90	0.20	0.1	0.01	0.06			0.001	2.6
	0.95	0.19	0.0	0.01	0.06			0.001	2.4
	1.00	0.18	0.1	0.01	0.06			0.001	3.4
	1.10	0.17	0.1	0.02	0.07			0.001	5.1
	1.20	0.15	0.1	0.02	0.07			0.001	4.5
	1.30	0.17	0.1	0.02	0.06			0.001	4.3
	1.40	0.18	0.1	0.02	0.08			0.001	6.1
	1.50	0.15	0.1	0.02	0.09			0.001	5.7
	1.60	0.15	0.1	0.02	0.09			0.001	5.7
	1.70	0.21	0.1	0.02	0.08			0.002	7.1
	1.80	0.21	0.1	0.02	0.07			0.001	6.3
	1.90	0.16	0.1	0.02	0.08			0.001	5.4
	2.00	0.14	0.1	0.01	0.09			0.001	5.4
	2.10	0.12	0.1	0.01	0.10			0.001	5.1
	2.20	0.10	0.1	0.01	0.10			0.001	4.3
	2.30	0.10	0.1	0.01	0.11			0.001	4.7
	2.40	0.16	0.1	0.02	0.10			0.002	6.8
	2.50	0.15	0.1	0.02	0.06			0.001	3.8
	2.60	0.12	0.1	0.01	0.06			0.001	3.1
	2.70	0.10	0.1	0.01	0.06			0.000	1.9
	2.75	0.10	0.0	0.00	0.07			0.000	1.5
LB	2.80	0.00	0.0	0.00	0.00			0.000	0.0
Total Q								**0.024**	**100.0**

General Notes

PT depth: 0.189. Much of flow subsurface near PT. Went 20m DS to measure. Stage value adjusted to 99.269 m in rating curve based on fit to PT record.

Appendix 3. Manual Stage and Discharge Measurements, Site TIA-H1

Site Information				
Project Name	Back River			
Station Identification	TIA-H1			
Stream Name	TIA-Outflow			
Date Monitored	12-Sep-13			
Time at Site (24 hr)	**Start Time:**	10:00:00 AM	**End Time:**	
Personnel	Eli H, Robert M.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	0431069	7273106	285	
Weather Conditions	Cloudy, recent rain			

Transducer Information			
PT Model	PT2X	**Serial #**	0021302033
Gain	1	**Offset**	0
Status	Active	**Battery**	3.2V
# of Records		**Memory Free**	
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 6	0.734	100.734		100.000	
BM 7			0.656	100.078	
BM 8			0.669	100.065	
PT			1.640	99.094	0.080
WL			1.558	**99.176**	
SG			1.031	99.703	-0.500
TBM	1.139	100.690	1.183	99.551	
SG			0.985	99.705	
WL			1.511	**99.179**	
PT			1.595	99.095	
BM 8			0.623	100.067	
BM 7			0.611	100.079	
BM 6			0.689	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 7	100.072	100.079	0.006	
BM 8	100.059	100.066	0.007	
PT	99.092	99.095	0.002	

Summary	
Stage (m)	99.178
Discharge (m^3/s)	0.013
Pressure Transducer Reading (m)	0.584
Pressure Transducer Elevation (m)	98.593

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	11:15	**End**	11:57	**Location**	Two mmts. 100m US of PT	
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950	
Flow Meter Type	Electromagnetic			**Instrument Serial #**		3747	
Stage (m)	**Start**	**Reading**		**Time**	11:15	SG	-0.5
	End	**Reading**		**Time**	11:57		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB chan #1	0.60	0.00	0.0	0.00	0.00			0.000	0.0
	0.70	0.02	0.1	0.00	0.02			0.000	0.3
	0.80	0.04	0.1	0.00	0.05			0.000	1.5
	0.90	0.08	0.1	0.01	0.10			0.001	6.1
	1.00	0.06	0.1	0.01	0.15			0.001	6.9
	1.10	0.06	0.1	0.00	0.16			0.001	5.5
	1.15	0.12	0.0	0.01	0.13			0.001	6.0
	1.20	0.10	0.1	0.01	0.11			0.001	4.2
	1.25	0.11	0.1	0.01	0.08			0.000	3.4
	1.30	0.11	0.1	0.01	0.02			0.000	1.3
	1.40	0.12	0.1	0.01	0.04			0.000	3.7
	1.50	0.12	0.1	0.01	0.11			0.001	10.1
	1.60	0.13	0.1	0.01	0.13			0.001	9.7
	1.65	0.12	0.0	0.01	0.14			0.001	6.4
	1.70	0.13	0.1	0.01	0.14			0.001	7.0
	1.75	0.13	0.1	0.01	0.11			0.001	5.5
	1.80	0.14	0.1	0.01	0.09			0.001	7.2
	1.90	0.09	0.1	0.01	0.06			0.001	4.1
	2.00	0.12	0.1	0.01	0.01			0.000	0.9
	2.10	0.10	0.1	0.02	0.01			0.000	1.2
	2.30	0.16	0.2	0.03	0.00			0.000	0.0
	2.50	0.06	0.2	0.01	-0.01			0.000	-0.9
	2.70	0.07	0.2	0.01	-0.01			0.000	-0.8
LB Chan #1	2.80	0.00	0.1	0.00	0.00			0.000	0.0
RB Chan #2	0.75	0.00	0.0	0.00	0.00			0.000	0.0
	0.80	0.09	0.1	0.01	0.00			0.000	0.0
	0.95	0.18	0.2	0.03	0.02			0.001	4.1
	1.10	0.16	0.2	0.03	0.03			0.001	6.4
	1.3	0.09	0.2	0.02	0.00			0.000	0.0
LB Chan #2	1.6	0.03	0.3	0.01	0.00			0.000	0.0
Total Q								**0.013**	**100.0**

General Notes

Could not plug into logger on this date. Lots of flow through boulders. Walked US to find suitable flow location and minimize underground flow.

Appendix 3. Manual Stage and Discharge Measurements, Site UM-H1

Site Information				
Project Name	Back River			
Station Identification	UM-H1			
Stream Name	Umwelt Outflow			
Date Monitored	3-Jun-13			
Time at Site (24 hr)	**Start Time:**	6:00:00 AM	**End Time:**	
Personnel	Eli H, Jeff A			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	429166	7270649	302	
Weather Conditions	Sunny, cool			

Transducer Information			
PT Model		**Serial #**	2122025
Gain	1.006502	**Offset**	-0.044
Status	Active	**Battery**	3.1V
# of Records		**Memory Free**	
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 62	1.752	101.752		100.000	
BM 63			0.386	101.366	
BM 64			0.648	101.104	
PT			2.248	99.504	0.375
WL			1.873	**99.879**	-0.043
SG			1.832	99.920	
TBM	1.743	101.695	1.800	99.952	
SG			1.777	99.918	
WL			1.817	**99.878**	GOOD
PT			2.192	99.503	
BM 64			0.591	101.104	
BM 63			0.329	101.366	
BM 62			1.697	99.998	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 63	101.366	101.366	0.000	
BM 64	101.104	101.104	0.000	
PT	99.504	99.504	0.000	

Summary	
Stage (m)	99.879
Discharge (m^3/s)	0.167
Pressure Transducer Reading (m)	0.384
Pressure Transducer Elevation (m)	99.495

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	10:22	**End**	10:50	**Location**	4m U/S of PT	
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950	
Flow Meter Type	Electromagnetic			**Instrument Serial #**		same	
Stage (m)	**Start**	**Reading**		**Time**	10:22		
	End	**Reading**		**Time**	10:50		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	1.00	0.00	0.0	0.02	0.00			0.000	0.0
Grass	1.50	0.08	0.5	0.04	0.03			0.001	0.7
Grass	2.00	0.12	0.5	0.19	0.01			0.002	1.2
Grass	4.70	0.00	2.7	0.00	0.00			0.000	0.0
Grass	6.00	0.00	1.3	0.00	0.00			0.000	0.0
	6.40	0.16	0.4	0.06	0.03			0.002	1.2
	6.80	0.22	0.4	0.09	0.07			0.006	3.7
	7.20	0.26	0.4	0.12	0.19			0.022	13.4
	7.70	0.27	0.5	0.16	0.04			0.006	3.9
Grass	8.40	0.06	0.7	0.04	0.02			0.001	0.5
Grass	9.00	0.10	0.6	0.05	0.14			0.007	4.2
	9.40	0.20	0.4	0.08	0.14			0.011	6.7
	9.80	0.26	0.4	0.10	0.06			0.006	3.7
	10.20	0.21	0.4	0.08	0.06			0.005	3.0
	10.60	0.21	0.4	0.07	0.04			0.003	1.8
	10.90	0.28	0.3	0.08	0.10			0.008	5.0
	11.20	0.24	0.3	0.07	0.14			0.009	5.5
	11.45	0.36	0.3	0.09	0.15			0.014	8.1
	11.70	0.32	0.3	0.08	0.28			0.022	13.5
	11.95	0.25	0.3	0.06	0.15			0.009	5.6
	12.20	0.18	0.3	0.07	0.13			0.009	5.3
	12.70	0.10	0.5	0.06	0.08			0.004	2.6
	13.30	0.10	0.6	0.06	0.00			0.000	0.0
	13.80	0.15	0.5	0.08	0.10			0.008	4.5
	14.30	0.17	0.5	0.08	0.10			0.008	4.6
	14.70	0.12	0.4	0.04	0.06			0.002	1.3
LB	14.90	0.00	0.2	0.01	0			0.000	0.0
Total Q								**0.167**	**100.0**

General Notes

PT located at outflow of Umwelt Lake. Two BMs (63,64) on rock. Coble bed at PT (30cm dia.). Divided flow DS of PT with one main channel

Appendix 3. Manual Stage and Discharge Measurements, Site UM-H1

Site Information				
Project Name	Back River			
Station Identification	UM-H1			
Stream Name	Umwelt Outflow			
Date Monitored	16-Jun-13			
Time at Site (24 hr)	**Start Time:**	6:50:00 AM	**End Time:**	
Personnel	Eli H, Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	429166	7270649	302	
Weather Conditions	Cloudy			

Transducer Information			
PT Model	PT2X	**Serial #**	2122025
Gain	1.006502	**Offset**	-0.044
Status	Active	**Battery**	3.0V
# of Records	1857	**Memory Free**	522282
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 62	1.437	101.437		100.000	
BM 63			0.066	101.371	
BM 64			0.329	101.108	
PT			1.959	99.478	0.331
WL			1.634	**99.803**	
SG			1.542	99.895	
TBM	1.907	101.503	1.841	99.596	
SG			1.608	99.895	
WL			1.697	**99.806**	
PT			2.022	99.481	
BM 64			0.392	101.111	
BM 63			0.130	101.373	
BM 62			1.502	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 63	101.366	101.372	0.006	
BM 64	101.104	101.110	0.005	
PT	99.504	99.480	-0.025	

Summary		
Surveyed Stage (m)	99.805	
Discharge (m^3/s)	0.101	
Pressure Transducer Reading (m)	0.348	
Pressure Transducer Elevation (m)	99.456	

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	9:30	**End**	10:00	**Location**		
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950	
Flow Meter Type	Electromagnetic			**Instrument Serial #**		same	
Stage (m)	**Start**	**Reading**	0.349	**Time**	9:30	SG	0.092
	End	**Reading**	0.35	**Time**	10:00		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	0.10	0.00	0.0	0.01	0.00			0.000	0.0
	0.40	0.04	0.3	0.01	0.02			0.000	0.2
	0.70	0.08	0.3	0.02	0.01			0.000	0.2
Grass edge	0.90	0.09	0.2	0.01	-0.01			0.000	-0.1
	1.00	0.12	0.1	0.02	0.04			0.001	0.6
	1.15	0.12	0.2	0.02	0.08			0.001	1.4
	1.30	0.18	0.2	0.03	0.20			0.005	5.4
	1.45	0.14	0.2	0.02	0.16			0.003	3.3
	1.60	0.12	0.2	0.02	0.20			0.004	3.6
	1.75	0.16	0.2	0.02	0.15			0.004	3.6
	1.90	0.13	0.2	0.02	0.14			0.003	2.7
	2.05	0.14	0.2	0.02	0.10			0.002	2.1
	2.20	0.20	0.2	0.03	0.10			0.003	3.0
	2.35	0.14	0.2	0.02	0.13			0.003	2.7
	2.50	0.21	0.2	0.03	0.16			0.004	4.2
	2.60	0.26	0.1	0.03	0.24			0.006	6.2
	2.70	0.28	0.1	0.03	0.20			0.006	5.6
	2.80	0.28	0.1	0.03	0.28			0.008	7.8
	2.90	0.27	0.1	0.03	0.36			0.010	9.7
	3.00	0.31	0.1	0.03	0.35			0.011	10.8
	3.10	0.28	0.1	0.03	0.35			0.010	9.8
	3.20	0.28	0.1	0.03	0.25			0.007	7.0
	3.30	0.32	0.1	0.03	0.17			0.005	5.4
	3.40	0.30	0.1	0.02	0.13			0.003	2.5
LB	3.43	0.00	0.0	0.00	0.00			0.000	0.0
RB side channel	1.80	0.00	1.6	0.01	0.00			0.000	0.0
	1.60	0.07	0.2	0.01	0.07			0.001	1.0
	1.40	0.08	0.2	0.02	0.06			0.001	1.0
	1.20	0.06	0.2	0.01	0.04			0.000	0.5
LB side channel	1.00	0.00	0.4	0.01	0.00			0.000	0.0
Total Q								**0.101**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site UM-H1

Site Information				
Project Name	Back River			
Station Identification	UM-H1			
Stream Name	Umwelt Outflow			
Date Monitored	15-Jul-13			
Time at Site (24 hr)	**Start Time:**	8:50:00 AM	**End Time:**	
Personnel	Eli H, Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	429166	7270649	302	
Weather Conditions	Cloudy, windy			

Transducer Information			
PT Model	PT2X	**Serial #**	2122025
Gain	1.006502	**Offset**	-0.044
Status	Active	**Battery**	3.0V
# of Records	6045	**Memory Free**	518095
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 62	1.465	101.465		100.000	
BM 63			0.095	101.370	
BM 64			0.358	101.107	
PT			2.006	99.459	bad, depth: 0.2
WL			1.810	**99.655**	
SG			1.579	99.886	
TBM	1.628	101.418	1.675	99.790	
SG			1.531	99.887	
WL			1.760	**99.658**	
PT			1.595	99.823	good
BM 64			0.309	101.109	
BM 63			0.047	101.371	
BM 62			1.417	100.001	
DSLB			**1.760**	99.658	
DSRB			1.782	99.636	
USLB			1.700	99.718	left channel
USRB			1.701	99.717	right channel

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 63	101.366	101.371	0.005	
BM 64	101.104	101.108	0.004	
PT	99.504	99.459	-0.045	

Summary	
Stage (m)	99.657
Discharge (m^3/s)	0.005
Pressure Transducer Reading (m)	0.223
Pressure Transducer Elevation (m)	99.434

Discharge Measurement - Mid-Section Method								
Time (24 hr)	**Start**	9:30	**End**	10:30	**Location**			
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950		
Flow Meter Type	Electromagnetic			**Instrument Serial #**		same		
Stage (m)	**Start**	**Reading**	0.226	**Time**	9:30	SG		0.226
	End	**Reading**	0.224	**Time**	10:30			

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	0.75	0.00	0.0	0.00	0.00			0.000	0.0
	0.80	0.03	0.1	0.00	0.02			0.000	0.8
	0.88	0.25	0.1	0.02	0.02			0.000	8.2
	0.96	0.18	0.1	0.01	0.03			0.000	6.6
	1.00	0.17	0.0	0.01	0.02			0.000	2.8
	1.04	0.16	0.0	0.01	0.03			0.000	5.9
	1.12	0.16	0.1	0.01	0.02			0.000	5.2
	1.20	0.17	0.1	0.01	0.03			0.000	8.4
	1.28	0.17	0.1	0.01	0.03			0.000	8.4
	1.36	0.16	0.1	0.01	0.03			0.000	7.9
	1.44	0.16	0.1	0.01	0.04			0.000	7.9
	1.48	0.18	0.0	0.01	0.03			0.000	4.4
	1.52	0.17	0.0	0.01	0.03			0.000	3.7
	1.55	0.17	0.0	0.01	0.03			0.000	4.2
	1.60	0.05	0.1	0.00	0.04			0.000	2.7
	1.68	0.04	0.1	0.00	0.03			0.000	2.0
	1.76	0.04	0.1	0.00	0.03			0.000	2.0
	1.84	0.06	0.1	0.00	0.02			0.000	2.0
	1.92	0.14	0.1	0.01	0.02			0.000	4.6
	2.00	0.13	0.1	0.01	0.03			0.000	6.4
	2.08	0.08	0.1	0.01	0.02			0.000	2.6
	2.16	0.08	0.1	0.01	0.01			0.000	1.3
	2.24	0.06	0.1	0.00	0.01			0.000	1.0
	2.32	0.06	0.1	0.00	0.01			0.000	1.0
	2.40	0.03	0.1	0.00	0.01			0.000	0.3
RB	2.43	0.00	0.1	0.00	0.00			0.000	0.0
Total Q								**0.005**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site UM-H1

Site Information				
Project Name	Back River			
Station Identification	UM-H1			
Stream Name	Umwelt Outflow			
Date Monitored	15-Jul-13			
Time at Site (24 hr)	**Start Time:**	8:50:00 AM	**End Time:**	
Personnel	Eli H, Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	429166	7270649	302	
Weather Conditions	Cloudy, windy			

Transducer Information			
PT Model	PT2X	**Serial #**	2122025
Gain	1.006502	**Offset**	-0.044
Status	Active	**Battery**	3.0V
# of Records	6045	**Memory Free**	518095
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 62	1.465	101.465		100.000	
BM 63			0.095	101.370	
BM 64			0.358	101.107	
PT			2.006	99.459	bad, depth: 0.2
WL			1.810	**99.655**	
SG			1.579	99.886	
TBM	1.628	101.418	1.675	99.790	
SG			1.531	99.887	
WL			1.760	**99.658**	
PT			1.595	99.823	good
BM 64			0.309	101.109	
BM 63			0.047	101.371	
BM 62			1.417	100.001	
DSLB			1.760	99.658	
DSRB			1.782	99.636	
USLB			1.700	99.718	
USRB			1.701	99.717	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 63	101.366	101.371	0.005	
BM 64	101.104	101.108	0.004	
PT	99.504	99.459	-0.045	

Summary			
Surveyed Stage Stage (m)	99.657	**Corrected (m):**	99.662
Discharge (m^3/s)	0.005		
Pressure Transducer Reading (m)	0.228		
Pressure Transducer Elevation (m)	99.434		

Discharge Measurement - Mid-Section Method No.2

Time (24 hr)	**Start**	11:00	**End**	11:30	**Location**	
Method	Velocity-area (Mid-section)			**Instrument Model**	FH950	
Flow Meter Type	Electromagnetic			**Instrument Serial #**	same	
Stage (m)	**Start**	**Reading**	0.226	**Time**	11:00	
	End	**Reading**	0.224	**Time**	11:30	

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	0.40	0.00	0.0	0.00	0.00			0.000	0.0
	0.50	0.08	0.1	0.01	0.01			0.000	1.5
	0.60	0.12	0.1	0.01	0.04			0.000	9.0
	0.70	0.12	0.1	0.01	0.05			0.001	11.2
	0.80	0.08	0.1	0.01	0.04			0.000	6.0
	0.90	0.11	0.1	0.01	0.03			0.000	6.2
	1.00	0.06	0.1	0.01	0.04			0.000	4.5
	1.10	0.06	0.1	0.01	0.03			0.000	3.4
	1.20	0.07	0.1	0.01	0.04			0.000	5.2
	1.30	0.07	0.1	0.01	0.05			0.000	6.5
	1.40	0.14	0.1	0.01	0.03			0.000	7.8
	1.50	0.11	0.1	0.01	0.03			0.000	6.2
	1.60	0.09	0.1	0.01	0.02			0.000	3.4
	1.70	0.10	0.1	0.01	0.03			0.000	5.6
	1.80	0.13	0.1	0.01	0.02			0.000	4.9
	1.90	0.12	0.1	0.01	0.03			0.000	6.7
	2.00	0.14	0.1	0.01	0.02			0.000	5.2
	2.10	0.15	0.1	0.02	0.01			0.000	2.8
	2.20	0.12	0.1	0.01	0.00			0.000	0.0
	2.30	0.12	0.1	0.01	0.01			0.000	2.2
	2.40	0.10	0.1	0.01	0.01			0.000	1.9
	2.50	0.06	0.1	0.01	0.00			0.000	0.0
RB	2.60	0.00	0.2	0.00	0.00			0.000	0.0
Total Q								**0.005**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site UM-H1

Site Information				
Project Name	Back River			
Station Identification	UM-H1			
Stream Name	Umwelt Outflow			
Date Monitored	20-Aug-13			
Time at Site (24 hr)	**Start Time:**	6:20:00 AM	**End Time:**	
Personnel	Eli H., Mark W.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	429166	7270649	302	
Weather Conditions	Cloudy, windy			

Transducer Information			
PT Model	PT2X	**Serial #**	2122025
Gain	1.006502	**Offset**	-0.044
Status	Active	**Battery**	3.0V
# of Records	11213	**Memory Free**	512929
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 62	1.395	101.395		100.000	
BM 63			0.029	101.366	
BM 64			0.286	101.109	
PT			1.934	99.461	0.180
WL			1.758	**99.637**	
SG			1.506	99.889	
TBM	1.652	101.447	1.600	99.795	
SG			1.563	99.884	
WL			1.811	**99.636**	
PT			1.988	99.459	
BM 64			0.340	101.107	
BM 63			0.082	101.365	
BM 62			1.448	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 63	101.366	101.366	-0.001	
BM 64	101.104	101.108	0.004	
PT	99.504	99.460	-0.044	

Summary			
Surveyed Stage Stage (m)	99.637	**Corrected (m):**	99.632
Discharge (m^3/s)	0.002		
Pressure Transducer Reading (m)	0.199		
Pressure Transducer Elevation (m)	99.438		

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	6:27	**End**	7:09	**Location**	-5m DS of PT	
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-mate	
Flow Meter Type	Electromagnetic			**Instrument Serial #**		same	
Stage (m)	**Start**	**Reading**	0.2	**Time**	6:27		
	End	**Reading**	0.2	**Time**	7:09		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	0.23	0.00	0.0	0.00	0.00			0.000	0.0
	0.30	0.06	0.1	0.01	0.02			0.000	4.9
	0.40	0.15	0.1	0.02	0.02			0.000	14.5
	0.50	0.15	0.1	0.02	0.01			0.000	7.3
	0.60	0.16	0.1	0.02	0.01			0.000	7.8
	0.70	0.16	0.1	0.01	0.01			0.000	6.6
	0.77	0.16	0.1	0.01	0.01			0.000	5.4
	0.84	0.18	0.1	0.01	0.01			0.000	6.1
	0.91	0.18	0.1	0.01	0.01			0.000	6.1
	0.98	0.18	0.1	0.01	0.01			0.000	6.1
	1.05	0.18	0.1	0.01	0.01			0.000	6.1
	1.12	0.18	0.1	0.01	0.01			0.000	6.1
	1.19	0.18	0.1	0.01	0.01			0.000	6.1
	1.26	0.18	0.1	0.01	0.01			0.000	6.1
	1.33	0.20	0.1	0.01	0.01			0.000	6.8
	1.40	0.18	0.1	0.02	0.00			0.000	0.0
	1.50	0.20	0.1	0.02	0.00			0.000	0.0
	1.60	0.14	0.1	0.01	0.01			0.000	6.8
	1.70	0.14	0.1	0.01	0.01			0.000	6.8
	1.80	0.06	0.1	0.01	-0.02			0.000	-5.8
	1.90	0.04	0.1	0.00	-0.03			0.000	-3.8
RB	1.93	0.00	0.1	0.00	0.00			0.000	0.0
Total Q								**0.002**	**100.0**

General Notes

Stage value adjusted to 99.632 m in rating curve based on fit to PT record.

Appendix 3. Manual Stage and Discharge Measurements, Site UM-H1

Site Information				
Project Name	Back River			
Station Identification	UM-H1			
Stream Name	Umwelt Outflow			
Date Monitored	11-Sep-13			
Time at Site (24 hr)	**Start Time:**	12:45:00 PM	**End Time:**	
Personnel	Eli H., Robert M.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	429166	7270649	302	
Weather Conditions	Cloudy, windy			

Transducer Information			
PT Model	PT2X	**Serial #**	2122025
Gain	1.006502	**Offset**	-0.044
Status	Active	**Battery**	2.9V
# of Records	14420	**Memory Free**	509719
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 62	1.594	101.594		100.000	
BM 63			0.253	101.341	
BM 64			0.479	101.115	
PT			2.118	99.476	0.210
WL			1.919	**99.675**	
SG			1.698	99.896	
TBM	1.862	101.634	1.822	99.772	
SG			1.737	99.897	
WL			1.960	**99.674**	
PT			2.162	99.472	
BM 64			0.519	101.115	
BM 63			0.296	101.338	
BM 62			1.634	100.000	
DSWL			1.970	99.664	
USWL			1.911	99.723	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 63	101.366	101.340	-0.027	
BM 64	101.104	101.115	0.011	
PT	99.504	99.474	-0.030	

Summary			
Surveyed Stage Stage (m)	99.675	**Corrected (m):**	99.667
Discharge (m^3/s)	0.005		
Pressure Transducer Reading (m)	0.233		
Pressure Transducer Elevation (m)	99.442		

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	12:54	**End**	13:30	**Location**	Approx. 5 m DS of PT			
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-mate			
Flow Meter Type	Electromagnetic			**Instrument Serial #**		same			
Stage (m)	**Start**	**Reading**	0.233	**Time**	12:54				
	End	**Reading**	0.233	**Time**	13:30				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	1.10	0.00	0.0	0.00	0.00			0.000	0.0
	1.20	0.04	0.1	0.00	0.00			0.000	0.0
	1.30	0.07	0.1	0.01	-0.01			0.000	-1.4
	1.40	0.12	0.1	0.01	0.00			0.000	0.0
	1.50	0.12	0.1	0.01	0.00			0.000	0.0
	1.60	0.06	0.1	0.01	0.00			0.000	0.0
	1.70	0.05	0.1	0.01	0.01			0.000	1.0
	1.80	0.09	0.1	0.01	0.02			0.000	3.5
	1.90	0.13	0.1	0.01	0.03			0.000	7.5
	2.00	0.14	0.1	0.01	0.03			0.000	8.1
	2.10	0.12	0.1	0.01	0.03			0.000	7.0
	2.20	0.12	0.1	0.01	0.01			0.000	2.3
	2.30	0.08	0.1	0.01	0.03			0.000	4.6
	2.40	0.09	0.1	0.01	0.04			0.000	7.0
	2.50	0.10	0.1	0.01	0.05			0.001	9.7
	2.60	0.09	0.1	0.01	0.02			0.000	3.5
	2.70	0.08	0.1	0.01	0.04			0.000	6.2
	2.80	0.08	0.1	0.01	0.04			0.000	6.2
	2.90	0.10	0.1	0.01	0.05			0.001	9.7
	3.00	0.10	0.1	0.01	0.04			0.000	7.7
	3.10	0.10	0.1	0.01	0.04			0.000	7.7
	3.20	0.10	0.1	0.01	0.04			0.000	7.7
	3.30	0.08	0.1	0.01	0.01			0.000	1.5
	3.40	0.03	0.1	0.00	0.01			0.000	0.4
LB	3.45	0.00	0.1	0.00	0.00			0.000	0.0
Total Q	**0.21**							**0.005**	**100.0**

General Notes
Stage value adjusted to 99.667 m in rating curve based on fit to PT record.

Appendix 3. Manual Stage and Discharge Measurements, Site UM-H1

Site Information				
Project Name	Back River			
Station Identification	UM-H1			
Stream Name	Umwelt Outflow			
Date Monitored	16-Sep-13			
Time at Site (24 hr)	**Start Time:**	10:17:00 AM	**End Time:**	
Personnel	Eli H., Robert M.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	429166	7270649	302	
Weather Conditions	Cloudy, windy			

Transducer Information			
PT Model	PT2X	**Serial #**	2122025
Gain	1.006502	**Offset**	-0.044
Status	Active	**Battery**	2.9V
# of Records	15128	**Memory Free**	509011
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 62	1.730	101.730		100.000	
BM 63			0.391	101.339	Old
BM 64			0.610	101.120	
BM 65			0.983	100.747	
PT			2.252	99.478	
WL			1.987	**99.743**	
SG			1.832	99.898	0.252
TBM	1.988	101.793	1.925	99.805	
SG			1.893	99.900	
WL			2.047	**99.746**	
PT			2.312	99.481	
BM 65			1.046	100.747	
BM 64			0.672	101.121	
BM 63			0.453	101.340	Old
BM 62			1.791	100.002	
BM 63*			0.822	100.971	new elevation

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 63	101.366	101.340	-0.026	
BM 64	101.104	101.121	0.017	
BM 65	100.747	100.747	0.000	established on th

Summary			
Surveyed Stage Stage (m)	99.745	**Corrected (m):**	99.714
Discharge (m^3/s)	0.034		
Pressure Transducer Reading (m)	0.280		
Pressure Transducer Elevation (m)	99.465		

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	10:50	**End**	11:30	**Location**	Approx. 5 m DS of PT			
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-mate			
Flow Meter Type	Electromagnetic			**Instrument Serial #**		same			
Stage (m)	**Start**	**Reading**	0.281	**Time**	10:50				
	End	**Reading**	0.28	**Time**	11:30				

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	0.37	0.00	0.0	0.00	0.00			0.000	0.0
	0.40	0.26	0.0	0.02	0.01			0.000	0.5
	0.50	0.26	0.1	0.03	0.07			0.002	5.3
	0.60	0.22	0.1	0.02	0.12			0.003	7.7
	0.70	0.22	0.1	0.02	0.15			0.003	9.6
	0.80	0.23	0.1	0.02	0.15			0.003	10.0
	0.90	0.22	0.1	0.02	0.19			0.004	12.2
	1.00	0.21	0.1	0.02	0.17			0.004	10.4
	1.10	0.21	0.1	0.02	0.12			0.003	7.3
	1.20	0.20	0.1	0.02	0.10			0.002	5.8
	1.30	0.15	0.1	0.02	0.06			0.001	3.3
	1.45	0.11	0.2	0.02	0.07			0.001	3.4
	1.60	0.14	0.2	0.02	0.12			0.003	7.3
	1.75	0.09	0.2	0.01	0.06			0.001	2.4
	1.90	0.16	0.2	0.02	0.03			0.001	2.1
	2.05	0.13	0.2	0.02	-0.01			0.000	-0.6
	2.20	0.10	0.2	0.02	0.07			0.001	3.1
	2.35	0.13	0.2	0.02	0.04			0.001	2.3
	2.50	0.14	0.2	0.02	0.06			0.001	4.3
	2.70	0.09	0.2	0.01	0.05			0.001	2.0
	2.80	0.08	0.1	0.01	0.05			0.001	1.5
	2.95	0.04	0.2	0.01	0.00			0.000	0.0
	3.10	0.02	0.2	0.00	0.00			0.000	0.0
RB	3.15	0.00	0.0	0.00	0.00			0.000	0.0
LB Side channel	2.70	0.00	0.0	0.00	0.00			0.000	0.0
	2.55	0.03	0.2	0.00	0.01			0.000	0.1
	2.50	0.06	0.0	0.00	0.02			0.000	0.3
	2.40	0.04	0.1	0.00	-0.01			0.000	-0.1
	2.30	0.03	0.1	0.00	0.01			0.000	0.1
	2.20	0.02	0.1	0.00	0.01			0.000	0.1
RB Side channel	2.10	0.00	0.1	0.00	0.00			0.000	0.0
Total Q	**0.42**							**0.034**	**100.0**

General Notes

Stage value adjusted to 99.714 m in rating curve based on fit to PT record.

Appendix 3. Manual Stage and Discharge Measurements, Site WP-H1

Site Information				
Project Name	Back River			
Station Identification	WP-H1			
Stream Name	Wasp Lake			
Date Monitored	12-Sep-13			
Time at Site (24 hr)	**Start Time:**	7:30:00 AM	**End Time:**	9:30:00 AM
Personnel	Eli H, Jeff A			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	431087	7274467		
Weather Conditions	Sunny			

Transducer Information			
PT Model	PTX2	**Serial #**	21221020
Gain	1.05487	**Offset**	-0.006
Status	Active	**Battery**	3.1V
# of Records	2	**Memory Free**	524,137
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 3	1.114	101.114		100.000	
BM 4			1.167	99.947	
BM 5			1.247	99.867	
PT			2.342	98.772	0.634+-2mm
WL			1.702	**99.412**	
TBM	1.233	101.212	1.135	99.979	
WL			1.798	**99.414**	
PT			2.439	98.773	
BM 5			1.343	99.869	
BM 4			1.264	99.948	
BM 3			1.213	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 4	99.948	99.948	0.000	
BM 5	99.868	99.868	0.000	
PT	98.773	98.773	0.000	

Summary	
Stage (m)	99.413
Discharge (m^3/s)	0.748
Pressure Transducer Reading (m)	0.675
Pressure Transducer Elevation (m)	98.738

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	7:40	**End**		**Location**	at PT
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950
Flow Meter Type	Electromagnetic			**Instrument Serial #**		same
Stage (m)	**Start**	**Reading**		**Time**	7:40	
	End	**Reading**		**Time**		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
	0.30	0.00	0.0	0.00	0.00			0.000	0.0
	0.80	0.00	0.5	0.00	0.00			0.000	0.0
	1.40	0.12	0.6	0.05	0.02			0.001	0.1
	1.70	0.08	0.3	0.02	0.00			0.000	0.0
	1.90	0.15	0.2	0.02	0.12			0.003	0.4
	2.00	0.31	0.1	0.07	0.23			0.016	2.1
	2.35	0.46	0.4	0.14	0.19			0.026	3.5
	2.60	0.46	0.3	0.13	0.26			0.033	4.4
	2.90	0.37	0.3	0.11	0.27			0.030	4.0
	3.20	0.44	0.3	0.13	0.29			0.038	5.1
	3.50	0.46	0.3	0.14	0.34			0.047	6.3
	3.80	0.37	0.3	0.11	0.35			0.039	5.2
	4.10	0.34	0.3	0.10	0.44			0.045	6.0
	4.40	0.36	0.3	0.09	0.43			0.039	5.2
	4.60	0.44	0.2	0.10	0.44			0.044	5.8
	4.85	0.71	0.3	0.14	0.40			0.057	7.6
	5.00	0.65	0.2	0.10	0.44			0.043	5.7
	5.15	0.55	0.2	0.08	0.46			0.038	5.1
	5.30	0.52	0.1	0.08	0.46			0.036	4.8
	5.45	0.52	0.2	0.08	0.43			0.034	4.5
	5.60	0.49	0.1	0.09	0.49			0.042	5.6
	5.80	0.46	0.2	0.09	0.49			0.045	6.0
	6.00	0.40	0.2	0.08	0.48			0.038	5.1
	6.20	0.40	0.2	0.08	0.39			0.031	4.2
	6.40	0.31	0.2	0.05	0.33			0.018	2.4
	6.55	0.21	0.1	0.03	0.22			0.006	0.8
	6.65	0.04	0.1	0.00	0.14			0.000	0.1
	6.70	0.00	0.0	0.00	0.00			0.000	0.0
Total Q								**0.748**	**100.0**

General Notes

PT in line with flow

Appendix 3. Manual Stage and Discharge Measurements, Site WP-H1

Site Information				
Project Name	Back River			
Station Identification	WP-H1			
Stream Name	Wasp Lake			
Date Monitored	12-Sep-13			
Time at Site (24 hr)	**Start Time:**	1:50:00 PM	**End Time:**	
Personnel	Eli H., Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	431087	7274467		
Weather Conditions	High cloud			

Transducer Information			
PT Model	PT2X	**Serial #**	21221020
Gain	1.05487	**Offset**	-0.006
Status	Active	**Battery**	3.1V
# of Records	1467	**Memory Free**	522,627
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 3	0.797	100.797		100.000	
BM 4			0.848	99.949	
BM 5			0.927	99.870	
PT			2.023	98.774	0.535
WL			1.486	**99.311**	
TBM	1.826	100.731	1.892	98.905	
WL			1.423	**99.308**	
PT			1.959	98.772	
BM 5			0.861	99.870	
BM 4			0.782	99.949	
BM 3			0.730	100.001	
US LB			**1.418**	99.313	
US RB			1.424	99.307	
DS LB			1.466	99.265	
DS RB			1.463	99.268	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 4	99.948	99.949	0.001	
BM 5	99.868	99.870	0.002	
PT	98.773	98.773	0.000	

Summary	
Stage (m)	99.310
Discharge (m^3/s)	0.393
Pressure Transducer Reading (m)	0.569
Pressure Transducer Elevation (m)	98.740

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	13:50	**End**	14:20	**Location**	at PT			
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950			
Flow Meter Type	Electromagnetic			**Instrument Serial #**		same			
Stage (m)	**Start**	**Reading**	0.569	**Time**	13:50				
	End	**Reading**	0.569	**Time**	14:20				

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	0.15	0.00	0.0	0.01	0.00			0.000	0.0
	0.20	0.26	0.1	0.03	0.14			0.005	1.2
	0.40	0.28	0.2	0.06	0.19			0.011	2.7
	0.60	0.30	0.2	0.06	0.23			0.014	3.5
	0.80	0.34	0.2	0.07	0.29			0.020	5.0
	1.00	0.37	0.2	0.07	0.31			0.023	5.8
	1.20	0.39	0.2	0.08	0.33			0.026	6.5
	1.40	0.44	0.2	0.09	0.34			0.030	7.6
	1.60	0.54	0.2	0.11	0.25			0.027	6.9
	1.80	0.60	0.2	0.12	0.32			0.038	9.8
	2.00	0.61	0.2	0.12	0.23			0.028	7.1
	2.20	0.66	0.2	0.13	0.22			0.029	7.4
Behind rock	2.40	0.58	0.2	0.12	0.10			0.012	2.9
	2.60	0.30	0.2	0.06	0.23			0.014	3.5
	2.80	0.26	0.2	0.05	0.26			0.014	3.4
	3.00	0.33	0.2	0.07	0.26			0.017	4.4
	3.20	0.38	0.2	0.08	0.24			0.018	4.6
	3.40	0.34	0.2	0.07	0.16			0.011	2.8
	3.60	0.34	0.2	0.07	0.20			0.014	3.5
	3.80	0.34	0.2	0.07	0.21			0.014	3.6
	4.00	0.34	0.2	0.07	0.18			0.012	3.1
	4.20	0.41	0.2	0.08	0.12			0.010	2.5
	4.40	0.43	0.2	0.08	0.11			0.009	2.2
RB	4.56	0.00	0.2	0.03	0.00			0.000	0.0
Total Q								**0.393**	**100.0**

General Notes
PT in line with flow edge of boulder

Appendix 3. Manual Stage and Discharge Measurements, Site WP-H1

Site Information				
Project Name	Back River			
Station Identification	WP-H1			
Stream Name	Wasp Lake			
Date Monitored	12-Sep-13			
Time at Site (24 hr)	**Start Time:**	7:45:00 AM	**End Time:**	10:00:00 AM
Personnel	Eli H., Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	431087	7274467		
Weather Conditions	Cloudy, light rain			

Transducer Information			
PT Model	PT2X	**Serial #**	21221020
Gain	1.05487	**Offset**	-0.006
Status	Active	**Battery**	3.0V
# of Records	5898	**Memory Free**	518,241
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 3	0.957	100.957		100.000	
BM 4			1.008	99.949	
BM 5			1.087	99.870	
PT			2.184	98.773	0.392
WL			1.792	**99.165**	
TBM	1.139	101.014	1.082	99.875	
WL			1.848	**99.166**	
PT			2.241	98.773	
BM 5			1.144	99.870	
BM 4			1.064	99.950	
BM 3			1.013	100.001	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 4	99.948	99.950	0.002	
BM 5	99.868	99.870	0.002	
PT	98.773	98.773	0.000	

Summary	
Stage (m)	99.166
Discharge (m^3/s)	0.066
Pressure Transducer Reading (m)	0.423
Pressure Transducer Elevation (m)	98.742

Discharge Measurement - Mid-Section Method								
Time (24 hr)	**Start**	7:55	**End**	8:35	**Location**	at PT		
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950		
Flow Meter Type	Electromagnetic			**Instrument Serial #**		same		
Stage (m)	**Start**	**Reading**	0.423	**Time**	7:55			
	End	**Reading**	0.423	**Time**	8:35			

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
	0.20	0.00	0.0	0.02	0.00			0.000	0.0
	0.40	0.16	0.2	0.03	0.01			0.000	0.5
	0.60	0.16	0.2	0.03	0.06			0.002	2.9
	0.80	0.19	0.2	0.04	0.09			0.003	5.2
	1.00	0.22	0.2	0.04	0.13			0.006	8.7
	1.20	0.28	0.2	0.06	0.13			0.007	11.1
	1.40	0.28	0.2	0.04	0.12			0.005	7.7
	1.50	0.31	0.1	0.03	0.11			0.003	5.2
	1.60	0.32	0.1	0.03	0.06			0.002	2.9
	1.70	0.44	0.1	0.04	0.11			0.005	7.4
	1.80	0.42	0.1	0.04	0.09			0.004	5.8
	1.90	0.36	0.1	0.04	0.09			0.003	4.9
	2.00	0.45	0.1	0.07	0.06			0.004	6.2
	2.20	0.12	0.2	0.02	0.10			0.002	3.7
	2.40	0.08	0.2	0.02	0.07			0.001	1.7
	2.60	0.12	0.2	0.02	0.11			0.003	4.0
	2.80	0.18	0.2	0.04	0.08			0.003	4.4
	3.00	0.18	0.2	0.04	0.07			0.003	3.8
	3.20	0.18	0.2	0.04	0.06			0.002	3.3
	3.40	0.22	0.2	0.04	0.04			0.002	2.7
	3.60	0.17	0.2	0.03	0.04			0.001	2.1
	3.80	0.13	0.2	0.03	0.04			0.001	1.6
	4.00	0.24	0.2	0.05	0.03			0.001	2.2
	4.20	0.24	0.2	0.05	0.02			0.001	1.6
	4.45	0.08	0.3	0.02	0.02			0.000	0.5
	4.60	0.00	0.8	0.01	0.00			0.000	0.0
Total Q								**0.066**	**100.0**

General Notes
PT in line with flow edge of boulder

Appendix 3. Manual Stage and Discharge Measurements, Site WP-H1

Site Information				
Project Name	Back River			
Station Identification	WP-H1			
Stream Name	Wasp Lake			
Date Monitored	12-Sep-13			
Time at Site (24 hr)	Start Time:	8:36:00 AM	End Time:	
Personnel	Eli H., Byeong K.			
Station Cordinates	Easting	Northing	Elevation	
	431087	7274467		
Weather Conditions	Cloudy, windless			

Transducer Information			
PT Model	PT2X	Serial #	21221020
Gain	1.05487	Offset	-0.006
Status	Active	Battery	3.0V
# of Records	6478	Memory Free	517,661
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
	No survey on this date				
BM#	Established Elevation (m)	Mean Elevation (this date) (m)		Difference (m)	Notes

Summary	
Stage (m)	99.152
Discharge (m^3/s)	0.055
Pressure Transducer Reading (m)	0.410
Pressure Transducer Elevation (m)	98.742

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	8:39	End	9:05	Location				
Method	Velocity-area (Mid-section)			Instrument Model		FH950			
Flow Meter Type	Electromagnetic			Instrument Serial #		same			
Stage (m)	Start	Reading	0.41	Time	8:39				
	End	Reading	0.41	Time	9:05				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.10	0.00	0.0	0.01	0.00			0.000	0.0
	0.20	0.16	0.1	0.02	0.00			0.000	0.0
	0.40	0.18	0.2	0.05	0.00			0.000	0.0
	0.70	0.27	0.3	0.08	0.02			0.002	2.9
	1.00	0.18	0.3	0.05	0.03			0.001	2.5
	1.20	0.18	0.2	0.04	0.05			0.002	3.3
	1.40	0.24	0.2	0.05	0.04			0.002	3.5
	1.60	0.20	0.2	0.04	0.03			0.001	2.2
	1.80	0.20	0.2	0.04	0.04			0.002	2.9
	2.00	0.23	0.2	0.05	0.03			0.001	2.5
	2.20	0.43	0.2	0.09	0.02			0.002	3.1
	2.40	0.38	0.2	0.08	0.03			0.002	4.1
	2.60	0.47	0.2	0.07	0.01			0.001	1.3
	2.70	0.49	0.1	0.05	0.04			0.002	3.6
	2.80	0.49	0.1	0.07	0.05			0.004	6.7
	3.00	0.51	0.2	0.10	0.05			0.005	9.3
	3.20	0.52	0.2	0.10	0.05			0.005	9.4
	3.40	0.40	0.2	0.08	0.12			0.010	17.4
	3.60	0.28	0.2	0.06	0.10			0.006	10.2
	3.80	0.22	0.2	0.06	0.08			0.004	8.0
	4.10	0.23	0.3	0.07	0.04			0.003	5.0
	4.40	0.20	0.3	0.06	0.02			0.001	2.2
	4.70	0.10	0.3	0.02	0.00			0.000	0.0
LB	4.85	0.00	0.1	0.01	0.00			0.000	0.0
Total Q								**0.055**	**100.0**

General Notes
PT depth measured 0.378m. First flow potentially affected by rocks upstream. If different use #2 (following tab).

Appendix 3. Manual Stage and Discharge Measurements, Site WP-H1

Site Information				
Project Name	Back River			
Station Identification	WP-H1			
Stream Name	Wasp Lake			
Date Monitored	12-Sep-13			
Time at Site (24 hr)	Start Time:	8:36:00 AM	End Time:	
Personnel	Eli H., Byeong K.			
Station Cordinates	Easting	Northing	Elevation	
	431087	7274467		
Weather Conditions	Cloudy, windless			

Transducer Information			
PT Model	PT2X	Serial #	21221020
Gain	1.05487	Offset	-0.006
Status	Active	Battery	3.0V
# of Records	6478	Memory Free	517,661
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
	No Survey on this date				
BM#	Established Elevation (m)	Mean Elevation (this date) (m)		Difference (m)	Notes

Summary	
Stage (m)	99.152
Discharge (m^3/s)	0.043
Pressure Transducer Reading (m)	0.410
Pressure Transducer Elevation (m)	98.742

Discharge Measurement - Mid-Section Method								
Time (24 hr)	Start	9:15	End	9:45	Location	3m US of PT		
Method	Velocity-area (Mid-section)			Instrument Model		FH950		
Flow Meter Type	Electromagnetic			Instrument Serial #		same		
Stage (m)	Start	Reading	0.41	Time	9:15			
	End	Reading	0.41	Time	9:45			

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.15	0.00	0.0	0.00	0.00			0.000	0.0
	0.30	0.04	0.2	0.01	0.05			0.000	0.8
	0.50	0.06	0.2	0.01	0.11			0.001	3.4
	0.75	0.08	0.3	0.01	0.21			0.003	6.8
	0.85	0.04	0.1	0.00	0.18			0.001	1.7
	0.95	0.14	0.1	0.01	0.08			0.001	2.6
	1.05	0.10	0.1	0.01	0.18			0.002	4.2
	1.15	0.06	0.1	0.01	0.17			0.001	2.4
	1.25	0.10	0.1	0.01	0.13			0.001	3.0
	1.35	0.12	0.1	0.01	0.13			0.002	3.6
	1.45	0.15	0.1	0.02	0.12			0.002	4.2
	1.55	0.12	0.1	0.01	0.15			0.002	4.2
	1.65	0.11	0.1	0.01	0.19			0.002	4.8
	1.75	0.07	0.1	0.01	0.18			0.001	2.9
	1.85	0.06	0.1	0.01	0.18			0.001	2.5
	1.95	0.09	0.1	0.01	0.20			0.002	4.2
	2.05	0.09	0.1	0.01	0.16			0.001	3.3
	2.15	0.09	0.1	0.01	0.17			0.002	3.5
	2.25	0.10	0.1	0.01	0.18			0.002	4.2
	2.35	0.12	0.1	0.01	0.18			0.002	5.0
	2.45	0.22	0.1	0.02	0.18			0.004	9.2
	2.55	0.24	0.1	0.02	0.21			0.004	8.8
	2.60	0.20	0.1	0.01	0.20			0.002	4.6
	2.65	0.15	0.0	0.01	0.22			0.002	5.7
	2.75	0.08	0.1	0.01	0.22			0.001	3.1
	2.80	0.04	0.0	0.00	0.20			0.001	1.4
LB	2.90	0.00	0.1	0.00	0.00			0.000	0.0
Total Q								**0.043**	**100.0**

General Notes
PT depth measured

Appendix 3. Manual Stage and Discharge Measurements, Site WP-H1

Site Information				
Project Name	Back River			
Station Identification	WP-H1			
Stream Name	Wasp Lake			
Date Monitored	12-Sep-13			
Time at Site (24 hr)	**Start Time:**	10:55:00 AM	**End Time:**	
Personnel	Eli H., Mark W.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	431087	7274467		
Weather Conditions	Cloudy			

Transducer Information			
PT Model	PT2X	**Serial #**	21221020
Gain	1.05487	**Offset**	-0.006
Status	Active	**Battery**	3.0V
# of Records	10811	**Memory Free**	513326
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 3	0.733	100.733		100.000	
BM 4			0.784	99.949	
BM 5			0.863	99.870	
PT			1.962	98.771	0.355
WL			1.604	**99.129**	
TBM	1.979	101.079	1.633	99.100	
WL			1.949	**99.130**	
PT			2.309	98.770	
BM 5			1.212	99.867	
BM 4			1.130	99.949	
BM 3			1.078	100.001	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 4	99.948	99.949	0.002	
BM 5	99.868	99.869	0.001	
PT	98.773	98.771	-0.002	

Summary	
Stage (m)	99.130
Discharge (m^3/s)	0.026
Pressure Transducer Reading (m)	0.387
Pressure Transducer Elevation (m)	98.742

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	10:50	**End**	11:35	**Location**	Approx. 20 m DS of station			
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-mate			
Flow Meter Type	Electromagnetic			**Instrument Serial #**		same			
Stage (m)	**Start**	**Reading**	0.387	**Time**	10:50				
	End	**Reading**	0.388	**Time**	11:35				

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	0.15	0.00	0.0	0.00	0.00			0.000	0.0
	0.20	0.03	0.1	0.00	0.05			0.000	0.4
	0.30	0.06	0.1	0.01	-0.03			0.000	-0.7
	0.40	0.10	0.1	0.01	0.11			0.001	4.2
	0.50	0.12	0.1	0.01	0.26			0.003	10.1
	0.57	0.16	0.1	0.01	0.21			0.002	6.4
	0.60	0.16	0.0	0.01	0.23			0.001	4.9
	0.64	0.18	0.0	0.01	0.22			0.002	6.0
	0.68	0.19	0.0	0.01	0.21			0.001	5.3
	0.71	0.20	0.0	0.01	0.19			0.001	5.1
	0.75	0.20	0.0	0.01	0.19			0.001	5.1
	0.78	0.21	0.0	0.01	0.16			0.002	6.4
	0.85	0.15	0.1	0.01	0.12			0.002	5.8
	0.95	0.11	0.1	0.01	0.08			0.001	3.3
	1.05	0.10	0.1	0.01	0.04			0.000	1.5
	1.15	0.10	0.1	0.01	0.06			0.001	2.3
	1.25	0.10	0.1	0.01	0.05			0.001	1.9
	1.35	0.09	0.1	0.01	0.11			0.001	3.8
	1.45	0.08	0.1	0.01	0.19			0.002	5.8
	1.55	0.08	0.1	0.01	0.25			0.002	6.5
	1.62	0.08	0.1	0.01	0.26			0.001	5.5
	1.69	0.08	0.1	0.01	0.19			0.001	4.0
	1.76	0.08	0.1	0.01	0.13			0.001	3.2
	1.85	0.06	0.1	0.01	0.07			0.000	1.5
	1.95	0.08	0.1	0.01	0.08			0.000	1.8
RB	2.00	0.00	0.3	0.00	0.00			0.000	0.0
Total Q								**0.026**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site WP-H1

Site Information				
Project Name	Back River			
Station Identification	WP-H1			
Stream Name	Wasp Lake			
Date Monitored	12-Sep-13			
Time at Site (24 hr)	**Start Time:**	1:50:00 PM	**End Time:**	
Personnel	Eli H.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	431087	7274467		
Weather Conditions	Cloudy, recent rain			

Transducer Information			
PT Model	PT2X	**Serial #**	21221020
Gain	1.05487	**Offset**	-0.006
Status	active	**Battery**	2.9V
# of Records	14285	**Memory Free**	509854
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 3	0.701	100.701		100.000	
BM 4			0.752	99.949	
BM 5			0.831	99.870	
WL			1.549	**99.152**	
PT			1.929	98.772	
TBM	1.444	100.664	1.481	99.220	
PT			1.891	98.773	
WL			1.512	**99.152**	
BM 5			0.793	99.871	
BM 4			0.714	99.950	
BM 3			0.663	100.001	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 4	99.948	99.950	0.002	
BM 5	99.868	99.871	0.002	
PT	98.773	98.773	0.000	

Summary	
Stage (m)	99.152
Discharge (m^3/s)	0.051
Pressure Transducer Reading (m)	0.410
Pressure Transducer Elevation (m)	98.742

Discharge Measurement - Mid-Section Method								
Time (24 hr)	**Start**	13:53	**End**	14:20	**Location**	1m downstream of PT		
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-mate		
Flow Meter Type	Electromagnetic			**Instrument Serial #**				
Stage (m)	**Start**	**Reading**	0.409	**Time**	13:53			
	End	**Reading**	0.41	**Time**	14:20			

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	0.10	0.00	0.0	0.00	0.00			0.000	0.0
	0.20	0.06	0.1	0.01	0.16			0.001	1.9
	0.30	0.14	0.1	0.01	0.20			0.003	5.5
	0.40	0.21	0.1	0.02	0.22			0.005	9.0
	0.50	0.29	0.1	0.03	0.17			0.005	9.6
	0.60	0.21	0.1	0.02	0.13			0.003	5.3
	0.70	0.11	0.1	0.01	0.17			0.002	3.6
	0.80	0.14	0.1	0.01	0.15			0.002	4.1
	0.90	0.10	0.1	0.01	0.15			0.002	2.9
	1.00	0.13	0.1	0.01	0.17			0.002	4.3
	1.10	0.16	0.1	0.02	0.14			0.002	4.4
	1.20	0.16	0.1	0.02	0.16			0.003	5.0
	1.30	0.18	0.1	0.02	0.14			0.003	4.9
	1.40	0.16	0.1	0.02	0.14			0.002	4.4
	1.50	0.16	0.1	0.02	0.13			0.002	4.1
	1.60	0.14	0.1	0.01	0.15			0.002	4.1
	1.70	0.11	0.1	0.01	0.13			0.001	2.8
	1.80	0.08	0.1	0.01	0.16			0.001	2.5
	1.90	0.10	0.1	0.01	0.17			0.002	3.3
	2.00	0.14	0.1	0.01	0.16			0.002	4.4
	2.10	0.07	0.1	0.01	0.15			0.001	2.0
	2.20	0.11	0.1	0.01	0.16			0.002	3.4
	2.30	0.16	0.1	0.02	0.14			0.002	4.4
	2.40	0.07	0.1	0.01	0.15			0.001	2.0
	2.50	0.08	0.1	0.01	0.13			0.001	2.0
RB	2.60	0.00	0.4	0.00	0.00			0.000	0.0
Total Q								**0.051**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site WR-H1

Site Information				
Project Name	Back River			
Station Identification	WR-H1			
Stream Name	Wasterock OF			
Date Monitored	1-Jun-13			
Time at Site (24 hr)	**Start Time:**	2:00:00 PM	**End Time:**	4:00:00 PM
Personnel	Eli H., Jeff A.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	434687	7269635	277	
Weather Conditions	Sunny, clear			

Transducer Information			
PT Model	ELF-2	**Serial #**	8040143
Gain		**Offset**	
Status	OK	**Battery**	100%
# of Records	1	**Memory Free**	32530
Date Serviced		**Crest Gauges**	n/a

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 1	1.777	100.547		98.770	-0.035
BM 2a			1.047	99.500	
BM 3a			1.528	99.019	
PT			2.352	98.195	
WL			1.810	**98.737**	
TBM	1.439	100.451	1.535	99.012	
WL			1.712	**98.739**	
PT			2.256	98.195	
BM 3a			1.430	99.021	
BM 2a			0.949	99.502	
BM 1			1.679	98.772	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 2a	99.501	99.501	0.000	
BM 3a	99.020	99.020	0.000	
PT	98.195	98.195	0.000	

Summary	
Stage (m)	98.738
Discharge (m^3/s)	0.416
Pressure Transducer Reading (m)	n/a
Pressure Transducer Elevation (m)	98.145

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	14:00	**End**	14:30	**Location**	near PT			
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950			
Flow Meter Type	Electromagnetic			**Instrument Serial #**		130881001502			
Stage (m)	**Start**	**Reading**		**Time**	14:00				
	End	**Reading**		**Time**	14:30				

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	0.15	0.00	0.0	0.00	0.00			0.000	0.0
	0.25	0.07	0.1	0.03	0.00			0.000	0.0
	1.00	0.12	0.8	0.09	0.00			0.000	0.0
	1.80	0.20	0.8	0.10	0.00			0.000	0.0
	2.00	0.24	0.2	0.05	0.00			0.000	0.0
	2.20	0.34	0.2	0.07	-0.02			-0.001	-0.3
	2.40	0.39	0.2	0.10	0.16			0.016	3.7
	2.70	0.48	0.3	0.14	0.11			0.016	3.8
	3.00	0.55	0.3	0.17	0.11			0.018	4.4
	3.30	0.59	0.3	0.18	0.12			0.021	5.1
	3.60	0.61	0.3	0.18	0.15			0.027	6.6
	3.90	0.65	0.3	0.18	0.14			0.025	6.0
	4.15	0.66	0.3	0.17	0.16			0.026	6.3
	4.40	0.66	0.3	0.17	0.15			0.025	5.9
	4.65	0.64	0.3	0.16	0.14			0.022	5.4
	4.90	0.64	0.3	0.16	0.15			0.024	5.8
	5.15	0.64	0.3	0.16	0.18			0.029	6.9
	5.40	0.62	0.3	0.16	0.18			0.028	6.7
	5.65	0.60	0.3	0.15	0.15			0.023	5.4
	5.90	0.62	0.3	0.16	0.11			0.017	4.1
	6.15	0.62	0.3	0.16	0.13			0.020	4.8
	6.40	0.61	0.3	0.15	0.11			0.017	4.0
	6.65	0.61	0.3	0.15	0.11			0.017	4.0
	6.90	0.60	0.3	0.17	0.08			0.013	3.2
	7.20	0.59	0.3	0.21	0.05			0.010	2.5
	7.60	0.58	0.4	0.26	0.09			0.023	5.6
	8.10	0.55	0.5	0.39	0.02			0.008	1.9
	9.00	0.50	0.9	0.40	-0.02			-0.008	-1.9
LB	9.70	0.00	0.7	0.18	0			0.000	0.0
Total Q								**0.416**	**100.0**

General Notes
Gravel bottom at PT

Appendix 3. Manual Stage and Discharge Measurements, Site WR-H1

Site Information				
Project Name	Back River			
Station Identification	WR-H1			
Stream Name	Wasterock OF			
Date Monitored	8-Jun-13			
Time at Site (24 hr)	**Start Time:**	2:30:00 PM	**End Time:**	4:00:00 PM
Personnel	Eli H., Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	434687	7269635	277	
Weather Conditions	Snowy, windy			

Transducer Information			
PT Model	ELF-2	**Serial #**	8040143
Gain		**Offset**	
Status	OK	**Battery**	100%
# of Records	913	**Memory Free**	32032
Date Serviced		**Crest Gauges**	n/a

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 3	0.322	100.322		100.000	-0.070
BM 2			0.653	99.669	NEW
BM 1			1.552	98.770	NEW
PT			2.139	98.183	
WL			1.618	**98.704**	Good
TBM	1.241	100.267	1.296	99.026	**Old BM 3a**
WL			1.568	**98.699**	
PT			2.086	98.181	
BM 1			1.497	98.770	
BM 2			0.598	99.669	
BM 3			0.267	100.000	
BM 2			0.763	99.504	OK

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 2	99.669	99.669	0.000	
BM 1	98.770	98.770	0.000	
PT	98.182	98.182	0.000	

Summary	
Stage (m)	98.702
Discharge (m^3/s)	0.269
Pressure Transducer Reading (m)	0.557
Pressure Transducer Elevation (m)	98.145

Discharge Measurement - Mid-Section Method								
Time (24 hr)	**Start**	14:50	**End**	15:23	**Location**			
Method	Velocity-area (Mid-section)			**Instrument Model**	FH950			
Flow Meter Type	Electromagnetic			**Instrument Serial #**	130881001502			
Stage (m)	**Start**	**Reading**	0.557	**Time**	14:50			
	End	**Reading**		**Time**	15:23			

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	0.00	0.00	0.0	0.00	0.00			0.000	0.0
Grass	0.10	0.06	0.1	0.01	0.01			0.000	0.0
Grass	0.40	0.09	0.3	0.03	0.01			0.000	0.1
Grass	0.80	0.15	0.4	0.04	0.09			0.003	1.3
Grass	0.90	0.20	0.1	0.03	0.16			0.004	1.5
	1.05	0.27	0.2	0.04	0.23			0.009	3.5
	1.20	0.32	0.2	0.05	0.24			0.012	4.3
	1.35	0.34	0.2	0.05	0.21			0.011	4.0
	1.50	0.37	0.2	0.06	0.26			0.014	5.4
	1.65	0.44	0.2	0.06	0.25			0.014	5.1
	1.75	0.49	0.1	0.05	0.26			0.013	4.7
	1.85	0.51	0.1	0.05	0.26			0.013	4.9
	1.95	0.52	0.1	0.05	0.26			0.014	5.0
	2.05	0.54	0.1	0.05	0.26			0.014	5.2
	2.15	0.55	0.1	0.06	0.25			0.014	5.1
	2.25	0.55	0.1	0.06	0.27			0.015	5.5
	2.35	0.55	0.1	0.06	0.26			0.014	5.3
	2.45	0.54	0.1	0.07	0.26			0.018	6.5
	2.60	0.50	0.2	0.08	0.26			0.020	7.2
	2.75	0.46	0.2	0.07	0.28			0.019	7.2
	2.90	0.40	0.2	0.06	0.29			0.017	6.5
	3.05	0.36	0.2	0.05	0.29			0.016	5.8
	3.20	0.31	0.2	0.05	0.24			0.011	4.1
Edge of grass	3.35	0.22	0.2	0.03	0.06			0.002	0.7
Grass	3.50	0.15	0.2	0.02	0.03			0.001	0.3
Grass	3.65	0.12	0.2	0.04	0.01			0.000	0.2
	4.20	0.10	0.6	0.07	0.01			0.001	0.3
	5.00	0.08	0.8	0.07	0.01			0.001	0.3
RB	6.00	0.09	1.0	0.04	0			0.000	0.0
Total Q								**0.269**	**100.0**

General Notes
Gravel bottom at PT

Appendix 3. Manual Stage and Discharge Measurements, Site WR-H1

Site Information				
Project Name	Back River			
Station Identification	WR-H1			
Stream Name	Wasterock OF			
Date Monitored	16-Jul-13			
Time at Site (24 hr)	**Start Time:**	2:11:00 PM	**End Time:**	
Personnel	Eli H., Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	434687	7269635	277	
Weather Conditions	Sunny, windy			

Transducer Information			
PT Model	ELF-2	**Serial #**	2809023
Gain	3.5094	**Offset**	0.0136
Status	OK	**Battery**	100%
# of Records	6379	**Memory Free**	29305
Date Serviced		**Crest Gauges**	n/a

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 3	0.218	100.218		100.000	=SG
BM 2			0.621	99.597	Rebar right bank
BM 1			1.502	98.716	station rebar
PT			2.081	98.137	0.273
WL			1.813	**98.405**	
TBM	1.254	100.259	1.213	99.005	
WL			1.857	**98.402**	
PT			2.120	98.139	
BM 1			1.541	98.718	
BM 2			0.665	99.594	
BM 3			0.258	100.001	
DSWL1			**1.870**	98.389	
DSWL 2			1.856	98.403	
USWL 1			1.858	98.401	
BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**		**Difference (m)**	**Notes**
BM 2	99.669	99.596		-0.073	
BM 1	98.770	98.717		-0.053	
PT	98.182	98.138		-0.044	

Summary	
Stage (m)	98.404
Discharge (m^3/s)	0.00
Pressure Transducer Reading (m)	0.297
Pressure Transducer Elevation (m)	98.107

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	14:15	**End**		**Location**				
Method	Velocity-area (Mid-section)				**Instrument Model**	FH950			
Flow Meter Type	Electromagnetic				**Instrument Serial #**				
Stage (m)	**Start**	**Reading**	0.297		**Time**	14:15			
	End	**Reading**			**Time**	0:00			

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	0.60	0.00	0.0	0.00	0.00			0.000	0.0
	0.70	0.05	0.1	0.01	0.00			0.000	0.0
	0.90	0.04	0.2	0.01	0.01			0.000	3.0
	1.10	0.17	0.2	0.03	0.01			0.000	12.7
	1.30	0.23	0.2	0.05	0.01			0.000	17.1
	1.50	0.26	0.2	0.05	0.01			0.001	19.4
	1.70	0.25	0.2	0.05	0.01			0.001	18.6
	1.90	0.24	0.2	0.05	0.01			0.000	17.9
	2.10	0.23	0.2	0.05	0.01			0.000	17.1
	2.30	0.20	0.2	0.04	-0.01			0.000	-14.9
	2.50	0.14	0.2	0.02	0.01			0.000	9.1
	2.65	0.08	0.2	0.01	0.00			0.000	0.0
RB	2.75	0.00	0.1	0.00	0.00			0.000	0.0
Total Q	**0.37**							**0.00**	**100.0**

General Notes
Channel disconnected at both ends. Flow negligiable. Flow measurement conducted to verify the lack of flow. Strong wind may affect the flow.

Appendix 3. Manual Stage and Discharge Measurements, Site WR-H1

Site Information					
Project Name	Back River				
Station Identification	WR-H1				
Stream Name	Wasterock OF				
Date Monitored	22-Aug-13				
Time at Site (24 hr)	Start Time:	1:10:00 PM	End Time:		
Personnel	Eli H., Mark W.				
Station Cordinates	Easting	Northing	Elevation		
	434687	7269635	277		
Weather Conditions	Light rain				

Transducer Information			
PT Model	ELF-2	Serial #	2809023
Gain	3.5094	Offset	0.0136
Status	OK	Battery	100%
# of Records	11702	Memory Free	26644
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 3	0.508	100.508		100.000	
BM 2			0.940	99.568	
BM 1			1.790	98.718	
PT			2.363	98.145	
WL			1.987	**98.521**	
TBM	1.354	100.486	1.376	99.132	
WL			1.964	**98.522**	
PT			2.344	98.142	**0.380**
BM 1			1.769	98.717	
BM 2			0.918	99.568	
BM 3			0.486	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 2	99.669	99.568	-0.101	
BM 1	98.77	98.718	-0.053	
PT	98.182	98.144	-0.039	

Summary	
Stage (m)	98.522
Discharge (m^3/s)	0.022
Pressure Transducer Reading (m)	0.409
Pressure Transducer Elevation (m)	98.113

Discharge Measurement - Mid-Section Method							
Time (24 hr)	Start	13:17	End	13:50	Location	Approx. 1 m DS of PT	
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate	
Flow Meter Type	Electromagnetic			Instrument Serial #			
Stage (m)	Start	Reading	0.407	Time	13:17	SG: 0.194	
	End	Reading	0.409	Time	13:50	SG: 0.196	

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	0.40	0.00	0.0	0.00	0.00			0.000	0.0
	0.45	0.06	0.1	0.00	-0.02			0.000	-0.3
	0.50	0.12	0.1	0.01	0.00			0.000	0.0
	0.60	0.18	0.1	0.02	0.00			0.000	0.0
	0.70	0.23	0.1	0.02	0.01			0.000	1.0
	0.80	0.27	0.1	0.03	0.03			0.001	3.6
	0.90	0.33	0.1	0.03	0.02			0.001	3.0
	1.00	0.34	0.1	0.03	0.03			0.001	4.6
	1.10	0.33	0.1	0.03	0.03			0.001	4.4
	1.20	0.35	0.1	0.04	0.04			0.001	6.3
	1.30	0.36	0.1	0.04	0.04			0.001	6.5
	1.40	0.38	0.1	0.04	0.04			0.002	6.8
	1.50	0.38	0.1	0.04	0.04			0.002	6.8
	1.60	0.39	0.1	0.04	0.04			0.002	7.0
	1.70	0.39	0.1	0.04	0.04			0.002	7.0
	1.80	0.38	0.1	0.04	0.04			0.002	6.8
	1.90	0.38	0.1	0.04	0.04			0.002	6.8
	2.00	0.36	0.1	0.04	0.04			0.001	6.5
	2.10	0.36	0.1	0.04	0.04			0.001	6.5
	2.20	0.32	0.1	0.03	0.04			0.001	5.7
	2.30	0.28	0.1	0.03	0.04			0.001	5.0
	2.40	0.22	0.1	0.02	0.04			0.001	3.9
	2.50	0.18	0.1	0.02	0.02			0.000	1.6
	2.60	0.12	0.1	0.01	0.01			0.000	0.5
	2.67	0.10	0.1	0.00	0.00			0.000	0.0
RB	2.69	0.00	0.0	0.00	0			0.000	0.0
Total Q	**0.67**							**0.022**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site WR-H1

Site Information				
Project Name	Back River			
Station Identification	WR-H1			
Stream Name	Wasterock OF			
Date Monitored	25-Aug-13			
Time at Site (24 hr)	Start Time:	7:22:00 AM	End Time:	
Personnel	Eli H., Mark W.			
Station Cordinates	Easting	Northing	Elevation	
	434687	7269635	277	
Weather Conditions	Cloudy, cool			

Transducer Information			
PT Model	ELF-2	Serial #	2809023
Gain	3.5094	Offset	0.0136
Status	OK	Battery	100%
# of Records	12099	Memory Free	26441
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 3	0.313	100.313		100.000	SG
BM 2			0.751	99.562	
BM 1			1.597	98.716	
PT			2.170	98.143	0.415
WL			1.760	**98.553**	
TBM	1.128	100.278	1.163	99.150	
WL			1.727	**98.551**	
PT			2.134	98.144	
BM 1			1.562	98.716	
BM 2			0.724	99.554	
BM 3			0.280	99.998	
Old BM			0.803	99.475	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 2	99.669	99.558	-0.111	
BM 1	98.77	98.716	-0.054	
PT	98.182	98.144	-0.038	

Summary	
Stage (m)	98.552
Discharge (m^3/s)	0.040
Pressure Transducer Reading (m)	0.445
Pressure Transducer Elevation (m)	98.107

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	7:26	End	8:00	Location	~2m DS of PT			
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate			
Flow Meter Type	Electromagnetic			Instrument Serial #					
Stage (m)	Start	Reading	0.445	Time	7:26	SG: 0.163			
	End	Reading	0.445	Time	8:00	SG: 0.163			

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	0.60	0.00	0.0	0.00	0.00			0.000	0.0
Flooded grass	0.65	0.06	0.1	0.01	0.01			0.000	0.2
Flooded grass	0.80	0.12	0.2	0.02	0.02			0.000	0.8
Edge of grass	0.90	0.14	0.1	0.01	0.03			0.000	1.1
	1.00	0.18	0.1	0.02	0.03			0.001	1.7
	1.15	0.22	0.2	0.03	0.04			0.001	3.3
	1.30	0.24	0.2	0.04	0.05			0.002	4.5
	1.45	0.30	0.2	0.04	0.06			0.002	5.6
	1.55	0.36	0.1	0.04	0.06			0.002	5.4
	1.65	0.40	0.1	0.04	0.05			0.002	5.0
	1.75	0.42	0.1	0.04	0.05			0.002	5.3
	1.85	0.43	0.1	0.04	0.05			0.002	5.4
	1.95	0.46	0.1	0.05	0.06			0.003	6.9
	2.05	0.45	0.1	0.05	0.06			0.003	6.8
	2.15	0.43	0.1	0.04	0.06			0.003	6.5
	2.25	0.42	0.1	0.04	0.06			0.003	6.3
	2.35	0.39	0.1	0.04	0.06			0.002	5.9
	2.45	0.39	0.1	0.04	0.06			0.002	5.9
	2.55	0.37	0.1	0.04	0.06			0.002	5.6
	2.65	0.36	0.1	0.04	0.06			0.002	5.4
	2.75	0.32	0.1	0.03	0.06			0.002	4.8
	2.85	0.29	0.1	0.04	0.06			0.002	5.4
	3.00	0.22	0.2	0.03	0.03			0.001	2.1
Edge of grass	3.11	0.15	0.1	0.02	0.01			0.000	0.5
Grass	3.25	0.07	0.1	0.01	0.00			0.000	0.0
Grass	3.50	0.03	0.3	0.01	0.00			0.000	0.0
RB	3.60	0.00	0.1	0.00	0.00			0.000	0.0
Total Q	**0.79**							**0.040**	**100.0**

General Notes
Cleaned some sediment off of PT (mostly organic matter). PT appears stable on gravel bed

Appendix 3. Manual Stage and Discharge Measurements, Site WR-H1

Site Information					
Project Name	Back River				
Station Identification	WR-H1				
Stream Name	Wasterock OF				
Date Monitored	13-Sep-13				
Time at Site (24 hr)	**Start Time:**	12:00:00 PM	**End Time:**		
Personnel	Eli H.				
Station Cordinates	**Easting**	**Northing**	**Elevation**		
	434687	7269635	277		
Weather Conditions	Cloudy, light snow				

Transducer Information			
PT Model	ELF-2	**Serial #**	2809023
Gain	3.5094	**Offset**	0.0136
Status		**Battery**	100%
# of Records	14864	**Memory Free**	25062
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 3	0.378	100.378		100.000	
BM 2			0.830	99.548	
BM 1			1.660	98.718	
PT			2.230	98.148	
WL			1.629	**98.749**	
TBM	1.439	100.415	1.402	98.976	
WL			1.668	**98.747**	
PT			2.271	98.144	
BM 1			1.701	98.714	
BM 2			0.881	99.534	
BM 3			0.412	100.003	
BM 4			1.221	99.194	Hammered in BM2
US WL RB			1.610	98.805	
UW WL LB			1.582	98.833	
DS WL			**1.685**	98.730	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 2	99.669	99.541	-0.128	
BM 1	98.77	98.716	-0.054	
PT	98.182	98.146	-0.036	

Summary	
Stage (m)	98.748
Discharge (m^3/s)	0.399
Pressure Transducer Reading (m)	0.640
Pressure Transducer Elevation (m)	98.108

Discharge Measurement - Mid-Section Method							
Time (24 hr)	**Start**	12:15	**End**	13:14	**Location**	at PT	
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-mate	
Flow Meter Type	Electromagnetic			**Instrument Serial #**			
Stage (m)	**Start**	**Reading**	0.639	**Time**	12:15	SG:	
	End	**Reading**	0.64	**Time**	13:14	SG:	

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	0.00	0.00	0.0	0.01	0.00			0.000	0.0
Flooded Grass	0.30	0.08	0.3	0.02	0.01			0.000	0.1
Flooded Grass	0.50	0.11	0.2	0.02	0.03			0.001	0.2
Flooded Grass	0.70	0.06	0.2	0.01	0.00			0.000	0.0
Grass	0.80	0.00	0.1	0.00	0.00			0.000	0.0
Grass	2.10	0.00	1.3	0.00	0.00			0.000	0.0
Flooded Grass	2.20	0.10	0.1	0.02	0.02			0.000	0.1
Flooded Grass	2.40	0.16	0.2	0.03	0.04			0.001	0.3
Flooded Grass	2.60	0.18	0.2	0.02	0.03			0.001	0.1
Flooded Grass	2.61	0.00	0.0	0.00	0.00			0.000	0.0
Flooded Grass	3.50	0.00	0.9	0.00	0.00			0.000	0.0
Flooded Grass	3.60	0.13	0.1	0.03	0.03			0.001	0.2
Flooded Grass	4.00	0.18	0.4	0.08	0.05			0.004	1.0
Flooded Grass	4.50	0.22	0.5	0.11	0.03			0.003	0.8
Flooded Grass	5.00	0.27	0.5	0.14	0.03			0.004	1.0
Flooded Grass	5.50	0.25	0.5	0.13	0.06			0.008	1.9
Flooded Grass	6.00	0.24	0.5	0.12	0.06			0.007	1.8
Flooded Grass	6.50	0.29	0.5	0.10	0.05			0.005	1.3
	6.70	0.42	0.2	0.11	0.18			0.019	4.7
	7.00	0.50	0.3	0.10	0.36			0.036	9.0
	7.10	0.56	0.1	0.07	0.34			0.024	6.0
	7.25	0.32	0.2	0.04	0.32			0.013	3.2
	7.35	0.60	0.1	0.08	0.32			0.024	6.0
	7.50	0.34	0.2	0.04	0.34			0.014	3.6
	7.60	0.64	0.1	0.08	0.33			0.026	6.6
	7.75	0.62	0.2	0.08	0.30			0.023	5.8
	7.85	0.62	0.1	0.08	0.34			0.026	6.6
	8.00	0.61	0.2	0.08	0.36			0.027	6.9
Total Q	**1.58**							**0.269**	**67.3**

General Notes
Left station in, will demobilize @ end of trip
Changed elevation of BM 2 and re-surveyed it (loose rebar)
Much of flow through flooded grass

Appendix 3. Manual Stage and Discharge Measurements, Site WR-H1

Site Information				
Project Name	Back River			
Station Identification	WR-H1			
Stream Name	Wasterock OF			
Date Monitored	13-Sep-13			
Time at Site (24 hr)	**Start Time:**	12:00:00 PM	**End Time:**	
Personnel	Eli H.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	434687	7269635	277	
Weather Conditions	Cloudy, light snow			

Transducer Information			
PT Model	ELF-2	**Serial #**	2809023
Gain	3.5094	**Offset**	0.0136
Status		**Battery**	100%
# of Records	14864	**Memory Free**	25062
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 3	0.378	100.378		100.000	
BM 2			0.830	99.548	
BM 1			1.660	98.718	
PT			2.230	98.148	
WL			1.629	**98.749**	
TBM	1.439	100.415	1.402	98.976	
WL			1.668	**98.747**	
PT			2.271	98.144	
BM 1			1.701	98.714	
BM 2			0.881	99.534	
BM 3			0.412	100.003	
BM 4			1.221	99.194	Hammered in BM2
US WL RB			1.610	98.805	
UW WL LB			1.582	98.833	
DS WL			**1.685**	98.730	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 2	99.669	99.541	-0.128	
BM 1	98.77	98.716	-0.054	
PT	98.182	98.146	-0.036	

Summary	
Stage (m)	98.748
Discharge (m^3/s)	0.399
Pressure Transducer Reading (m)	0.640
Pressure Transducer Elevation (m)	98.108

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
	8.10	0.58	0.1	0.07	0.33			0.024	6.0
	8.25	0.53	0.2	0.07	0.36			0.024	6.0
	8.35	0.49	0.1	0.06	0.36			0.022	5.5
	8.50	0.50	0.2	0.06	0.33			0.021	5.2
	8.60	0.48	0.1	0.06	0.32			0.019	4.8
	8.75	0.47	0.2	0.07	0.12			0.008	2.1
Flooded Grass	8.90	0.38	0.2	0.09	0.06			0.005	1.3
Flooded Grass	9.20	0.21	0.3	0.08	0.04			0.003	0.8
Flooded Grass	9.70	0.20	0.5	0.10	0.04			0.004	1.0
Flooded Grass	10.20	0.12	0.5	0.04	0.00			0.000	0.0
Flooded Grass	10.40	0.00	0.2	0.00	0.00			0.000	0.0
Total Q	**2.28**							**0.399**	**32.7**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site WR-H1

Site Information				
Project Name	Back River			
Station Identification	WR-H1			
Stream Name	Wasterock OF			
Date Monitored	15-Sep-13			
Time at Site (24 hr)	**Start Time:**	11:26:00 AM	**End Time:**	
Personnel	Eli H.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	434687	7269635	277	
Weather Conditions	Cloudy, light snow			

Transducer Information			
PT Model	ELF-2	**Serial #**	2809023
Gain	3.5094	**Offset**	0.0136
Status	ok	**Battery**	100%
# of Records	15142	**Memory Free**	24921
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 1					
BM 2					
BM 3					
PT					
WL					
TBM					
WL					
PT					
BM 3					
BM 2					
BM 1					
BM 4					
No Survey performed, use staff gauge reading					

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 2				
BM 3				
PT				

Summary	
Stage (m)	98.636
Discharge (m^3/s)	0.141
Pressure Transducer Reading (m)	0.528
Pressure Transducer Elevation (m)	98.108

Discharge Measurement - Mid-Section Method						
Time (24 hr)	**Start**		**End**		**Location**	
Method	Velocity-area (Mid-section)			**Instrument Model**	Flo-mate	
Flow Meter Type	Electromagnetic			**Instrument Serial #**		
Stage (m)	**Start**	**Reading**	0.528	**Time**	11:26	SG: .077 below staff gauge
	End	**Reading**		**Time**		SG:

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	0.30	0.00	0.0	0.01	0.00			0.000	0.0
	0.50	0.05	0.2	0.02	0.01			0.000	0.1
	0.90	0.09	0.4	0.02	0.03			0.001	0.5
	1.05	0.17	0.2	0.03	0.06			0.002	1.1
	1.20	0.24	0.2	0.04	0.10			0.004	2.5
	1.35	0.28	0.2	0.04	0.12			0.005	3.6
	1.50	0.29	0.2	0.04	0.12			0.005	3.7
	1.65	0.34	0.2	0.05	0.14			0.007	5.1
	1.80	0.38	0.2	0.06	0.13			0.007	5.2
	1.95	0.45	0.2	0.07	0.14			0.009	6.7
	2.10	0.50	0.2	0.08	0.13			0.010	6.9
	2.25	0.53	0.2	0.08	0.14			0.011	7.9
	2.40	0.54	0.2	0.08	0.13			0.011	7.5
	2.55	0.52	0.2	0.08	0.14			0.011	7.7
	2.70	0.48	0.2	0.07	0.14			0.010	7.1
	2.85	0.44	0.2	0.07	0.14			0.009	6.5
	3.00	0.42	0.2	0.06	0.14			0.009	6.2
	3.15	0.40	0.2	0.06	0.15			0.009	6.4
	3.30	0.40	0.2	0.06	0.16			0.010	6.8
	3.45	0.39	0.2	0.06	0.10			0.006	4.1
	3.60	0.30	0.2	0.04	0.02			0.001	0.5
	3.70	0.24	0.1	0.04	0.02			0.001	0.5
	3.90	0.14	0.2	0.04	0.02			0.001	0.6
	4.30	0.06	0.4	0.03	0.02			0.001	0.4
	4.90	0.05	0.6	0.03	0.02			0.001	0.5
	5.60	0.10	0.7	0.07	0.03			0.002	1.5
	6.30	0.07	0.7	0.04	0.01			0.000	0.3
RB	6.70	0.00	0.4	0.01	0.00			0.000	0.0
Total Q	**1.36**							**0.141**	**100.0**

General Notes

PT stopped at 11:26
Depth above PT = .498

Appendix 3. Manual Stage and Discharge Measurements, Site KL-H1

Site Information				
Project Name	Back River			
Station Identification	KL-H1			
Stream Name	Esker Pond outflow			
Date Monitored	4-Jun-13			
Time at Site (24 hr)	Start Time:	2:00:00 PM	End Time:	5:00:00 PM
Personnel	Eli H., Jeff A.			
Station Cordinates	Easting	Northing	Elevation	
	390592	7309400	310	
Weather Conditions	Clear, sunny at 18C			

Transducer Information			
PT Model	PT2X	Serial #	21221019
Gain	1.006956	Offset	-0.016
Status	Active	Battery	3.1V
# of Records	1	Memory Free	524,139
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 85	0.762	100.762		100.000	BM 85
BM 86			0.639	100.123	BM 86
BM 87			1.139	99.623	BM 87
PT			2.695	98.067	0.892
WL			1.801	**98.961**	
SG			2.087	98.675	Rebar in stream
TBM	0.761	100.687	0.836	99.926	
SG			2.012	98.675	(+0.285)
WL			1.724	**98.963**	
PT			2.620	98.067	
BM 87			1.063	99.624	BM 87
BM 86			0.563	100.124	BM 86
BM 85			0.686	100.001	BM 85

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 86	100.125	100.124	-0.001	
BM 87	99.627	99.624	-0.003	
PT	98.089	98.067	-0.022	

Summary	
Stage (m)	98.962
Discharge (m^3/s)	0.784
Pressure Transducer Reading (m)	0.928
Pressure Transducer Elevation (m)	98.034

Discharge Measurement - Mid-Section Method

Time (24 hr)	Start	12:40	End	13:10	Location	3m Dowstream of PT	
Method	Velocity-area (Mid-section)			Instrument Model		FH950	
Flow Meter Type	Electromagnetic			Instrument Serial #			
Stage (m)	Start	Reading	0.927	SG	0.285	Time	12:40
	End	Reading	0.928	SG	0.285	Time	13:10

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.25	0.00	0.0	0.05	0			0.000	0.0
	1.40	0.08	1.2	0.07	0			0.000	0.0
	2.00	0.14	0.6	0.06	-0.01			-0.001	-0.1
	2.25	0.16	0.3	0.03	0.02			0.001	0.1
	2.40	0.27	0.2	0.03	0.28			0.008	1.0
	2.45	0.68	0.1	0.05	0.27			0.014	1.8
	2.55	0.72	0.1	0.05	0.44			0.024	3.0
	2.60	0.73	0.1	0.05	0.57			0.031	4.0
	2.70	0.74	0.1	0.07	0.58			0.043	5.5
	2.80	0.72	0.1	0.07	0.57			0.041	5.2
	2.90	0.71	0.1	0.07	0.56			0.040	5.1
	3.00	0.69	0.1	0.07	0.53			0.037	4.7
	3.10	0.68	0.1	0.07	0.57			0.039	4.9
	3.20	0.67	0.1	0.07	0.57			0.038	4.9
	3.30	0.66	0.1	0.07	0.57			0.038	4.8
	3.40	0.64	0.1	0.06	0.56			0.036	4.6
	3.50	0.62	0.1	0.06	0.57			0.035	4.5
	3.60	0.61	0.1	0.06	0.56			0.034	4.4
	3.70	0.59	0.1	0.06	0.58			0.034	4.4
	3.80	0.58	0.1	0.06	0.57			0.033	4.2
	3.90	0.57	0.1	0.06	0.57			0.032	4.1
	4.00	0.57	0.1	0.06	0.56			0.032	4.1
	4.10	0.56	0.1	0.06	0.55			0.031	3.9
	4.20	0.56	0.1	0.06	0.55			0.031	3.9
	4.30	0.55	0.1	0.06	0.59			0.032	4.1
	4.40	0.54	0.1	0.05	0.56			0.030	3.9
	4.50	0.54	0.1	0.05	0.5			0.027	3.4
	4.60	0.54	0.1	0.05	0.42			0.023	2.9
	4.70	0.53	0.1	0.05	0.31			0.016	2.1
	4.80	0.51	0.1	0.04	0.09			0.003	0.4
	4.85	0.49	0.0	0.02	0			0.000	0.0
	4.90	0.15	0.1	0.06	0			0.000	0.0
	5.60	0.15	0.7	0.10	0.01			0.001	0.1
	6.20	0.12	0.6	0.06	0.02			0.001	0.2
	6.65	0.07	0.5	0.01	0			0.000	0.0
LB	6.50	0.00	0.2	0.01	0			0.000	0.0
Total Q								**0.784**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site KL-H1

Site Information				
Project Name	Back River			
Station Identification	KL-H1			
Stream Name	Esker Pond outflow			
Date Monitored	12-Jun-13			
Time at Site (24 hr)	Start Time:	11:26:00 AM	End Time:	
Personnel	Eli H., Byeong K.			
Station Cordinates	Easting	Northing	Elevation	
	390592	7309400	310	
Weather Conditions	Cloudy			

Transducer Information			
PT Model	PT2X	Serial #	21221019
Gain	1.006956	Offset	-0.016
Status	Active	Battery	3.1V
# of Records	1128	Memory Free	523,011
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM#	Established Elevation (m)	Mean Elevation (this date) (m)		Difference (m)	Notes

Summary	
Stage (m)	98.953
Discharge (m^3/s)	0.777
Pressure Transducer Reading (m)	0.919
Pressure Transducer Elevation (m)	98.034

Discharge Measurement - Mid-Section Method							
Time (24 hr)	Start	11:30	End	12:15	Location	7m Dowstream of PT	
Method	Velocity-area (Mid-section)			Instrument Model		FH950	
Flow Meter Type	Electromagnetic			Instrument Serial #			
Stage (m)	Start	Reading	0.919	SG	0.304	Time	11:30
	End	Reading	0.919	SG	0.304	Time	12:15

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	35.50	0.00	0.0	0.01	0	0	0.00	0.000	0.0
Grass	35.70	0.08	0.2	0.02	0.02	0	0	0.000	0.0
	35.90	0.15	0.2	0.02	0.17	0	0	0.004	0.5
	36.00	0.34	0.1	0.04	0.45	0.00	0.00	0.019	2.5
	36.15	0.70	0.1	0.10	0.45	0.00	0.00	0.047	6.1
	36.30	0.75	0.1	0.09	0	0.54	0.53	0.050	6.5
	36.40	0.76	0.1	0.08	0	0.55	0.54	0.041	5.3
	36.50	0.74	0.1	0.07	0.55	0.00	0.00	0.041	5.2
	36.60	0.73	0.1	0.07	0.53	0.00	0.00	0.039	5.0
	36.70	0.72	0.1	0.11	0.53	0.00	0.00	0.057	7.4
	36.90	0.72	0.2	0.14	0.5	0.00	0.00	0.072	9.3
	37.10	0.71	0.2	0.14	0.51	0.00	0.00	0.072	9.3
	37.30	0.68	0.2	0.14	0.51	0.00	0.00	0.069	8.9
	37.50	0.62	0.2	0.12	0.55	0.00	0.00	0.068	8.8
	37.70	0.58	0.2	0.12	0.56	0.00	0.00	0.065	8.4
	37.90	0.60	0.2	0.12	0.52	0.00	0.00	0.062	8.0
	38.10	0.61	0.2	0.11	0.43	0.00	0.00	0.046	5.9
	38.25	0.60	0.1	0.06	0.3	0.00	0.00	0.018	2.3
Grass	38.30	0.13	0.0	0.02	0.21	0.00	0.00	0.003	0.4
Grass	38.50	0.09	0.2	0.03	0.01	0.00	0.00	0.000	0.0
Grass	39.00	0.10	0.5	0.05	0.01	0.00	0.00	0.001	0.1
Grass	39.50	0.10	0.5	0.04	0.01	0.00	0.00	0.000	0.0
LB	39.70	0.00	0.2	0.01	0	0.00	0.00	0.000	0.0
Total Q								**0.777**	**100.0**

General Notes
PT depth: 0.870

Appendix 3. Manual Stage and Discharge Measurements, Site KL-H1

Site Information				
Project Name	Back River			
Station Identification	KL-H1			
Stream Name	Esker Pond outflow			
Date Monitored	12-Jul-13			
Time at Site (24 hr)	Start Time:	1:52:00 PM	End Time:	3:30:00 PM
Personnel	Eli H., Byeong K.			
Station Cordinates	Easting	Northing	Elevation	
	390592	7309400	310	
Weather Conditions	Windy, cloudy			

Transducer Information			
PT Model	PT2X	Serial #	21221019
Gain	1.006956	Offset	-0.016
Status	Active	Battery	3.1V
# of Records	5463	Memory Free	518,676
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 85	0.766	100.766		100.000	
BM 86			0.642	100.124	
BM 87			1.142	99.624	
PT			2.688	98.078	
WL			2.083	**98.683**	
SG					
TBM	0.782	100.718	0.830	99.936	
SG			2.063	98.655	
WL			2.036	**98.682**	
PT			2.633	98.085	0.608
BM 87			1.093	99.625	
BM 86			0.594	100.124	
BM 85			0.718	100.000	
DSRB			2.040	98.678	
DSLB			2.040	98.678	
USLB			2.034	98.684	
DSRB			2.037	98.681	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM86	100.126	100.124	0.002	
BM87	99.627	99.625	0.002	
PT	98.034	98.082	-0.047	

Summary			
Surveyed Stage (m)	98.683	Corrected:	99.682
Discharge (m^3/s)	0.126		
Pressure Transducer Reading (m)	0.639		
Pressure Transducer Elevation (m)	98.044		

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	13:20	End	14:00	Location	5m Dowstream of PT			
Method	Velocity-area (Mid-section)			Instrument Model		FH950			
Flow Meter Type	Electromagnetic			Instrument Serial #					
Stage (m)	Start	Reading	0.637	SG		Time	11:30		
	End	Reading	0.639	SG	0.028	Time	12:15		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	0.33	0.00	0.0	0.00	0			0.000	0.0
	0.35	0.26	0.0	0.01	0.07			0.001	0.5
	0.40	0.28	0.1	0.02	0.1			0.002	1.7
	0.50	0.30	0.1	0.03	0.12			0.004	2.9
	0.60	0.31	0.1	0.03	0.13			0.004	3.2
	0.70	0.30	0.1	0.03	0.16			0.005	3.8
	0.80	0.30	0.1	0.03	0.17			0.005	4.1
	0.90	0.30	0.1	0.03	0.17			0.005	4.1
	1.00	0.29	0.1	0.03	0.16			0.005	3.7
	1.10	0.29	0.1	0.03	0.16			0.005	3.7
	1.20	0.30	0.1	0.03	0.13			0.004	3.1
	1.30	0.32	0.1	0.03	0.17			0.005	4.3
	1.40	0.33	0.1	0.03	0.16			0.005	4.2
	1.50	0.36	0.1	0.04	0.14			0.005	4.0
	1.60	0.39	0.1	0.04	0.15			0.006	4.6
	1.70	0.39	0.1	0.04	0.15			0.006	4.6
	1.80	0.39	0.1	0.04	0.13			0.005	4.0
	1.90	0.40	0.1	0.04	0.12			0.005	3.8
	2.00	0.40	0.1	0.04	0.12			0.005	3.8
	2.10	0.41	0.1	0.04	0.16			0.007	5.2
	2.20	0.42	0.1	0.04	0.17			0.007	5.7
	2.30	0.44	0.1	0.04	0.18			0.008	6.3
	2.40	0.45	0.1	0.05	0.18			0.008	6.4
	2.50	0.46	0.1	0.05	0.16			0.007	5.8
	2.60	0.44	0.1	0.04	0.14			0.005	4.2
	2.67	0.42	0.1	0.02	0.11			0.002	1.8
	2.70	0.22	0.0	0.01	0.06			0.001	0.4
	2.75	0.05	0.0	0.00	0			0.000	0.0
RB	2.83	0.00	0.1	0.00	0			0.000	0.0
Total Q								**0.126**	**100.0**

General Notes
PT depth: 0.608

Appendix 3. Manual Stage and Discharge Measurements, Site KL-H1

Site Information				
Project Name	Back River			
Station Identification	KL-H1			
Stream Name	Esker Pond outflow			
Date Monitored	17-Aug-13			
Time at Site (24 hr)	Start Time:	12:55:00 PM	End Time:	2:00:00 PM
Personnel	Eli H., Mark W.			
Station Cordinates	Easting	Northing	Elevation	
	390592	7309400	310	
Weather Conditions	Cloudy			

Transducer Information			
PT Model	PT2X	Serial #	21221019
Gain	1.006956	Offset	-0.016
Status	Active	Battery	3.0V
# of Records	10641	Memory Free	513498
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 85	0.740	100.740		100.000	
BM 86			0.614	100.126	
BM 87			1.112	99.628	
PT			2.675	98.065	0.480
WL			2.198	**98.542**	
TBM	2.042	100.689	2.093	98.647	
WL			2.149	**98.540**	
PT			2.622	98.067	
BM 87			1.061	99.628	
BM 86			0.561	100.128	
BM 85			0.689	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM86	100.126	100.127	-0.001	
BM87	99.627	99.628	-0.001	
PT	98.034	98.066	-0.032	

Summary			
Surveyed Stage (m)	98.541	Corrected:	99.551
Discharge (m^3/s)	0.031		
Pressure Transducer Reading (m)	0.516		
Pressure Transducer Elevation (m)	98.025		

Discharge Measurement - Mid-Section Method

Time (24 hr)	Start	13:05	End	13:40	Location	5m Dowstream of PT	
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate	
Flow Meter Type	Electromagnetic			Instrument Serial #			
Stage (m)	Start	Reading	0.516	SG		Time	13:05
	End	Reading	0.516	SG		Time	13:40

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.30	0.00	0.0	0.01	0			0.000	0.0
	0.35	0.26	0.1	0.01	0.01			0.000	0.4
	0.40	0.32	0.1	0.02	0.05			0.001	3.9
	0.50	0.34	0.1	0.03	0.07			0.002	7.8
	0.60	0.33	0.1	0.03	0.07			0.002	7.6
	0.70	0.32	0.1	0.03	0.07			0.002	7.3
	0.80	0.32	0.1	0.03	0.07			0.002	7.3
	0.90	0.30	0.1	0.03	0.06			0.002	5.9
	1.00	0.30	0.1	0.03	0.05			0.002	4.9
	1.10	0.30	0.1	0.03	0.04			0.001	3.9
	1.20	0.29	0.1	0.03	0.04			0.001	3.8
	1.30	0.29	0.1	0.03	0.05			0.001	4.8
	1.40	0.30	0.1	0.03	0.06			0.002	5.9
	1.50	0.29	0.1	0.03	0.03			0.001	2.9
	1.60	0.26	0.1	0.03	0.03			0.001	2.6
	1.70	0.24	0.1	0.02	0.04			0.001	3.1
	1.80	0.21	0.1	0.02	0.03			0.001	2.1
	1.90	0.21	0.1	0.02	0.05			0.001	3.4
	2.00	0.20	0.1	0.02	0.06			0.001	3.9
	2.10	0.20	0.1	0.02	0.05			0.001	3.3
	2.20	0.20	0.1	0.02	0.04			0.001	2.6
	2.30	0.21	0.1	0.02	0.05			0.001	3.4
	2.40	0.22	0.1	0.02	0.05			0.001	3.6
	2.50	0.20	0.1	0.02	0.06			0.001	3.9
	2.60	0.14	0.1	0.01	0.04			0.000	1.4
	2.65	0.08	0.0	0.00	0.02			0.000	0.2
LB	2.66	0.00	0.0	0.00	0			0.000	0.0
Total Q								**0.031**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site KL-H1

Site Information				
Project Name	Back River			
Station Identification	KL-H1			
Stream Name	Esker Pond outflow			
Date Monitored	17-Sep-13			
Time at Site (24 hr)	Start Time:	7:35:00 AM	End Time:	8:45:00 AM
Personnel	Eli H, Kokiak Peetooloot			
Station Cordinates	Easting	Northing	Elevation	
	390592	7309400	310	
Weather Conditions	Cloudy, -2 C			

Transducer Information			
PT Model	PT2X	Serial #	21221019
Gain	1.006956	Offset	-0.016
Status	active	Battery	
# of Records	15073	Memory Free	509066
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 85	0.624	100.624		100.000	
BM 86			0.499	100.125	
BM 87			0.999	99.625	
PT			2.568	98.056	0.648
WL			1.927	**98.697**	
TBM	0.902	100.579	0.947	99.677	
WL			1.883	**98.696**	
PT			2.524	98.055	
BM 87			0.952	99.627	
BM 86			0.453	100.126	
BM 85			0.581	99.998	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM86	100.126	100.126	0.001	
BM87	99.627	99.626	0.001	
PT	98.034	98.056	-0.021	

Summary			
Surveyed Stage (m)	98.697	Corrected:	99.717
Discharge (m^3/s)	0.150		
Pressure Transducer Reading (m)	0.682		
Pressure Transducer Elevation (m)	98.015		

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	7:40	End	8:10	Location	5m Dowstream of PT			
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate			
Flow Meter Type	Electromagnetic			Instrument Serial #		3747			
Stage (m)	Start	Reading	0.683	SG		Time	7:40		
	End	Reading	0.683	SG		Time	8:10		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.40	0.00	0.0	0.01	0			0.000	0.0
	0.50	0.12	0.1	0.01	0.04			0.000	0.2
	0.53	0.48	0.0	0.02	0.06			0.001	1.0
	0.60	0.50	0.1	0.04	0.13			0.006	3.7
	0.70	0.51	0.1	0.05	0.15			0.008	5.1
	0.80	0.50	0.1	0.05	0.16			0.008	5.3
	0.90	0.49	0.1	0.05	0.17			0.008	5.5
	1.00	0.48	0.1	0.05	0.17			0.008	5.4
	1.10	0.46	0.1	0.05	0.17			0.008	5.2
	1.20	0.46	0.1	0.05	0.17			0.008	5.2
	1.30	0.46	0.1	0.05	0.16			0.007	4.9
	1.40	0.46	0.1	0.05	0.15			0.007	4.6
	1.50	0.47	0.1	0.05	0.16			0.008	5.0
	1.60	0.47	0.1	0.05	0.16			0.008	5.0
	1.70	0.45	0.1	0.05	0.14			0.006	4.2
	1.80	0.42	0.1	0.04	0.15			0.006	4.2
	1.90	0.39	0.1	0.04	0.16			0.006	4.2
	2.00	0.38	0.1	0.04	0.17			0.006	4.3
	2.10	0.36	0.1	0.04	0.16			0.006	3.8
	2.20	0.36	0.1	0.04	0.16			0.006	3.8
	2.30	0.37	0.1	0.04	0.16			0.006	3.9
	2.40	0.36	0.1	0.04	0.16			0.006	3.8
	2.50	0.36	0.1	0.04	0.16			0.006	3.8
	2.60	0.38	0.1	0.04	0.15			0.006	3.8
	2.70	0.36	0.1	0.04	0.13			0.005	3.1
	2.80	0.30	0.1	0.02	0.06			0.001	0.9
LB	2.85	0.00	0.1	0.01	0			0.000	0.0
Total Q								**0.150**	**100.0**

General Notes
PT Terminated at 9:35

Appendix 3. Manual Stage and Discharge Measurements, Site KL-H2

Site Information				
Project Name	Back River			
Station Identification	KL-H2			
Stream Name	George Lake Outflow			
Date Monitored	11-Jun-13			
Time at Site (24 hr)	Start Time:	2:30:00 PM	End Time:	4:30:00 PM
Personnel	Eli H., Byeong K.			
Station Cordinates	Easting	Northing	Elevation	
	386687	7314673	337m	
Weather Conditions	Mis of Sun and Cloud, Flurries			

Transducer Information			
PT Model	PT2X	Serial #	21312031
Gain	1	Offset	0
Status	Active	Battery	3.1V
# of Records	1	Memory Free	524138
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 73	2.067	102.067		100.000	BM 73
BM 42			1.455	100.612	BM 42
BM 43			1.612	100.455	BM 43
PT			3.082	98.985	
WL			2.483	**99.584**	
TBM	2.964	101.990	3.041	99.026	
WL			2.404	**99.586**	
PT			3.008	98.982	
BM 43			1.535	100.455	
BM 42			1.378	100.612	
BM 73			1.990	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 42	100.612	100.612	0.000	
BM 43	100.455	100.455	0.000	
PT	98.984	98.984	0.000	

Summary	
Stage (m)	99.585
Discharge (m^3/s)	0.005
Pressure Transducer Reading (m)	0.622
Pressure Transducer Elevation (m)	98.963

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	14:30	End	16:30	Location	20m DS of PT			
Method	Velocity-area (Mid-section)			Instrument Model		FH950			
Flow Meter Type	Electromagnetic			Instrument Serial #					
Stage (m)	Start	Reading	0.622	Time	14:30				
	End	Reading		Time					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	31.50	0.00	0.0	0.02	0			0.000	0.0
	32.00	0.08	0.5	0.03	0.05			0.001	0.4
	32.20	0.16	0.2	0.04	0.17			0.007	2.0
	32.50	0.29	0.3	0.08	0.3			0.024	7.0
	32.75	0.31	0.3	0.08	0.33			0.026	7.5
	33.00	0.29	0.3	0.07	0.21			0.015	4.5
	33.25	0.25	0.3	0.06	0.42			0.024	7.0
	33.45	0.31	0.2	0.06	0.43			0.027	7.8
	33.65	0.31	0.2	0.06	0.27			0.017	4.9
	33.85	0.31	0.2	0.06	0.33			0.020	6.0
	34.05	0.32	0.2	0.06	0.31			0.020	5.8
	34.25	0.32	0.2	0.06	0.3			0.019	5.7
	34.45	0.28	0.2	0.06	0.42			0.024	6.9
	34.65	0.28	0.2	0.06	0.29			0.016	4.8
	34.85	0.25	0.2	0.05	0.22			0.011	3.2
	35.05	0.22	0.2	0.04	0.2			0.009	2.6
	35.25	0.23	0.2	0.05	0.13			0.006	1.8
	35.45	0.34	0.2	0.08	0			0.000	0.0
	35.70	0.34	0.3	0.13	-0.04			-0.005	-1.5
	36.20	0.32	0.5	0.16	-0.04			-0.006	-1.9
	36.70	0.43	0.5	0.22	-0.02			-0.004	-1.3
	37.20	0.48	0.5	0.19	0.01			0.002	0.6
LB	37.50	0.52	0.3	0.16	0.02			0.003	0.9
	37.80	0.55	0.3	0.17	0.09			0.015	4.4
	38.10	0.60	0.3	0.18	0.14			0.025	7.4
	38.40	0.53	0.3	0.16	0.13			0.021	6.1
	38.70	0.37	0.3	0.11	0.17			0.019	5.6
	39.00	0.16	0.3	0.04	0.13			0.005	1.5
	39.20	0.08	0.2	0.01	0.06			0.001	0.2
	39.30	0.00	0.1	0.00	0			0.000	0.0
Total Q								**0.340**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site KL-H2

Site Information				
Project Name	Back River			
Station Identification	KL-H2			
Stream Name	George Lake Outflow			
Date Monitored	13-Jun-13			
Time at Site (24 hr)	Start Time:	4:03:00 PM	End Time:	
Personnel	Eli H., Byeong K.			
Station Cordinates	Easting	Northing	Elevation	
	386687	7314673	337	
Weather Conditions				

Transducer Information			
PT Model	PT2X	Serial #	21312031
Gain	1	Offset	0
Status	Active	Battery	3.1V
# of Records	1	Memory Free	524138
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 73	1.808	101.808		100.000	BM 73
BM 42			1.194	100.614	BM 42
BM 43			1.350	100.458	BM 43
PT			2.826	98.982	
WL			2.237	**99.571**	
TBM	2.654	101.780	2.682	99.126	
WL			2.208	**99.572**	
PT			2.798	98.982	
BM 43			1.321	100.459	
BM 42			1.167	100.613	
BM 73			1.781	99.999	
BM74			1.934	99.846	
BM78			1.049	100.731	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 42	100.612	100.614	0.002	
BM 43	100.455	100.459	0.004	
PT	98.984	98.982	-0.002	

Summary	
Stage (m)	99.572
Discharge (m^3/s)	0.287
Pressure Transducer Reading (m)	0.609
Pressure Transducer Elevation (m)	98.963

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	16:07	End	16:50	Location	20m DS of PT			
Method	Velocity-area (Mid-section)			Instrument Model		FH950			
Flow Meter Type	Electromagnetic			Instrument Serial #					
Stage (m)	Start	Reading	0.608	Time	16:07				
	End	Reading	0.609	Time	16:50				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	2.30	0.00	0.0	0.01	0			0.000	0.0
	2.50	0.10	0.2	0.02	0			0.000	0.0
	2.70	0.22	0.2	0.06	0.09			0.005	1.7
	3.00	0.30	0.3	0.09	0.3			0.027	9.4
	3.30	0.34	0.3	0.09	0.28			0.024	8.3
	3.50	0.44	0.2	0.09	0.35			0.031	10.8
	3.70	0.38	0.2	0.08	0.31			0.024	8.2
	3.90	0.46	0.2	0.09	0.1			0.009	3.2
	4.10	0.43	0.2	0.09	0.07			0.006	2.1
	4.30	0.42	0.2	0.11	0.13			0.014	4.8
	4.60	0.36	0.3	0.11	0.2			0.022	7.5
	4.90	0.40	0.3	0.12	0.15			0.018	6.3
	5.20	0.36	0.3	0.11	0.1			0.011	3.8
	5.50	0.38	0.3	0.15	0.03			0.005	1.6
	6.00	0.46	0.5	0.23	-0.02			-0.005	-1.6
	6.50	0.42	0.5	0.21	0.01			0.002	0.7
	7.00	0.48	0.5	0.19	0.05			0.010	3.4
	7.30	0.51	0.3	0.15	0.07			0.011	3.7
	7.60	0.51	0.3	0.15	0.09			0.014	4.8
	7.90	0.51	0.3	0.15	0.13			0.020	6.9
	8.20	0.50	0.3	0.13	0.14			0.018	6.1
	8.40	0.50	0.2	0.13	0.11			0.014	4.8
	8.70	0.24	0.3	0.07	0.11			0.008	2.8
	9.00	0.24	0.3	0.06	0.03			0.002	0.6
	9.20	0.08	0.2	0.01	0.01			0.000	0.0
LB	9.30	0.00	0.1	0.00	0			0.000	0.0
Total Q								**0.287**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site KL-H2

Site Information				
Project Name	Back River			
Station Identification	KL-H2			
Stream Name	George Lake Outflow			
Date Monitored	13-Jul-13			
Time at Site (24 hr)	Start Time:		End Time:	
Personnel	Eli H., Byeong K.			
Station Cordinates	Easting	Northing	Elevation	
	386687	7314673	337	
Weather Conditions	Rainy, cloudy, windy			

Transducer Information			
PT Model	PT2X	Serial #	21312031
Gain		Offset	
Status	Active	Battery	3.1V
# of Records	4597	Memory Free	519542
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 73	2.047	102.047		100.000	
BM 42			1.428	100.619	
BM 43			1.585	100.462	
PT			3.102	98.945	0.510
WL			2.600	**99.447**	
TBM	1.476	101.988	1.535	100.512	
WL			2.541	**99.447**	
PT			3.048	98.940	good, 0.510
BM 43			1.527	100.461	
BM 42			1.369	100.619	
BM 73			1.989	99.999	
DSWL1			2.555	99.433	
DSWL2			2.619	99.369	
DSWL3			2.74	99.248	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 42	100.612	100.619	0.007	
BM 43	100.455	100.462	0.007	
PT	98.984	98.943	-0.041	

Summary	
Stage (m)	99.447
Discharge (m^3/s)	0.052
Pressure Transducer Reading (m)	0.525
Pressure Transducer Elevation (m)	98.922

Discharge Measurement - Mid-Section Method								
Time (24 hr)	Start	13:30	End	14:00	Location	20m DS of PT		
Method	Velocity-area (Mid-section)			Instrument Model		FH950		
Flow Meter Type	Electromagnetic			Instrument Serial #				
Stage (m)	Start	Reading	0.525	Time	13:30			
	End	Reading	0.525	Time	14:00			

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	28.80	0.00	0.0	0.01	0			0.000	0.0
	29.00	0.10	0.2	0.03	0.05			0.001	2.9
	29.40	0.12	0.4	0.04	0.05			0.002	3.4
	29.60	0.09	0.2	0.03	0.01			0.000	0.5
	30.00	0.04	0.4	0.02	0.03			0.000	0.9
	30.40	0.07	0.4	0.03	0.06			0.002	3.2
	30.80	0.18	0.4	0.07	0			0.000	0.0
	31.20	0.13	0.4	0.05	0.07			0.004	6.9
	31.60	0.11	0.4	0.04	0.04			0.002	3.4
	32.00	0.22	0.4	0.08	0.04			0.003	5.9
	32.30	0.24	0.3	0.07	0.04			0.003	5.5
	32.60	0.26	0.3	0.08	0.03			0.002	4.5
	32.90	0.26	0.3	0.08	0.04			0.003	5.9
	33.20	0.27	0.3	0.08	0.05			0.004	7.7
	33.50	0.30	0.3	0.09	0.05			0.004	8.6
	33.80	0.34	0.3	0.10	0.06			0.006	11.7
	34.10	0.34	0.3	0.09	0.07			0.006	11.3
	34.30	0.32	0.2	0.06	0.08			0.005	9.8
	34.50	0.20	0.2	0.04	0.08			0.003	6.1
	34.70	0.30	0.2	0.08	0.01			0.001	1.4
	35.00	0.10	0.3	0.02	0.01			0.000	0.4
LB	35.10	0.00	0.1	0.01	0			0.000	0.0
Total Q								**0.052**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site KL-H2

Site Information				
Project Name	Back River			
Station Identification	KL-H2			
Stream Name	George Lake Outflow			
Date Monitored	18-Jul-13			
Time at Site (24 hr)	Start Time:	7:30:00 AM	End Time:	10:00:00 AM
Personnel	Eli H., Mark W.			
Station Cordinates	Easting	Northing	Elevation	
	386687	7314673	337	
Weather Conditions	Cloudy, light breeze			

Transducer Information			
PT Model	PT2X	Serial #	21312031
Gain	1	Offset	0
Status	Active	Battery	3.0V
# of Records	9746	Memory Free	514373
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 73	2.127	102.127		100.000	
BM 42			1.509	100.618	
BM 43			1.664	100.463	
PT			3.198	98.929	0.460
WL			2.734	**99.393**	
TBM	1.432	102.094	1.465	100.662	
WL			2.702	**99.392**	
PT			3.166	98.928	
BM 43			1.631	100.463	
BM 42			1.474	100.620	
BM 73			2.095	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 42	100.612	100.619	0.007	
BM 43	100.455	100.463	0.008	
PT	98.984	98.929	-0.055	

Summary			
Surveyed Stage (m)	99.393	Corrected:	99.401
Discharge (m^3/s)	0.00878		
Pressure Transducer Reading (m)	0.482		
Pressure Transducer Elevation (m)	98.911		

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	7:40	End	8:19	Location				
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate			
Flow Meter Type	Electromagnetic			Instrument Serial #					
Stage (m)	Start	Reading	0.481	Time	7:40				
	End	Reading	0.482	Time	8:19				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.10	0.00	0.0	0.00	0			0.000	0.0
	0.20	0.06	0.1	0.01	0.05			0.000	4.1
	0.34	0.06	0.1	0.01	0.03			0.000	2.2
	0.41	0.06	0.1	0.00	0.04			0.000	1.9
	0.48	0.07	0.1	0.01	0.06			0.000	5.0
	0.62	0.06	0.1	0.01	0.05			0.000	4.8
	0.76	0.08	0.1	0.01	0.07			0.001	8.9
	0.90	0.10	0.1	0.01	0.07			0.001	11.2
	1.04	0.09	0.1	0.01	0.05			0.001	7.2
	1.18	0.07	0.1	0.01	0.04			0.000	4.5
	1.32	0.05	0.1	0.01	0.04			0.000	3.2
	1.46	0.06	0.1	0.01	0.04			0.000	3.8
	1.60	0.06	0.1	0.01	0.03			0.000	2.9
	1.74	0.07	0.1	0.01	0.03			0.000	3.4
	1.88	0.12	0.1	0.02	0.05			0.001	9.6
	2.02	0.08	0.1	0.01	0.04			0.000	5.1
	2.16	0.06	0.1	0.01	0.04			0.000	3.8
	2.30	0.08	0.1	0.01	0.03			0.000	3.8
	2.44	0.06	0.1	0.01	0.04			0.000	3.8
	2.58	0.08	0.1	0.01	0.03			0.000	3.8
	2.72	0.06	0.1	0.01	0.02			0.000	1.9
	2.86	0.05	0.1	0.01	0			0.000	0.0
LB	2.95	0.00	0.1	0.00	0			0.000	0.0
second chanel RB	0.00	0.00	0.0	0.00	0			0.000	0.0
mid 2nd channel	0.10	0.05	0.1	0.01	0.09			0.000	5.1
2nd channel LB	0.20	0.00	0.0	0.00	0			0.000	0.0
Total Q								**0.009**	**100.0**

General Notes

Flow very low, trickle through rocks observed in second channel.

Appendix 3. Manual Stage and Discharge Measurements, Site KL-H2

Site Information				
Project Name	Back River			
Station Identification	KL-H2			
Stream Name	George Lake Outflow			
Date Monitored	14-Sep-13			
Time at Site (24 hr)	Start Time:	11:00:00 AM	End Time:	
Personnel	Eli H., Robert M.			
Station Cordinates	Easting	Northing	Elevation	
	386687	7314673	337	
Weather Conditions				

Transducer Information			
PT Model	PT2X	Serial #	21312031
Gain	1	Offset	0
Status	Acvtive	Battery	3.0V
# of Records	13654	Memory Free	510485
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 73	2.043	102.043		100.000	
BM 42			1.422	100.621	
BM 43			1.581	100.462	
PT			3.129	98.914	0.521
WL			2.603	**99.440**	
TBM	2.543	101.998	2.588	99.455	
WL			2.561	**99.437**	
PT			3.082	98.916	
BM 43			1.539	100.459	
BM 42			1.380	100.618	
BM 73			2.001	99.997	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 42	100.612	100.620	0.008	
BM 43	100.455	100.461	0.006	
PT	98.984	98.915	-0.069	

Summary			
Surveyed Stage (m)	99.439	Corrected:	99.447
Discharge (m^3/s)	0.046		
Pressure Transducer Reading (m)	0.535		
Pressure Transducer Elevation (m)	98.904		

Discharge Measurement - Mid-Section Method

Time (24 hr)	Start	11:00	End	11:40	Location	Downstream of outlet and riffle	
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate	
Flow Meter Type	Electromagnetic			Instrument Serial #		3474	
Stage (m)	Start	Reading	0.533	Time	11:00		
	End	Reading	0.534	Time	11:40		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	1.70	0.00	0.0	0.01	0			0.000	0.0
	1.80	0.12	0.1	0.02	-0.01			0.000	-0.5
	2.10	0.08	0.3	0.02	0			0.000	0.0
	2.40	0.21	0.3	0.06	-0.01			-0.001	-1.4
	2.70	0.28	0.3	0.08	0.03			0.003	5.5
	3.00	0.28	0.3	0.08	0.02			0.002	3.7
	3.30	0.20	0.3	0.06	0.01			0.001	1.3
	3.60	0.18	0.3	0.05	0.02			0.001	2.4
	3.90	0.16	0.3	0.05	0.03			0.001	3.2
	4.20	0.16	0.3	0.05	0.03			0.001	3.2
	4.50	0.16	0.3	0.05	0.04			0.002	4.2
	4.80	0.14	0.3	0.04	0.02			0.001	1.8
	5.10	0.22	0.3	0.07	0.02			0.001	2.9
	5.40	0.18	0.3	0.05	0.03			0.002	3.6
	5.70	0.21	0.3	0.06	0.03			0.002	4.1
	6.00	0.27	0.3	0.08	0.04			0.003	7.1
	6.30	0.28	0.3	0.07	0.03			0.002	4.6
	6.50	0.32	0.2	0.06	0.04			0.003	5.6
	6.70	0.36	0.2	0.07	0.07			0.005	11.1
	6.90	0.38	0.2	0.08	0.06			0.005	10.0
	7.10	0.38	0.2	0.08	0.06			0.005	10.0
	7.30	0.38	0.2	0.08	0.06			0.005	10.0
	7.50	0.40	0.2	0.08	0.04			0.003	7.0
	7.70	0.15	0.2	0.03	0.01			0.000	0.7
LB	7.90	0.00	0.2	0.02	0			0.000	0.0
Total Q								**0.046**	**100.0**

General Notes

PT stopped @ 12:05. Additional meaurements made upstream to double-check flow measurement. Upstream flows slightly lower (see QAQC notes)

Appendix 3. Manual Stage and Discharge Measurements, Site LG-H1

Site Information					
Project Name	Back River				
Station Identification	LG-H1				
Stream Name	Long Lake Outflow				
Date Monitored	11-Jun-13				
Time at Site (24 hr)	**Start Time:**	7:00:00 AM	**End Time:**		
Personnel	Eli H. Byeong K.				
Station Cordinates	**Easting**	**Northing**	**Elevation**		
	394280	7305113	312		
Weather Conditions	Sunny				

Transducer Information			
PT Model	PT2X	**Serial #**	21242043
Gain	1.007795	**Offset**	0.006
Status	Active	**Battery**	3.1V
# of Records	2	**Memory Free**	524137
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 95	0.750	100.750		100.000	
BM 96			1.073	99.677	
BM 97			0.993	99.757	
PT			3.975	96.775	US of third hose clamp
WL			2.990	**97.760**	
TBM	0.485	100.663	0.572	100.178	
WL			2.905	**97.758**	+_1cm
PT			3.888	96.775	depth: 0.980+_1cm
BM 97			0.905	99.758	
BM 96			0.987	99.676	
BM 95			0.665	99.998	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 96	99.677	99.677	0.000	
BM 97	99.758	99.758	0.000	
PT	96.775	96.775	0.000	

Summary	
Stage (m)	97.759
Discharge (m^3/s)	10.979
Pressure Transducer Reading (m)	1.065
Pressure Transducer Elevation (m)	96.694

Discharge Measurement - Mid-Section Method							
Time (24 hr)	**Start**	11:30	**End**	13:30	**Location**	100m US of PT above	
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950	
Flow Meter Type	Electromagnetic			**Instrument Serial #**			
Stage (m)	**Start**	**Reading**	1.071	**Time**	11:30		
	End	**Reading**		**Time**	13:30		

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	4.20	0.00	0.0	0.02	0.00	0.00	0.00	0.000	0.0
Grass	4.50	0.16	0.3	0.06	0.05	0.00	0.00	0.003	0.0
	4.90	0.20	0.4	0.15	0.09	0.00	0.00	0.014	0.1
	6.00	0.19	1.1	0.29	0.28	0.00	0.00	0.082	0.8
	8.00	0.34	2.0	0.68	0.34	0.00	0.00	0.231	2.1
	10.00	0.39	2.0	0.78	0.38	0.00	0.00	0.296	2.7
	12.00	0.40	2.0	0.80	0.41	0.00	0.00	0.328	3.0
	14.00	0.60	2.0	1.20	0.46	0.00	0.00	0.552	5.0
	16.00	0.73	2.0	1.46	0.40	0.00	0.00	0.584	5.3
	18.00	0.78	2.0	1.56	0.00	0.81	0.30	0.866	7.9
	20.00	0.79	2.0	1.58	0.00	0.88	0.38	0.995	9.1
	22.00	0.85	2.0	1.70	0.00	0.81	0.42	1.046	9.5
	24.00	0.76	2.0	1.52	0.00	0.91	0.49	1.064	9.7
	26.00	0.72	2.0	1.44	0.88	0.00	0.00	1.267	11.5
	28.00	0.63	2.0	1.26	0.86	0.00	0.00	1.084	9.9
	30.00	0.42	2.0	0.84	0.72	0.00	0.00	0.605	5.5
	32.00	0.42	2.0	0.84	0.51	0.00	0.00	0.428	3.9
	34.00	0.39	2.0	0.78	0.56	0.00	0.00	0.437	4.0
	36.00	0.45	2.0	0.90	0.45	0.00	0.00	0.405	3.7
	38.00	0.37	2.0	0.74	0.59	0.00	0.00	0.437	4.0
	40.00	0.32	2.0	0.77	0.30	0.00	0.00	0.230	2.1
	42.80	0.10	2.8	0.18	0.13	0.00	0.00	0.023	0.2
	43.50	0.31	0.7	0.14	0.02	0.00	0.00	0.003	0.0
RB	43.70	0.00	0.2	0.03	0.00	0.00	0.00	0.000	0.0
Total Q								**10.979**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site LG-H1

Site Information				
Project Name	Back River			
Station Identification	LG-H1			
Stream Name	Long Lake Outflow			
Date Monitored	13-Jun-13			
Time at Site (24 hr)	Start Time:	11:25:00 AM	End Time:	
Personnel	Eli H. Byeong K.			
Station Cordinates	Easting	Northing	Elevation	
	394280	7305113	312	
Weather Conditions				

Transducer Information			
PT Model	PT2X	Serial #	21242043
Gain		Offset	
Status		Battery	
# of Records	291	Memory Free	523848
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM#	Established Elevation (m)	Mean Elevation (this date) (m)		Difference (m)	Notes

Summary	
Stage (m)	97.730
Discharge (m^3/s)	9.587
Pressure Transducer Reading (m)	1.037
Pressure Transducer Elevation (m)	96.694

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	11:30	End	13:00	Location				
Method	Velocity-area (Mid-section)				Instrument Model	FH950			
Flow Meter Type	Electromagnetic				Instrument Serial #	same			
Stage (m)	Start	Reading	1.04		Time	11:30	Staff Gauge:	-0.204	
	End	Reading	1.04		Time	13:00			

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	3.00	0.00	0.0	0.01	0.00	0.00	0.00	0.000	0.0
Grass	3.20	0.14	0.2	0.14	0.00	0.00	0.00	0.000	0.0
	5.00	0.11	1.8	0.21	0.00	0.00	0.00	0.000	0.0
	7.00	0.23	2.0	0.46	0.34	0.00	0.00	0.156	1.6
	9.00	0.42	2.0	0.84	0.42	0.00	0.00	0.353	3.7
	11.00	0.26	2.0	0.52	0.35	0.00	0.00	0.182	1.9
	13.00	0.39	2.0	0.78	0.48	0.00	0.00	0.374	3.9
	15.00	0.62	2.0	1.24	0.42	0.00	0.00	0.521	5.4
	17.00	0.77	2.0	1.35	0.00	0.60	0.28	0.593	6.2
	18.50	0.79	1.5	1.19	0.00	0.71	0.45	0.687	7.2
	20.00	0.66	1.5	0.99	0.68	0.00	0.00	0.673	7.0
	21.50	0.74	1.5	1.11	0.65	0.00	0.00	0.722	7.5
	23.00	0.74	1.5	1.11	0.69	0.00	0.00	0.766	8.0
	24.50	0.80	1.5	1.20	0.00	0.85	0.54	0.834	8.7
	26.00	0.70	1.5	1.05	0.82	0.00	0.00	0.861	9.0
	27.50	0.58	1.5	0.87	0.74	0.00	0.00	0.644	6.7
	29.00	0.36	1.5	0.63	0.68	0.00	0.00	0.428	4.5
	31.00	0.31	2.0	0.62	0.64	0.00	0.00	0.397	4.1
	33.00	0.32	2.0	0.64	0.59	0.00	0.00	0.378	3.9
	35.00	0.32	2.0	0.64	0.24	0.00	0.00	0.154	1.6
	37.00	0.42	2.0	0.84	0.43	0.00	0.00	0.361	3.8
	39.00	0.32	2.0	0.64	0.32	0.00	0.00	0.205	2.1
	41.00	0.38	2.0	0.76	0.24	0.00	0.00	0.182	1.9
	43.00	0.37	2.0	0.56	0.21	0.00	0.00	0.117	1.2
	44.00	0.25	1.0	0.18	0.00	0.00	0.00	0.000	0.0
	44.40	0.00	0.4	0.05	0.00	0.00	0.00	0.000	0.0
Total Q								**9.587**	**100.0**

General Notes

Installed Staff Gauge on this date
WL From SG (Surveyed in July) = 97.938 - 0.204 = 97.734
PT Elevation from reading = 97.734 - 1.037 = 96.697

Appendix 3. Manual Stage and Discharge Measurements, Site LG-H1

Site Information				
Project Name	Back River			
Station Identification	LG-H1			
Stream Name	Long Lake Outflow			
Date Monitored	13-Jul-13			
Time at Site (24 hr)	**Start Time:**	8:40:00 AM	**End Time:**	
Personnel	Eli H. Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	394280	7305113	312	
Weather Conditions	Partly sunny and cloudy, cool			

Transducer Information			
PT Model	PT2X	**Serial #**	21242043
Gain	1.007795	**Offset**	0.006
Status	Active	**Battery**	3.0V
# of Records	4590	**Memory Free**	519549
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 95	1.300	101.300		100.000	
BM 96			1.623	99.677	
BM 97			1.542	99.758	
PT			4.609	96.691	
WL			3.917	**97.383**	
SG			3.368	97.932	bad
TBM	0.493	101.080	0.713	100.587	
SG			3.142	97.938	use
WL			3.697	**97.383**	
PT			4.390	96.690	0.685
BM 97			1.322	99.758	
BM 96			1.403	99.677	
BM 95			1.079	100.001	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 96	99.677	99.677	0.000	
BM 97	99.758	99.758	0.001	
PT	96.775	96.691	-0.085	

Summary	
Stage (m)	97.383
Discharge (m^3/s)	2.043
Pressure Transducer Reading (m)	0.714
Pressure Transducer Elevation (m)	96.669

Discharge Measurement - Mid-Section Method								
Time (24 hr)	**Start**	9:26	**End**	11:00	**Location**	200m US of PT		
Method	Velocity-area (Mid-section)				**Instrument Model**	FH950		
Flow Meter Type	Electromagnetic				**Instrument Serial #**			
Stage (m)	**Start**	**Reading**	0.715	**Time**	9:26	Staff Gauge:	-0.560	
	End	**Reading**		**Time**	11:00			

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	6.80	0.00	0.0	0.03	0.00			0.000	0.0
	7.50	0.08	0.7	0.07	0.10			0.007	0.3
	8.50	0.14	1.0	0.18	0.09			0.016	0.8
	10.00	0.15	1.5	0.23	0.18			0.041	2.0
	11.50	0.20	1.5	0.30	0.17			0.051	2.5
	13.00	0.21	1.5	0.32	0.23			0.072	3.5
	14.50	0.28	1.5	0.42	0.26			0.109	5.3
	16.00	0.43	1.5	0.54	0.17			0.091	4.5
	17.00	0.28	1.0	0.28	0.26			0.073	3.6
Behind rock	18.00	0.38	1.0	0.38	0.17			0.065	3.2
	19.00	0.42	1.0	0.42	0.20			0.084	4.1
	20.00	0.34	1.0	0.34	0.29			0.099	4.8
	21.00	0.54	1.0	0.54	0.30			0.162	7.9
	22.00	0.51	1.0	0.51	0.31			0.158	7.7
	23.00	0.37	1.0	0.37	0.33			0.122	6.0
	24.00	0.42	1.0	0.42	0.32			0.134	6.6
	25.00	0.38	1.0	0.38	0.35			0.133	6.5
	26.00	0.41	1.0	0.41	0.27			0.111	5.4
	27.00	0.32	1.0	0.32	0.35			0.112	5.5
	28.00	0.32	1.0	0.32	0.34			0.109	5.3
	29.00	0.26	1.0	0.33	0.36			0.117	5.7
	30.50	0.21	1.5	0.32	0.34			0.107	5.2
	32.00	0.14	1.5	0.20	0.26			0.051	2.5
	33.30	0.08	1.3	0.09	0.13			0.012	0.6
	34.30	0.08	1.0	0.07	0.11			0.007	0.4
	35.00	0.03	0.7	0.02	0.04			0.001	0.0
RB	35.30	0.00	0.3	0.00	0.00			0.000	0.0
Total Q								**2.043**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site LG-H1

Site Information				
Project Name	Back River			
Station Identification	LG-H1			
Stream Name	Long Lake Outflow			
Date Monitored	23-Aug-13			
Time at Site (24 hr)	**Start Time:**	11:40:00 AM	**End Time:**	
Personnel	Eli H., Mark W.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	394280	7305113	312	
Weather Conditions	Cloudy			

Transducer Information			
PT Model	PT2X	**Serial #**	21242043
Gain	1.007795	**Offset**	0.006
Status	Active	**Battery**	2.9V
# of Records	10516	**Memory Free**	513623
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 95	1.315	101.315		100.000	
BM 96			1.639	99.676	
BM 97			1.558	99.757	
PT			4.628	96.687	
WL			4.065	**97.250**	
SG			3.379	97.936	
TBM	0.518	101.258	0.575	100.740	
SG			3.321	97.937	
WL			4.008	**97.250**	
PT			4.568	96.690	0.560
BM 97			1.499	99.759	
BM 96			1.581	99.677	
BM 95			1.258	100.000	
DSWL			4.115	97.143	
USWL			3.949	97.309	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 96	99.677	99.677	0.000	
BM 97	99.758	99.758	0.001	
PT	96.775	96.689	-0.087	

Summary	
Stage (m)	97.250
Discharge (m^3/s)	0.825
Pressure Transducer Reading (m)	0.589
Pressure Transducer Elevation (m)	96.661

Discharge Measurement - Mid-Section Method							
Time (24 hr)	**Start**	12:50	**End**	13:30	**Location**	100m US of PT above cascade	
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-mate	
Flow Meter Type	Electromagnetic			**Instrument Serial #**			
Stage (m)	**Start**	**Reading**	0.589	**Time**	12:50		
	End	**Reading**	0.589	**Time**	13:30		

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	1.20	0.00	0.0	0.00	0.00			0.000	0.0
	1.30	0.04	0.1	0.03	0.03			0.001	0.1
	2.50	0.06	1.2	0.08	0.03			0.002	0.3
	4.00	0.06	1.5	0.09	0.01			0.001	0.1
	5.50	0.10	1.5	0.15	0.13			0.020	2.4
	7.00	0.22	1.5	0.28	0.16			0.044	5.3
	8.00	0.14	1.0	0.14	0.09			0.013	1.5
	9.00	0.20	1.0	0.20	0.12			0.024	2.9
	10.00	0.28	1.0	0.28	0.09			0.025	3.1
	11.00	0.26	1.0	0.26	0.16			0.042	5.0
	12.00	0.26	1.0	0.26	0.14			0.036	4.4
	13.00	0.24	1.0	0.24	0.19			0.046	5.5
	14.00	0.35	1.0	0.26	0.22			0.058	7.0
	14.50	0.42	0.5	0.21	0.20			0.042	5.1
	15.00	0.27	0.5	0.20	0.13			0.026	3.2
	16.00	0.27	1.0	0.27	0.19			0.051	6.2
	17.00	0.33	1.0	0.33	0.24			0.079	9.6
	18.00	0.26	1.0	0.26	0.20			0.052	6.3
	19.00	0.26	1.0	0.26	0.31			0.081	9.8
	20.00	0.20	1.0	0.20	0.27			0.054	6.5
	21.00	0.21	1.0	0.21	0.26			0.055	6.6
	22.00	0.16	1.0	0.16	0.24			0.038	4.7
	23.00	0.14	1.0	0.14	0.14			0.020	2.4
	24.00	0.08	1.0	0.10	0.11			0.011	1.3
	25.50	0.06	1.5	0.05	0.11			0.006	0.7
Rocks	25.70	0.00	0.2	0.00	0.00			0.000	0.0
Rocks	26.50	0.00	0.8	0.00	0.00			0.000	0.0
	26.60	0.06	0.1	0.01	0.00			0.000	0.0
Min, flow through rocks	26.80	0.00	0.2	0.00	0.00			0.000	0.0
Min, flow through rocks	28.50	0.00	3.0	0.00	0.00			0.000	0.0
RB	28.60	0.00	0.1	0.00	0.00			0.000	0.0
Total Q								**0.825**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site LG-H1

Site Information				
Project Name	Back River			
Station Identification	LG-H1			
Stream Name	Long Lake Outflow			
Date Monitored	11-Sep-13			
Time at Site (24 hr)	Start Time:	7:30:00 AM	End Time:	
Personnel	Eli H., Mark W.			
Station Cordinates	Easting	Northing	Elevation	
	394280	7305113	312	
Weather Conditions	Cloudy			

Transducer Information			
PT Model	PT2X	Serial #	21242043
Gain	1.007795	Offset	0.006
Status	Active	Battery	2.9V
# of Records	13227	Memory Free	510912
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 95	1.362	101.362		100.000	
BM 96			1.686	99.676	
BM 97			1.604	99.758	
PT			4.673	96.689	
WL			4.012	**97.350**	
SG			3.428	97.934	
TBM	1.151	101.330	1.183	100.179	
SG			3.394	97.936	
WL			3.981	**97.349**	
PT			4.641	96.689	0.660
BM 97			1.572	99.758	
BM 96			1.652	99.678	
BM 95			1.330	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 96	99.677	99.677	0.000	
BM 97	99.758	99.758	0.000	
PT	96.775	96.689	-0.086	

Summary	
Stage (m)	97.350
Discharge (m^3/s)	1.674
Pressure Transducer Reading (m)	0.689
Pressure Transducer Elevation (m)	96.660

Discharge Measurement - Mid-Section Method

Time (24 hr)	Start	7:32	End	8:20	Location	100m US of PT above cascade	
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate	
Flow Meter Type	Electromagnetic			Instrument Serial #		3474	
Stage (m)	Start	Reading	0.69	Time	7:32	Staf Gauge:	-0.523
	End	Reading	0.69	Time	8:20		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	5.10	0.00	0.0	0.00	0.00			0.000	0.0
	5.30	0.04	0.2	0.02	0.01			0.000	0.0
	6.00	0.06	0.7	0.08	0.00			0.000	0.0
	8.00	0.03	2.0	0.05	0.03			0.002	0.1
	9.50	0.12	1.5	0.18	0.09			0.016	1.0
	11.00	0.14	1.5	0.25	0.30			0.074	4.4
	13.00	0.40	2.0	0.60	0.29			0.174	10.4
	14.00	0.42	1.0	0.42	0.23			0.097	5.8
	15.00	0.41	1.0	0.41	0.16			0.066	3.9
	16.00	0.28	1.0	0.28	0.17			0.048	2.8
	17.00	0.41	1.0	0.41	0.16			0.066	3.9
	18.00	0.59	1.0	0.44	0.27			0.119	7.1
	18.50	0.55	0.5	0.28	0.37			0.102	6.1
	19.00	0.41	0.5	0.31	0.24			0.074	4.4
	20.00	0.41	1.0	0.41	0.34			0.139	8.3
	21.00	0.42	1.0	0.32	0.34			0.107	6.4
	21.50	0.46	0.5	0.23	0.11			0.025	1.5
	22.00	0.44	0.5	0.22	0.37			0.081	4.9
	22.50	0.18	0.5	0.09	0.36			0.032	1.9
	23.00	0.38	0.5	0.38	0.24			0.091	5.4
	24.50	0.38	1.5	0.57	0.32			0.182	10.9
	26.00	0.26	1.5	0.39	0.25			0.098	5.8
	27.50	0.14	1.5	0.21	0.14			0.029	1.8
	29.00	0.10	1.5	0.15	0.16			0.024	1.4
	30.50	0.16	1.5	0.24	0.09			0.022	1.3
	32.00	0.10	1.5	0.18	0.02			0.004	0.2
	34.00	0.12	2.0	0.24	0.01			0.002	0.1
	36.00	0.06	2.0	0.07	-0.01			-0.001	0.0
	36.20	0.00	0.2	0.00	0.00			0.000	0.0
	38.50	0.00	2.3	0.00	0.00			0.000	0.0
	38.60	0.06	0.1	0.01	0.05			0.000	0.0
	38.80	0.00	0.2	0.00	0.00			0.000	0.0
	39.30	0.00	0.5	0.00	0.00			0.000	0.0
	39.40	0.08	0.1	0.01	0.03			0.000	0.0
RB	39.60	0.00	0.2	0.01	0.00			0.000	0.0
Total Q								**1.674**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site LY-H1

Site Information				
Project Name	Back River			
Station Identification	LY-H1			
Stream Name	Lytle Outflow			
Date Monitored	10-Jun-13			
Time at Site (24 hr)	**Start Time:**	6:30:00 AM	**End Time:**	10:00:00 AM
Personnel	Eli H., Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	387171	7313490	338	
Weather Conditions	Sunny, cool			

Transducer Information			
PT Model	PT2X	**Serial #**	21242040
Gain	1.00394	**Offset**	0.008
Status	Active	**Battery**	3.1V
# of Records	5	**Memory Free**	524134
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 60	1.642	101.642		100.000	
BM 61			1.793	99.849	
BM 62			1.702	99.940	
PT			2.381	99.261	Use average
WL			1.915	**99.727**	
TBM	2.363	101.580	2.425	99.217	
WL			1.852	**99.728**	
PT			2.323	99.257	Use average
BM 62			1.640	99.940	
BM 61			1.732	99.848	
BM 60			1.581	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 61	99.849	99.849	0.000	
BM 62	99.940	99.940	0.000	
PT	99.259	99.259	0.000	

Summary	
Stage (m)	99.728
Discharge (m^3/s)	0.327
Pressure Transducer Reading (m)	0.495
Pressure Transducer Elevation (m)	99.232

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	8:45	**End**	9:26	**Location**	20m DS of PT			
Method	Velocity-area (Mid-section)				**Instrument Model**	FH950			
Flow Meter Type	Electromagnetic				**Instrument Serial #**	same			
Stage (m)	**Start**	**Reading**	0.471	**Time**	8:45				
	End	**Reading**	0.496	**Time**	9:26				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	1.40	0.00	0.0	0.01	0.00			0.000	0.0
Grass	1.70	0.09	0.3	0.04	0.03			0.001	0.3
	2.20	0.10	0.5	0.05	0.03			0.001	0.4
	2.60	0.10	0.4	0.07	0.01			0.001	0.2
	3.60	0.10	1.0	0.10	0.05			0.005	1.5
	4.60	0.10	1.0	0.10	0.02			0.002	0.6
	5.60	0.07	1.0	0.07	0.02			0.001	0.4
	6.60	0.08	1.0	0.06	0.03			0.002	0.5
	7.00	0.11	0.4	0.08	0.03			0.002	0.7
	8.00	0.14	1.0	0.14	0.02			0.003	0.9
	9.00	0.12	1.0	0.12	0.03			0.004	1.1
	10.00	0.17	1.0	0.17	0.05			0.009	2.6
	11.00	0.26	1.0	0.26	0.02			0.005	1.6
	12.00	0.30	1.0	0.30	0.01			0.003	0.9
	13.00	0.21	1.0	0.21	0.01			0.002	0.6
	14.00	0.17	1.0	0.11	0.01			0.001	0.3
	14.30	0.22	0.3	0.06	0.12			0.007	2.0
	14.50	0.38	0.2	0.10	0.15			0.014	4.4
	14.80	0.30	0.3	0.09	0.51			0.046	14.0
	15.10	0.34	0.3	0.10	0.46			0.047	14.3
	15.40	0.35	0.3	0.11	0.37			0.039	11.9
	15.70	0.28	0.3	0.08	0.30			0.025	7.7
	16.00	0.32	0.3	0.10	0.33			0.032	9.7
	16.30	0.27	0.3	0.08	0.27			0.022	6.7
	16.60	0.26	0.3	0.08	0.13			0.010	3.1
Grass	16.90	0.21	0.3	0.06	0.34			0.021	6.5
	17.20	0.20	0.3	0.06	0.19			0.011	3.5
	17.50	0.14	0.3	0.03	0.22			0.007	2.1
	17.65	0.13	0.1	0.03	0.16			0.004	1.3
RB	17.90	0.00	0.3	0.02	0			0.000	0.0
Total Q								**0.327**	**100.0**

General Notes

Did not observe change in WL Difference in real time readings due to PT adjusting after installation. Use second.

Appendix 3. Manual Stage and Discharge Measurements, Site LY-H1

Site Information				
Project Name	Back River			
Station Identification	LY-H1			
Stream Name	Lytle Outflow			
Date Monitored	12-Jun-13			
Time at Site (24 hr)	Start Time:	3:00:00 PM	End Time:	
Personnel	Eli H., Byeong K.			
Station Cordinates	Easting	Northing	Elevation	
	387171	7313490	338	
Weather Conditions	Sunny, cool			

Transducer Information			
PT Model	PT2X	Serial #	21242040
Gain	1.00394	Offset	0.01
Status	Active	Battery	3.1V
# of Records	326	Memory Free	523813
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 60	1.587	101.587		100.000	
BM 61			1.738	99.849	
BM 62			1.646	99.941	
PT			2.330	99.257	0.444
WL			1.893	**99.694**	
TBM	2.449	101.773	2.263	99.324	
WL			2.078	**99.695**	
PT			2.516	99.257	
BM 62			1.830	99.943	
BM 61			1.922	99.851	
BM 60			1.771	100.002	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 61	99.849	99.850	0.001	
BM 62	99.940	99.942	0.002	
PT	99.259	99.257	-0.002	

Summary	
Stage (m)	99.695
Discharge (m^3/s)	0.295
Pressure Transducer Reading (m)	0.434
Pressure Transducer Elevation (m)	99.261

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	15:04	End	15:33	Location				
Method	Velocity-area (Mid-section)			Instrument Model		FH950			
Flow Meter Type	Electromagnetic			Instrument Serial #					
Stage (m)	Start	Reading	0.434	Time	15:04				
	End	Reading		Time	15:33				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	33.80	0.00	0.0	0.01	0.00			0.000	0.0
Grass	33.90	0.11	0.1	0.02	0.07			0.001	0.4
	34.10	0.07	0.2	0.02	0.01			0.000	0.1
	34.60	0.05	0.5	0.07	0.01			0.001	0.2
	37.00	0.06	2.4	0.11	0.01			0.001	0.4
	38.40	0.06	1.4	0.08	0.01			0.001	0.3
	39.80	0.14	1.4	0.18	0.01			0.002	0.6
	41.00	0.12	1.2	0.10	0.03			0.003	1.0
	41.50	0.15	0.5	0.05	0.04			0.002	0.7
	41.70	0.19	0.2	0.04	0.07			0.003	0.9
	41.90	0.23	0.2	0.05	0.02			0.001	0.3
	42.10	0.25	0.2	0.08	0.04			0.003	1.0
	42.50	0.23	0.4	0.22	0.00			0.000	0.0
	44.00	0.24	1.5	0.29	0.02			0.006	2.0
	44.90	0.14	0.9	0.11	0.00			0.000	0.0
	45.50	0.12	0.6	0.05	0.00			0.000	0.0
	45.70	0.14	0.2	0.03	0.02			0.001	0.2
	45.90	0.25	0.2	0.04	0.15			0.006	1.9
	46.00	0.36	0.1	0.06	0.18			0.011	3.8
	46.25	0.32	0.3	0.08	0.39			0.031	10.6
	46.50	0.39	0.3	0.10	0.43			0.042	14.2
	46.75	0.36	0.3	0.09	0.44			0.040	13.4
	47.00	0.40	0.3	0.10	0.53			0.053	18.0
	47.25	0.12	0.3	0.03	0.44			0.013	4.5
	47.50	0.19	0.3	0.05	0.37			0.018	6.0
	47.75	0.18	0.3	0.05	0.35			0.016	5.3
	48.00	0.20	0.3	0.05	0.10			0.005	1.7
	48.25	0.22	0.3	0.06	0.25			0.014	4.7
	48.50	0.17	0.3	0.04	0.29			0.012	4.2
	48.75	0.04	0.3	0.01	0.33			0.003	1.1
	49.00	0.10	0.3	0.03	0.16			0.004	1.4
Grass	49.25	0.14	0.3	0.02	0.14			0.003	1.2
	49.35	0.04	0.1	0.00	0.02			0.000	0.0
LB	49.40	0.00	0.0	0.00	0.00			0.000	0.0
Total Q								**0.295**	**100.0**

General Notes

Did not observe change in WL Difference in real time readings due to PT adjusting after installation. Use second.

Appendix 3. Manual Stage and Discharge Measurements, Site LY-H1

Site Information				
Project Name	Back River			
Station Identification	LY-H1			
Stream Name	Lytle Outflow			
Date Monitored	13-Jul-13			
Time at Site (24 hr)	**Start Time:**	11:44:00 AM	**End Time:**	1:08:00 PM
Personnel	Eli H., Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	387171	7313490	338	
Weather Conditions	Light rain			

Transducer Information			
PT Model	PT2X	**Serial #**	21242040
Gain		**Offset**	
Status		**Battery**	
# of Records		**Memory Free**	
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 60	1.601	101.601		100.000	
BM 61			1.752	99.849	
BM 62			1.661	99.940	
PT			2.400	99.201	Depth: 0.249
WL			2.150	**99.451**	
TBM	2.480	101.646	2.435	99.166	
WL			2.195	**99.451**	
PT			2.445	99.201	
BM 62			1.706	99.940	
BM 61			1.798	99.848	
BM 60			1.646	100.000	
DSLB			2.200	99.446	
DSRB			2.207	99.439	
USWL			2.190	99.456	
DSWL-2			2.215	99.431	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 61	99.849	99.849	0.000	
BM 62	99.940	99.940	0.000	
PT	99.259	99.201	-0.058	

Summary	
Stage (m)	99.451
Discharge (m^3/s)	0.025
Pressure Transducer Reading (m)	0.279
Pressure Transducer Elevation (m)	99.172

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	11:46	**End**	12:12	**Location**	5m DS of PT			
Method	Velocity-area (Mid-section)				**Instrument Model**	FH950			
Flow Meter Type	Electromagnetic				**Instrument Serial #**				
Stage (m)	**Start**	**Reading**	0.279		**Time**	11:46			
	End	**Reading**	0.279		**Time**	12:12			

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	0.10	0.00	0.0	0.00	0.00			0.000	0.0
	0.20	0.05	0.1	0.01	0.00			0.000	0.0
	0.40	0.05	0.2	0.01	0.01			0.000	0.3
	0.55	0.06	0.2	0.01	0.01			0.000	0.5
	0.80	0.06	0.3	0.01	0.04			0.001	2.2
	1.00	0.07	0.2	0.01	0.01			0.000	0.6
	1.20	0.10	0.2	0.02	0.03			0.001	2.4
	1.40	0.08	0.2	0.02	0.03			0.000	1.9
	1.60	0.15	0.2	0.03	0.01			0.000	1.2
	1.80	0.20	0.2	0.03	0.02			0.001	2.4
	1.90	0.20	0.1	0.02	0.01			0.000	0.8
	2.00	0.14	0.1	0.01	0.02			0.000	1.1
	2.10	0.18	0.1	0.02	0.02			0.000	1.4
	2.20	0.21	0.1	0.02	0.01			0.000	0.8
	2.30	0.19	0.1	0.02	0.01			0.000	0.8
	2.40	0.14	0.1	0.01	0.06			0.001	3.3
	2.50	0.22	0.1	0.02	0.03			0.001	2.6
	2.60	0.22	0.1	0.02	0.06			0.001	3.9
	2.65	0.21	0.0	0.01	0.09			0.001	3.8
	2.70	0.22	0.1	0.01	0.11			0.001	4.8
	2.75	0.22	0.0	0.01	0.14			0.002	6.1
	2.80	0.30	0.0	0.02	0.16			0.002	9.6
	2.85	0.29	0.1	0.01	0.16			0.002	9.2
	2.90	0.22	0.0	0.01	0.21			0.002	9.2
	2.95	0.20	0.1	0.01	0.19			0.002	7.6
	3.00	0.18	0.0	0.01	0.20			0.003	10.8
	3.10	0.15	0.1	0.02	0.10			0.002	6.0
	3.20	0.16	0.1	0.02	0.04			0.001	3.8
Grass	3.40	0.18	0.2	0.06	0.00			0.000	0.0
	3.90	0.13	0.5	0.07	0.01			0.001	2.8
RB	4.50	0.00	0.6	0.04	0.00			0.000	0.0
Total Q								**0.025**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site LY-H1

Site Information				
Project Name	Back River			
Station Identification	LY-H1			
Stream Name	Lytle Outflow			
Date Monitored	21-Jul-13			
Time at Site (24 hr)	**Start Time:**	1:33:00 PM	**End Time:**	
Personnel	Eli H., Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	387171	7313490	338	
Weather Conditions	Sunny, windy			

Transducer Information			
PT Model	PT2X	**Serial #**	21242040
Gain	1.00394	**Offset**	0.009
Status	Active	**Battery**	3.0V
# of Records	5934	**Memory Free**	518205
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 60	1.499	101.499		100.000	
BM 61			1.648	99.851	
BM 62			1.556	99.943	
PT			2.293	99.206	Depth: 0.201
WL			2.095	**99.404**	
TBM	1.898	101.464	1.933	99.566	
WL			2.062	**99.402**	
PT			2.258	99.206	
BM 62			1.520	99.944	
BM 61			1.611	99.853	
BM 60			1.461	100.003	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 61	99.849	99.852	0.003	
BM 62	99.940	99.944	0.004	
PT	99.259	99.206	-0.053	

Summary	
Stage (m)	99.403
Discharge (m^3/s)	0.017
Pressure Transducer Reading (m)	0.231
Pressure Transducer Elevation (m)	99.172

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	13:36	**End**	14:20	**Location**	12m DS of PT			
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950			
Flow Meter Type	Electromagnetic			**Instrument Serial #**					
Stage (m)	**Start**	**Reading**	0.233	**Time**	13:36				
	End	**Reading**	0.231	**Time**	14:20				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	0.10	0.00	0.0	0.01	0.00			0.000	0.0
Flooded grass	0.30	0.08	0.2	0.02	0.01			0.000	1.2
Flooded grass	0.60	0.13	0.3	0.04	0.01			0.000	2.3
Flooded grass	0.90	0.14	0.3	0.04	0.01			0.000	2.1
	1.10	0.19	0.2	0.03	0.05			0.001	7.6
	1.17	0.18	0.1	0.01	0.10			0.001	7.4
	1.24	0.17	0.1	0.01	0.11			0.001	7.7
	1.31	0.17	0.1	0.01	0.13			0.002	9.1
	1.38	0.18	0.1	0.01	0.14			0.002	10.4
	1.45	0.18	0.1	0.01	0.10			0.001	7.4
	1.52	0.16	0.1	0.01	0.09			0.001	5.9
	1.59	0.16	0.1	0.01	0.07			0.001	4.6
	1.66	0.19	0.1	0.01	0.10			0.001	7.8
	1.73	0.20	0.1	0.01	0.08			0.001	6.6
	1.80	0.16	0.1	0.01	0.07			0.001	4.6
	1.87	0.21	0.1	0.01	0.05			0.001	4.3
	1.94	0.12	0.1	0.01	0.05			0.000	2.5
	2.01	0.10	0.1	0.01	0.03			0.000	2.3
	2.20	0.10	0.2	0.02	0.02			0.000	2.3
	2.40	0.10	0.2	0.02	0.01			0.000	1.2
	2.60	0.04	0.2	0.01	0.00			0.000	0.0
	2.90	0.06	0.3	0.02	0.00			0.000	0.0
	3.20	0.05	0.3	0.02	0.02			0.000	1.8
	3.50	0.04	0.3	0.01	0.02			0.000	0.9
LB	3.60	0.00	0.1	0.00	0.00			0.000	0.0
Total Q								**0.017**	**100.0**

General Notes

Cleared weeds in vicinity of discharge measurement in order to conduct flow measurement.

Appendix 3. Manual Stage and Discharge Measurements, Site LY-H1

Site Information				
Project Name	Back River			
Station Identification	LY-H1			
Stream Name	Lytle Outflow			
Date Monitored	17-Aug-13			
Time at Site (24 hr)	**Start Time:**	9:30:00 AM	**End Time:**	11:30:00 AM
Personnel	Eli H., Mark W.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	387171	7313490	338	
Weather Conditions				

Transducer Information			
PT Model	PT2X	**Serial #**	21242040
Gain	1.00394	**Offset**	0.009
Status	Active	**Battery**	3.0V
# of Records	5934	**Memory Free**	518205
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 60	1.449	101.449		100.000	
BM 61			1.600	99.849	
BM 62			1.509	99.940	
PT			2.256	99.193	0.150
WL			2.103	**99.346**	
TBM	1.930	101.340	2.039	99.410	
WL			1.994	**99.346**	
PT			2.148	99.192	
BM 62			1.399	99.941	
BM 61			1.491	99.849	
BM 60			1.340	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 61	99.849	99.849	0.001	
BM 62	99.940	99.941	0.001	
PT	99.259	99.193	-0.067	

Summary	
Stage (m)	99.346
Discharge (m^3/s)	0.004
Pressure Transducer Reading (m)	0.184
Pressure Transducer Elevation (m)	99.162

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	9:23	**End**	10:15	**Location**	12m DS of PT	
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-mate	
Flow Meter Type	Electromagnetic			**Instrument Serial #**			
Stage (m)	**Start**	**Reading**	0.185	**Time**	9:23		
	End	**Reading**	0.184	**Time**	10:15		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	1.00	0.00	0.0	0.00	0.00			0.000	0.0
	1.05	0.04	0.1	0.00	-0.02			0.000	-1.3
	1.12	0.04	0.1	0.00	0.01			0.000	0.8
	1.19	0.01	0.1	0.00	0.00			0.000	0.0
	1.26	0.06	0.1	0.00	-0.01			0.000	-1.2
	1.34	0.06	0.1	0.00	0.01			0.000	1.2
	1.41	0.04	0.1	0.00	0.03			0.000	2.3
	1.48	0.05	0.1	0.00	0.02			0.000	1.9
	1.55	0.05	0.1	0.00	0.00			0.000	0.0
	1.62	0.07	0.1	0.00	0.01			0.000	1.3
	1.69	0.06	0.1	0.00	0.03			0.000	3.5
	1.76	0.06	0.1	0.00	0.06			0.000	6.9
	1.83	0.06	0.1	0.00	0.05			0.000	5.8
	1.90	0.04	0.1	0.00	0.03			0.000	2.3
	1.97	0.07	0.1	0.00	0.06			0.000	8.1
	2.04	0.13	0.1	0.01	0.05			0.000	11.6
	2.10	0.14	0.1	0.01	0.05			0.000	10.6
	2.15	0.15	0.0	0.01	0.05			0.000	10.3
	2.20	0.17	0.1	0.01	0.03			0.000	7.0
	2.25	0.16	0.0	0.01	0.04			0.000	8.8
	2.30	0.16	0.0	0.01	0.04			0.000	8.8
	2.35	0.18	0.1	0.01	0.04			0.000	9.9
	2.40	0.17	0.0	0.01	0.01			0.000	2.3
	2.45	0.05	0.1	0.00	-0.01			0.000	-0.7
RB	2.50	0.00	0.0	0.00	0.00			0.000	0.0
Total Q								**0.004**	**100.0**

General Notes

Could not download logger at time of measurement due to problem with cable. Returned to download in afternoon

Appendix 3. Manual Stage and Discharge Measurements, Site LY-H1

Site Information				
Project Name	Back River			
Station Identification	LY-H1			
Stream Name	Lytle Outflow			
Date Monitored	14-Sep-13			
Time at Site (24 hr)	Start Time:	1:00:00 PM	End Time:	
Personnel	Eli H, Robert M, Jem M.			
Station Cordinates	Easting	Northing	Elevation	
	387171	7313490	338	
Weather Conditions	Mix Sun and Cloud			

Transducer Information			
PT Model	PT2X	Serial #	21242040
Gain	1.00394	Offset	0.009
Status		Battery	
# of Records		Memory Free	
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 60	1.542	101.542		100.000	
BM 61			1.693	99.849	
BM 62			1.601	99.941	
PT			2.371	99.171	0.250
WL			2.119	**99.423**	
TBM	2.110	101.510	2.142	99.400	
WL			2.087	**99.423**	
PT			2.339	99.171	
BM 62			1.569	99.941	
BM 61			1.661	99.849	
BM 60			1.510	100.000	
DS WL 1			2.099	99.411	
DS WL 2			2.109	99.401	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 61	99.849	99.849	0.001	
BM 62	99.940	99.941	0.001	
PT	99.259	99.171	-0.088	

Summary			
Surveyed Stage (m)	99.423	Corrected:	99.456
Discharge (m^3/s)	0.030		
Pressure Transducer Reading (m)	0.284		
Pressure Transducer Elevation (m)	99.139		

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start		End		Location	10m downstream of station			
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate			
Flow Meter Type	Electromagnetic			Instrument Serial #					
Stage (m)	Start	Reading	0.284	Time	13:00				
	End	Reading		Time					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	1.10	0.00	0.0	0.00	0.00			0.000	0.0
	1.20	0.06	0.1	0.01	0.01			0.000	0.3
	1.35	0.09	0.2	0.01	0.02			0.000	0.9
	1.50	0.12	0.2	0.03	0.01			0.000	0.9
	1.80	0.05	0.3	0.01	0.06			0.001	2.5
	2.00	0.10	0.2	0.02	0.06			0.001	4.0
	2.20	0.09	0.2	0.02	0.03			0.001	1.8
	2.40	0.09	0.2	0.02	0.05			0.001	3.0
	2.60	0.16	0.2	0.03	0.04			0.001	4.3
	2.80	0.07	0.2	0.01	0.06			0.001	2.1
	2.90	0.16	0.1	0.02	0.07			0.001	3.8
	3.00	0.14	0.1	0.01	0.09			0.001	4.2
	3.10	0.12	0.1	0.01	0.14			0.002	5.7
	3.20	0.26	0.1	0.03	0.13			0.003	11.4
	3.30	0.22	0.1	0.02	0.12			0.003	8.9
	3.40	0.20	0.1	0.02	0.14			0.003	9.4
	3.50	0.20	0.1	0.02	0.08			0.002	5.4
	3.60	0.22	0.1	0.02	0.16			0.004	11.8
	3.70	0.26	0.1	0.03	0.12			0.003	10.5
	3.80	0.28	0.1	0.03	0.05			0.001	4.7
	3.90	0.20	0.1	0.04	0.01			0.000	1.3
	4.20	0.18	0.3	0.05	0.01			0.001	1.8
	4.50	0.14	0.3	0.04	0.01			0.000	1.4
	4.80	0.04	0.3	0.01	0.01			0.000	0.4
	5.10	0.10	0.3	0.04	-0.01			0.000	-1.3
	5.60	0.06	0.5	0.02	0.01			0.000	0.7
RB	5.75	0.00	0.2	0.00	0.00			0.000	0.0
Total Q								**0.030**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site MC-H1

Site Information				
Project Name	Back River			
Station Identification	MC-H1 (LAKE)			
Stream Name	McCoy Lake			
Date Monitored	10-Jun-13			
Time at Site (24 hr)	**Start Time:**	12:00:00 PM	**End Time:**	
Personnel	Eli H. Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	0386946	7312416	340	
Weather Conditions				

Transducer Information			
PT Model	PT2X	**Serial #**	21251010
Gain	1.007212	**Offset**	0.01
Status	Active	**Battery**	3.1V
# of Records	1	**Memory Free**	525138
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 45	0.580	100.580		100.000	
BM 46			0.717	99.863	
BM 47			1.255	99.325	
PT			2.658	97.922	
WL			2.050	**98.530**	
TBM	2.394	100.664	2.310	98.270	
WL			2.134	**98.530**	
PT			2.742	97.922	
BM 47			1.340	99.324	
BM 46			0.801	99.863	
BM 45			0.664	100.000	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 46	99.863	99.863	0.000	
BM 47	99.325	99.325	0.000	
PT	97.922	97.922	0.000	

Summary	
Stage (m)	98.530
Discharge (m^3/s)	0.347
Pressure Transducer Reading (m)	0.647
Pressure Transducer Elevation (m)	97.883

Discharge Measurement - Mid-Section Method							
Time (24 hr)	**Start**	14:10	**End**	14:55	**Location**	McCoy Outflow	
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950	
Flow Meter Type	Electromagnetic			**Instrument Serial #**		same	
Stage (m)	**Start**	**Reading**	0.647	**Time**	14:10		
	End	**Reading**		**Time**	14:55		

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	1.20	0.00	0.0	0.01	0.00			0.000	0.0
Grass	1.30	0.15	0.1	0.08	0.01			0.001	0.2
	2.30	0.17	1.0	0.23	0.01			0.002	0.7
	4.00	0.11	1.7	0.15	0.03			0.004	1.3
	5.00	0.12	1.0	0.12	0.05			0.006	1.7
	6.00	0.14	1.0	0.14	0.04			0.006	1.6
	7.00	0.20	1.0	0.16	0.12			0.019	5.5
	7.60	0.24	0.6	0.14	0.12			0.017	5.0
	8.20	0.20	0.6	0.12	0.11			0.013	3.8
	8.80	0.26	0.6	0.16	0.16			0.025	7.2
	9.40	0.14	0.6	0.08	0.14			0.012	3.4
	10.00	0.17	0.6	0.10	0.20			0.020	5.9
	10.60	0.22	0.6	0.13	0.26			0.034	9.9
	11.20	0.08	0.6	0.05	0.20			0.010	2.8
Behind boulder	11.80	0.22	0.6	0.12	0.09			0.011	3.1
	12.30	0.26	0.5	0.14	0.07			0.010	2.9
	12.90	0.08	0.6	0.05	0.30			0.014	4.2
	13.50	0.27	0.6	0.16	0.10			0.016	4.7
	14.10	0.15	0.6	0.09	0.11			0.010	2.9
	14.70	0.28	0.6	0.17	0.14			0.024	6.8
	15.30	0.18	0.6	0.11	0.14			0.015	4.4
	15.90	0.19	0.6	0.11	0.20			0.023	6.6
	16.50	0.20	0.6	0.12	0.12			0.014	4.2
	17.10	0.24	0.6	0.13	0.15			0.020	5.7
	17.60	0.26	0.5	0.10	0.11			0.011	3.3
	17.90	0.15	0.3	0.03	0.07			0.002	0.6
Grass	18.00	0.00	0.1	0.00	0.00			0.000	0.0
Grass	19.80	0.00	1.8	0.00	0.00			0.000	0.0
	20.10	0.06	0.3	0.03	0.06			0.002	0.5
	20.80	0.10	0.7	0.09	0.02			0.002	0.5
	21.80	0.06	1.0	0.05	0.06			0.003	0.8
RB	22.40	0.00	0.6	0.02	0.00			0.000	0.0
Total Q								**0.347**	**100.0**

General Notes
Station in lake. Cobble bed. Flow measured at outflow. Benchmarks in large rocks.

Appendix 3. Manual Stage and Discharge Measurements, Site MC-H1

Site Information				
Project Name	Back River			
Station Identification	MC-H1 (Lake)			
Stream Name	McCoy Lake			
Date Monitored	13-Jun-13			
Time at Site (24 hr)	**Start Time:**	8:50:00 AM	**End Time:**	
Personnel	Eli H. Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	0386946	7312416	340	
Weather Conditions	Sun, scattered cloud			

Transducer Information			
PT Model	PT2X	**Serial #**	21251010
Gain	1.007212	**Offset**	0.01
Status	Active	**Battery**	3.1V
# of Records	411	**Memory Free**	523728
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 45	0.567	100.567		100.000	
BM 46			0.709	99.858	
BM 47			1.240	99.327	
PT			2.662	97.905	0.580
WL			2.083	**98.484**	
TBM	2.753	100.665	2.655	97.912	
WL			2.184	**98.481**	
PT			2.759	97.906	
BM 47			1.338	99.327	
BM 46			0.808	99.857	
BM 45			0.666	99.999	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 46	99.863	99.858	-0.006	
BM 47	99.325	99.327	0.002	
PT	97.922	97.906	-0.017	

Summary	
Stage (m)	98.483
Discharge (m^3/s)	0.223
Pressure Transducer Reading (m)	0.608
Pressure Transducer Elevation (m)	97.875

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	8:50	**End**		**Location**	McCoy Outflow
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950
Flow Meter Type	Electromagnetic			**Instrument Serial #**		
Stage (m)	**Start**	**Reading**	0.608	**Time**	8:50	
	End	**Reading**		**Time**		

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	0.85	0.00	0.0	0.00	0.00			0.000	0.0
	0.90	0.09	0.1	0.02	0.32			0.006	2.9
	1.30	0.12	0.4	0.05	0.34			0.016	7.3
	1.70	0.10	0.4	0.04	0.23			0.009	4.1
	2.10	0.15	0.4	0.06	0.21			0.013	5.6
	2.50	0.08	0.4	0.03	0.05			0.001	0.6
Grass Island	2.80	0.00	0.3	0.00	0.00			0.000	0.0
Grass Island	3.20	0.00	0.4	0.00	0.00			0.000	0.0
	3.30	0.09	0.1	0.01	0.32			0.004	1.9
	3.50	0.11	0.2	0.04	0.39			0.015	6.7
	4.00	0.04	0.5	0.02	0.27			0.005	2.4
	4.50	0.08	0.5	0.04	0.37			0.015	6.6
	5.00	0.14	0.5	0.07	0.28			0.020	8.8
	5.50	0.10	0.5	0.05	0.35			0.018	7.8
	6.00	0.07	0.5	0.04	0.28			0.012	5.5
	6.75	0.05	0.8	0.04	0.21			0.008	3.5
	7.50	0.11	0.8	0.07	0.29			0.020	8.9
	8.00	0.14	0.5	0.07	0.33			0.023	10.3
	8.50	0.10	0.5	0.05	0.02			0.001	0.4
	9.00	0.08	0.5	0.04	0.19			0.008	3.4
	9.50	0.14	0.5	0.07	0.15			0.011	4.7
	10.00	0.17	0.5	0.06	0.07			0.004	2.0
	10.25	0.08	0.3	0.03	0.14			0.004	2.0
	10.80	0.12	0.6	0.06	0.14			0.009	3.9
	11.30	0.04	0.5	0.02	0.01			0.000	0.1
	12.00	0.04	0.7	0.03	0.01			0.000	0.1
	12.70	0.04	0.7	0.02	0.01			0.000	0.1
LB	12.80	0.00	0.1	0.00	0.00			0.000	0.0
Total Q								**0.223**	**100.0**

General Notes

Channel gradient: 2%

Appendix 3. Manual Stage and Discharge Measurements, Site MC-H1

Site Information				
Project Name	Back River			
Station Identification	MC-H1 (LAKE)			
Stream Name	McCoy Lake			
Date Monitored	12-Jul-13			
Time at Site (24 hr)	**Start Time:**	7:19:00 AM	**End Time:**	
Personnel	Eli H. Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	0386946	7312416	340	
Weather Conditions	Windy, rainy			

Transducer Information			
PT Model	PT2X	**Serial #**	21251010
Gain	1.007212	**Offset**	0.01
Status	Active	**Battery**	3.0V
# of Records	4571	**Memory Free**	519568
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 45	0.668	100.668		100.000	
BM 46			0.809	99.859	
BM 47			1.351	99.317	
PT			2.785	97.883	0.580
WL			2.375	**98.293**	
TBM	2.691	100.742	2.617	98.051	
WL			2.450	**98.292**	
PT			2.861	97.881	
BM 47			1.426	99.316	
BM 46			0.884	99.858	
BM 45			0.743	99.999	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 46	99.863	99.859	-0.004	
BM 47	99.325	99.317	-0.008	
PT	97.922	97.882	-0.040	

Summary	
Stage (m)	98.293
Discharge (m^3/s)	0.0158
Pressure Transducer Reading (m)	0.440
Pressure Transducer Elevation (m)	97.853

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	7:10	**End**	7:53	**Location**	40m from McCoy Outflow			
Method	Velocity-area (Mid-section)				**Instrument Model**	FH950			
Flow Meter Type	Electromagnetic				**Instrument Serial #**				
Stage (m)	**Start**	**Reading**	0		**Time**	7:10			
	End	**Reading**	0.425-0.441		**Time**	7:53			

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	6.40	0.00	0.0	0.02	0.00			0.000	0.0
	6.70	0.11	0.3	0.03	0.00			0.000	0.0
	7.00	0.14	0.3	0.04	0.01			0.000	2.7
	7.30	0.17	0.3	0.05	0.01			0.001	3.2
	7.60	0.15	0.3	0.05	0.02			0.001	5.7
	7.90	0.16	0.3	0.05	0.02			0.001	6.1
	8.20	0.11	0.3	0.03	0.03			0.001	6.3
	8.50	0.16	0.3	0.05	0.03			0.001	9.1
	8.80	0.10	0.3	0.03	0.03			0.001	5.7
	9.10	0.14	0.3	0.04	0.01			0.000	2.7
	9.40	0.08	0.3	0.02	0.05			0.001	7.6
	9.70	0.10	0.3	0.03	0.04			0.001	7.6
	10.00	0.10	0.3	0.03	0.03			0.001	5.7
	10.30	0.12	0.3	0.04	0.03			0.001	6.9
	10.60	0.10	0.3	0.03	0.03			0.001	5.7
	10.90	0.10	0.3	0.03	0.04			0.001	7.6
Rock	11.20	0.10	0.3	0.03	0.03			0.001	5.7
Rock	11.50	0.11	0.3	0.03	0.01			0.000	2.1
Rock	11.80	0.09	0.3	0.03	0.02			0.001	3.4
Rock	12.10	0.06	0.3	0.02	0.02			0.000	2.3
Behind rock	12.40	0.06	0.3	0.02	0.04			0.001	3.8
	12.60	0.09	0.2	0.02	0.00			0.000	0.0
LB	12.80	0.00	0.2	0.01	0.00			0.000	0.0
Total Q								**0.016**	**100.0**

General Notes
Wind blowing across lake towards mouth. Large waves at PT.

Appendix 3. Manual Stage and Discharge Measurements, Site MC-H1

Site Information				
Project Name	Back River			
Station Identification	MC-H1 (Lake)			
Stream Name	McCoy Lake			
Date Monitored	21-Jul-13			
Time at Site (24 hr)	Start Time:	11:00:00 AM	End Time:	
Personnel	Eli H. Byeong K.			
Station Cordinates	Easting	Northing	Elevation	
	0386946	7312416	340	
Weather Conditions	Mix sun + cloud, breezy			

Transducer Information			
PT Model	PT2X	Serial #	21251010
Gain	1.007212	Offset	0.01
Status	Active	Battery	3.0V
# of Records	5899	Memory Free	518240
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 45	0.929	100.929		100.000	
BM 46			1.070	99.859	
BM 47			1.612	99.317	
PT			3.049	97.880	0.390+_0.01
WL			2.662	**98.267**	
TBM	2.223	100.860	2.292	98.637	
WL			2.594	**98.266**	
PT			2.981	97.879	
BM 47			1.542	99.318	
BM 46			1.001	99.859	
BM 45			0.860	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 46	99.863	99.859	-0.004	
BM 47	99.325	99.318	-0.007	
PT	97.922	97.880	-0.042	

Summary	
Stage (m)	98.267
Discharge (m^3/s)	0.00462
Pressure Transducer Reading (m)	0.417
Pressure Transducer Elevation (m)	97.849

Discharge Measurement - Mid-Section Method						
Time (24 hr)	Start		End	12:40	Location	40m from McCoy Outflow
Method	Velocity-area (Mid-section)			Instrument Model		FH950
Flow Meter Type	Electromagnetic			Instrument Serial #		
Stage (m)	Start	Reading		Time		
	End	Reading	0.412	Time	12:40	

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	2.65	0.00	0.0	0.01	0.00			0.000	0.0
	2.75	0.14	0.1	0.02	0.01			0.000	3.8
	2.90	0.08	0.2	0.01	0.02			0.000	6.1
	3.10	0.10	0.2	0.02	0.01			0.000	4.3
	3.30	0.08	0.2	0.01	0.02			0.000	5.2
	3.40	0.08	0.1	0.02	0.01			0.000	3.5
	3.70	0.12	0.3	0.03	0.01			0.000	6.5
	3.90	0.08	0.2	0.02	0.02			0.000	6.9
	4.10	0.09	0.2	0.02	0.00			0.000	0.0
	4.30	0.13	0.2	0.03	0.01			0.000	5.6
	4.50	0.16	0.2	0.03	0.01			0.000	6.9
	4.70	0.14	0.2	0.03	0.01			0.000	6.1
	4.90	0.14	0.2	0.03	0.01			0.000	6.1
	5.10	0.14	0.2	0.03	0.01			0.000	6.1
	5.30	0.10	0.2	0.02	0.01			0.000	4.3
	5.50	0.05	0.2	0.01	0.02			0.000	4.3
	5.70	0.05	0.2	0.01	0.02			0.000	4.3
	5.90	0.12	0.2	0.02	0.01			0.000	5.2
	6.10	0.12	0.2	0.02	0.01			0.000	5.2
	6.30	0.11	0.2	0.02	0.02			0.000	9.5
	6.50	0.06	0.2	0.02	0.00			0.000	0.0
	6.90	0.03	0.4	0.01	0.00			0.000	0.0
RB	7.05	0.00	0.1	0.00	0.00			0.000	0.0
Total Q								**0.005**	**100.0**

General Notes
Wind blowing across lake towards mouth. Large waves at PT

Appendix 3. Manual Stage and Discharge Measurements, Site MC-H1

Site Information				
Project Name	Back River			
Station Identification	MC-H1			
Stream Name	McCoy Lake Inflow			
Date Monitored	23-Aug-13			
Time at Site (24 hr)	**Start Time:**	9:20:00 AM	**End Time:**	10:30:00 AM
Personnel	Eli H., Mark W.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	0386946	7312416	340	
Weather Conditions	Mix sun + cloud, cool			

Transducer Information			
PT Model	PT2X	**Serial #**	21251010
Gain	1.007212	**Offset**	0.01
Status	Active	**Battery**	3.0V
# of Records	10637	**Memory Free**	513502
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 45	0.501	100.501		100.000	
BM 46			0.642	99.859	
BM 47			1.188	99.313	
PT			2.631	97.870	0.380
WL			2.251	**98.250**	
TBM	2.113	100.433	2.181	98.320	
WL			2.183	**98.250**	
PT			2.565	97.868	
BM 47			1.120	99.313	
BM 46			0.577	99.856	
BM 45			0.434	99.999	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 46	99.863	99.858	-0.005	
BM 47	99.325	99.313	-0.011	
PT	97.922	97.869	-0.053	

Summary	
Stage (m)	98.250
Discharge (m^3/s)	0.00260
Pressure Transducer Reading (m)	0.411
Pressure Transducer Elevation (m)	97.839

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	9:55	**End**	10:30	**Location**	~20m DS of outlet			
Method	Velocity-area (Mid-section)				**Instrument Model**	Flo-mate			
Flow Meter Type	Electromagnetic				**Instrument Serial #**				
Stage (m)	**Start**	**Reading**	0.411		**Time**	9:55			
	End	**Reading**	0.41		**Time**	10:30			

					Velocity (m/s)				
	Station	**Depth**	**Distance**	**Area**				**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	0.85	0.00	0.0	0.01	0.00			0.000	0.0
	0.90	0.30	0.1	0.02	-0.01			0.000	-8.7
Rocks	1.00	0.00	0.1	0.00	0.00			0.000	0.0
Rocks	1.70	0.00	0.7	0.00	0.00			0.000	0.0
	1.75	0.07	0.1	0.01	0.00			0.000	0.0
Rocks	1.90	0.00	0.2	0.00	0.00			0.000	0.0
Rocks	2.80	0.00	0.9	0.00	0.00			0.000	0.0
	2.90	0.04	0.1	0.01	-0.03			0.000	-6.9
	3.10	0.20	0.2	0.04	0.01			0.000	15.4
	3.30	0.12	0.2	0.02	0.02			0.000	18.5
	3.50	0.09	0.2	0.02	0.01			0.000	6.9
	3.70	0.10	0.2	0.02	0.01			0.000	7.7
	3.90	0.07	0.2	0.01	-0.01			0.000	-5.4
	4.10	0.09	0.2	0.02	0.00			0.000	0.0
	4.30	0.10	0.2	0.02	0.00			0.000	0.0
	4.50	0.08	0.2	0.02	0.00			0.000	0.0
	4.70	0.16	0.2	0.03	0.01			0.000	12.3
	4.90	0.12	0.2	0.02	0.01			0.000	9.2
	5.10	0.08	0.2	0.02	0.01			0.000	6.2
	5.30	0.10	0.2	0.02	0.01			0.000	7.7
	5.50	0.17	0.2	0.03	0.01			0.000	13.1
	5.70	0.11	0.2	0.02	0.00			0.000	0.0
	5.90	0.17	0.2	0.03	0.01			0.000	13.1
	6.10	0.14	0.2	0.03	0.01			0.000	10.8
	6.30	0.01	0.2	0.00	0.00			0.000	0.0
	6.50	0.01	0.2	0.00	0.00			0.000	0.0
	6.70	0.08	0.2	0.01	0.00			0.000	0.0
Rocks	6.75	0.00	0.0	0.00	0.00			0.000	0.0
Rocks	7.15	0.00	0.4	0.00	0.00			0.000	0.0
	7.25	0.02	0.1	0.00	0.00			0.000	0.0
RB	7.35	0.00	0.1	0.00	0.00			0.000	0.0
Total Q								**0.003**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site MC-H1

Site Information				
Project Name	Back River			
Station Identification	MC-H1 (Lake)			
Stream Name	McCoy Lake			
Date Monitored	14-Sep-13			
Time at Site (24 hr)	**Start Time:**	7:40:00 AM	**End Time:**	
Personnel	Eli H. Robert M.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	0386946	7312416	340	
Weather Conditions	Cloudy, Calm			

Transducer Information			
PT Model	PT2X	**Serial #**	21251010
Gain	1.007212	**Offset**	0.01
Status	Active	**Battery**	2.9V
# of Records	13775	**Memory Free**	510344
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 45	1.662	101.662		100.000	
BM 46			1.803	99.859	
BM 47			2.348	99.314	
PT			3.790	97.872	0.460
WL			3.331	**98.331**	
TBM	1.861	101.614	1.909	99.753	
WL			3.284	**98.330**	
PT			3.741	97.873	
BM 47			2.300	99.314	
BM 46			1.757	99.857	
BM 45			1.614	100.000	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 46	99.863	99.858	-0.005	
BM 47	99.325	99.314	-0.010	
PT	97.922	97.873	-0.049	

Summary	
Stage (m)	98.331
Discharge (m^3/s)	0.047
Pressure Transducer Reading (m)	0.487
Pressure Transducer Elevation (m)	97.844

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	9:20	**End**	10:00	**Location**	40m downstream of Outflow			
Method	Velocity-area (Mid-section)				**Instrument Model**	Flo-Mate			
Flow Meter Type	Electromagnetic				**Instrument Serial #**				
Stage (m)	**Start**	**Reading**	0.487		**Time**	9:20			
	End	**Reading**	0.487		**Time**	10:00			

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	3.90	0.00	0.0	0.00	0.00			0.000	0.0
	4.00	0.02	0.1	0.01	0.00			0.000	0.0
	4.70	0.03	0.7	0.02	0.00			0.000	0.0
	5.30	0.06	0.6	0.03	0.02			0.001	1.3
	5.70	0.10	0.4	0.04	0.00			0.000	0.0
	6.00	0.14	0.3	0.06	0.04			0.002	4.7
	6.50	0.10	0.5	0.05	0.01			0.001	1.1
	7.00	0.13	0.5	0.07	0.08			0.005	11.0
	7.50	0.18	0.5	0.09	0.03			0.003	5.7
	8.00	0.12	0.5	0.06	0.05			0.003	6.3
	8.50	0.14	0.5	0.07	0.06			0.004	8.8
	9.00	0.20	0.5	0.10	0.07			0.007	14.7
	9.50	0.20	0.5	0.10	0.06			0.006	12.6
	10.00	0.16	0.5	0.08	0.05			0.004	8.4
	10.50	0.20	0.5	0.10	0.03			0.003	6.3
	11.00	0.21	0.5	0.11	0.06			0.006	13.3
	11.50	0.06	0.5	0.02	0.05			0.001	2.4
	11.75	0.00	0.3	0.00	0.00			0.000	0.0
	12.30	0.00	0.6	0.00	0.00			0.000	0.0
	12.50	0.06	0.2	0.02	0.04			0.001	1.3
	12.80	0.00	0.3	0.00	0.00			0.000	0.0
	13.10	0.00	0.3	0.00	0.00			0.000	0.0
	13.20	0.04	0.1	0.01	0.02			0.000	0.3
	13.40	0.09	0.2	0.03	0.03			0.001	1.7
	13.80	0.03	0.4	0.01	0.01			0.000	0.2
	13.90	0.00	0.1	0.00	0.00			0.000	0.0
Total Q								**0.047**	**100.0**

General Notes
Terminated at 10:15

Appendix 3. Manual Stage and Discharge Measurements, Site MC-H2

Site Information				
Project Name	Back River			
Station Identification	MC-H2			
Stream Name	McCoy outflow			
Date Monitored	9-Jun-13			
Time at Site (24 hr)	Start Time:	12:00:00 PM	End Time:	3:00:00 PM
Personnel	Eli H., Byeong K.			
Station Cordinates	Easting	Northing	Elevation	
	385076	7310203		
Weather Conditions	Sunny, windy			

Transducer Information			
PT Model	PT2X	Serial #	21221021
Gain	1.006952	Offset	-0.169
Status	Active	Battery	3.0V
# of Records	1	Memory Free	524138
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 57	1.953	101.953		100.000	
BM 58			1.973	99.980	
BM 59			1.902	100.051	
PT			2.621	99.332	0.402
WL			2.224	**99.729**	
SG			2.035	99.918	-0.185
TBM	2.169	102.044	2.078	99.875	
SG			2.124	99.920	
WL			2.313	**99.731**	
PT			2.710	99.334	
BM 59			1.991	100.053	
BM 58			2.063	99.981	
BM 57			2.043	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 58	99.981	99.981	0.000	
BM 59	100.052	100.052	0.000	
PT	99.333	99.333	0.000	

Summary	
Stage (m)	99.730
Discharge (m^3/s)	0.509
Pressure Transducer Reading (m)	0.410
Pressure Transducer Elevation (m)	99.320

Discharge Measurement - Mid-Section Method

Time (24 hr)	Start	13:35	End	14:35	Location	1m US of PT	
Method	Velocity-area (Mid-section)			Instrument Model		FH950	
Flow Meter Type	Electromagnetic			Instrument Serial #			
Stage (m)	Start	Reading	0.411	SG	0.185	Time	13:35
	End	Reading	0.41	SG	0.185	Time	14:35

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	27.00	0.00	0.0	0.02	0.00			0.000	0.0
Grass	26.70	0.11	0.3	0.03	0.07			0.002	0.5
	26.40	0.14	0.3	0.04	0.14			0.006	1.2
	26.10	0.23	0.3	0.08	0.33			0.027	5.2
	25.70	0.31	0.4	0.12	0.36			0.045	8.8
	25.30	0.32	0.4	0.13	0.21			0.027	5.3
	24.90	0.26	0.4	0.10	0.33			0.034	6.7
	24.50	0.32	0.4	0.13	0.16			0.020	4.0
	24.10	0.37	0.4	0.19	0.04			0.007	1.5
	23.50	0.10	0.6	0.07	0.02			0.001	0.3
	22.80	0.05	0.7	0.04	0.05			0.002	0.4
	22.00	0.10	0.8	0.09	0.16			0.014	2.8
	21.00	0.21	1.0	0.21	0.03			0.006	1.2
	20.00	0.14	1.0	0.11	0.09			0.009	1.9
	19.50	0.18	0.5	0.09	0.14			0.013	2.5
	19.00	0.19	0.5	0.10	0.25			0.024	4.7
	18.50	0.14	0.5	0.07	0.09			0.006	1.2
	18.00	0.21	0.5	0.16	0.16			0.025	4.9
	17.00	0.26	1.0	0.26	0.15			0.039	7.7
	16.00	0.20	1.0	0.20	0.10			0.020	3.9
	15.00	0.30	1.0	0.30	0.11			0.033	6.5
	14.00	0.15	1.0	0.15	0.15			0.023	4.4
	13.00	0.37	1.0	0.37	0.06			0.022	4.4
	12.00	0.08	1.0	0.10	0.05			0.005	1.0
	10.50	0.21	1.5	0.34	0.05			0.017	3.3
	8.80	0.16	1.7	0.24	0.13			0.031	6.1
	7.50	0.14	1.3	0.20	0.07			0.014	2.7
	6.00	0.06	1.5	0.06	0.02			0.001	0.2
	5.40	0.17	0.6	0.14	0.10			0.014	2.8
	4.30	0.04	1.1	0.03	0.08			0.003	0.5
	3.70	0.00	0.6	0.00	0.00			0.000	0.0
	1.90	0.00	1.8	0.00	0.00			0.000	0.0
Grass	1.60	0.17	0.3	0.05	0.13			0.007	1.3
	1.30	0.40	0.3	0.20	0.05			0.010	2.0
	0.60	0.26	0.7	0.13	0.01			0.001	0.3
RB	0.30	0.00	0.3	0.04	0.00			0.000	0.0
Total Q								**0.509**	**100.0**

General Notes

Did not observe change in WL. Difference in real time readings due to PT adjusting after installation. Use second.

Appendix 3. Manual Stage and Discharge Measurements, Site MC-H2

Site Information				
Project Name	Back River			
Station Identification	MC-H2			
Stream Name	McCoy outflow			
Date Monitored	13-Jun-13			
Time at Site (24 hr)	Start Time:	6:15:00 AM	End Time:	8:00:00 AM
Personnel	Eli H., Byeong K.			
Station Cordinates	Easting	Northing	Elevation	
	385076	7310203		
Weather Conditions	Sun, scattered cloud			

Transducer Information			
PT Model	PT2X	Serial #	21221021
Gain	1.006952	Offset	-0.169
Status	Active	Battery	3.0V
# of Records	1	Memory Free	524138
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM#	Established Elevation (m)	Mean Elevation (this date) (m)		Difference (m)	Notes

Summary		
Stage (m)	99.660	PT elevation + re
Discharge (m^3/s)	0.178	
Pressure Transducer Reading (m)	0.340	
Pressure Transducer Elevation (m)	99.320	from 9/6/13 PT d

Discharge Measurement - Mid-Section Method

Time (24 hr)	Start	6:50	End	7:40	Location	2m US of PT	
Method	Velocity-area (Mid-section)			Instrument Model		FH950	
Flow Meter Type	Electromagnetic			Instrument Serial #			
Stage (m)	Start	Reading	0.34	SG	0.253	Time	6:50
	End	Reading	0.34	SG	0.253	Time	7:40

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	1.90	0.00	0.0	0.01	0.00			0.000	0.0
Grass	2.10	0.05	0.2	0.02	0.02			0.000	0.2
Grass end	2.50	0.20	0.4	0.09	0.09			0.008	4.5
	3.00	0.19	0.5	0.10	0.12			0.011	6.4
	3.50	0.14	0.5	0.07	0.15			0.011	5.9
	4.00	0.25	0.5	0.13	0.12			0.015	8.4
	4.50	0.24	0.5	0.12	0.08			0.010	5.4
	5.00	0.15	0.5	0.07	0.01			0.001	0.4
Rocks	5.40	0.05	0.4	0.04	-0.04			-0.001	-0.8
	6.45	0.15	1.1	0.16	0.09			0.014	8.0
	7.50	0.12	1.1	0.11	0.03			0.003	1.8
	8.25	0.23	0.8	0.17	0.01			0.002	1.0
	9.00	0.32	0.8	0.24	0.02			0.005	2.7
	9.75	0.09	0.8	0.07	0.18			0.012	6.8
	10.50	0.08	0.8	0.06	0.10			0.006	3.4
	11.25	0.20	0.8	0.15	0.12			0.018	10.1
	12.00	0.14	0.8	0.11	0.08			0.008	4.7
	12.75	0.11	0.8	0.08	0.08			0.007	3.7
	13.50	0.16	0.8	0.12	0.07			0.008	4.7
	14.25	0.32	0.8	0.24	0.04			0.010	5.4
	15.00	0.04	0.8	0.04	0.10			0.004	2.0
	16.00	0.10	1.0	0.09	0.08			0.007	3.9
	16.75	0.34	0.8	0.20	0.01			0.002	1.1
	17.20	0.36	0.4	0.12	0.07			0.008	4.6
Rocks	17.40	0.00	0.2	0.00	0.00			0.000	0.0
Rocks	18.70	0.00	1.3	0.00	0.00			0.000	0.0
	19.00	0.04	0.3	0.02	0.04			0.001	0.4
	19.70	0.03	0.7	0.02	0.03			0.001	0.3
Rocks	20.30	0.00	0.6	0.00	0.00			0.000	0.0
Rocks	23.20	0.00	2.9	0.00	0.00			0.000	0.0
	23.80	0.09	0.6	0.05	0.06			0.003	1.5
Rocks	24.20	0.00	0.4	0.00	0.00			0.000	0.0
Rocks	26.70	0.00	2.5	0.00	0.00			0.000	0.0
	27.00	0.06	0.3	0.03	0.07			0.002	1.1
	27.60	0.05	0.6	0.03	0.08			0.002	1.2
	28.10	0.12	0.5	0.05	0.04			0.002	1.1
LB	28.40	0.00	0.3	0.02	0.00			0.000	0.0
Total Q								**0.178**	**100.0**

General Notes
PT depth: 0.332

Appendix 3. Manual Stage and Discharge Measurements, Site MC-H2

Site Information				
Project Name	Back River			
Station Identification	MC-H2			
Stream Name	McCoy outflow			
Date Monitored	12-Jul-13			
Time at Site (24 hr)	**Start Time:**	9:00:00 AM	**End Time:**	
Personnel	Eli H., Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	385076	7310203		
Weather Conditions	Windy, cloudy			

Transducer Information			
PT Model	PT2X	**Serial #**	21221021
Gain	1.006952	**Offset**	-0.169
Status	Active	**Battery**	3.0V
# of Records	4725	**Memory Free**	519414
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 57	1.165	101.165		100.000	
BM 58			1.214	99.951	
BM 59			1.157	100.008	
PT			1.907	99.258	
WL1			2.066	**99.099**	Near PT
WL2			2.208	98.957	Pond
TBM	1.565	101.059	1.671	99.494	
WL2			2.102	98.957	
WL1			1.961	**99.098**	
PT			1.799	99.260	
BM 59			1.050	100.009	
BM 58			1.106	99.953	
BM 57			1.057	100.002	
SG			1.229	99.830	
PT(NEW)			2.448	98.611	Depth 0.339
WL(NEW)			2.111	98.948	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 58	99.981	99.952	-0.029	
BM 59	100.052	100.009	-0.043	
PT	99.333	99.259	-0.074	Old location

Summary	
Stage (m)	99.099
Discharge (m^3/s)	0.006
Pressure Transducer Reading (m)	0.346
Pressure Transducer Elevation (m)	98.753

Discharge Measurement - Mid-Section Method						
Time (24 hr)	**Start**		**End**		**Location**	15m US of old PT location
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950
Flow Meter Type	Electromagnetic			**Instrument Serial #**		same
Stage (m)	**Start**	**Reading**		**Time**		
	End	**Reading**	0.346	**Time**	10:36	

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	0.62	0.00	0.0	0.00	0.00			0.000	0.0
	0.70	0.11	0.1	0.01	0.01			0.000	1.3
	0.77	0.16	0.1	0.01	0.01			0.000	1.8
	0.84	0.12	0.1	0.01	0.02			0.000	2.6
	0.91	0.14	0.1	0.01	0.02			0.000	3.1
	0.98	0.14	0.1	0.01	0.02			0.000	3.1
	1.05	0.14	0.1	0.01	0.02			0.000	3.1
	1.12	0.26	0.1	0.02	0.02			0.000	5.7
	1.19	0.28	0.1	0.02	0.03			0.001	8.6
	1.25	0.33	0.1	0.02	0.03			0.001	8.5
	1.30	0.23	0.1	0.01	0.04			0.000	7.2
	1.35	0.23	0.1	0.01	0.04			0.000	7.2
	1.40	0.19	0.0	0.01	0.05			0.000	7.5
	1.45	0.18	0.1	0.01	0.05			0.000	7.1
	1.50	0.14	0.1	0.01	0.07			0.000	7.7
	1.55	0.08	0.1	0.00	0.07			0.000	4.4
	1.60	0.06	0.1	0.00	0.07			0.000	4.0
	1.67	0.06	0.1	0.00	0.06			0.000	4.0
	1.74	0.06	0.1	0.00	0.07			0.000	4.6
	1.81	0.06	0.1	0.00	0.07			0.000	4.6
	1.88	0.05	0.1	0.00	0.07			0.000	4.1
RB	1.96	0.00	0.1	0.00	0.00			0.000	0.0
Total Q								**0.006**	**100.0**

General Notes
Moved PT @ 9:35 to new location because water had retreated below the surface at the old location. - New location in pond different stage, discharge relationship

Appendix 3. Manual Stage and Discharge Measurements, Site MC-H2

Site Information				
Project Name	Back River			
Station Identification	MC-H2			
Stream Name	McCoy outflow			
Date Monitored	24-Aug-13			
Time at Site (24 hr)	**Start Time:**	7:00:00 AM	**End Time:**	
Personnel	Eli H., Mark W.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	385076	7310203		
Weather Conditions	Cloudy			

Transducer Information			
PT Model	PT2X	**Serial #**	21221021
Gain	1.006952	**Offset**	-0.169
Status	Active	**Battery**	2.9V
# of Records	10904	**Memory Free**	513235
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 57	0.947	100.947		100.000	
BM 58			0.996	99.951	
BM 59			0.939	100.008	
PT			2.353	98.594	0.300
WL1			1.881	**99.066**	Near BMs
WL2			2.051	98.896	in pond
SG			1.118	99.829	
TBM	1.866	100.894	1.919	99.028	
SG			1.067	99.827	
WL2			2.001	98.893	in pond
WL1			1.828	**99.066**	Near BMs
PT			2.302	98.592	
BM 59			0.888	100.006	
BM 58			0.943	99.951	
BM 57			0.894	100.000	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 58	99.981	99.951	-0.029	
BM 59	100.052	100.007	-0.045	
PT	99.333	98.593	-0.740	New location

Summary	
Stage (m)	99.066
Discharge (m^3/s)	0.003
Pressure Transducer Reading (m)	0.293
Pressure Transducer Elevation (m)	98.773

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	7:55	**End**	8:25	**Location**	~50m US of station far side of bedrock	
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-mate	
Flow Meter Type	Electromagnetic			**Instrument Serial #**			
Stage (m)	**Start**	**Reading**	0.293	**Time**	7:55		
	End	**Reading**	0.291	**Time**	8:25		

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	0.55	0.00	0.0	0.01	0.00			0.000	0.0
	0.65	0.16	0.1	0.01	0.00			0.000	0.0
	0.70	0.12	0.0	0.01	0.01			0.000	1.8
	0.75	0.13	0.1	0.01	0.00			0.000	0.0
	0.80	0.08	0.1	0.00	0.02			0.000	2.4
	0.85	0.08	0.0	0.00	0.04			0.000	4.8
	0.90	0.10	0.1	0.01	0.07			0.000	10.4
	0.95	0.24	0.0	0.01	0.05			0.001	17.8
	1.00	0.24	0.1	0.01	0.04			0.000	14.3
	1.05	0.24	0.1	0.01	0.03			0.000	10.7
	1.10	0.17	0.1	0.01	0.03			0.000	7.6
	1.15	0.17	0.0	0.01	0.02			0.000	5.1
	1.20	0.12	0.1	0.01	0.02			0.000	3.6
	1.25	0.11	0.1	0.01	0.02			0.000	3.3
	1.30	0.12	0.1	0.01	0.02			0.000	3.6
	1.35	0.12	0.1	0.01	0.02			0.000	3.6
	1.40	0.13	0.0	0.01	0.02			0.000	3.9
	1.45	0.14	0.1	0.01	0.02			0.000	4.2
	1.50	0.14	0.1	0.01	0.02			0.000	4.2
	1.55	0.06	0.1	0.00	-0.01			0.000	-0.9
LB	1.60	0.00	0.1	0.00	0.00			0.000	0.0
Total Q								**0.003**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site MC-H2

Site Information				
Project Name	Back River			
Station Identification	MC-H2			
Stream Name	McCoy outflow			
Date Monitored	17-Sep-13			
Time at Site (24 hr)	**Start Time:**	10:20:00 AM	**End Time:**	
Personnel	Eli, Kokiak			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	385076	7310203		
Weather Conditions	Cloudy			

Transducer Information			
PT Model	PT2X	**Serial #**	21221021
Gain	1.006952	**Offset**	-0.169
Status	Active	**Battery**	2.9V
# of Records	14380	**Memory Free**	509750
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 57	0.756	100.756		100.000	
BM 58			0.806	99.950	
BM 59			0.748	100.008	
PT			2.158	98.598	
WL old			1.597	**99.159**	
WL pond			1.738	99.018	
SG			0.927	99.829	
TBM	1.822	100.817	1.761	98.995	
SG			0.989	99.828	
WL pond			1.793	99.024	
WL old			1.658	**99.159**	
PT			2.219	98.598	0.432
BM 59			0.810	100.007	
BM 58			0.867	99.950	
BM 57			0.818	99.999	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 58	99.981	99.950	-0.031	
BM 59	100.052	100.008	-0.044	
PT	99.333	98.598	-0.735	

Summary	
Stage (m)	99.159
Discharge (m^3/s)	0.029
Pressure Transducer Reading (m)	0.426
Pressure Transducer Elevation (m)	98.733

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	11:00	**End**	12:00	**Location**	150m upstream of PT	
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-mate	
Flow Meter Type	Electromagnetic			**Instrument Serial #**			
Stage (m)	**Start**	**Reading**	0.426	**Time**	11:00	SG:	0.690
	End	**Reading**	0.427	**Time**	12:00	SG:	0.690

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB Chan #1	0.60	0.00	0.0	0.00	0.00			0.000	0.0
	0.70	0.05	0.1	0.01	0.01			0.000	0.3
	0.90	0.08	0.2	0.02	0.02			0.000	1.1
	1.10	0.09	0.2	0.02	0.01			0.000	0.6
	1.30	0.20	0.2	0.03	0.02			0.001	2.1
	1.40	0.22	0.1	0.02	0.06			0.001	4.6
	1.50	0.20	0.1	0.02	0.06			0.001	4.2
	1.60	0.22	0.1	0.02	0.05			0.001	3.8
	1.70	0.22	0.1	0.02	0.09			0.002	6.9
	1.80	0.22	0.1	0.02	0.10			0.002	7.7
	1.90	0.22	0.1	0.02	0.12			0.003	9.2
	2.00	0.24	0.1	0.02	0.06			0.001	5.0
	2.10	0.16	0.1	0.02	0.08			0.001	4.5
	2.20	0.19	0.1	0.02	0.08			0.002	5.3
	2.30	0.29	0.1	0.03	0.09			0.003	9.1
	2.40	0.22	0.1	0.02	0.06			0.001	4.6
	2.50	0.12	0.1	0.02	0.05			0.001	2.6
	2.65	0.11	0.2	0.02	0.08			0.001	4.6
	2.80	0.08	0.2	0.01	0.01			0.000	0.5
	3.00	0.08	0.2	0.02	0.01			0.000	0.6
RB Chan #1	3.20	0.00	0.2	0.01	0.00			0.000	0.0
RB Chan #2	1.30	0.00	1.3	0.00	0.00			0.000	0.0
	1.10	0.04	0.2	0.01	0.23			0.001	4.8
	1.00	0.05	0.1	0.01	0.34			0.002	5.9
	0.90	0.07	0.1	0.01	0.09			0.001	2.2
	0.80	0.08	0.1	0.01	0.05			0.000	1.4
	0.70	0.10	0.1	0.01	0.11			0.001	3.8
	0.60	0.05	0.1	0.01	0.10			0.001	1.7
	0.50	0.04	0.1	0.00	0.19			0.001	2.7
LB Chan #2	0.40	0.00	0.1	0.00	0.00			0.000	0.0
Total Q								**0.029**	**100.0**

General Notes

Lots of flow beneath boulders

Walked 200m upstream to channel in grass

Also measured flow coming through boulders from lake to the East

Appendix 3. Manual Stage and Discharge Measurements, Site REFQ-H1

Site Information				
Project Name	Back River			
Station Identification	REFQ-H1			
Stream Name	Reference Lake			
Date Monitored	12-Jun-13			
Time at Site (24 hr)	Start Time:	7:00:00 AM	End Time:	
Personnel	Eli H. Byeong K.			
Station Cordinates	Easting	Northing	Elevation	
	385551	7303203	326	
Weather Conditions	Rain			

Transducer Information			
PT Model	ELF-2	Serial #	2714017
Gain	3.5064	Offset	-0.1115
Status	OK	Battery	100V
# of Records	1	Memory Free	32530
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 44	0.860	100.860		100.000	
BM 93			1.436	99.424	
BM 94			1.720	99.140	
PT			2.363	98.497	
WL			1.968	**98.892**	
TBM	2.006	100.806	2.060	98.800	
WL			1.914	**98.892**	
PT			2.309	98.497	0.402
BM 94			1.666	99.140	
BM 93			1.381	99.425	
BM 44			0.805	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 93	99.425	99.425	0.000	
BM 94	99.140	99.140	0.000	
PT	98.497	98.497	0.000	

Summary	
Stage (m)	98.892
Discharge (m^3/s)	0.277
Pressure Transducer Reading (m)	0.417
Pressure Transducer Elevation (m)	98.475

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	9:00	End	9:40	Location	20m PS of PT			
Method	Velocity-area (Mid-section)				Instrument Model	FH950			
Flow Meter Type	Electromagnetic				Instrument Serial #				
Stage (m)	Start	Reading	0.416		Time	9:00			
	End	Reading	0.418		Time	9:40			

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	32.20	0.00	0.0	0.03	0.00			0.000	0.0
	32.40	0.30	0.2	0.04	0.22			0.010	3.6
	32.50	0.33	0.1	0.03	0.25			0.008	3.0
	32.60	0.33	0.1	0.04	0.25			0.010	3.7
	32.75	0.36	0.1	0.05	0.19			0.010	3.7
	32.90	0.36	0.1	0.05	0.27			0.015	5.3
	33.05	0.22	0.1	0.03	0.59			0.019	7.0
	33.20	0.20	0.2	0.03	0.12			0.004	1.3
	33.35	0.25	0.1	0.04	-0.04			-0.001	-0.5
	33.50	0.24	0.1	0.04	0.62			0.022	8.1
	33.65	0.18	0.1	0.03	0.74			0.020	7.2
	33.80	0.16	0.1	0.02	0.63			0.015	5.5
	33.95	0.18	0.2	0.03	0.61			0.016	5.9
	34.10	0.30	0.1	0.04	0.56			0.025	9.1
	34.25	0.30	0.1	0.04	0.57			0.026	9.3
	34.40	0.22	0.1	0.03	0.54			0.018	6.4
	34.55	0.36	0.1	0.05	0.29			0.016	5.7
	34.70	0.37	0.2	0.06	0.14			0.008	2.8
	34.85	0.28	0.1	0.04	0.15			0.006	2.3
	35.00	0.28	0.1	0.04	0.28			0.012	4.2
	35.15	0.27	0.1	0.04	0.27			0.011	3.9
	35.30	0.19	0.1	0.04	0.17			0.007	2.6
	35.60	0.08	0.3	0.03	-0.01			0.000	-0.1
LB	35.95	0.00	0.4	0.01	0.00			0.000	0.0
Total Q								**0.277**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site REFQ-H1

Site Information				
Project Name	Back River			
Station Identification	REFQ-H1			
Stream Name	Reference Lake			
Date Monitored	13-Jun-13			
Time at Site (24 hr)	**Start Time:**	2:00:00 PM	**End Time:**	
Personnel	Eli H. Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	385551	7303203	326	
Weather Conditions	Rain			

Transducer Information			
PT Model	ELF-2	**Serial #**	2714017
Gain	3.5064	**Offset**	-0.1115
Status	OK	**Battery**	100V
# of Records	173	**Memory Free**	32444
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 44	0.718	100.718		100.000	
BM 93			1.295	99.423	
BM 94			1.584	99.134	
PT			2.222	98.496	Depth: 0.398
WL			1.834	**98.884**	
TBM	1.855	100.665	1.908	98.810	
WL			1.780	**98.885**	
PT			2.170	98.495	
BM 94			1.530	99.135	
BM 93			1.241	99.424	
BM 44			0.665	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 93	99.425	99.424	-0.001	
BM 94	99.140	99.135	-0.005	
PT	98.497	98.496	-0.001	

Summary			
Surveyed Stage (m)	98.885	**Corrected:**	98.982
Discharge (m^3/s)	0.237		
Pressure Transducer Reading (m)	0.455		
Pressure Transducer Elevation (m)	98.430		

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	14:10	**End**		**Location**		
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950	
Flow Meter Type	Electromagnetic			**Instrument Serial #**		same	
Stage (m)	**Start**	**Reading**	0.455	**Time**	14:10		
	End	**Reading**		**Time**			

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.45	0.00	0.0	0.01	0.00			0.000	0.0
	0.55	0.23	0.1	0.03	0.12			0.003	1.5
	0.70	0.34	0.2	0.05	0.22			0.011	4.7
	0.85	0.18	0.2	0.03	0.40			0.011	4.6
	1.00	0.30	0.2	0.05	0.22			0.010	4.2
	1.15	0.30	0.2	0.05	0.41			0.018	7.8
	1.30	0.24	0.2	0.04	0.11			0.004	1.7
Behind rock	1.45	0.30	0.2	0.05	-0.08			-0.004	-1.5
	1.60	0.28	0.2	0.04	0.61			0.026	10.8
	1.75	0.14	0.2	0.02	0.64			0.013	5.7
	1.90	0.12	0.2	0.02	0.57			0.010	4.3
	2.05	0.12	0.2	0.02	0.53			0.010	4.0
	2.20	0.28	0.2	0.04	0.58			0.024	10.3
	2.35	0.26	0.2	0.04	0.56			0.022	9.2
	2.50	0.20	0.2	0.03	0.57			0.017	7.2
	2.65	0.24	0.2	0.04	0.40			0.014	6.1
	2.80	0.26	0.2	0.04	0.21			0.008	3.5
	2.95	0.33	0.2	0.05	0.15			0.007	3.1
	3.10	0.25	0.2	0.04	0.16			0.006	2.5
	3.25	0.27	0.2	0.04	0.27			0.011	4.6
	3.40	0.17	0.2	0.03	0.34			0.009	3.7
	3.55	0.14	0.2	0.02	0.12			0.003	1.1
	3.70	0.10	0.2	0.02	0.09			0.001	0.6
	3.85	0.08	0.2	0.01	0.06			0.001	0.3
LB	4.00	0.00	0.2	0.01	0.00			0.000	0.0
Total Q								**0.237**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site REFQ-H1

Site Information				
Project Name	Back River			
Station Identification	REFQ-H1			
Stream Name	Reference Lake			
Date Monitored	12-Jul-13			
Time at Site (24 hr)	**Start Time:**	11:30:00 AM	**End Time:**	
Personnel	Eli H. Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	385551	7303203	326	
Weather Conditions	Rain			

Transducer Information			
PT Model	ELF-2	**Serial #**	2714017
Gain	3.5064	**Offset**	-0.1115
Status	OK	**Battery**	100V
# of Records	4333	**Memory Free**	30364
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 44	0.715	100.715		100.000	
BM 93			1.290	99.425	
BM 94			1.594	99.121	
PT			2.239	98.476	Depth: 0.239
WL			2.002	**98.713**	
TBM	1.997	100.787	1.925	98.790	
WL			2.072	**98.715**	
PT			2.310	98.477	
BM 94			1.665	99.122	
BM 93			1.360	99.427	
BM 44			0.786	100.001	
USRB			2.043	98.744	
USLB			2.064	98.723	
DSLB			2.081	98.706	
DSRB			2.101	98.686	
DS middle			2.076	98.711	
US middle			2.05	98.737	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 93	99.425	99.426	0.002	
BM 94	99.140	99.122	-0.019	
PT	98.497	98.477	-0.020	

Summary	
Stage (m)	98.714
Discharge (m^3/s)	0.024
Pressure Transducer Reading (m)	0.284
Pressure Transducer Elevation (m)	98.430

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	11:40	**End**	12:10	**Location**	20M DS OF PT	
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950	
Flow Meter Type	Electromagnetic			**Instrument Serial #**			
Stage (m)	**Start**	**Reading**	0.284	**Time**	11:40		
	End	**Reading**	0.284	**Time**	12:10		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.30	0.00	0.0	0.01	0.00			0.000	0.0
	0.40	0.12	0.1	0.01	0.00			0.000	0.0
	0.50	0.16	0.1	0.02	0.04			0.001	2.7
	0.60	0.13	0.1	0.01	0.15			0.002	8.2
	0.70	0.14	0.1	0.01	0.17			0.002	10.0
	0.80	0.14	0.1	0.01	0.11			0.002	6.5
	0.90	0.16	0.1	0.02	0.12			0.002	8.1
	1.00	0.17	0.1	0.02	0.12			0.002	8.6
	1.10	0.18	0.1	0.02	0.11			0.002	8.4
	1.20	0.10	0.1	0.01	0.07			0.001	3.0
	1.30	0.10	0.1	0.01	0.09			0.001	3.8
	1.40	0.14	0.1	0.01	0.10			0.001	5.9
	1.50	0.15	0.1	0.02	0.08			0.001	5.1
	1.60	0.15	0.1	0.02	0.13			0.002	8.2
	1.70	0.09	0.1	0.01	0.12			0.001	4.6
	1.80	0.10	0.1	0.01	0.10			0.001	4.2
	1.90	0.11	0.1	0.01	0.06			0.001	2.8
	2.00	0.15	0.1	0.02	0.04			0.001	2.5
	2.10	0.15	0.1	0.02	0.04			0.001	2.5
	2.20	0.09	0.1	0.01	0.05			0.000	1.9
	2.30	0.09	0.1	0.01	0.06			0.001	2.3
Behind rock	2.40	0.06	0.1	0.01	0.03			0.000	0.8
LB	2.50	0.00	0.1	0.00	0.00			0.000	0.0
Total Q								**0.024**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site REFQ-H1

Site Information				
Project Name	Back River			
Station Identification	REFQ-H1			
Stream Name	Reference Lake			
Date Monitored	21-Jul-13			
Time at Site (24 hr)	**Start Time:**	8:22:00 AM	**End Time:**	10:45:00 AM
Personnel	Eli H. Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	385551	7303203	326	
Weather Conditions	Mixed sun, cloud, windy			

Transducer Information			
PT Model	ELF-2	**Serial #**	2714016
Gain	4.1146	**Offset**	0.0354
Status	OK	**Battery**	100%
# of Records	5810	**Memory Free**	29727
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 44	1.002	101.002		100.000	
BM 93			1.576	99.426	
BM 94			1.880	99.122	
Old PT			2.522	98.480	Depth: 0.201
WL			2.321	**98.681**	
TBM	2.185	100.977	2.210	98.792	
WL			2.298	**98.679**	
Old PT			2.500	98.477	
BM 94			1.855	99.122	
BM 93			1.551	99.426	
BM 44			0.978	99.999	
New PT			2.545	98.432	Depth: 0.248
WL			2.299	**98.678**	
DSWLRB			2.313	98.664	
DSWLLB			2.301	98.676	
USWL			2.280	98.697	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 93	99.425	99.426	0.002	
BM 94	99.140	99.122	-0.018	
Old PT	98.497	98.479	-0.019	

Summary	Old location	New Location	
Surveyed Stage (m)	98.680	**Corrected:**	98.882
Discharge (m^3/s)	0.013		
Pressure Transducer Reading (m)	0.249	0.264	
Pressure Transducer Elevation (m)	98.431	98.416	

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	10:00	**End**	10:30	**Location**	20M DS OF PT			
Method	Velocity-area (Mid-section)				**Instrument Model**	FH950			
Flow Meter Type	Electromagnetic				**Instrument Serial #**				
Stage (m)	**Start**	**Reading**	0.264		**Time**	10:00			
	End	**Reading**	0.264		**Time**	10:30			

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	0.40	0.00	0.0	0.01	0.00			0.000	0.0
	0.50	0.10	0.1	0.01	0.05			0.001	4.0
	0.60	0.07	0.1	0.01	0.10			0.001	5.6
	0.70	0.09	0.1	0.01	0.09			0.001	6.5
	0.80	0.14	0.1	0.01	0.08			0.001	8.9
	0.90	0.14	0.1	0.01	0.08			0.001	8.9
	1.00	0.15	0.1	0.02	0.03			0.000	3.6
	1.10	0.16	0.1	0.02	0.06			0.001	7.7
	1.20	0.10	0.1	0.01	0.12			0.001	9.6
	1.30	0.14	0.1	0.01	0.07			0.001	7.8
	1.40	0.10	0.1	0.01	0.08			0.001	6.4
	1.50	0.08	0.1	0.01	0.08			0.001	5.1
	1.60	0.08	0.1	0.01	0.09			0.001	5.8
	1.70	0.09	0.1	0.01	0.08			0.001	5.8
	1.80	0.12	0.1	0.01	0.05			0.001	4.8
	1.90	0.08	0.1	0.01	0.03			0.000	1.9
	2.00	0.09	0.1	0.01	0.03			0.000	2.2
	2.10	0.06	0.1	0.01	0.04			0.000	1.9
	2.20	0.08	0.1	0.01	0.03			0.000	1.9
	2.30	0.06	0.1	0.01	0.02			0.000	1.0
	2.40	0.06	0.1	0.00	0.02			0.000	0.7
LB	2.45	0.00	0.1	0.00	0.00			0.000	0.0
Total Q								**0.013**	**100.0**

General Notes
PT changed at 8:30 due to unstable readings. New PT located in slightly deeper location than old, on same cross-section

Appendix 3. Manual Stage and Discharge Measurements, Site REFQ-H1

Site Information				
Project Name	Back River			
Station Identification	REFQ-H1			
Stream Name	Reference Lake			
Date Monitored	18-Aug-13			
Time at Site (24 hr)	**Start Time:**	11:03:00 AM	**End Time:**	12:15:00 PM
Personnel	Eli H., Mark W.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	385551	7303203	326	
Weather Conditions	Mixed sun, cloud			

Transducer Information			
PT Model	ELF-2	**Serial #**	2714016
Gain	4.1146	**Offset**	0.0354
Status	OK	**Battery**	100%
# of Records	4039	**Memory Free**	30515
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 44	0.845	100.845		100.000	
BM 93			1.421	99.424	
BM 94			1.723	99.122	
PT			2.419	98.426	0.200
WL			2.220	**98.625**	
TBM	1.767	100.810	1.802	99.043	
WL			2.187	**98.623**	
PT			2.384	98.426	
BM 94			1.691	99.119	
BM 93			1.387	99.423	
BM 44			0.810	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 93	99.425	99.424	-0.001	
BM 94	99.140	99.121	-0.020	
PT	98.497	98.426	-0.071	

Summary			
Surveyed Stage (m)	98.624	**Corrected:**	98.649
Discharge (m^3/s)	0.004		
Pressure Transducer Reading (m)	0.219		
Pressure Transducer Elevation (m)	98.405		

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	11:10	**End**		**Location**	20M DS OF PT	
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-mate	
Flow Meter Type	Electromagnetic			**Instrument Serial #**			
Stage (m)	**Start**	**Reading**	0.217	**Time**	11:10		
	End	**Reading**		**Time**			

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.10	0.00	0.0	0.00	0.00			0.000	0.0
	0.20	0.06	0.1	0.01	0.01			0.000	1.6
	0.30	0.10	0.1	0.01	0.02			0.000	5.4
	0.40	0.12	0.1	0.01	0.02			0.000	6.4
	0.50	0.13	0.1	0.01	0.02			0.000	7.0
	0.60	0.14	0.1	0.01	0.02			0.000	7.5
	0.70	0.12	0.1	0.01	0.02			0.000	6.4
	0.80	0.12	0.1	0.01	0.03			0.000	9.7
	0.90	0.12	0.1	0.01	0.03			0.000	9.7
	1.00	0.06	0.1	0.01	0.03			0.000	4.8
	1.10	0.12	0.1	0.01	0.02			0.000	4.8
	1.15	0.08	0.0	0.00	0.04			0.000	4.3
	1.20	0.08	0.1	0.00	0.04			0.000	4.3
	1.25	0.09	0.1	0.00	0.03			0.000	3.6
	1.30	0.11	0.1	0.01	0.02			0.000	4.4
	1.40	0.06	0.1	0.01	0.02			0.000	3.2
	1.50	0.07	0.1	0.01	0.03			0.000	5.6
	1.60	0.08	0.1	0.01	0.03			0.000	6.4
	1.70	0.08	0.1	0.01	0.02			0.000	4.3
	1.80	0.05	0.1	0.01	0.01			0.000	1.3
	1.90	0.07	0.1	0.01	0.00			0.000	0.0
	2.00	0.08	0.1	0.01	0.00			0.000	0.0
	2.10	0.04	0.1	0.00	-0.01			0.000	-0.8
LB	2.15	0.00	0.0	0.00	0.00			0.000	0.0
Total Q								**0.004**	**100.0**

General Notes

Reading fluctuating by up to 4cm. Unsure of issue with date or variation on site

Appendix 3. Manual Stage and Discharge Measurements, Site REFQ-H1

Site Information				
Project Name	Back River			
Station Identification	REFQ-H1			
Stream Name	Reference Lake			
Date Monitored	18-Sep-13			
Time at Site (24 hr)	Start Time:	8:00:00 AM	End Time:	
Personnel	Eli H			
Station Cordinates	Easting	Northing	Elevation	
	385551	7303203	326	
Weather Conditions	Cloudy, -3 degrees			

Transducer Information			
PT Model	ELF-2	Serial #	2714016
Gain	4.1146	Offset	0.0354
Status		Battery	
# of Records		Memory Free	
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 44	0.480	100.480		100.000	
BM 93			1.053	99.427	
BM 94			1.359	99.121	
WL July			1.772	98.708	July WL
WL			1.683	**98.797**	
TBM	1.697	100.514	1.663	98.817	
WL			1.716	**98.798**	
BM 94			1.392	99.122	
BM 93			1.088	99.426	
BM 44			0.512	100.002	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 93	99.425	99.427	0.002	
BM 94	99.140	99.122	-0.018	

Summary			
Surveyed Stage (m)	98.798	Corrected:	98.800
Discharge (m^3/s)	0.101		
Pressure Transducer Reading (m)			
Pressure Transducer Elevation (m)	98.798		

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	8:00	End	8:25	Location	20m d/s of station			
Method	Velocity-area (Mid-section)				Instrument Model	Flo-mate			
Flow Meter Type	Electromagnetic				Instrument Serial #				
Stage (m)	Start	Reading			Time	8:00			
	End	Reading			Time	8:25			

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
	0.50	0.00	0.0	0.01	0.00			0.000	0.0
	0.57	0.24	0.1	0.02	0.05			0.001	1.2
	0.70	0.20	0.1	0.02	0.31			0.007	7.1
	0.80	0.16	0.1	0.02	0.39			0.006	6.2
	0.90	0.24	0.1	0.02	0.25			0.006	5.9
	1.00	0.21	0.1	0.02	0.24			0.005	5.0
	1.10	0.23	0.1	0.02	0.21			0.005	4.8
	1.20	0.24	0.1	0.02	0.23			0.006	5.5
	1.30	0.22	0.1	0.02	0.33			0.007	7.2
	1.40	0.20	0.1	0.02	0.33			0.007	6.5
	1.50	0.25	0.1	0.03	0.16			0.004	4.0
	1.60	0.22	0.1	0.02	0.14			0.003	3.0
	1.70	0.25	0.1	0.03	0.24			0.006	5.9
	1.80	0.19	0.1	0.02	0.23			0.004	4.3
	1.90	0.18	0.1	0.02	0.20			0.004	3.6
	2.00	0.24	0.1	0.02	0.26			0.006	6.2
	2.10	0.23	0.1	0.02	0.19			0.004	4.3
	2.20	0.20	0.1	0.02	0.27			0.005	5.3
	2.30	0.24	0.1	0.02	0.24			0.006	5.7
	2.40	0.24	0.1	0.02	0.19			0.005	4.5
	2.50	0.20	0.1	0.02	0.14			0.003	2.8
	2.60	0.14	0.1	0.01	0.06			0.001	0.8
	2.70	0.00	0.1	0.00	0.00			0.000	0.0
	3.20	0.00	0.5	0.00	0.00			0.000	0.0
	3.30	0.03	0.1	0.00	0.05			0.000	0.1
	3.40	0.03	0.1	0.00	0.02			0.000	0.1
	3.50	0.00	0.1	0.00	0.00			0.000	0.0
Total Q								**0.101**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site SL-H1

Site Information				
Project Name	Back River			
Station Identification	SL-H1			
Stream Name	Sleigh Outflow			
Date Monitored	9-Jun-13			
Time at Site (24 hr)	**Start Time:**	8:00:00 AM	**End Time:**	11:00:00 AM
Personnel	Eli H., Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	388274	7312296		
Weather Conditions	Cloudy, cool			

Transducer Information			
PT Model	N/A	**Serial #**	21252008
Gain	1	**Offset**	0
Status	Active	**Battery**	3.1V
# of Records	7	**Memory Free**	524132
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 98	1.202	101.202		100.000	
BM 99			1.283	99.919	
BM 100			1.169	100.033	
PT			2.271	98.931	.615(PT elev.)
WL			1.661	**99.541**	
TBM	1.378	101.245	1.335	99.867	
WL			1.699	**99.546**	Good
PT			2.310	98.935	
BM 100			1.210	100.035	
BM 99			1.325	99.920	
BM 98			1.244	100.001	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 99	99.920	99.920	0.000	
BM 100	100.034	100.034	0.000	
PT	98.933	98.933	0.000	

Summary	
Stage (m)	99.546
Discharge (m^3/s)	0.642
Pressure Transducer Reading (m)	0.628
Pressure Transducer Elevation (m)	98.918

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	8:40	**End**	9:40	**Location**	2m DS of PT			
Method	Velocity-area (Mid-section)				**Instrument Model**	FH950			
Flow Meter Type	Electromagnetic				**Instrument Serial #**	same			
Stage (m)	**Start**	**Reading**	0.627		**Time**	8:40			
	End	**Reading**	0.628		**Time**	9:40			

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	0.40	0.00	0.0	0.00	0.00			0.000	0.0
Grass	0.55	0.04	0.2	0.01	0.12			0.001	0.1
	0.65	0.08	0.1	0.01	0.71			0.006	0.9
	0.75	0.38	0.1	0.03	0.50			0.014	2.2
	0.80	0.56	0.1	0.04	0.61			0.026	4.0
	0.90	0.53	0.1	0.05	0.71			0.038	5.9
	1.00	0.52	0.1	0.05	0.73			0.038	5.9
	1.10	0.52	0.1	0.05	0.73			0.038	5.9
	1.20	0.51	0.1	0.05	0.75			0.038	6.0
	1.30	0.50	0.1	0.05	0.73			0.037	5.7
	1.40	0.49	0.1	0.05	0.72			0.035	5.5
	1.50	0.48	0.1	0.05	0.67			0.032	5.0
	1.60	0.49	0.1	0.05	0.69			0.034	5.3
	1.70	0.48	0.1	0.05	0.68			0.033	5.1
	1.80	0.48	0.1	0.05	0.66			0.032	4.9
	1.90	0.49	0.1	0.05	0.63			0.031	4.8
	2.00	0.49	0.1	0.05	0.62			0.030	4.7
	2.10	0.48	0.1	0.05	0.61			0.029	4.6
	2.20	0.47	0.1	0.05	0.63			0.030	4.6
	2.30	0.48	0.1	0.05	0.60			0.029	4.5
	2.40	0.48	0.1	0.05	0.56			0.027	4.2
	2.50	0.48	0.1	0.05	0.47			0.023	3.5
	2.60	0.49	0.1	0.05	0.36			0.018	2.7
	2.70	0.50	0.1	0.05	0.25			0.013	1.9
	2.80	0.46	0.1	0.03	0.24			0.008	1.3
Grass	2.85	0.13	0.1	0.02	0.24			0.005	0.7
	3.10	0.08	0.3	0.02	0.00			0.000	0.0
	3.40	0.10	0.3	0.03	0.00			0.000	0.0
	3.60	0.10	0.2	0.03	0.00			0.000	0.0
RB	3.90	0.00	0.3	0.02	0			0.000	0.0
Total Q								**0.642**	**100.0**

General Notes
1st WL: error, use 2nd WL survey. Use average PT elevation.

Appendix 3. Manual Stage and Discharge Measurements, Site SL-H1

Site Information				
Project Name	Back River			
Station Identification	SL-H1			
Stream Name	Sleigh Outflow			
Date Monitored	12-Jun-13			
Time at Site (24 hr)	**Start Time:**	12:50:00 PM	**End Time:**	2:29:00 PM
Personnel	Eli H., Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	388274	7312296		
Weather Conditions	Sun, scattered cloud			

Transducer Information			
PT Model	PT2X	**Serial #**	21252008
Gain	1	**Offset**	0
Status	Active	**Battery**	3.1V
# of Records	458	**Memory Free**	523681
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 98	1.100	101.100		100.000	
BM 99			1.185	99.915	
BM 100			1.071	100.029	
PT			2.196	98.904	Depth: 0.542
WL			1.663	**99.437**	
TBM	2.052	101.044	2.108	98.992	
WL			1.606	**99.438**	
PT			2.138	98.906	SG: 1.611, Depth: 0.016
BM 100			1.014	100.030	
BM 99			1.128	99.916	
BM 98			1.043	100.001	
US RB			1.590	99.454	
US LB			1.593	99.451	
DS LB			1.611	99.433	
DS RB			1.609	99.435	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 99	99.920	99.916	-0.004	
BM 100	100.034	100.030	-0.005	
PT	98.933	98.905	-0.028	

Summary	
Stage (m)	99.438
Discharge (m^3/s)	0.419
Pressure Transducer Reading (m)	0.562
Pressure Transducer Elevation (m)	98.876

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	13:40	**End**	14:23	**Location**				
Method	Velocity-area (Mid-section)			**Instrument Model**	FH950				
Flow Meter Type	Electromagnetic			**Instrument Serial #**					
Stage (m)	**Start**	**Reading**	0.562	**Time**	13:40				
	End	**Reading**		**Time**	14:23				

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	32.05	0.00	0.0	0.00	0.00			0.000	0.0
	32.10	0.06	0.1	0.00	0.44			0.002	0.5
	32.20	0.50	0.1	0.05	0.41			0.020	4.9
	32.30	0.50	0.1	0.05	0.56			0.028	6.7
	32.40	0.46	0.1	0.05	0.59			0.027	6.5
	32.50	0.46	0.1	0.05	0.59			0.027	6.5
	32.60	0.45	0.1	0.05	0.59			0.027	6.3
	32.70	0.42	0.1	0.04	0.59			0.025	5.9
	32.80	0.42	0.1	0.04	0.57			0.024	5.7
	32.90	0.42	0.1	0.04	0.54			0.023	5.4
	33.00	0.43	0.1	0.04	0.52			0.022	5.3
	33.10	0.44	0.1	0.04	0.52			0.023	5.5
	33.20	0.43	0.1	0.04	0.50			0.021	5.1
	33.30	0.42	0.1	0.04	0.49			0.021	4.9
	33.40	0.42	0.1	0.04	0.50			0.021	5.0
	33.50	0.42	0.1	0.04	0.49			0.021	4.9
	33.60	0.42	0.1	0.04	0.47			0.020	4.7
	33.70	0.40	0.1	0.04	0.46			0.018	4.4
	33.80	0.41	0.1	0.04	0.44			0.018	4.3
	33.90	0.38	0.1	0.04	0.32			0.012	2.9
	34.00	0.42	0.1	0.04	0.21			0.009	2.1
	34.10	0.42	0.1	0.04	0.22			0.009	2.2
	34.20	0.04	0.1	0.00	0.13			0.001	0.1
RB	34.30	0.00	0.1	0.00	0.00			0.000	0.0
Total Q								**0.419**	**100.0**

General Notes
Added rebar staff gauge.

Appendix 3. Manual Stage and Discharge Measurements, Site SL-H1

Site Information				
Project Name	Back River			
Station Identification	SL-H1			
Stream Name	Sleigh Outflow			
Date Monitored	13-Jul-13			
Time at Site (24 hr)	**Start Time:**	6:00:00 AM	**End Time:**	
Personnel	Eli H., Byeong K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	388274	7312296		
Weather Conditions	Cloudy, cool			

Transducer Information			
PT Model	PT2X	**Serial #**	21252008
Gain		**Offset**	
Status	Active	**Battery**	3.1V
# of Records	4881	**Memory Free**	519258
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 98	0.983	100.983		100.000	
BM 99			1.070	99.913	
BM 100			0.956	100.027	
PT			2.083	98.900	
WL			1.765	**99.218**	
TBM	2.093	101.051	2.025	98.958	
WL			1.836	**99.215**	
PT			2.152	98.899	
BM 100			1.022	100.029	
BM 99			1.140	99.911	
BM 98			1.051	100.000	
SG			1.658	99.393	
PT depth			0.318	100.733	
DSLB			1.840	99.211	
DSRB			1.839	99.212	
USLB			1.802	99.249	
USRB			1.794	99.257	
on top of riffle			1.661	99.390	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 99	99.920	99.912	-0.007	
BM 100	100.034	100.028	-0.006	
PT	98.933	98.900	-0.033	

Summary	
Stage (m)	99.217
Discharge (m^3/s)	0.090
Pressure Transducer Reading (m)	0.343
Pressure Transducer Elevation (m)	98.874

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	6:05	**End**	6:35	**Location**		
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950	
Flow Meter Type	Electromagnetic			**Instrument Serial #**		same	
Stage (m)	**Start**	**Reading**	0.343	**Time**	6:05		
	End	**Reading**	0.343	**Time**	6:35		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	0.55	0.00	0.0	0.00	0.00			0.000	0.0
	0.60	0.08	0.0	0.00	0.17			0.001	0.8
	0.65	0.26	0.1	0.01	0.15			0.002	2.2
	0.70	0.26	0.0	0.02	0.23			0.004	4.7
	0.79	0.26	0.1	0.02	0.24			0.006	6.2
	0.88	0.28	0.1	0.03	0.23			0.006	6.4
	0.97	0.26	0.1	0.02	0.21			0.005	5.5
	1.06	0.24	0.1	0.02	0.22			0.005	5.3
	1.15	0.22	0.1	0.02	0.23			0.005	5.1
	1.24	0.22	0.1	0.02	0.23			0.005	5.1
	1.33	0.22	0.1	0.02	0.21			0.004	4.6
	1.42	0.22	0.1	0.02	0.20			0.004	4.4
	1.51	0.23	0.1	0.02	0.20			0.004	4.6
	1.60	0.22	0.1	0.02	0.19			0.004	4.2
	1.69	0.21	0.1	0.02	0.20			0.004	4.2
	1.78	0.21	0.1	0.02	0.19			0.004	4.0
	1.87	0.22	0.1	0.02	0.21			0.004	4.6
	1.96	0.22	0.1	0.02	0.21			0.004	4.6
	2.05	0.22	0.1	0.01	0.20			0.002	2.0
	2.04	0.22	0.0	0.02	0.18			0.004	4.0
	2.23	0.22	0.2	0.03	0.19			0.006	6.5
	2.32	0.22	0.1	0.02	0.19			0.004	4.2
	2.41	0.22	0.1	0.02	0.15			0.003	3.3
	2.50	0.24	0.1	0.02	0.09			0.002	2.2
	2.59	0.24	0.1	0.01	0.07			0.001	1.0
	2.61	0.21	0.0	0.01	0.06			0.000	0.4
RB	2.65	0.00	0.0	0.00	0.00			0.000	0.0
RB									
Total Q								**0.090**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site SL-H1

Site Information				
Project Name	Back River			
Station Identification	SL-H1			
Stream Name	Sleigh Outflow			
Date Monitored	17-Aug-13			
Time at Site (24 hr)	**Start Time:**	7:10:00 AM	**End Time:**	
Personnel	Eli H., Mark W.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	388274	7312296		
Weather Conditions	Cloudy, recent rain			

Transducer Information			
PT Model	PT2X	**Serial #**	21252008
Gain		**Offset**	
Status	Active	**Battery**	3.0V
# of Records	9927	**Memory Free**	514212
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 98	0.967	100.967		100.000	
BM 99			1.052	99.915	
BM 100			0.938	100.029	
PT			2.081	98.886	
WL			1.878	**99.089**	
SG			1.583	99.384	
TBM	1.526	100.910			
SG			1.526	99.384	
WL			1.821	**99.089**	
PT			2.022	98.888	0.210
BM 100			0.880	100.030	
BM 99			0.993	99.917	
BM 98			0.908	100.002	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 99	99.920	99.916	-0.004	
BM 100	100.034	100.030	-0.005	
PT	98.933	98.887	-0.046	

Summary			
Surveyed Stage (m)	99.089	**Corrected:**	99.104
Discharge (m^3/s)	0.016		
Pressure Transducer Reading (m)	0.232		
Pressure Transducer Elevation (m)	98.857		

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	7:15	**End**	8:00	**Location**		
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-mate	
Flow Meter Type	Electromagnetic			**Instrument Serial #**			
Stage (m)	**Start**	**Reading**	0.232	**Time**	7:15		
	End	**Reading**	0.232	**Time**	8:00		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	0.42	0.00	0.0	0.00	0.00			0.000	0.0
	0.43	0.13	0.0	0.01	0.04			0.000	1.7
	0.53	0.14	0.1	0.01	0.06			0.001	4.3
	0.60	0.14	0.1	0.01	0.09			0.001	6.5
	0.70	0.12	0.1	0.01	0.10			0.001	7.3
	0.80	0.12	0.1	0.01	0.10			0.001	7.3
	0.90	0.12	0.1	0.01	0.07			0.001	5.1
	1.00	0.15	0.1	0.02	0.06			0.001	5.5
	1.10	0.16	0.1	0.02	0.05			0.001	4.9
	1.20	0.18	0.1	0.02	0.05			0.001	5.5
	1.30	0.18	0.1	0.02	0.04			0.001	4.4
	1.40	0.19	0.1	0.02	0.03			0.001	3.5
	1.50	0.18	0.1	0.02	0.04			0.001	4.4
	1.60	0.18	0.1	0.02	0.04			0.001	4.4
	1.70	0.16	0.1	0.02	0.05			0.001	4.9
	1.80	0.16	0.1	0.02	0.04			0.001	3.9
On rock	1.90	0.12	0.1	0.01	0.05			0.001	3.7
	2.00	0.20	0.1	0.02	0.05			0.001	6.1
	2.10	0.16	0.1	0.02	0.05			0.001	4.9
	2.20	0.22	0.1	0.02	0.04			0.001	5.4
	2.30	0.22	0.1	0.02	0.03			0.001	4.0
	2.40	0.23	0.1	0.02	0.02			0.000	2.8
	2.50	0.24	0.1	0.02	0.00			0.000	0.0
	2.60	0.04	0.1	0.00	-0.02			0.000	-0.4
RB	2.65	0.00	0.0	0.00	0.00			0.000	0.0
Total Q								**0.016**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site SL-H1

Site Information				
Project Name	Back River			
Station Identification	SL-H1			
Stream Name	Sleigh Outflow			
Date Monitored	17-Sep-13			
Time at Site (24 hr)	Start Time:	2:25:00 PM	End Time:	
Personnel	Eli H., Kokiak.			
Station Cordinates	Easting	Northing	Elevation	
	388274	7312296		
Weather Conditions				

Transducer Information			
PT Model	PT2X	Serial #	21252008
Gain		Offset	
Status		Battery	
# of Records		Memory Free	
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 98	0.847	100.847		100.000	
BM 99			0.932	99.915	
BM 100			0.820	100.027	
PT			1.970	98.877	
WL			1.686	**99.161**	
TBM	1.519	100.957	1.409	99.438	
WL			1.799	**99.158**	
PT			2.081	98.876	0.286
BM 100			0.929	100.028	
BM 99			1.042	99.915	
BM 98			0.958	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 99	99.920	99.915	-0.005	
BM 100	100.034	100.028	-0.007	
PT	98.933	98.877	-0.056	

Summary			
Surveyed Stage (m)	99.160	Corrected:	99.148
Discharge (m^3/s)	0.081		
Pressure Transducer Reading (m)	0.307		
Pressure Transducer Elevation (m)	98.853		

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	14:30	End		Location	2 m downstream of PT			
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate			
Flow Meter Type	Electromagnetic			Instrument Serial #					
Stage (m)	Start	Reading	0.306	Time	14:30				
	End	Reading		Time					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	0.47	0.00	0.0	0.01	0.00			0.000	0.0
	0.53	0.22	0.1	0.01	0.15			0.002	2.6
	0.60	0.24	0.1	0.02	0.16			0.003	4.0
	0.70	0.24	0.1	0.02	0.22			0.005	6.5
	0.80	0.23	0.1	0.02	0.23			0.005	6.5
	0.90	0.22	0.1	0.02	0.22			0.005	6.0
	1.00	0.19	0.1	0.02	0.22			0.004	5.2
	1.10	0.18	0.1	0.02	0.24			0.004	5.3
	1.20	0.18	0.1	0.02	0.22			0.004	4.9
	1.30	0.20	0.1	0.02	0.22			0.004	5.4
	1.40	0.20	0.1	0.02	0.21			0.004	5.2
	1.50	0.17	0.1	0.02	0.21			0.004	4.4
	1.60	0.18	0.1	0.02	0.19			0.003	4.2
	1.70	0.18	0.1	0.02	0.21			0.004	4.7
	1.80	0.17	0.1	0.02	0.20			0.003	4.2
	1.90	0.17	0.1	0.02	0.19			0.003	4.0
	2.00	0.17	0.1	0.02	0.20			0.003	4.2
	2.10	0.16	0.1	0.02	0.19			0.003	3.7
	2.20	0.16	0.1	0.02	0.20			0.003	3.9
	2.30	0.18	0.1	0.02	0.21			0.004	4.7
	2.40	0.20	0.1	0.02	0.20			0.004	4.9
	2.50	0.20	0.1	0.02	0.15			0.003	3.7
	2.60	0.19	0.1	0.01	0.12			0.001	1.7
RB	2.62	0.00	0.0	0.00	0.00			0.000	0.0
Total Q								**0.081**	**100.0**

General Notes

Appendix 4
Channel Geometry

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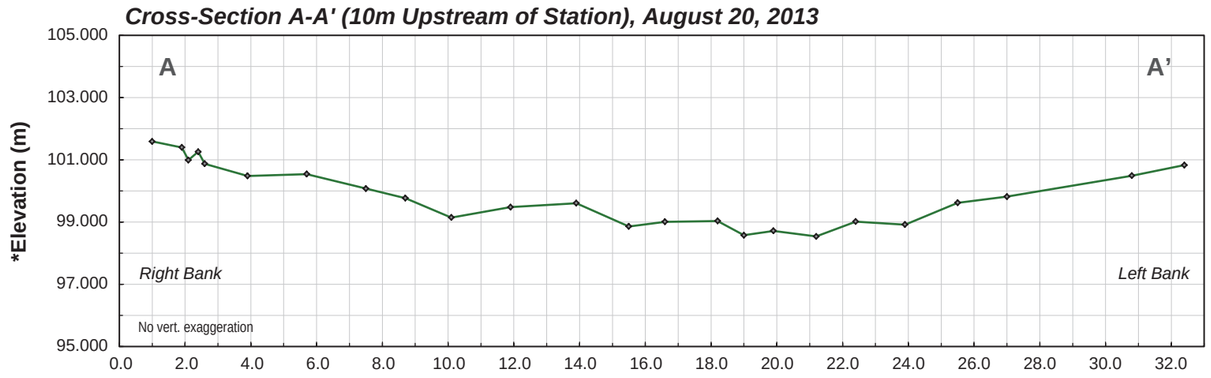
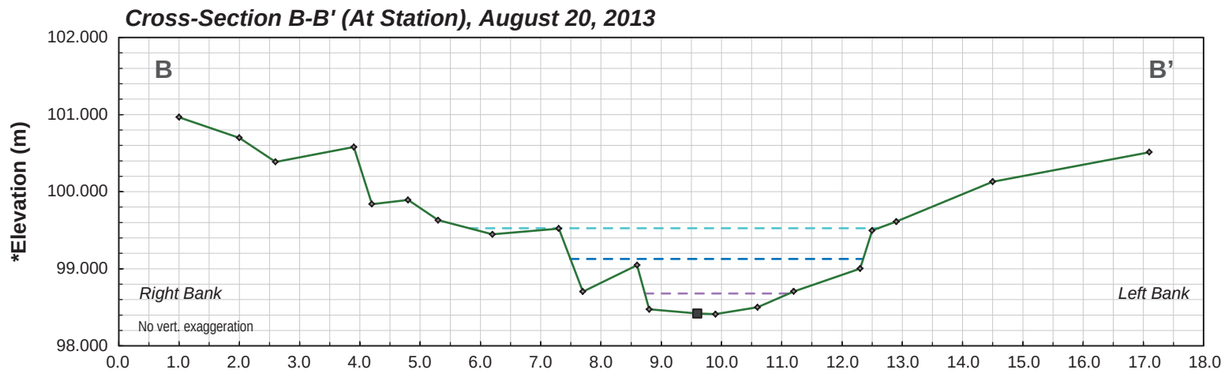
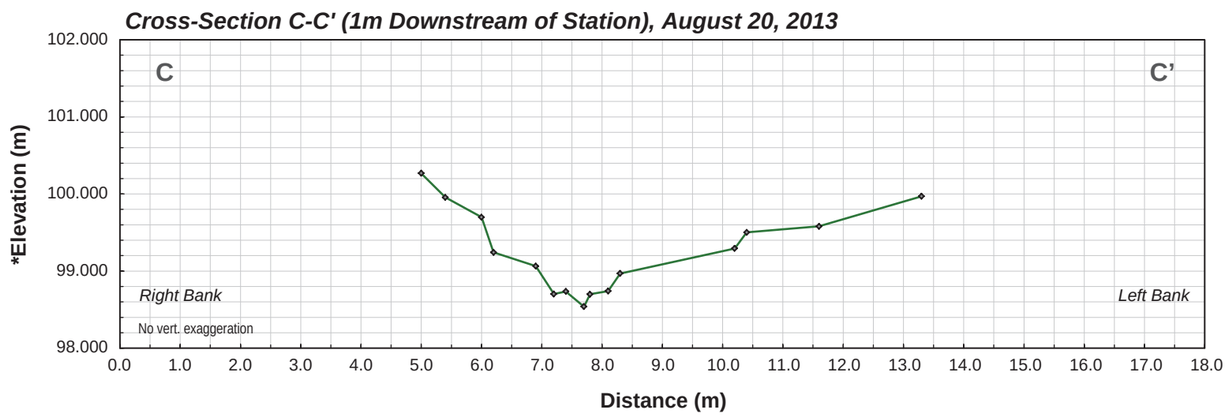
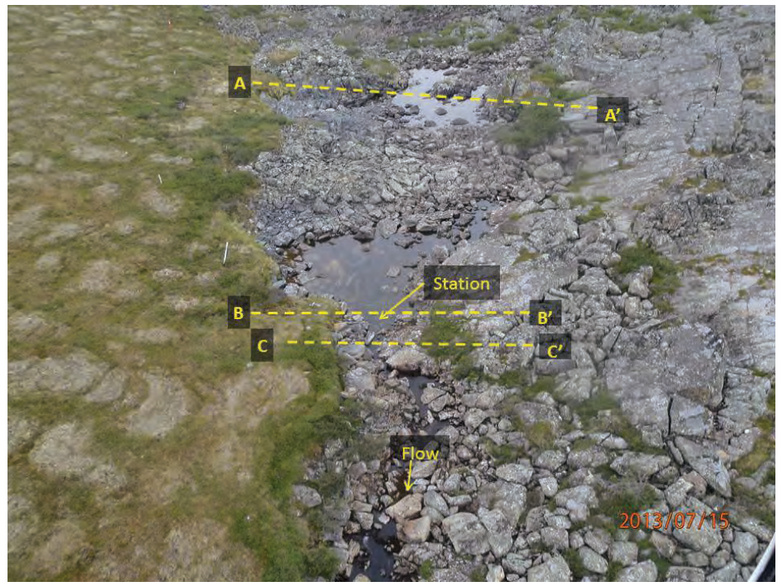






Notes: Water levels are referenced to a site specific non-geodetic datum.
Minimum, mean, and maximum discharge values are calculated from recorded water level data for the 2013 period of record.
Recorded values may differ from values for periods of record that include estimated data.
cms = cubic meters per second (m^3/s).

- 2013 Maximum Daily Discharge = 0.63 cms (Jun 8)
- 2013 Mean Daily Discharge = 0.11 cms
- 2013 Minimum Daily Discharge = 0.005 cms (Aug 16-18)
- Pressure Transducer



Aerial view of station GL-H1 and the surveyed channel reach – cross-sections A (10 m upstream of station), B (at station), and C (1 m downstream of station). July 15, 2013.

Upstream view of station GL-H1 and the surveyed channel reach. August 20, 2013.

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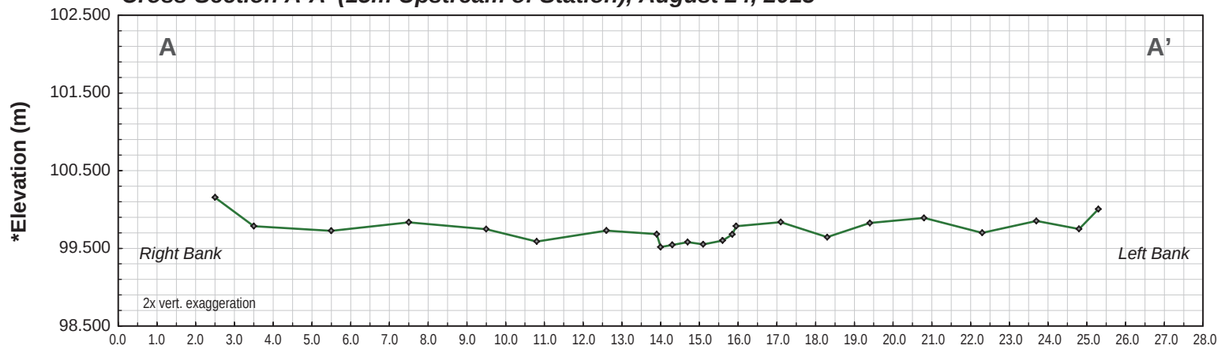
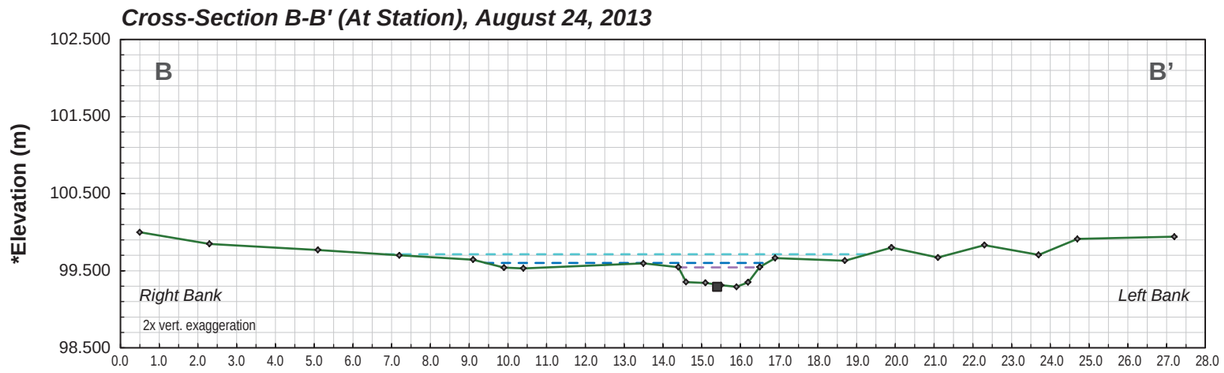
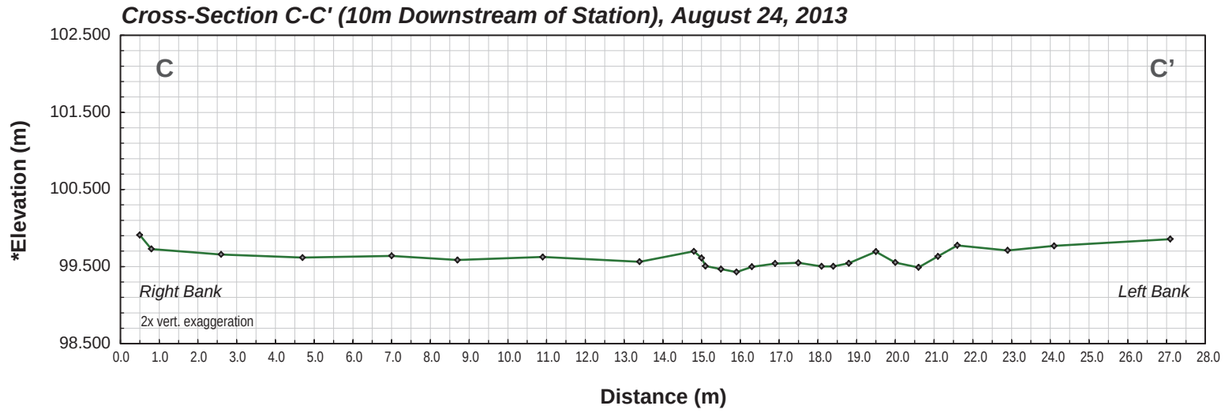
Appendix 4-1

GL-H1 Cross-Sections

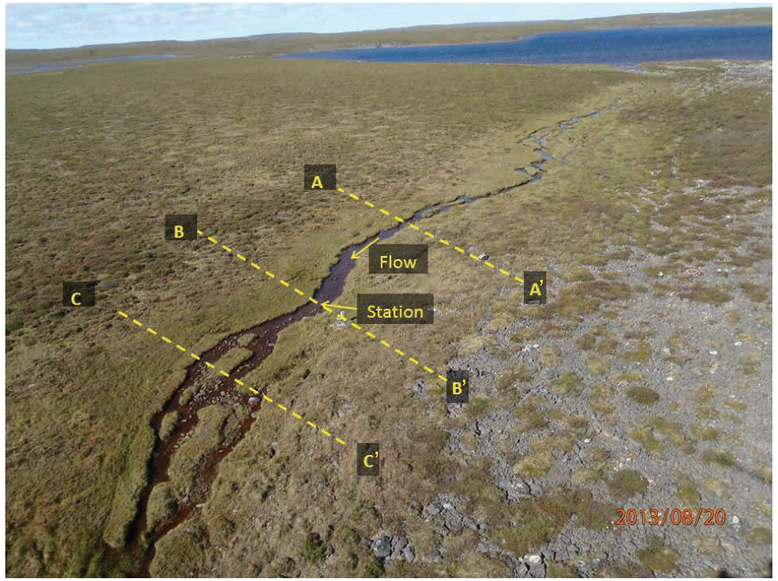






Notes: Water levels are referenced to a site specific non-geodetic datum.
Minimum, mean, and maximum discharge values are calculated from recorded water level data for the 2013 period of record.
Recorded values may differ from values for periods of record that include estimated data.
cms = cubic meters per second (m^3/s).

- 2013 Maximum Daily Discharge = 0.15 cms (Jun 8)
- 2013 Mean Daily Discharge = 0.03 cms
- 2013 Minimum Daily Discharge = <0.001 cms (Aug 13-21)
- Pressure Transducer



Aerial view of station GL-H2 and the surveyed channel reach – cross-sections A (15 m upstream of station), B (at station), and C (10 m downstream of station). August 20, 2013.

Upstream view of station GL-H2 and the surveyed channel reach. July 15, 2013.

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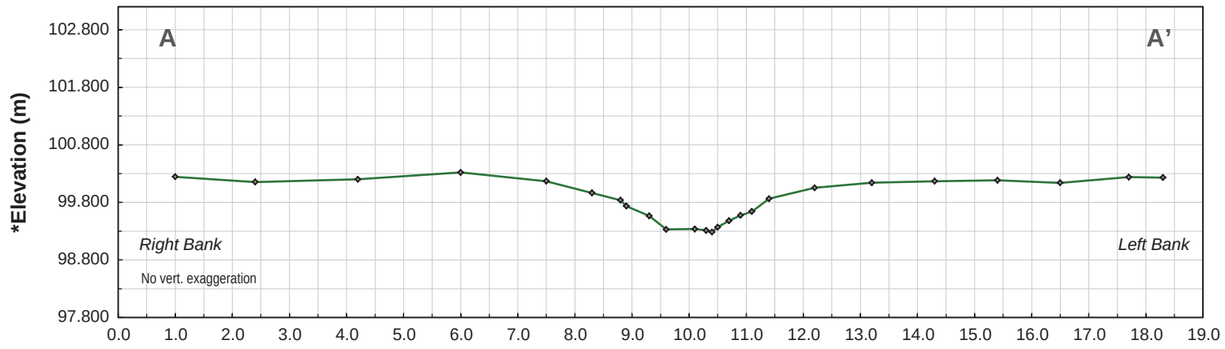
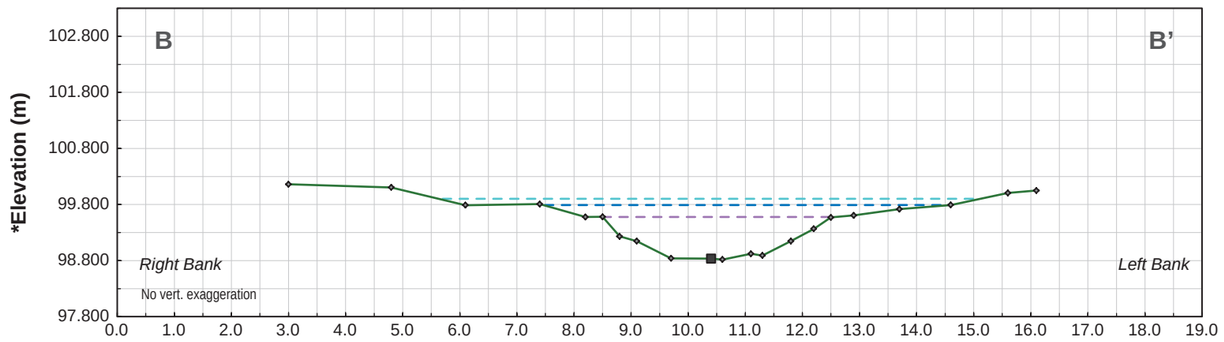
Appendix 4-2

GL-H2 Cross-Sections

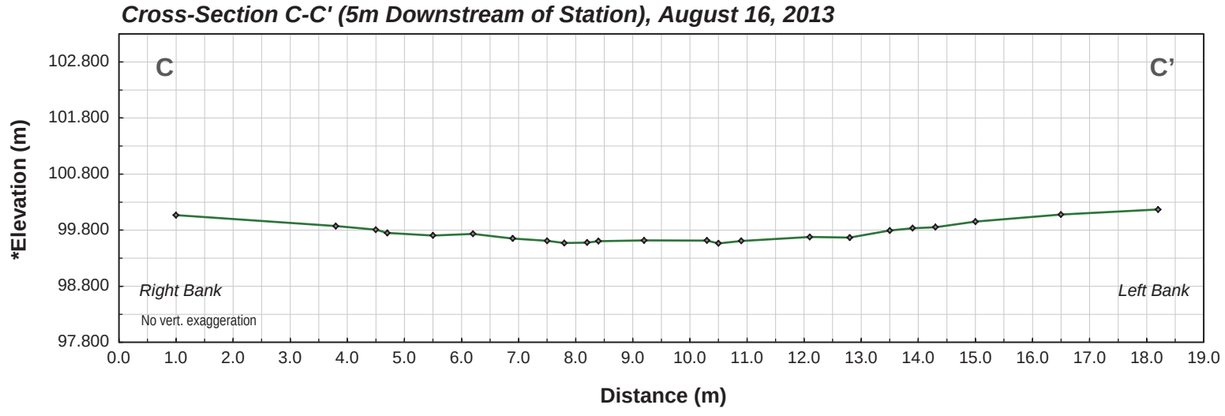
Cross-Section A-A' (14m Upstream of Station), August 16, 2013



Cross-Section B-B' (At Station), August 16, 2013

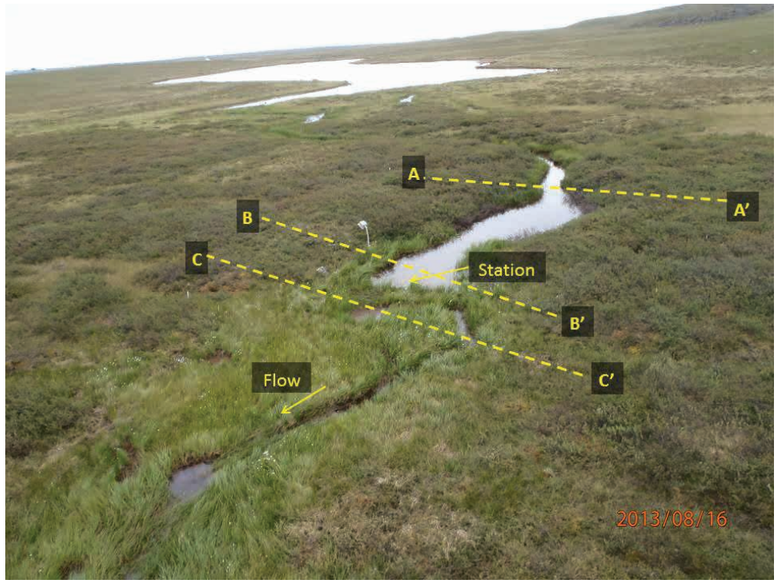


Cross-Section C-C' (5m Downstream of Station), August 16, 2013



Notes: Water levels are referenced to a site specific non-geodetic datum.
Minimum, mean, and maximum discharge values are calculated from recorded water level data for the 2013 period of record.
Recorded values may differ from values for periods of record that include estimated data.
cms = cubic meters per second (m^3/s).

- 2013 Maximum Daily Discharge = 0.49 cms (Jun 2)
- 2013 Mean Daily Discharge = 0.08 cms
- 2013 Minimum Daily Discharge = no flow (Aug 9-20)
- Pressure Transducer



Aerial view of station GL-H3 and the surveyed channel reach – cross-sections A (14 m upstream of station), B (at station), and C (5 m downstream of station). August 16, 2013.

Upstream view of station GL-H3 and the surveyed channel reach. August 16, 2013.

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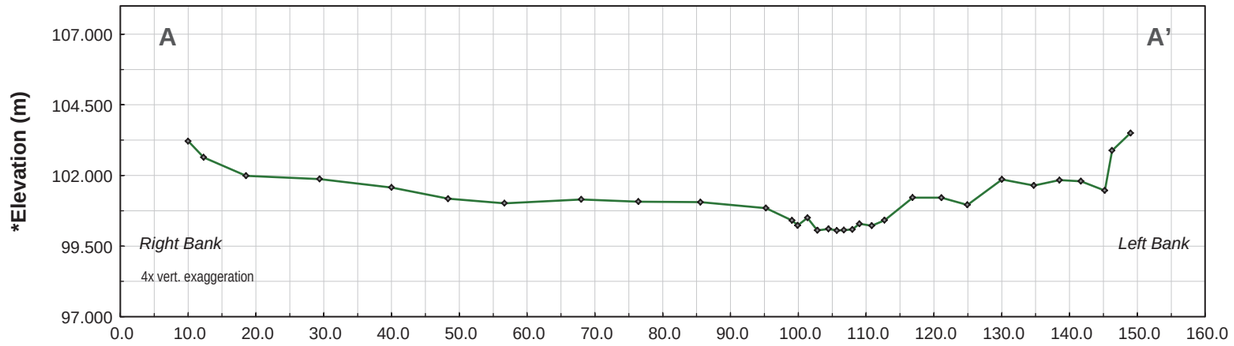
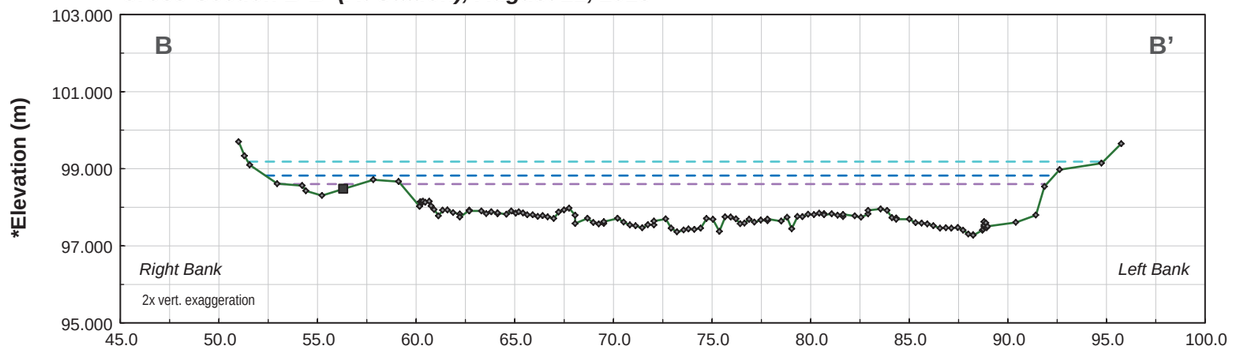
Appendix 4-3

GL-H3 Cross-Sections

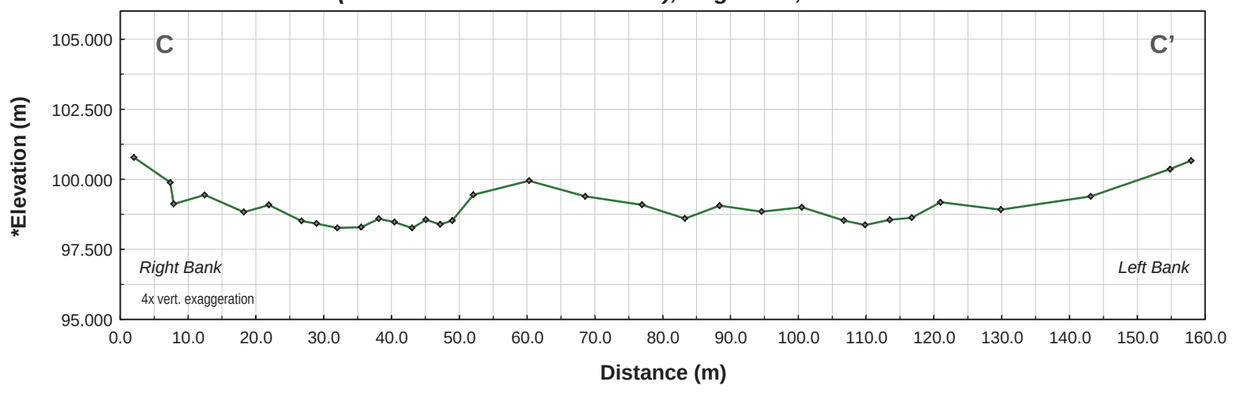
Cross-Section A-A' (400m Upstream of Station), August 21, 2013



Cross-Section B-B' (At Station), August 21, 2013



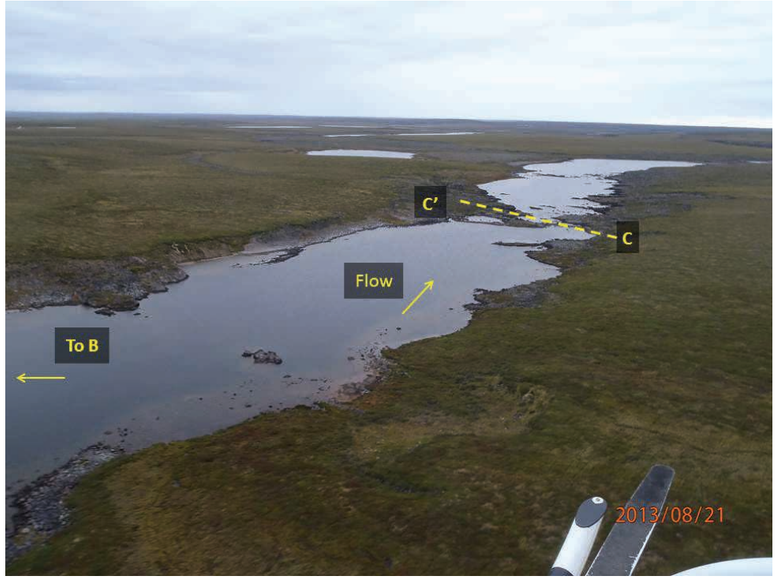
Cross-Section C-C' (500m Downstream of Station), August 21, 2013



Notes: Water levels are referenced to a site specific non-geodetic datum.
Minimum, mean, and maximum discharge values are calculated from recorded water level data for the 2013 period of record.
Recorded values may differ from values for periods of record that include estimated data.
cms = cubic meters per second (m^3/s).

- 2013 Maximum Daily Discharge = 7.91 cms (Jun 9)
- 2013 Mean Daily Discharge = 1.20 cms
- 2013 Minimum Daily Discharge = 0.18 cms (Sep 4)
- Pressure Transducer

Aerial view of station PL-H1 and the surveyed channel reach – cross-sections A (400 m upstream of station) and B (at station). August 21, 2013.



Aerial view of station PL-H1 and the surveyed channel reach – cross-section C (500 m downstream of station). August 21, 2013.

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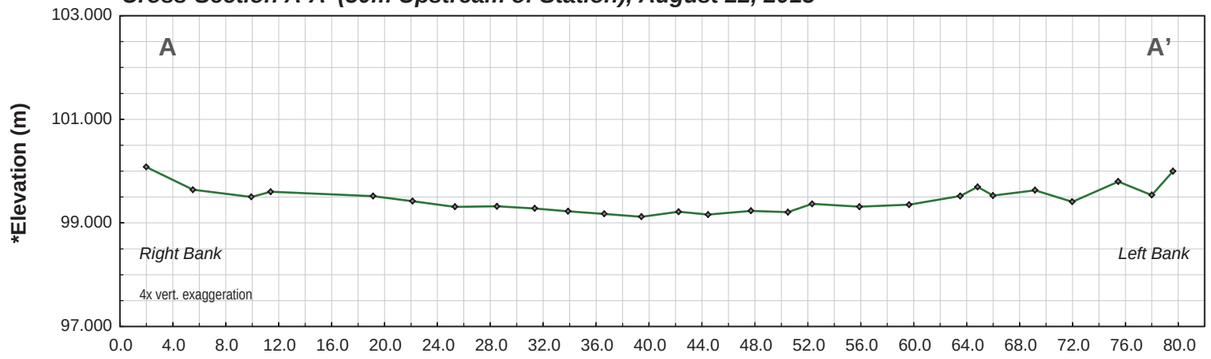
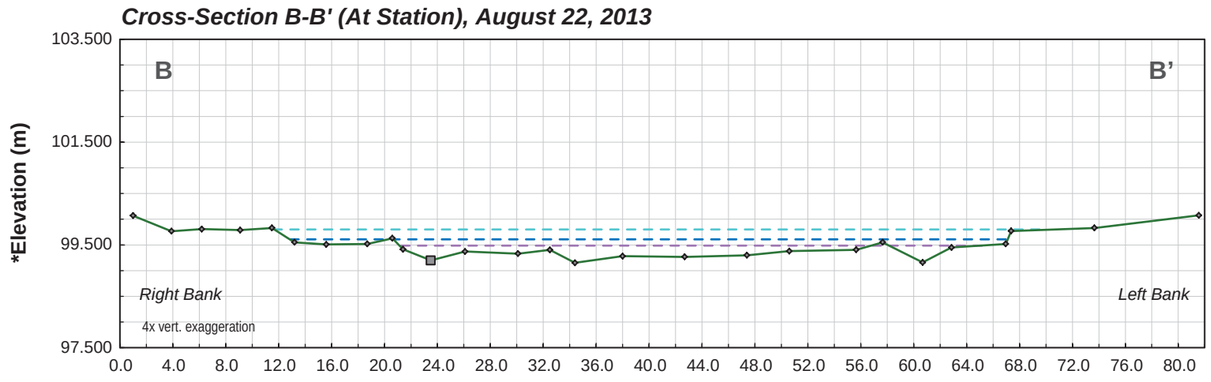
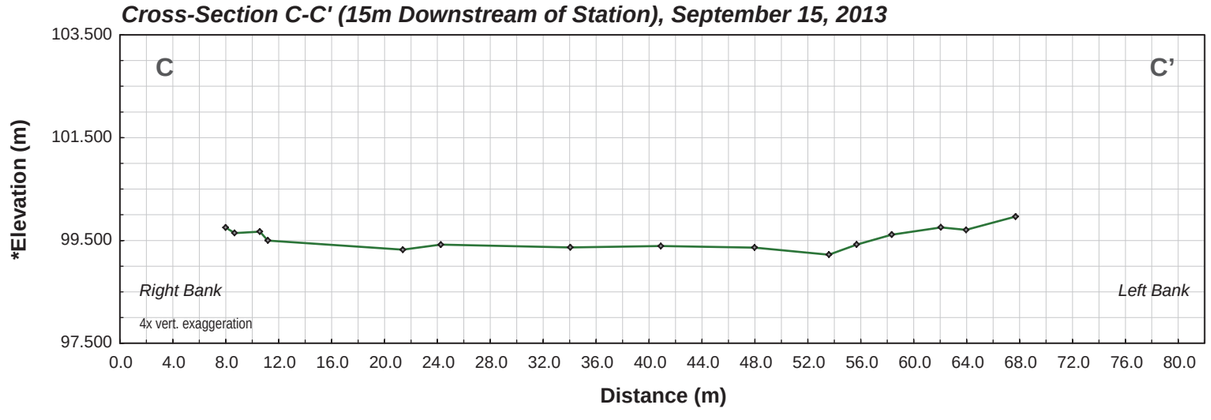
Appendix 4-4

PL-H1 Cross-Sections

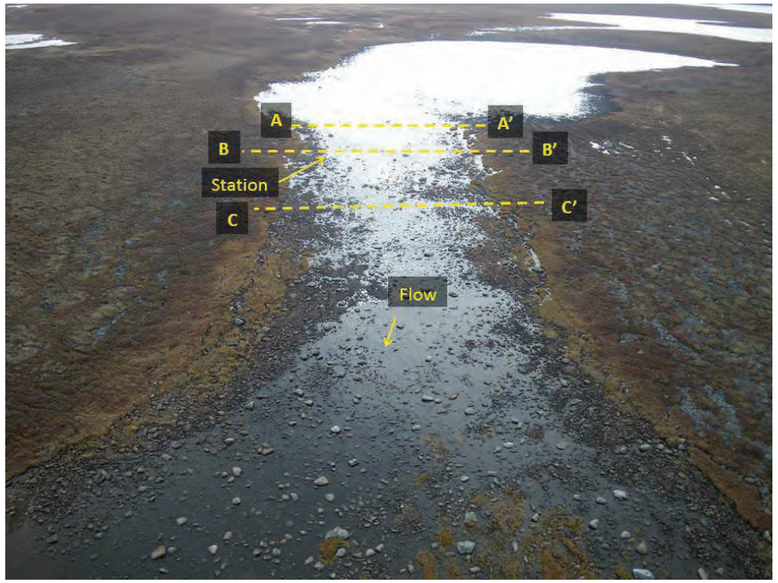




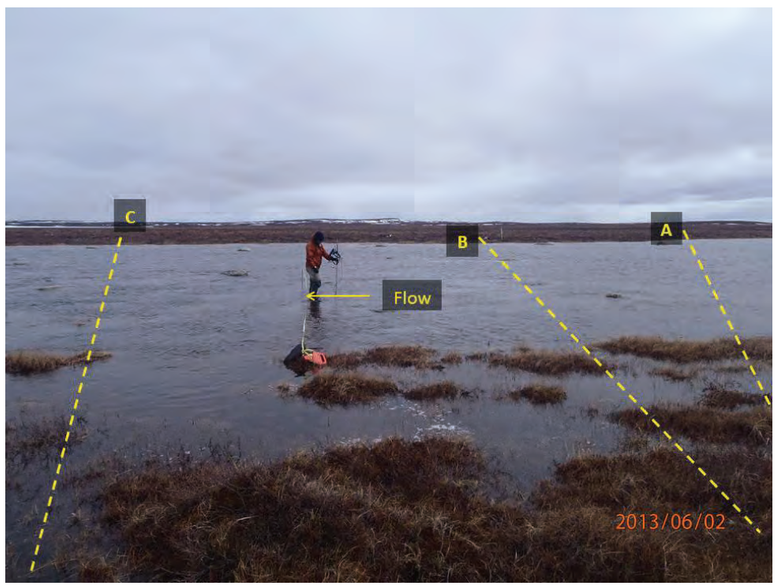


Notes: Water levels are referenced to a site specific non-geodetic datum.
Minimum, mean, and maximum discharge values are calculated from recorded water level data for the 2013 period of record.
Recorded values may differ from values for periods of record that include estimated data.
cms = cubic meters per second (m^3/s).

- 2013 Maximum Daily Discharge = 3.85 cms (Jun 3)
- 2013 Mean Daily Discharge = 0.75 cms
- 2013 Minimum Daily Discharge = 0.05 cms (Aug 20)
- Pressure Transducer



Aerial view of station PL-H2 and the surveyed channel reach – cross-sections A (30 m upstream of station), B (at station), and C (15 m downstream of station). June 2, 2013.



Cross stream view of station PL-H2 and the surveyed channel reach. June 2, 2013.

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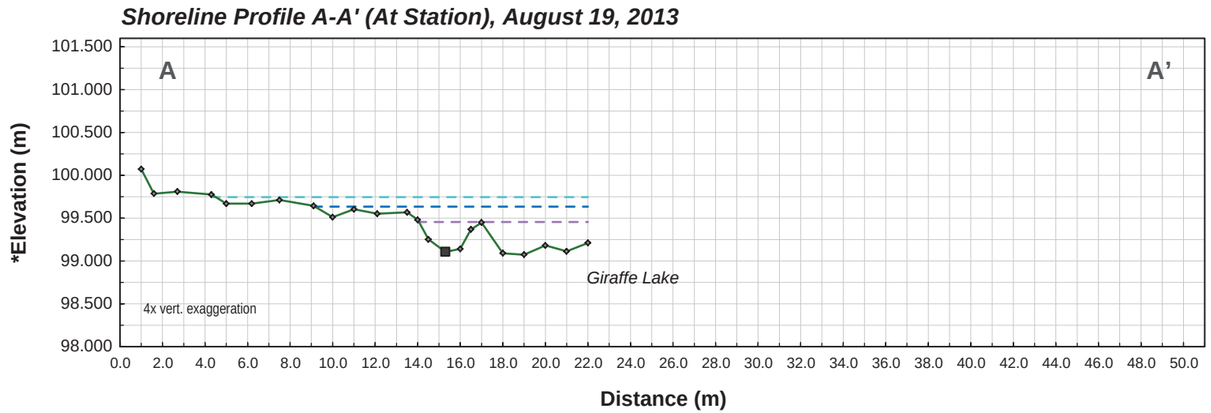
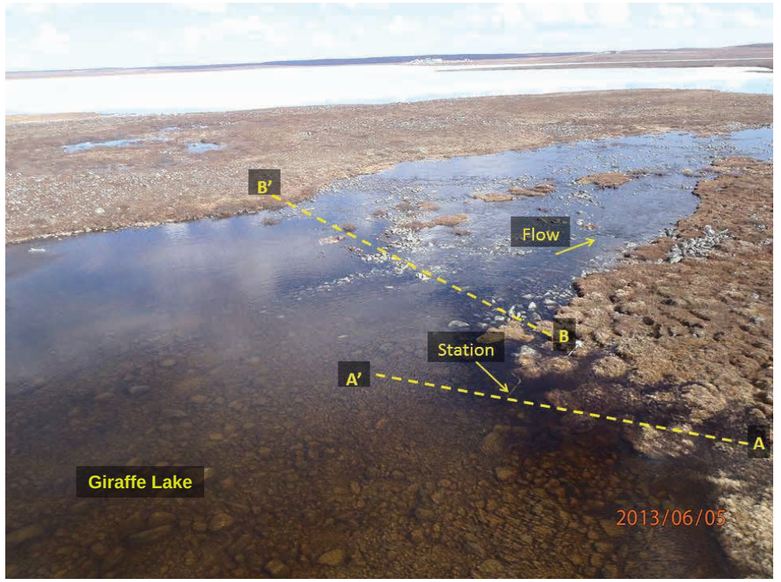
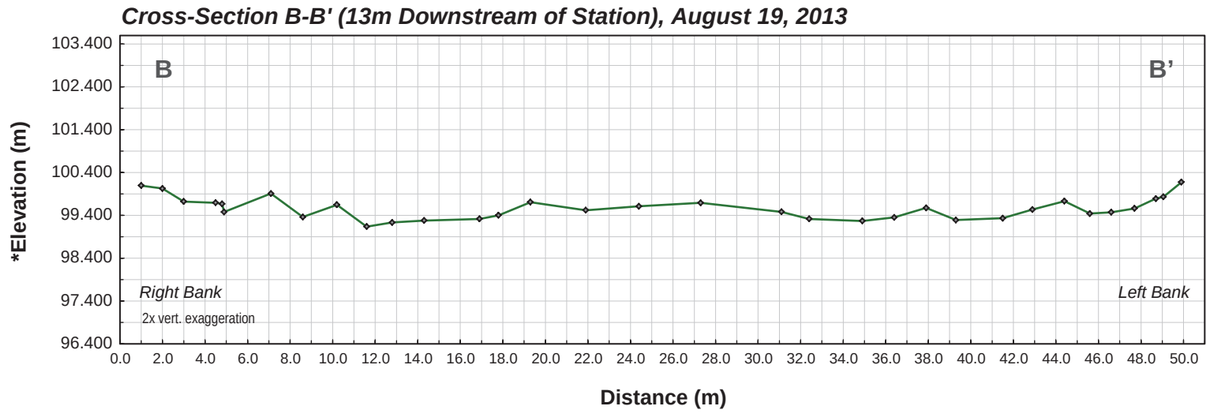
Appendix 4-5

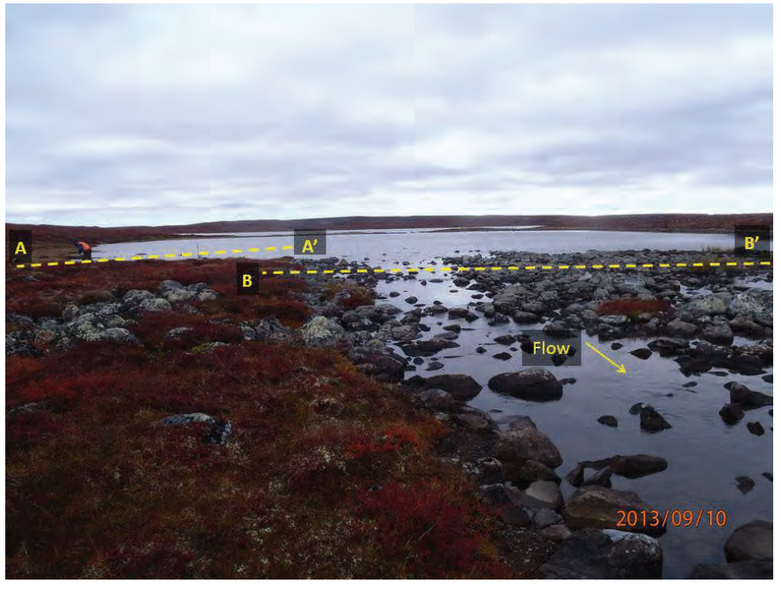
PL-H2 Cross-Sections





Aerial view of station GI-H1 and the surveyed channel reach – cross-sections A (shoreline profile at station) and B (lake outlet 13 m downstream of station). June 5, 2013.





Upstream view of station GI-H1 and the surveyed channel reach. September 10, 2013.

Notes: Water levels are referenced to a site specific non-geodetic datum.
Minimum, mean, and maximum discharge values are calculated from recorded water level data for the 2013 period of record.
Recorded values may differ from values for periods of record that include estimated data.
cms = cubic meters per second (m^3/s).

- 2013 Maximum Daily Discharge = 1.20 cms (Jun 8)
- 2013 Mean Daily Discharge = 0.13 cms
- 2013 Minimum Daily Discharge = <0.001 cms (Aug 14-15)
- Pressure Transducer

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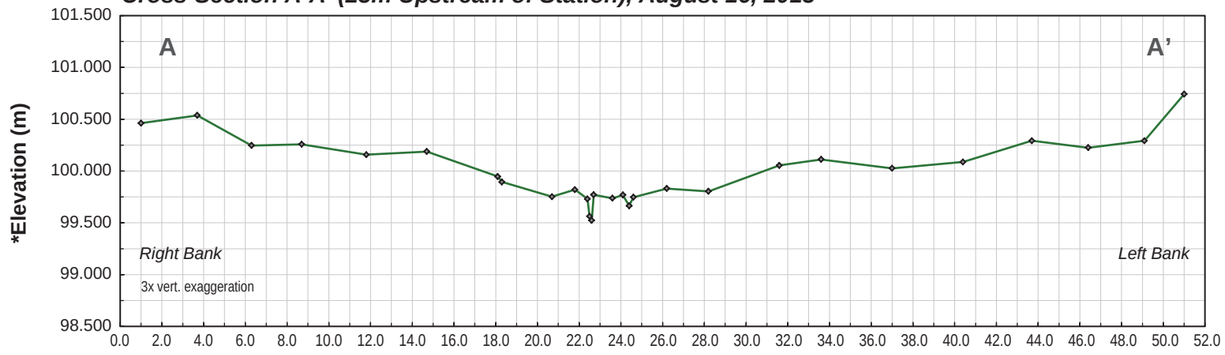
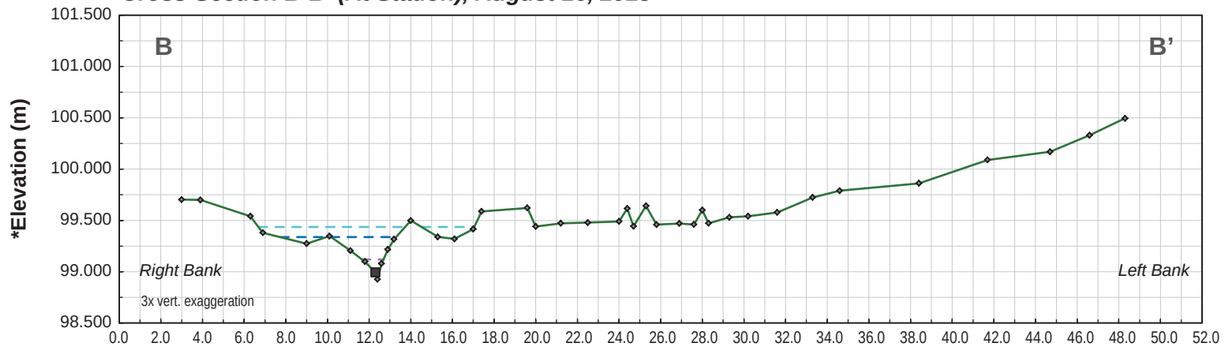
Appendix 4-6

GI-H1 Cross-Sections

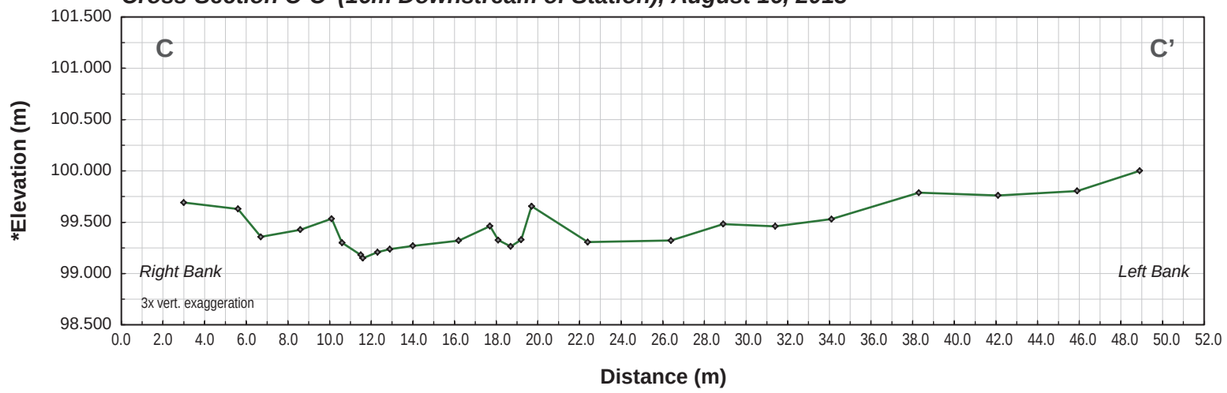
Cross-Section A-A' (23m Upstream of Station), August 16, 2013



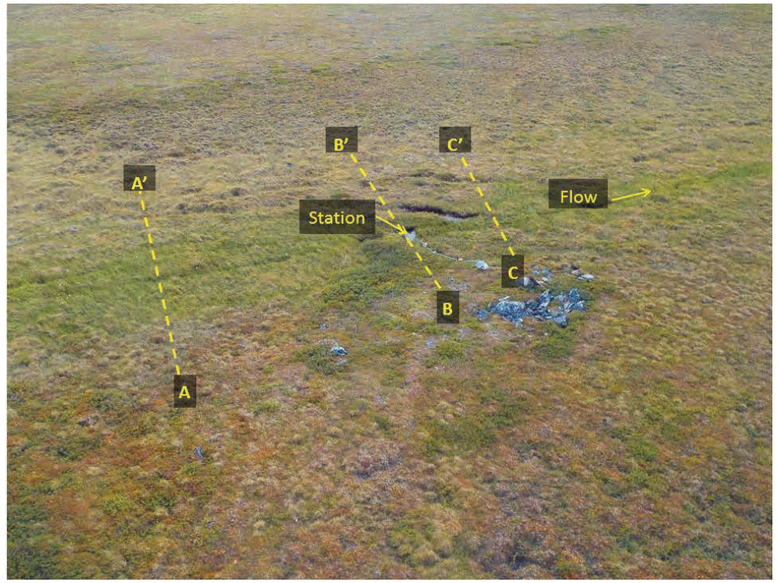
Cross-Section B-B' (At Station), August 16, 2013



Cross-Section C-C' (16m Downstream of Station), August 16, 2013



Notes: Water levels are referenced to a site specific non-geodetic datum.
Minimum, mean, and maximum discharge values are calculated from recorded water level data for the 2013 period of record.
Recorded values may differ from values for periods of record that include estimated data.
cms = cubic meters per second (m^3/s).



Aerial view of station EL-H1 and the surveyed channel reach – cross-sections A (23 m upstream of station), B (at station), and C (16 m downstream of station). September 2013.

Downstream view of station EL-H1 and the surveyed channel reach. September 12, 2013.

2013 Maximum Daily Discharge = 0.11 cms (May 31)
2013 Mean Daily Discharge = 0.01 cms
2013 Minimum Daily Discharge = no flow (Jul 22-26)
Pressure Transducer

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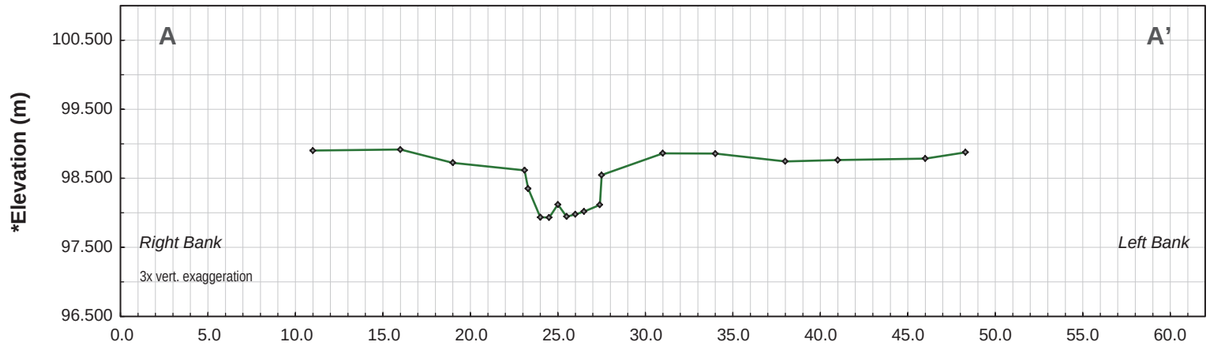
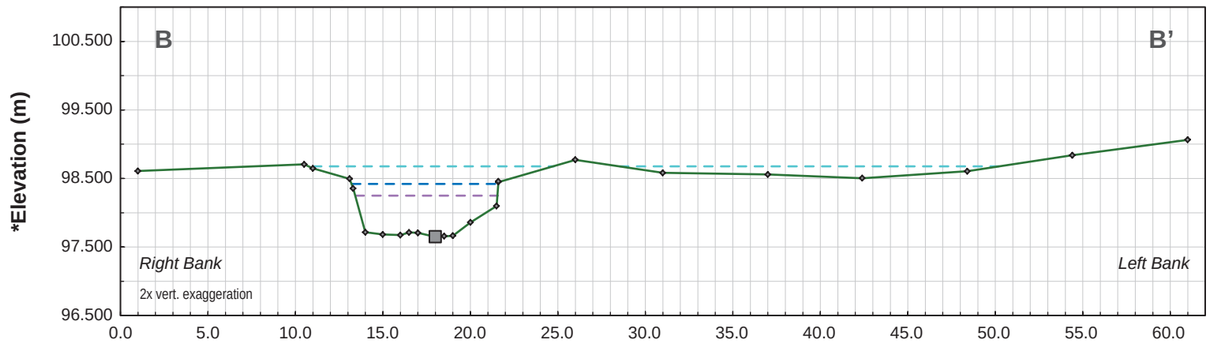
Appendix 4-7

EL-H1 Cross-Sections

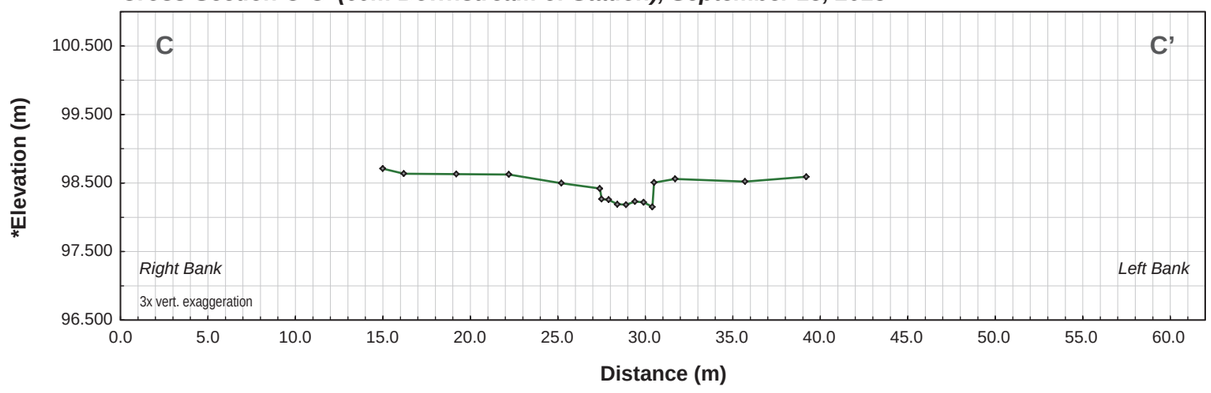
Cross-Section A-A' (40m Upstream of Station), September 15, 2013



Cross-Section B-B' (At Station), September 15, 2013



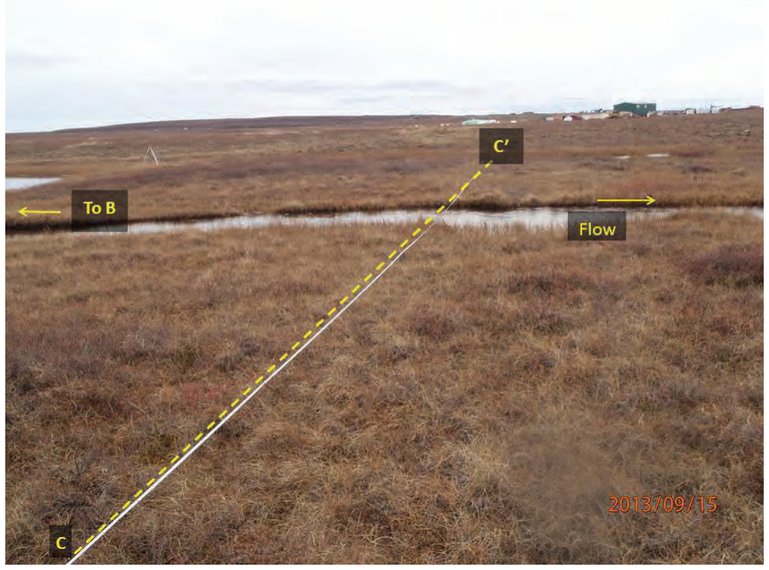
Cross-Section C-C' (60m Downstream of Station), September 15, 2013



Notes: Water levels are referenced to a site specific non-geodetic datum.
Minimum, mean, and maximum discharge values are calculated from recorded water level data for the 2013 period of record.
Recorded values may differ from values for periods of record that include estimated data.
cms = cubic meters per second (m^3/s).

- 2013 Maximum Daily Discharge = 1.08 cms (Jun 2)
- 2013 Mean Daily Discharge = 0.23 cms
- 2013 Minimum Daily Discharge = 0.01 cms (Aug 20)
- Pressure Transducer

Downstream view of station WL-H1 and the surveyed channel reach – cross-sections A (40 m upstream of station) and B (at station). September 15, 2013.



Cross stream view of station WL-H1 and the surveyed channel reach – cross-section C (60 m downstream of station). September 15, 2013.

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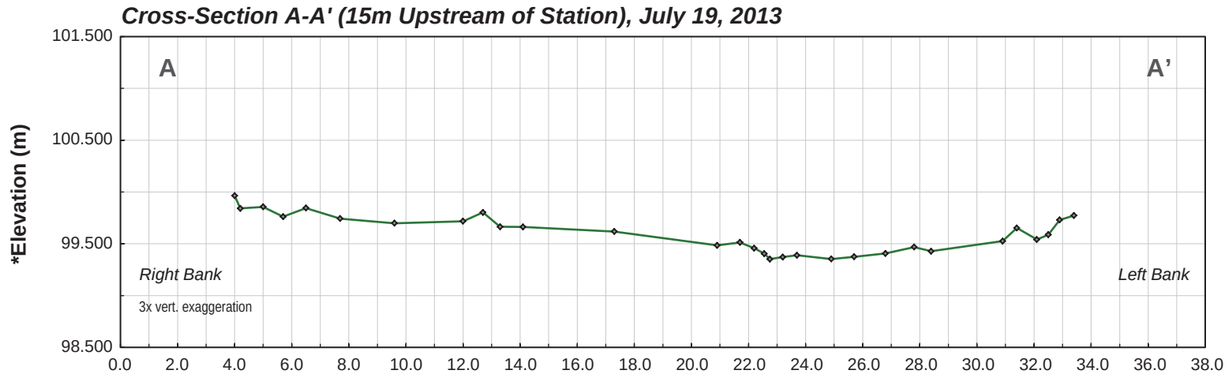
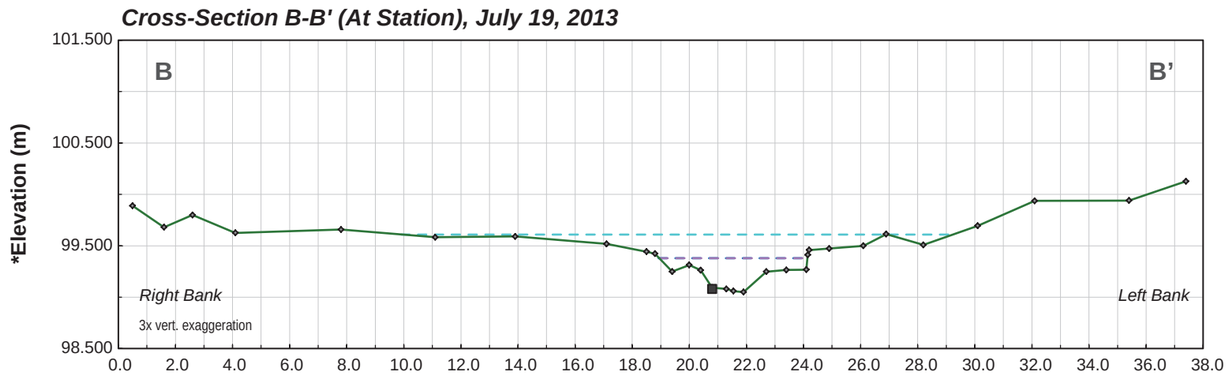
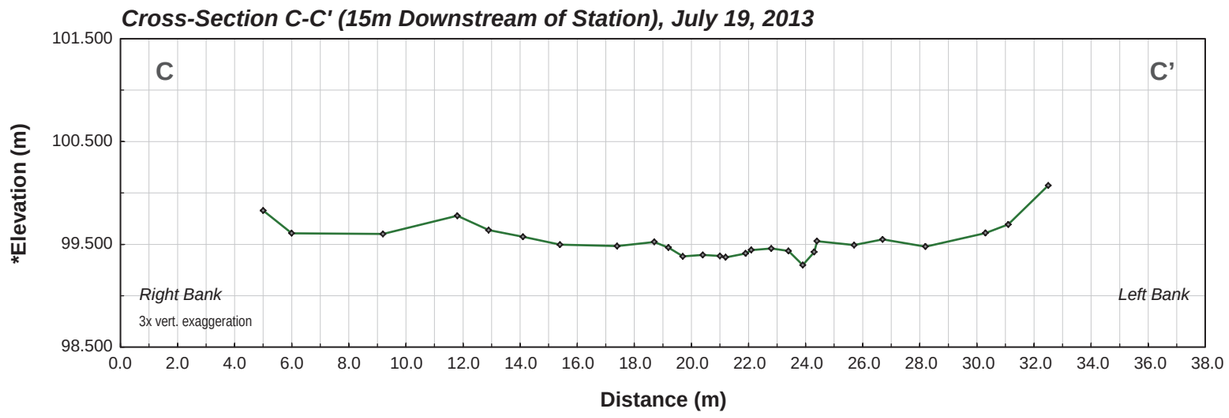
Appendix 4-8

WL-H1 Cross-Sections

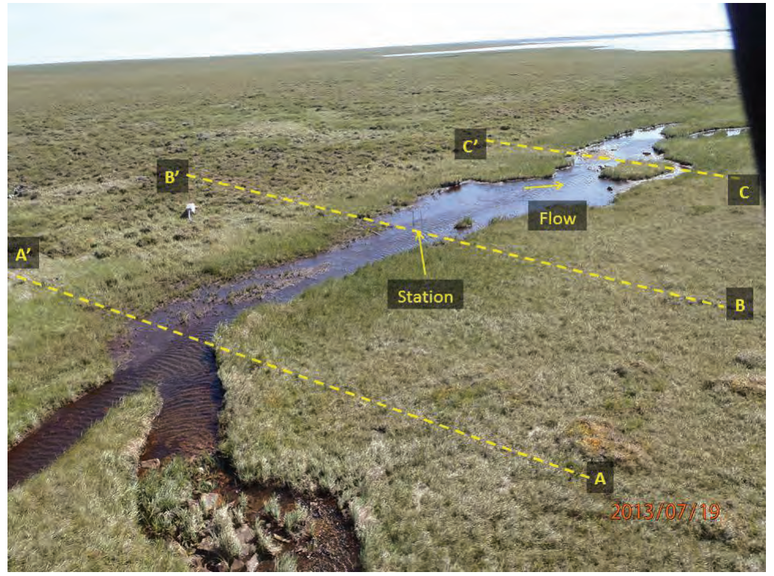




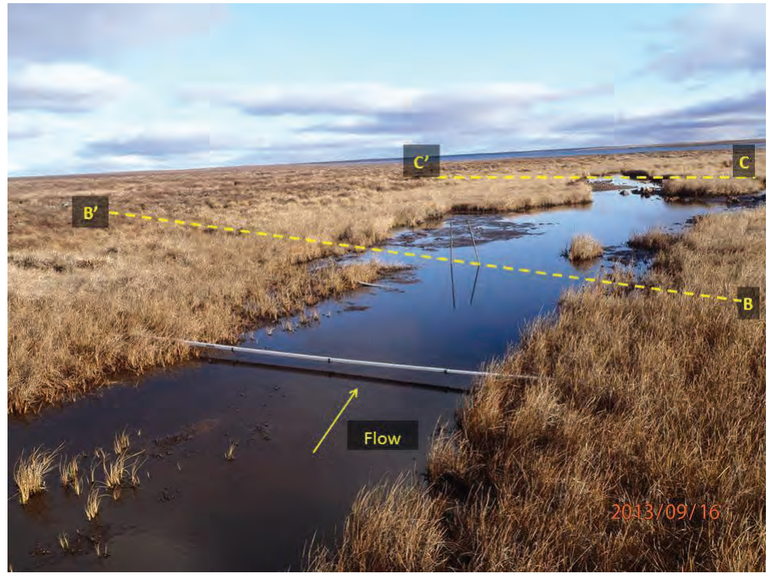


Notes: Water levels are referenced to a site specific non-geodetic datum.
Minimum, mean, and maximum discharge values are calculated from recorded water level data for the 2013 period of record.
Recorded values may differ from values for periods of record that include estimated data.
cms = cubic meters per second (m^3/s).

2013 Maximum Daily Discharge = 0.13 cms (Jun 8)
2013 Mean Daily Discharge = 0.00 cms
2013 Minimum Daily Discharge = no flow (Aug 8-22)
Pressure Transducer



Aerial view of station REFB-H1 and the surveyed channel reach – cross-sections A (15 m upstream of station), B (at station), and C (15 m downstream of station). July 19, 2013.



Downstream view of station REFB-H1 and the surveyed channel reach. September 16, 2013.

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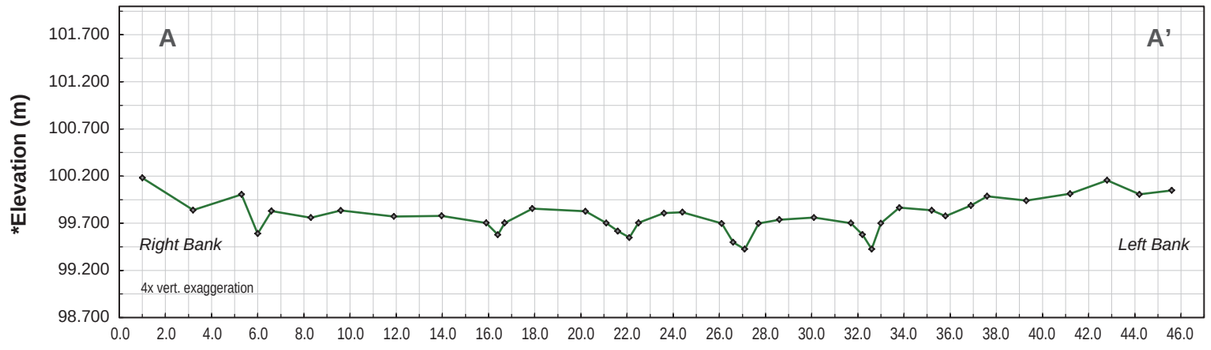
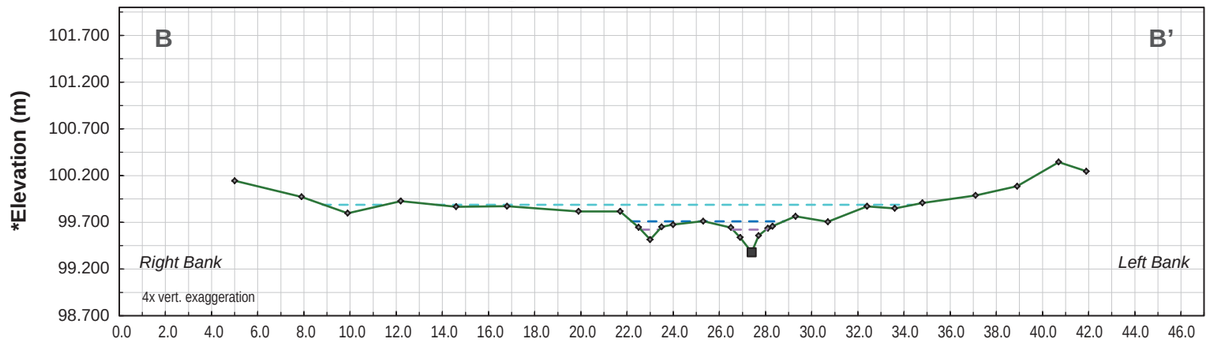
Appendix 4-9

REFB-H1 Cross-Sections

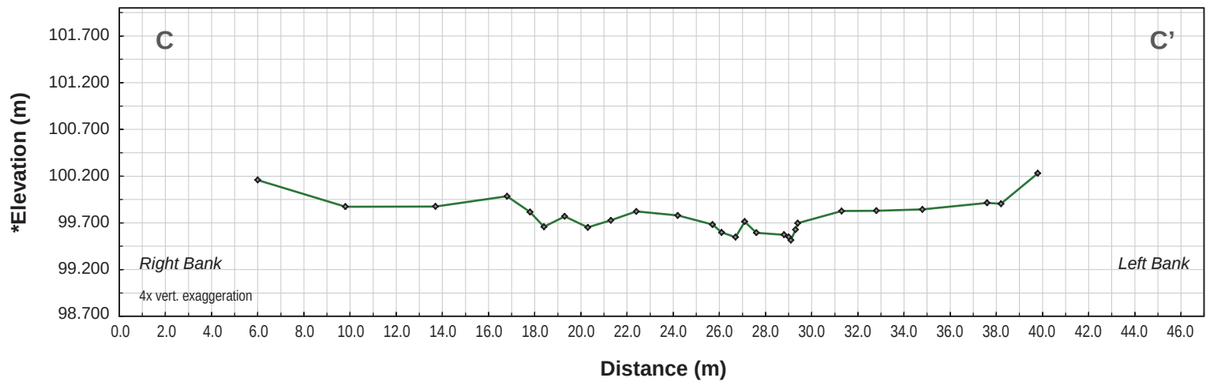
Cross-Section A-A' (12m Upstream of Station), August 20, 2013



Cross-Section B-B' (At Station), August 20, 2013

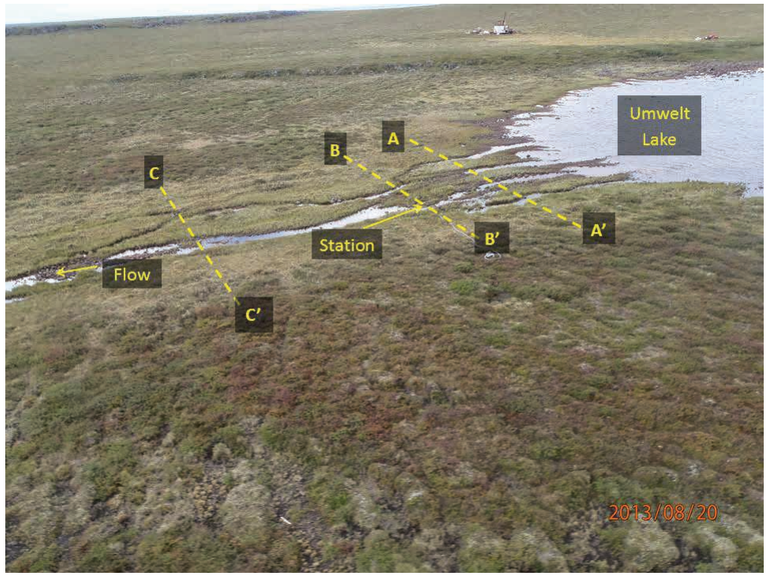


Cross-Section C-C' (18m Downstream of Station), August 20, 2013

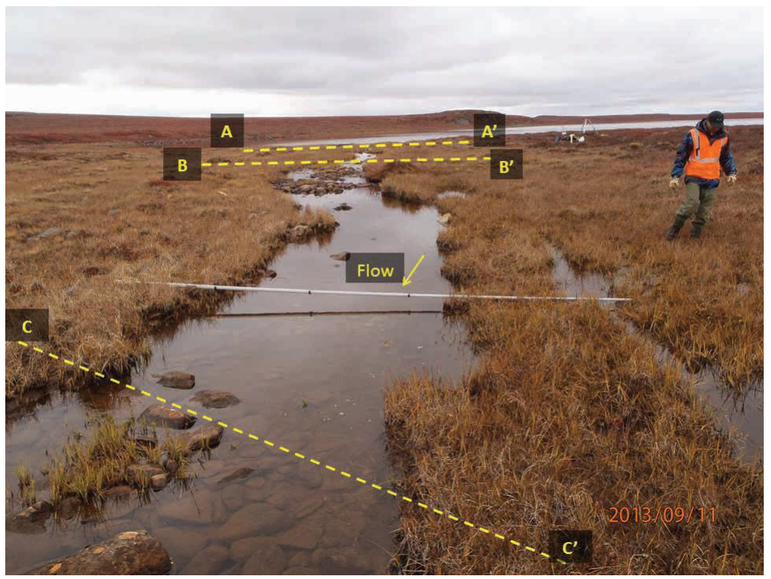


Notes: Water levels are referenced to a site specific non-geodetic datum.
Minimum, mean, and maximum discharge values are calculated from recorded water level data for the 2013 period of record.
Recorded values may differ from values for periods of record that include estimated data.
cms = cubic meters per second (m^3/s).

- 2013 Maximum Daily Discharge = 0.21 cms (Jun 8)
- 2013 Mean Daily Discharge = 0.02 cms
- 2013 Minimum Daily Discharge = 0.001 cms (Aug 16-18)
- Pressure Transducer



Aerial view of station UM-H1 and the surveyed channel reach – cross-sections A (12 m upstream of station), B (at station), and C (18 m downstream of station). August 20, 2013.



Upstream view of station UM-H1 and the surveyed channel reach. September 11, 2013.

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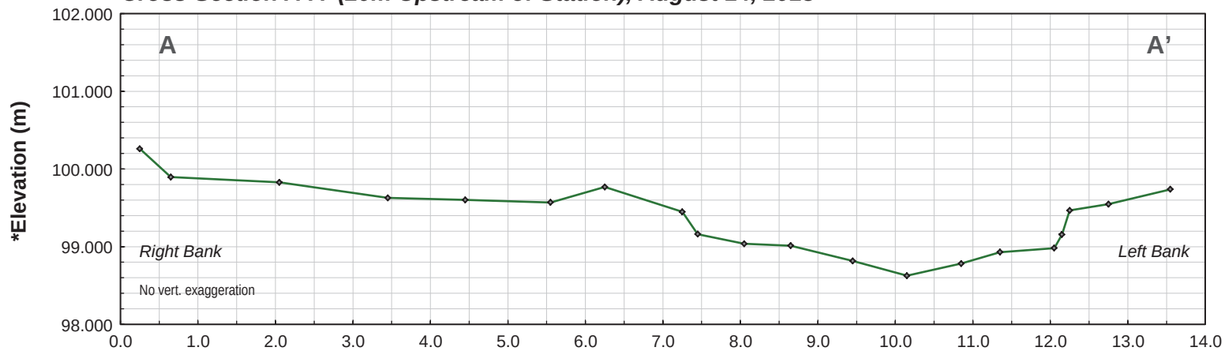
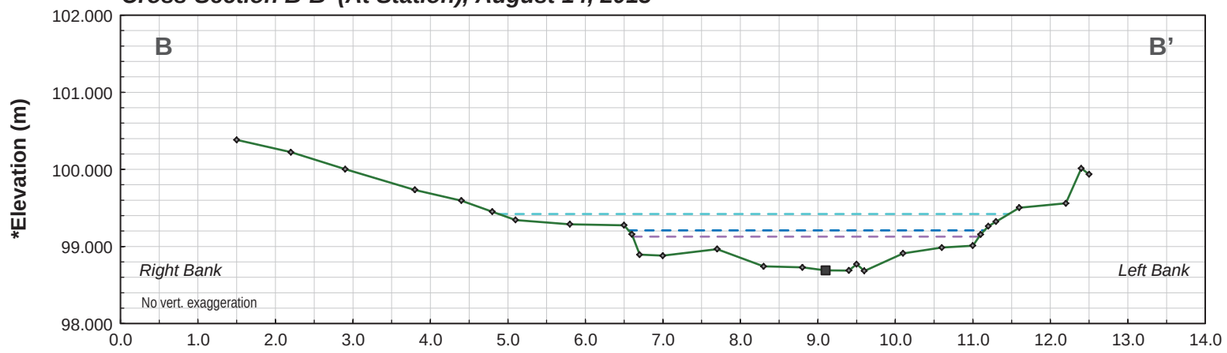
Appendix 4-10

UM-H1 Cross-Sections

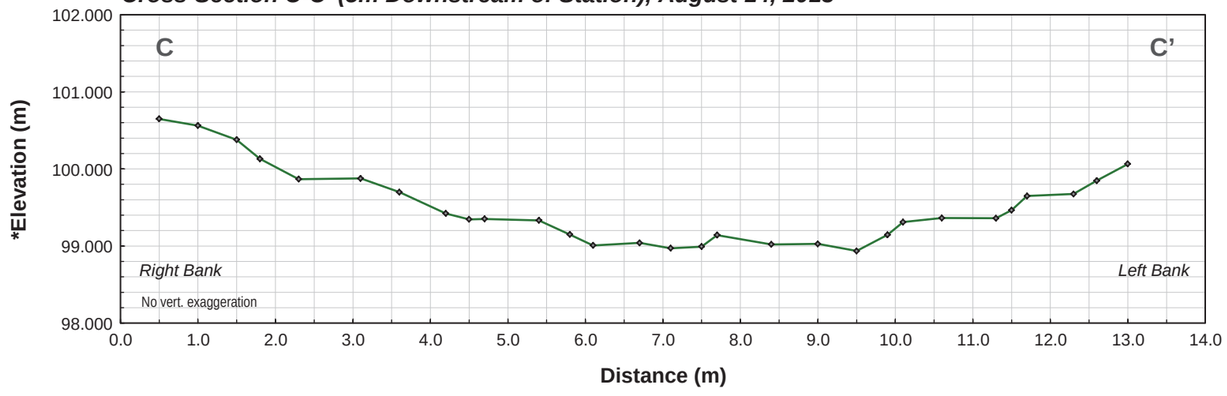
Cross-Section A-A' (20m Upstream of Station), August 14, 2013



Cross-Section B-B' (At Station), August 14, 2013



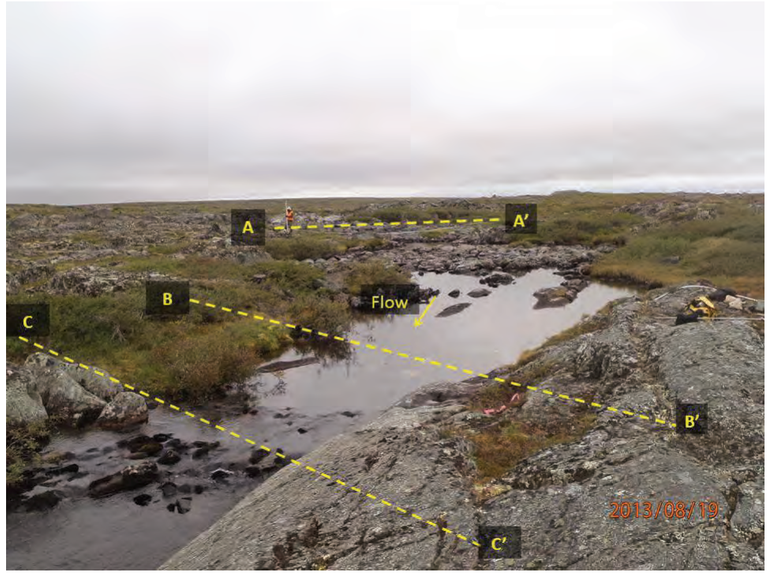
Cross-Section C-C' (5m Downstream of Station), August 14, 2013



Notes: Water levels are referenced to a site specific non-geodetic datum.
Minimum, mean, and maximum discharge values are calculated from recorded water level data for the 2013 period of record.
Recorded values may differ from values for periods of record that include estimated data.
cms = cubic meters per second (m^3/s).

- 2013 Maximum Daily Discharge = 0.77 cms (Jun 5)
- 2013 Mean Daily Discharge = 0.14 cms
- 2013 Minimum Daily Discharge = 0.03 cms (Aug 16-18)
- Pressure Transducer

Aerial view of station WP-H1 and the surveyed channel reach – cross-sections A (20 m upstream of station), B (at station), and C (5 m downstream of station). August 19, 2013.



Upstream view of station WP-H1 and the surveyed channel reach. August 19, 2013.

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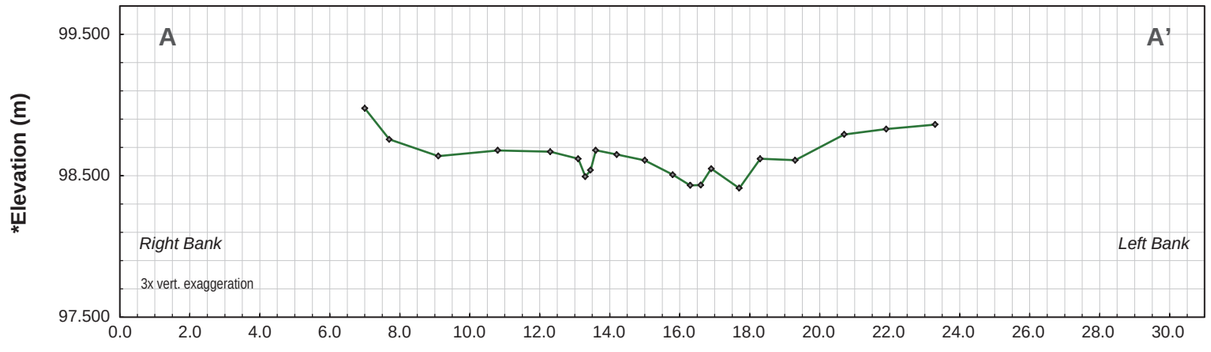
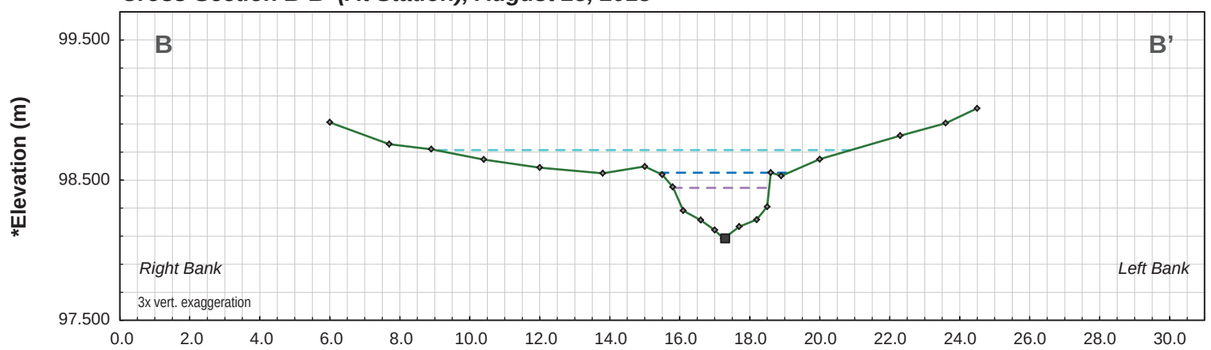
Appendix 4-11

WP-H1 Cross-Sections

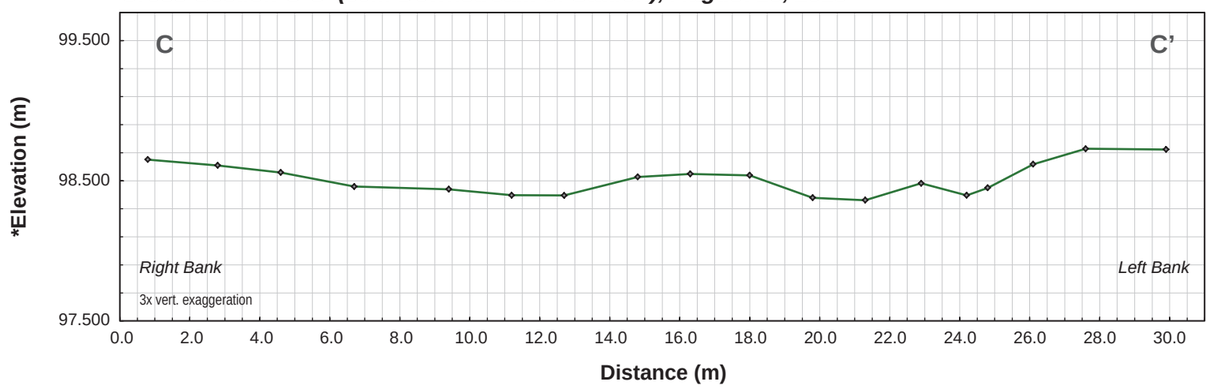
Cross-Section A-A' (15m Upstream of Station), August 25, 2013



Cross-Section B-B' (At Station), August 25, 2013

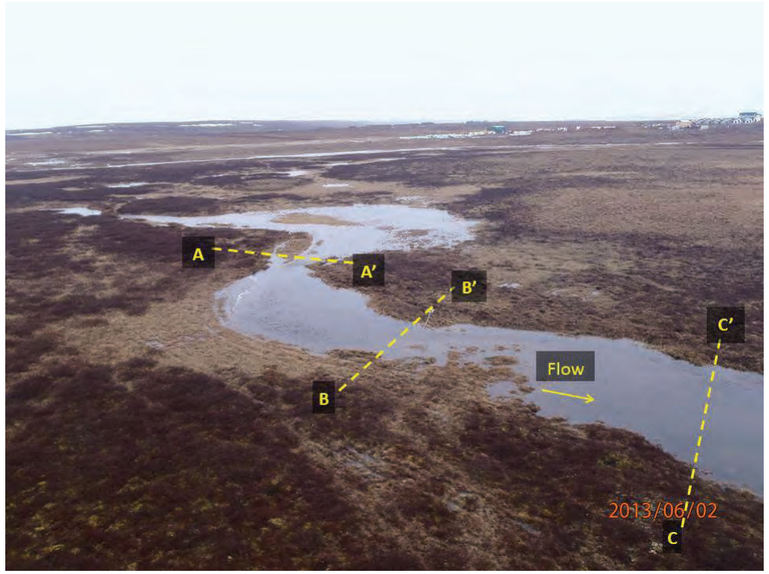


Cross-Section C-C' (30m Downstream of Station), August 25, 2013

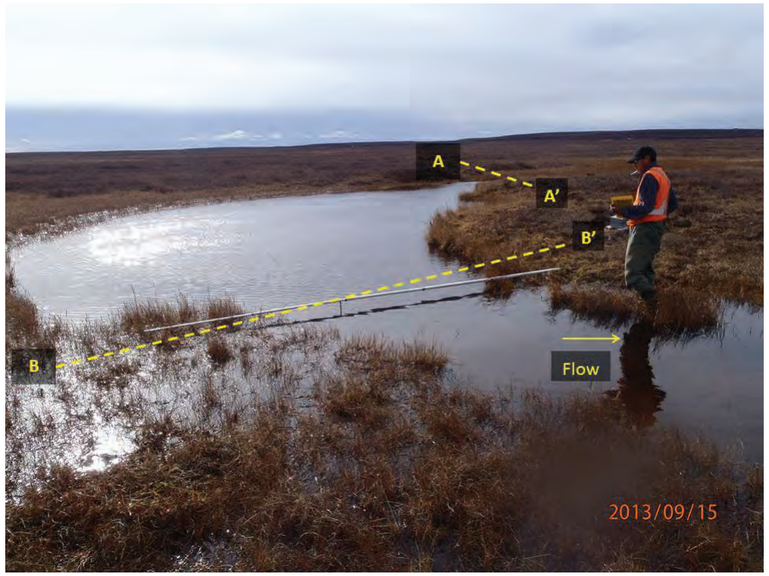


Notes: Water levels are referenced to a site specific non-geodetic datum.
Minimum, mean, and maximum discharge values are calculated from recorded water level data for the 2013 period of record.
Recorded values may differ from values for periods of record that include estimated data.
cms = cubic meters per second (m^3/s).

- 2013 Maximum Daily Discharge = 0.31 cms (Sep 13)
- 2013 Mean Daily Discharge = 0.04 cms
- 2013 Minimum Daily Discharge = no flow (Aug 9-20)
- Pressure Transducer



Aerial view of station WR-H1 and the surveyed channel reach – cross-sections A (15 m upstream of station), B (at station), and C (30 m downstream of station). June 2, 2013.



Cross stream view of station WR-H1 and the surveyed channel reach. September 15, 2013.

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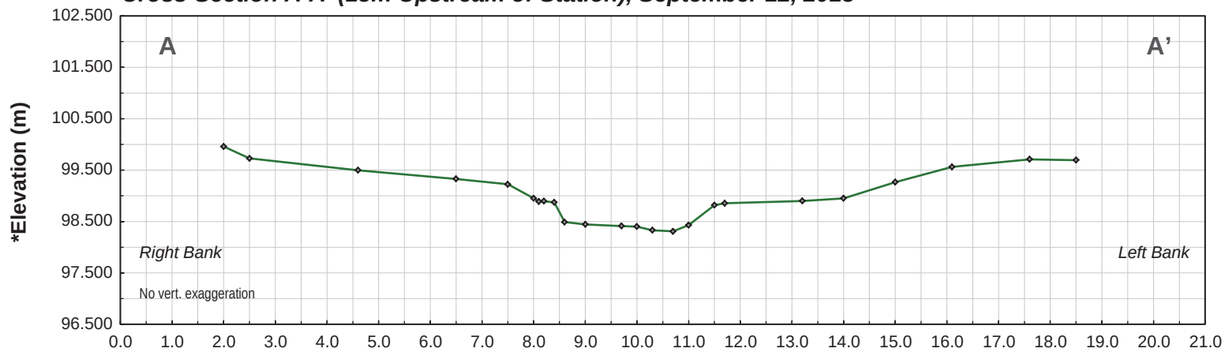
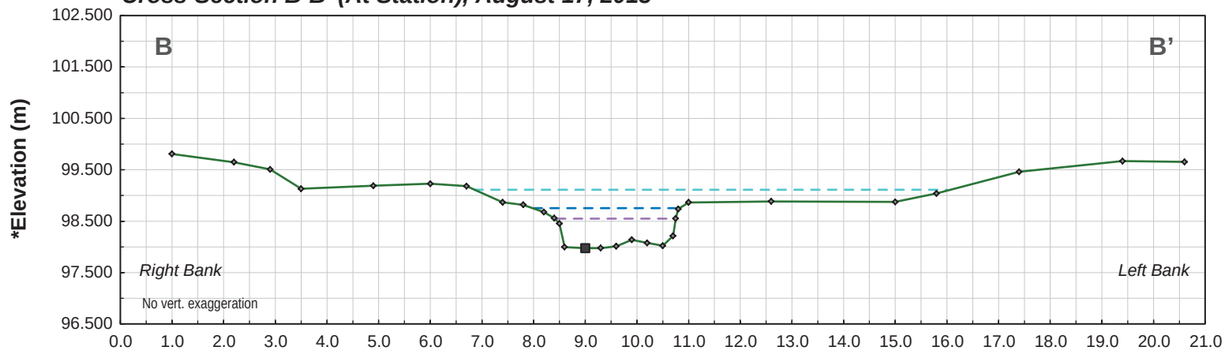
Appendix 4-12

WR-H1 Cross-Sections

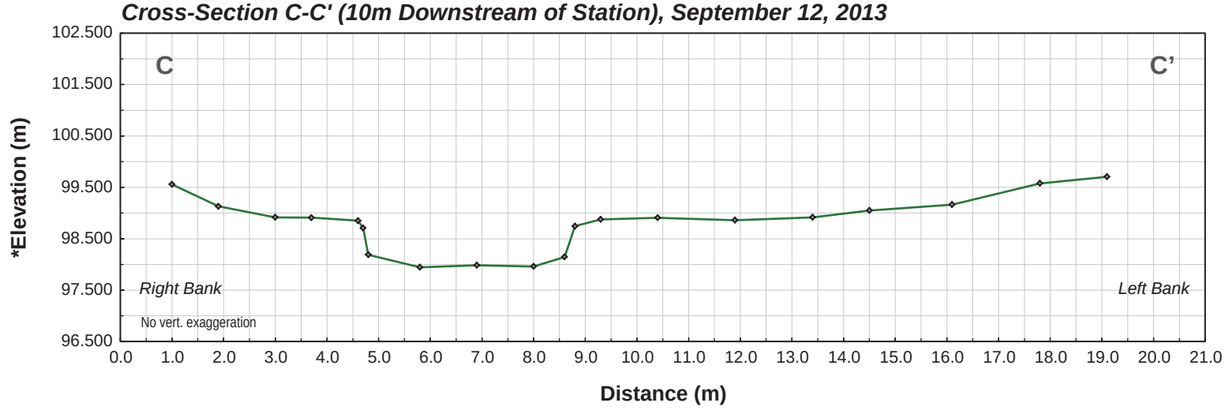
Cross-Section A-A' (15m Upstream of Station), September 12, 2013



Cross-Section B-B' (At Station), August 17, 2013

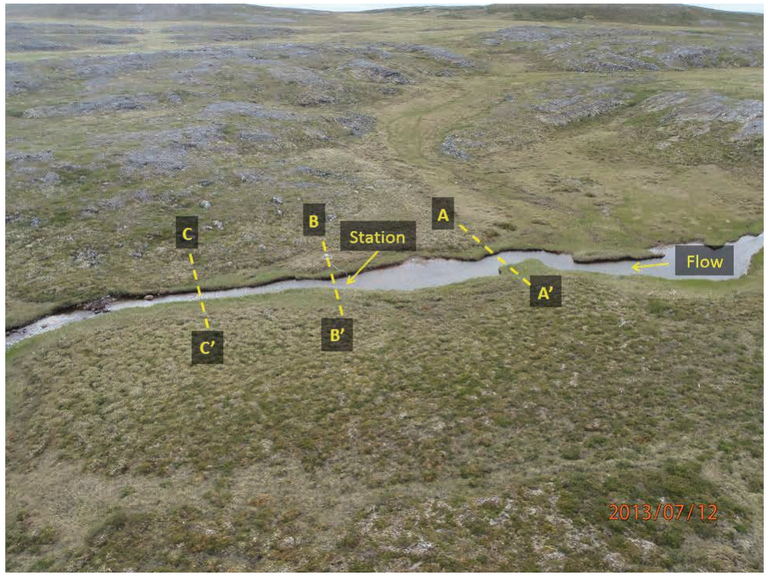


Cross-Section C-C' (10m Downstream of Station), September 12, 2013

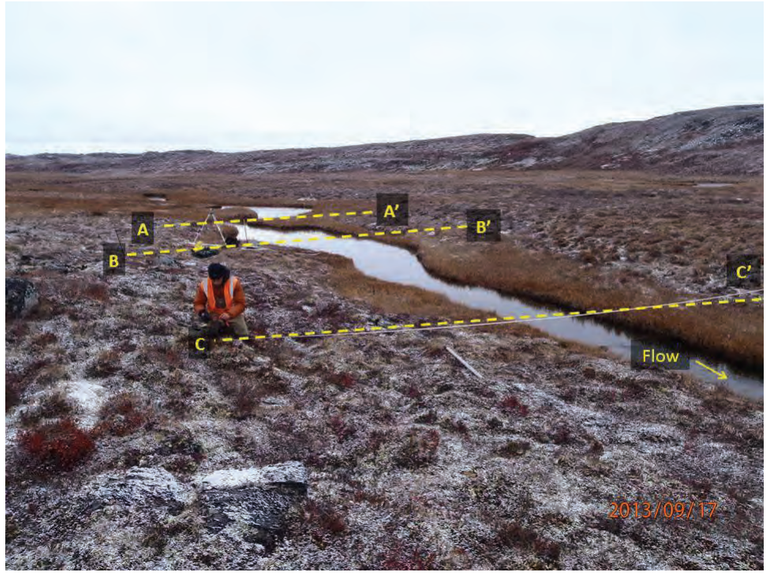


Notes: Water levels are referenced to a site specific non-geodetic datum.
Minimum, mean, and maximum discharge values are calculated from recorded water level data for the 2013 period of record.
Recorded values may differ from values for periods of record that include estimated data.
cms = cubic meters per second (m^3/s).

- 2013 Maximum Daily Discharge = 1.49 cms (Jun 7)
- 2013 Mean Daily Discharge = 0.26 cms
- 2013 Minimum Daily Discharge = 0.013 cms (Aug 16)
- Pressure Transducer



Aerial view of station KL-H1 and the surveyed channel reach – cross-sections A (15 m upstream of station), B (at station), and C (10 m downstream of station). July 12, 2013.



Upstream view of station KL-H1 and the surveyed channel reach. September 17, 2013.

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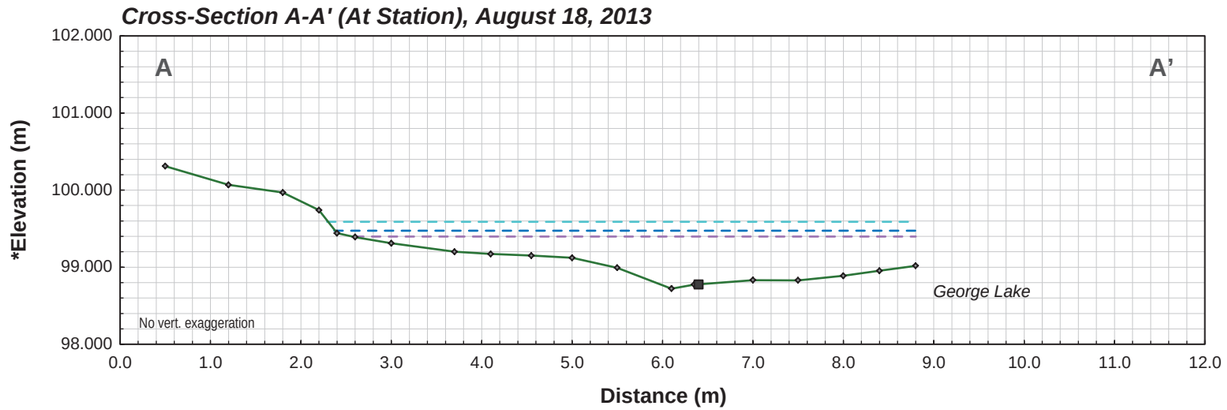
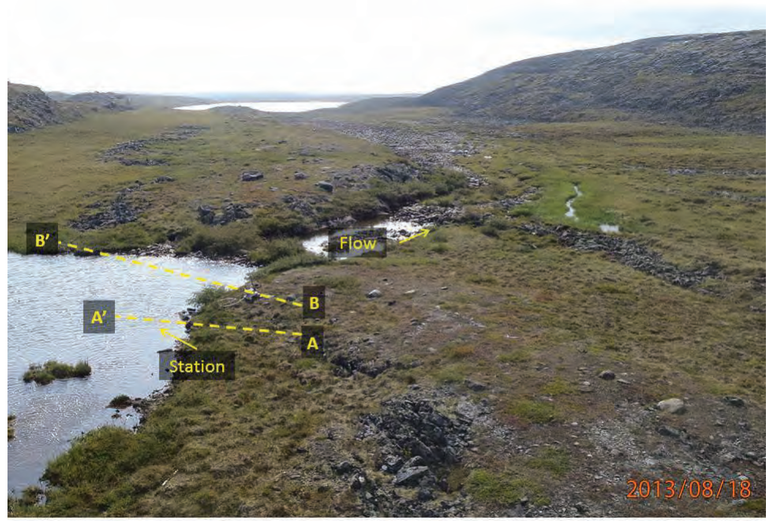
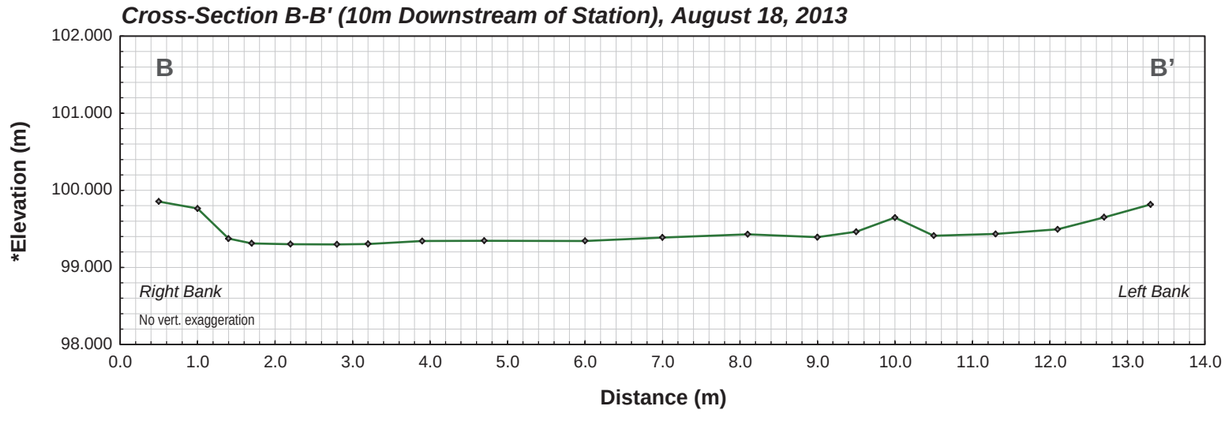
Appendix 4-13

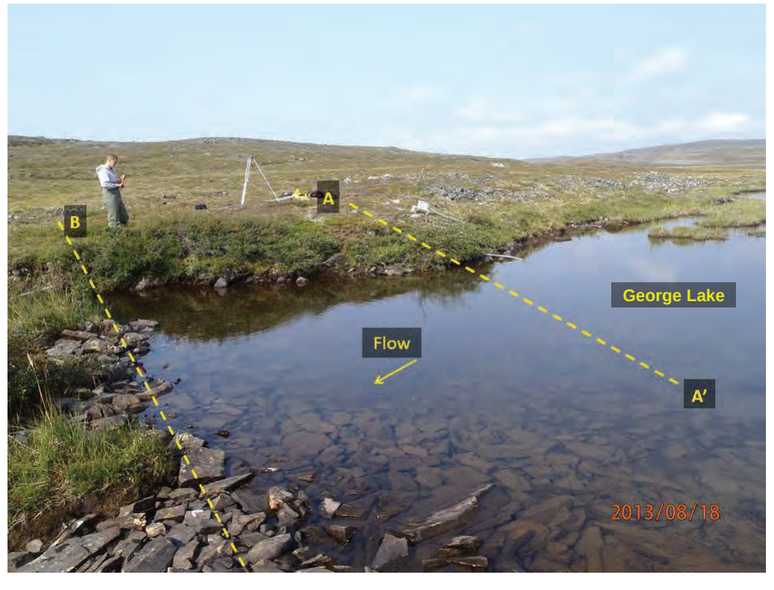
KL-H1 Cross-Sections





Aerial view of station KL-H2 and the surveyed channel reach – cross-sections A (shoreline profile at station) and B (lake outlet 10 m downstream of station). August 18, 2013.





Cross stream view of station KL-H2 and the surveyed channel reach. August 18, 2013.

Notes: Water levels are referenced to a site specific non-geodetic datum.
Minimum, mean, and maximum discharge values are calculated from recorded water level data for the 2013 period of record.
Recorded values may differ from values for periods of record that include estimated data.
cms = cubic meters per second (m^3/s).

- 2013 Maximum Daily Discharge = 0.36 cms (Jun 17)
- 2013 Mean Daily Discharge = 0.09 cms
- 2013 Minimum Daily Discharge = 0.007 cms (Aug 27)
- Pressure Transducer

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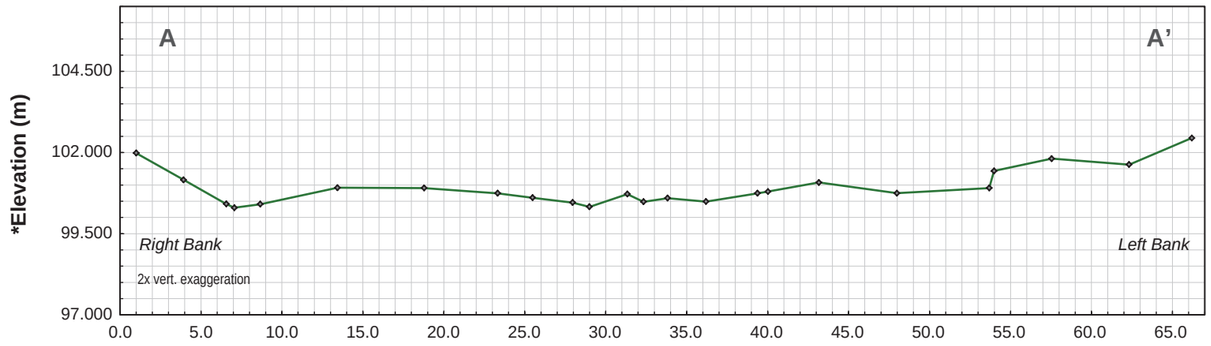
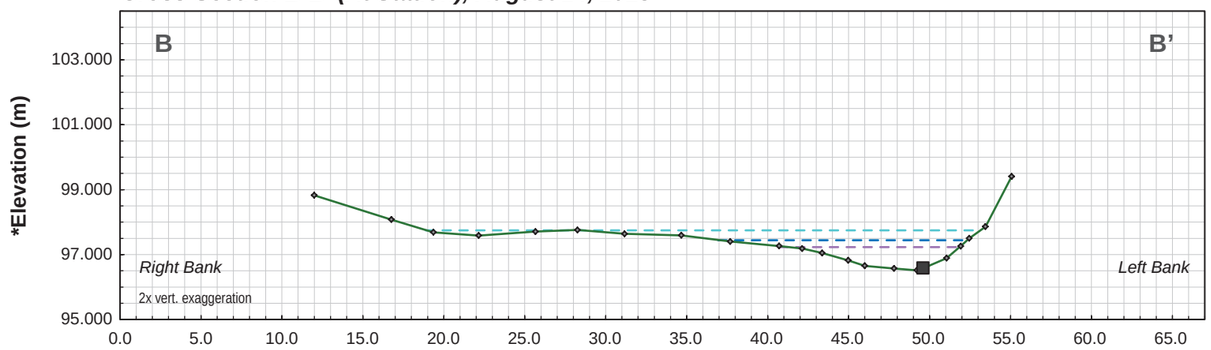
Appendix 4-14

KL-H2 Cross-Sections

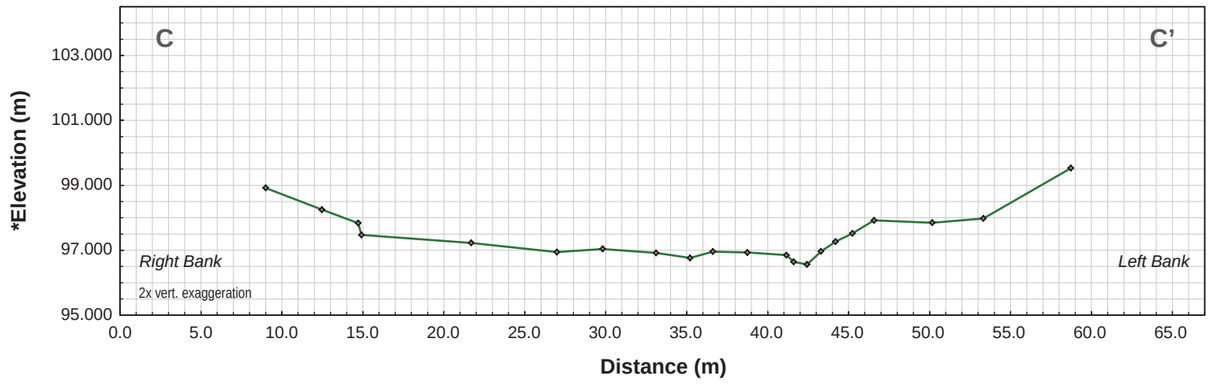
Cross-Section A-A' (30 m Upstream of Station), August 14, 2013



Cross-Section B-B' (At Station), August 14, 2013

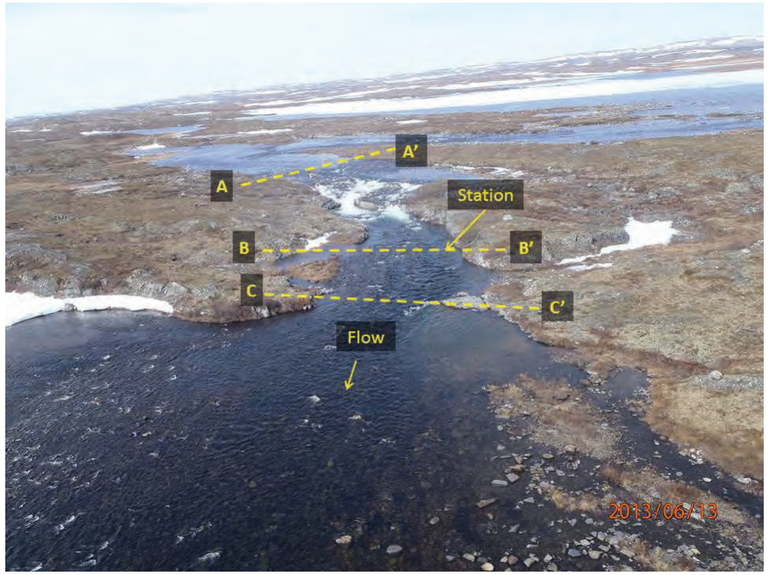


Cross-Section C-C' (10 m Downstream of Station), August 14, 2013

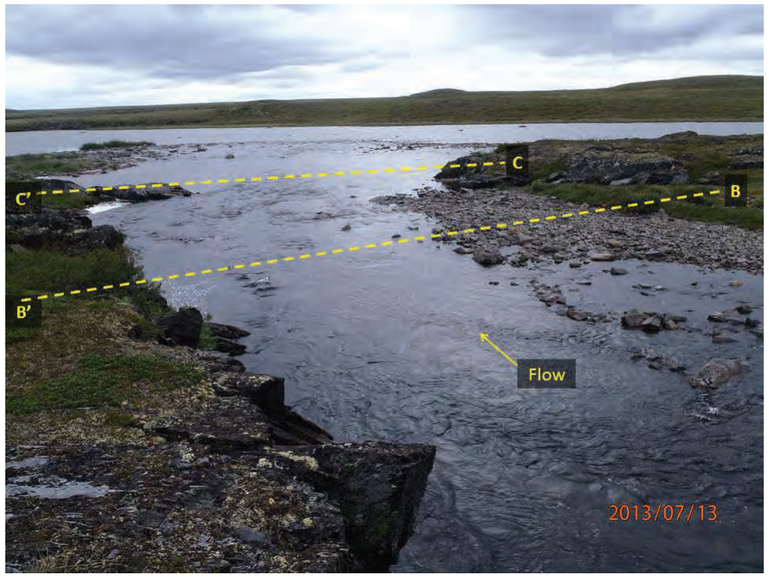


Notes: Water levels are referenced to a site specific non-geodetic datum.
Minimum, mean, and maximum discharge values are calculated from recorded water level data for the 2013 period of record.
Recorded values may differ from values for periods of record that include estimated data.
cms = cubic meters per second (m^3/s).

- 2013 Maximum Daily Discharge = 10.2 cms (Jun 12)
- 2013 Mean Daily Discharge = 3.0 cms
- 2013 Minimum Daily Discharge = 0.68 cms (Aug 18)
- Pressure Transducer



Aerial view of station LG-H1 and the surveyed channel reach – cross-sections A (30 m upstream of station), B (at station), and C (10 m downstream of station). June 13, 2013.



Downstream view of station LG-H1 and the surveyed channel reach. July 13, 2013.

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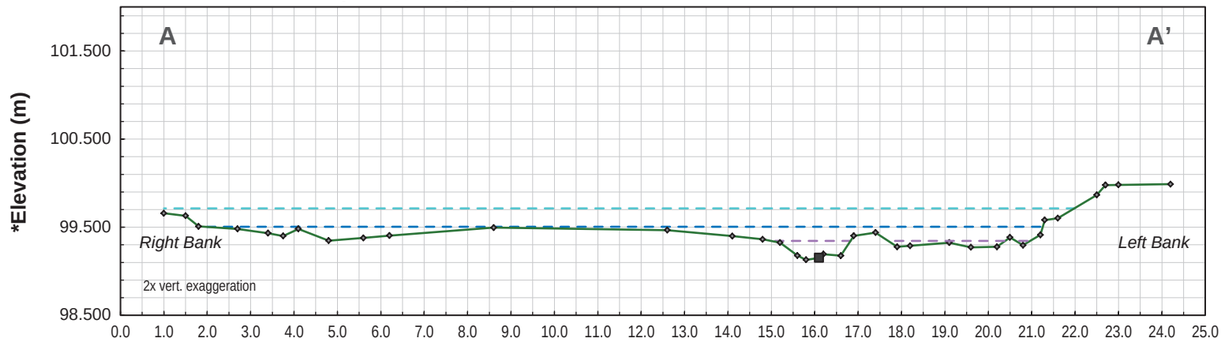
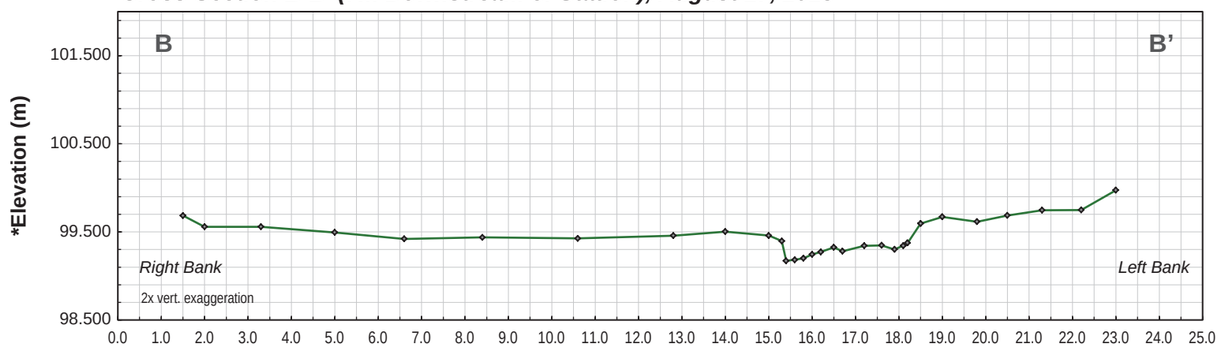
Appendix 4-15

LG-H1 Cross-Sections

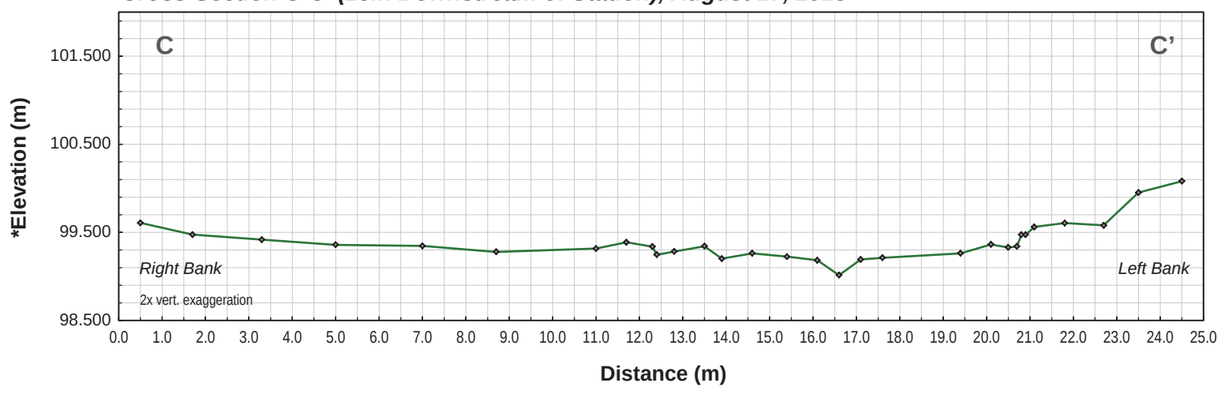
Cross-Section A-A' (At Station), July 21, 2013



Cross-Section B-B' (7m Downstream of Station), August 17, 2013

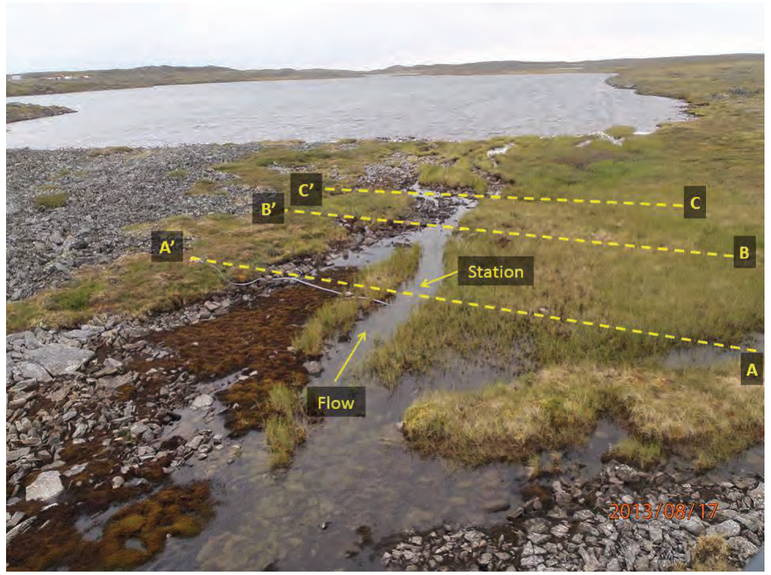


Cross-Section C-C' (15m Downstream of Station), August 17, 2013



Notes: Water levels are referenced to a site specific non-geodetic datum.
Minimum, mean, and maximum discharge values are calculated from recorded water level data for the 2013 period of record.
Recorded values may differ from values for periods of record that include estimated data.
cms = cubic meters per second (m^3/s).

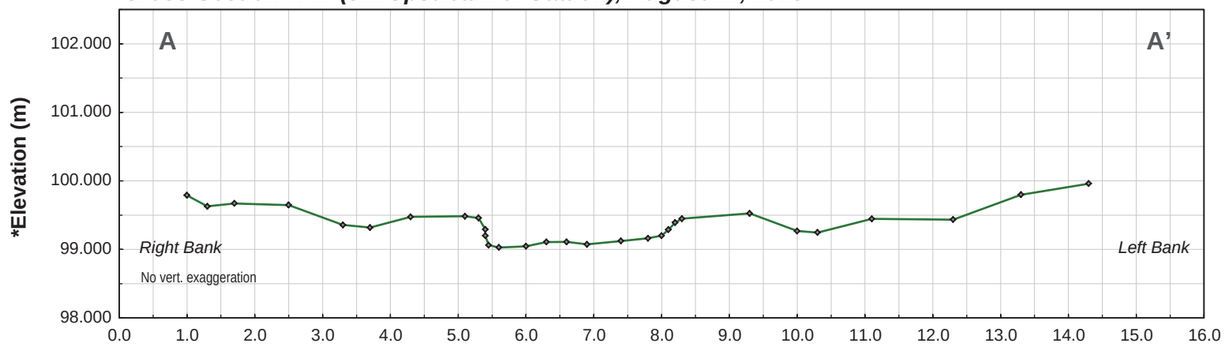
- 2013 Maximum Daily Discharge = 0.31 cms (Jun 10)
- 2013 Mean Daily Discharge = 0.050 cms
- 2013 Minimum Daily Discharge = 0.004 cms (Aug 19-20)
- Pressure Transducer

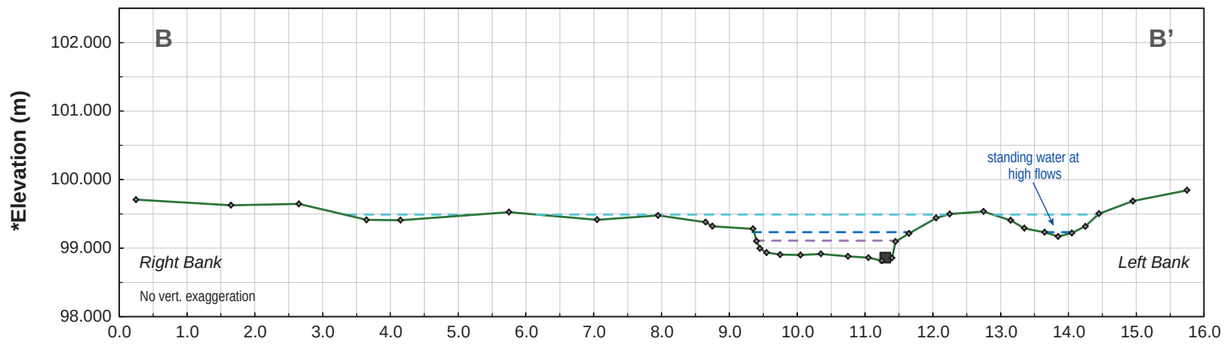


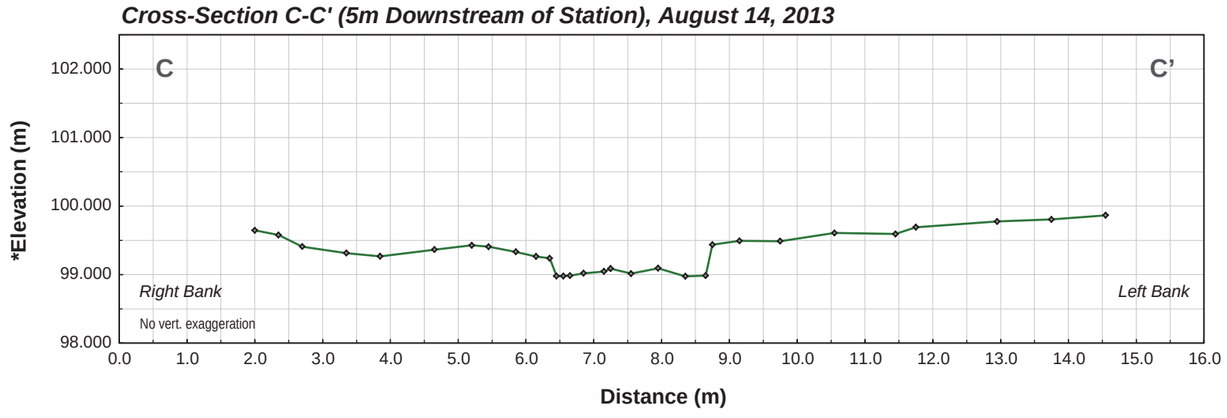
Aerial view of station LY-H1 and the surveyed channel reach – cross-sections A (at station), B (7 m downstream of station), and C (15 m downstream of station). August 17, 2013.

Upstream view of station LY-H1 and the surveyed channel reach. August 17, 2013.

LY-H1 Cross-Sections

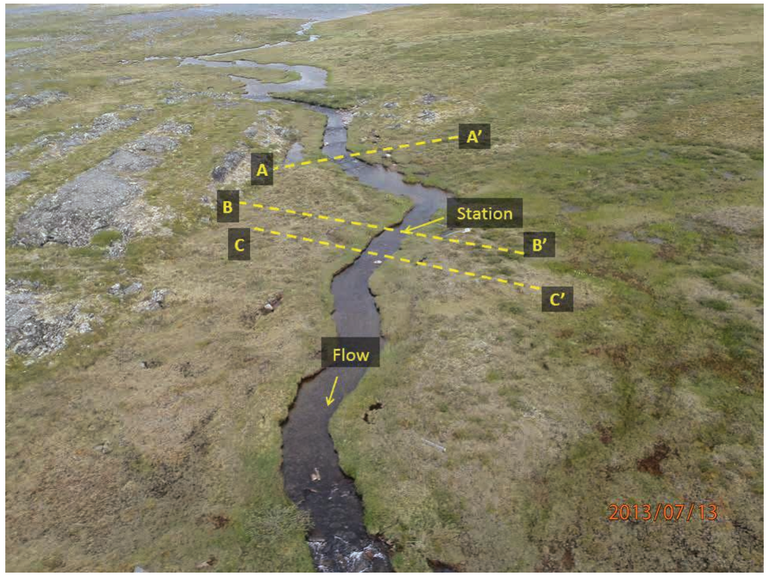




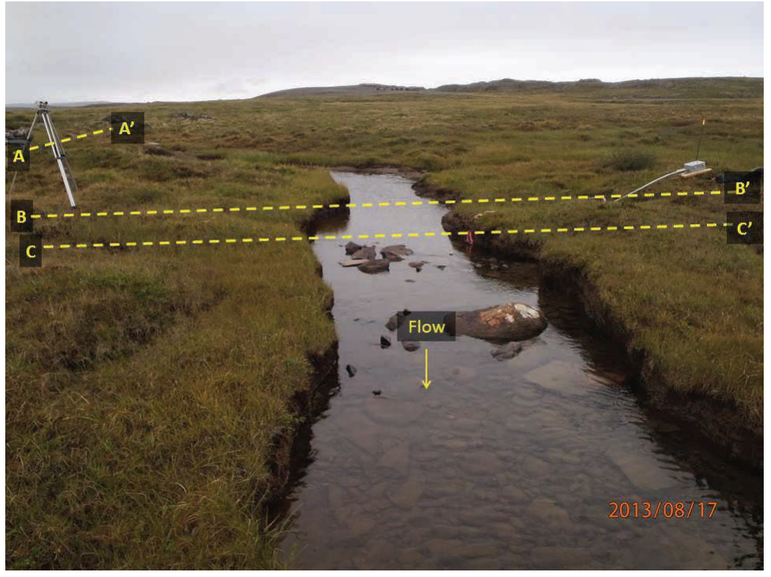


Notes: Water levels are referenced to a site specific non-geodetic datum.
Minimum, mean, and maximum discharge values are calculated from recorded water level data for the 2013 period of record.
Recorded values may differ from values for periods of record that include estimated data.
cms = cubic meters per second (m^3/s).

- 2013 Maximum Daily Discharge = 0.53 cms (Jun 10)
- 2013 Mean Daily Discharge = 0.12 cms
- 2013 Minimum Daily Discharge = 0.03 cms (Aug 17-19)
- Pressure Transducer



Aerial view of station SL-H1 and the surveyed channel reach – cross-sections A (8 m upstream of station), B (at station), and C (5 m downstream of station). July 13, 2013.



Upstream view of station SL-H1 and the surveyed channel reach. August 17, 2013.

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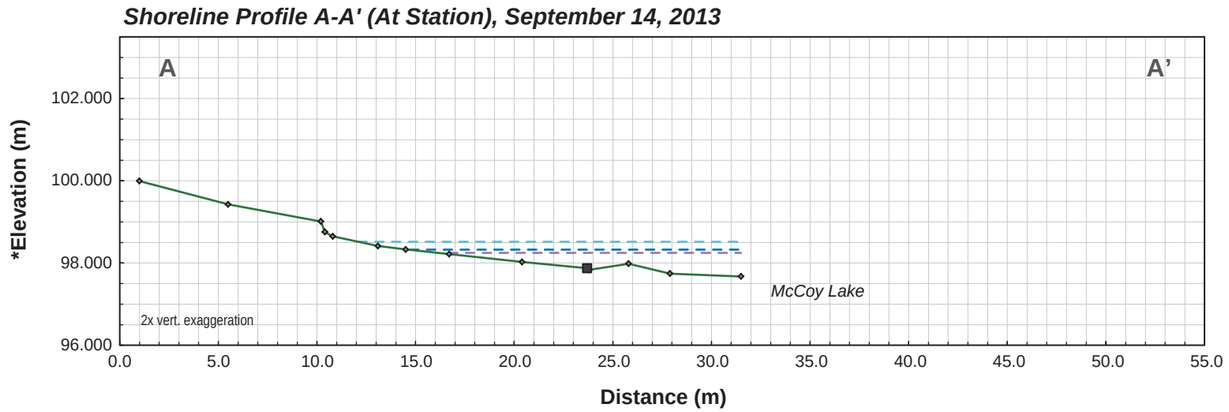
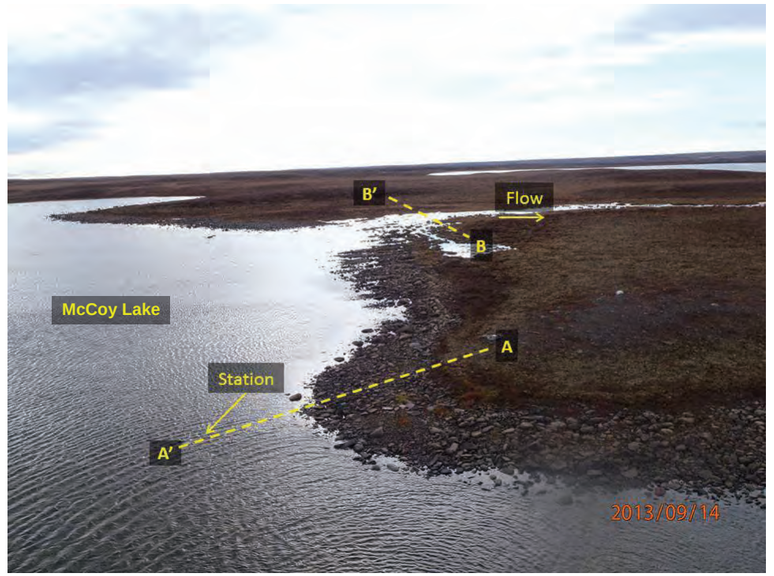
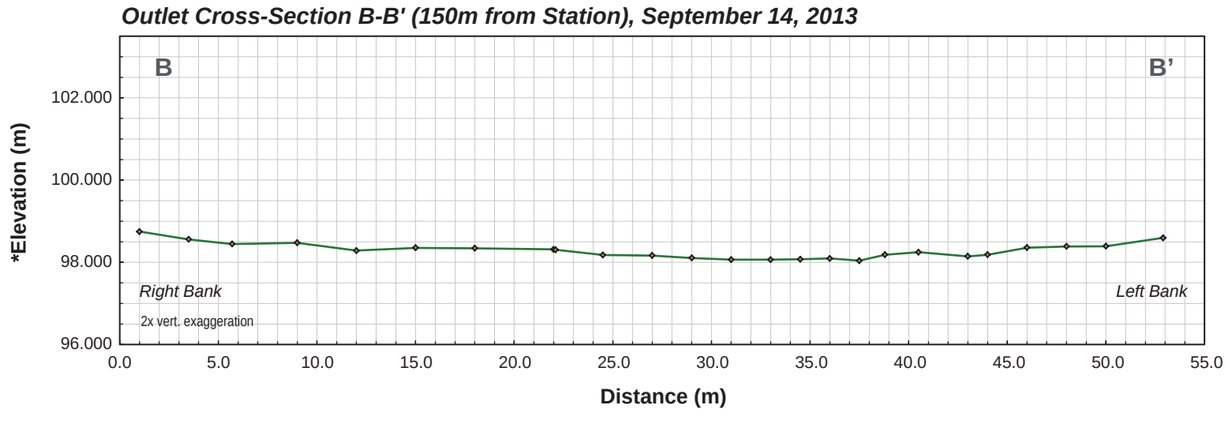
Appendix 4-17

SL-H1 Cross-Sections





Aerial view of station Mc-H1 and the surveyed channel reach – cross-sections A (shoreline profile at station) and B (lake outlet 150 m downstream of station). September 14, 2013.



View of the surveyed shoreline profile at station MC-H1. July 21, 2013.

Notes: Water levels are referenced to a site specific non-geodetic datum.
Minimum, mean, and maximum discharge values are calculated from recorded water level data for the 2013 period of record.
Recorded values may differ from values for periods of record that include estimated data.
cms = cubic meters per second (m^3/s).

2013 Maximum Daily Discharge = 0.32 cms (Jun 10)
2013 Mean Daily Discharge = 0.04 cms
2013 Minimum Daily Discharge = 0.001 cms (Aug 16-17 and 21-25)
Pressure Transducer

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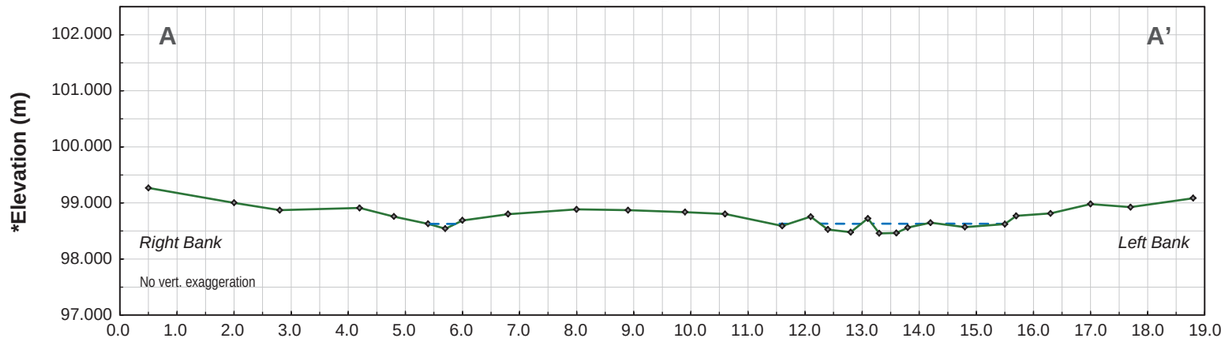
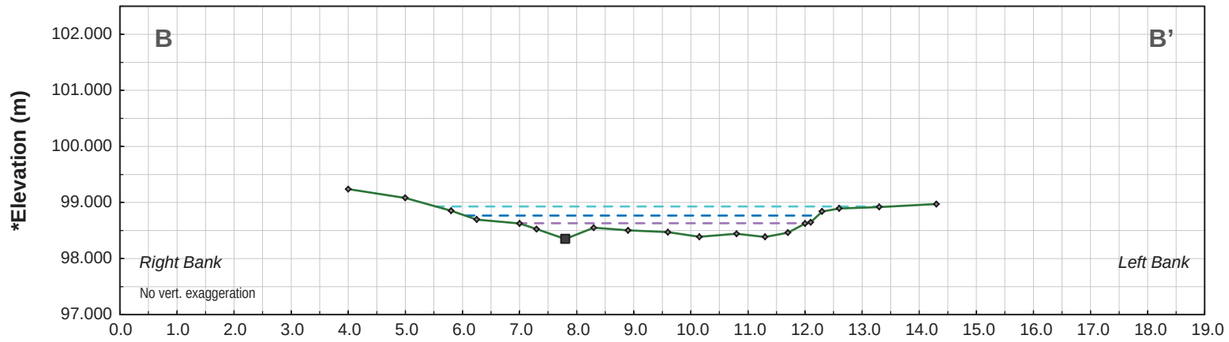
MC-H1 Cross-Sections

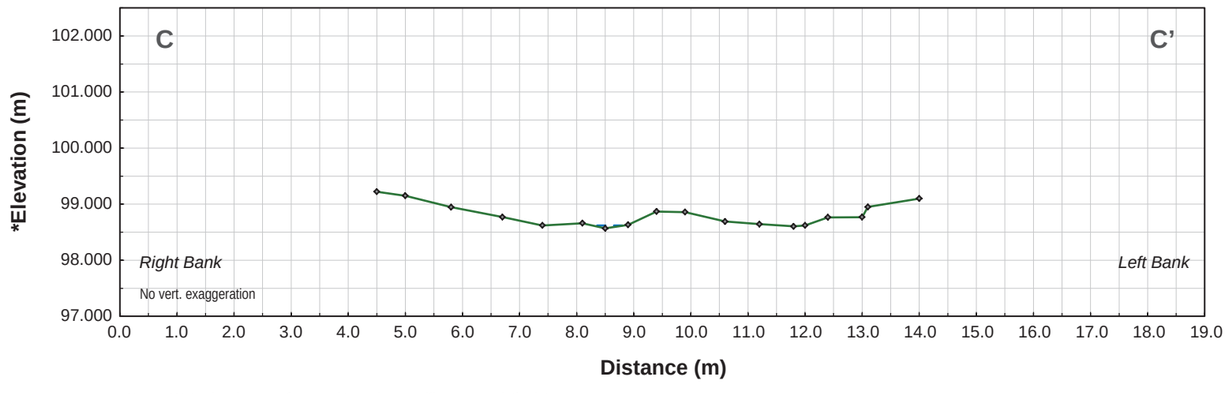
Cross-Section A-A' (7m Upstream of Station), August 18, 2013



Cross-Section B-B' (At Station), August 18, 2013



Cross-Section C-C' (2m Downstream of Station), August 18, 2013



Notes: Water levels are referenced to a site specific non-geodetic datum.
Minimum, mean, and maximum discharge values are calculated from recorded water level data for the 2013 period of record.
Recorded values may differ from values for periods of record that include estimated data.
cms = cubic meters per second (m^3/s).

- 2013 Maximum Daily Discharge = 0.35 cms (Jun 17)
- 2013 Mean Daily Discharge = 0.07 cms
- 2013 Minimum Daily Discharge = 0.0002 cms (Aug 16)
- Pressure Transducer

Aerial view of station REFQ-H1 and the surveyed channel reach – cross-sections A (7 m upstream of station), B (at station), and C (2 m downstream of station). July 12, 2013.

Downstream view of station REFQ-H1 and the surveyed channel reach. June 12, 2013.

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Appendix 4-19

REFQ-H1 Cross-Sections

Appendix 5
Rating Curves

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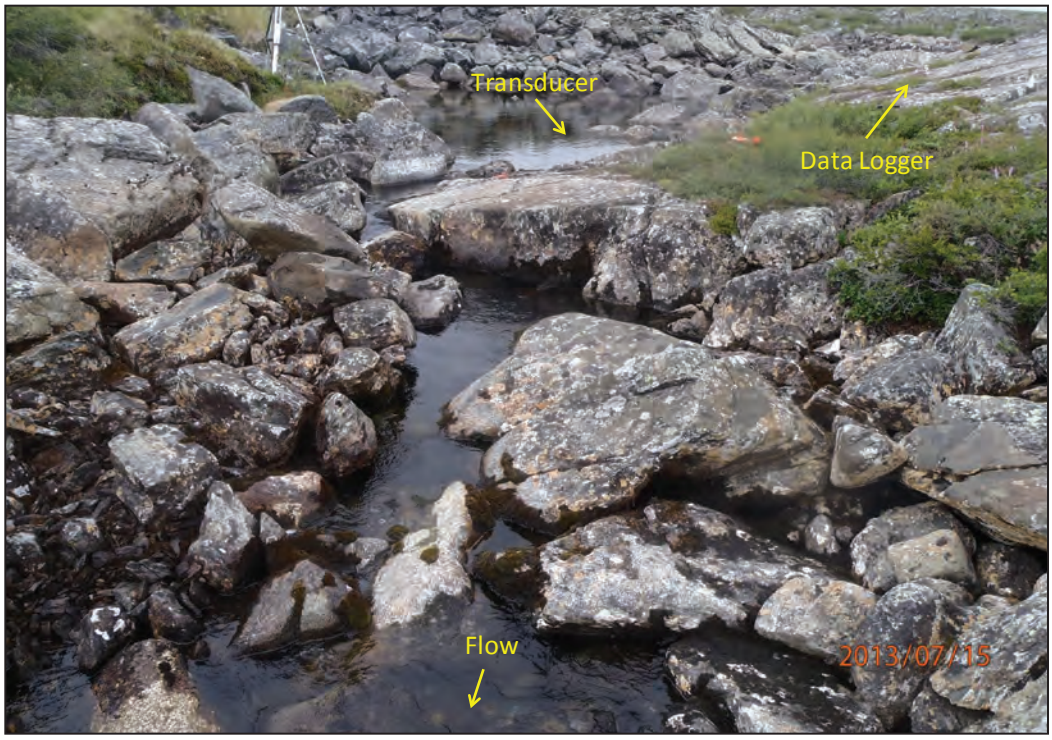
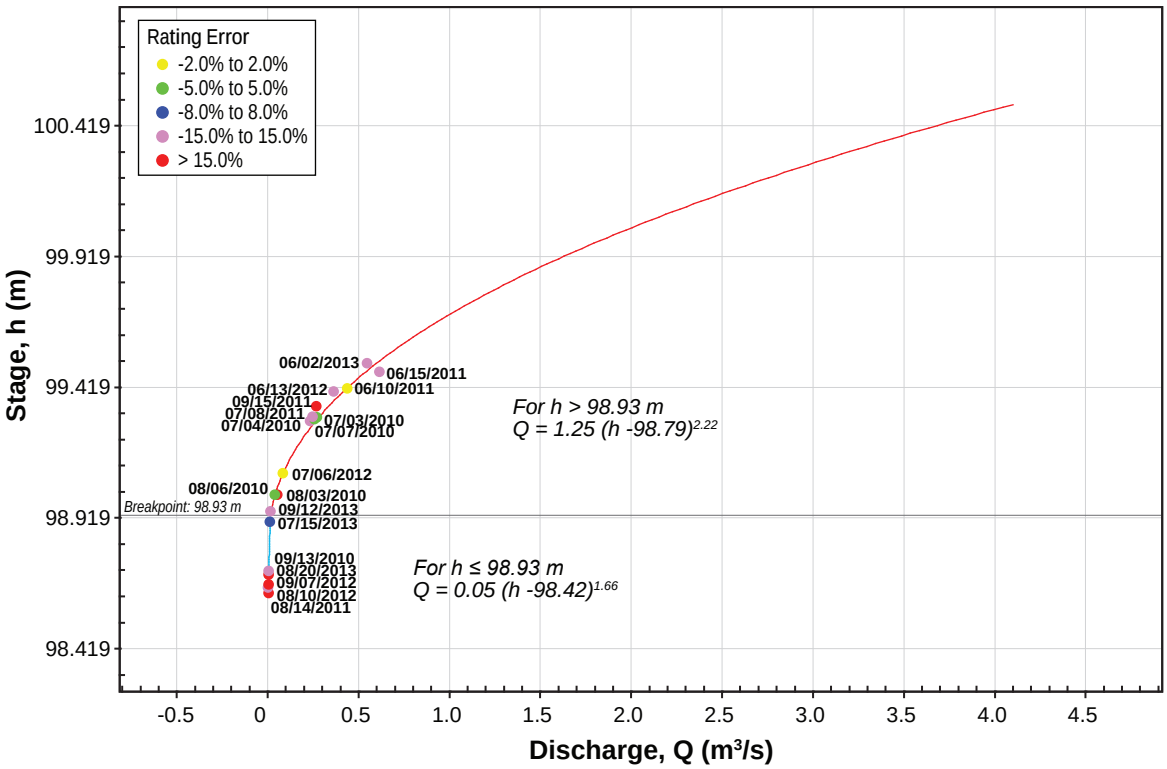


GL-H1, looking upstream toward the station. July 15, 2013.



Notes: Rating period from July 3, 2010 to September 12, 2013.
Pressure transducer stage readings are referenced to local (non geodetic) datum.

Figure A5-1

GL-H1
Stage-Discharge Rating Curve

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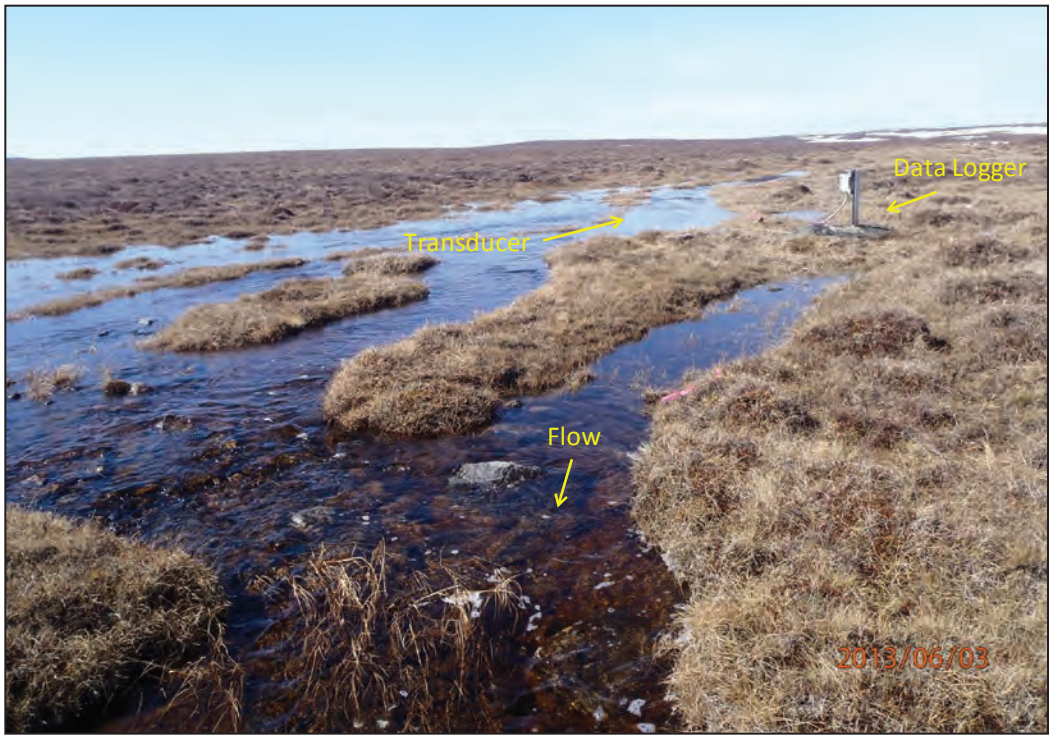
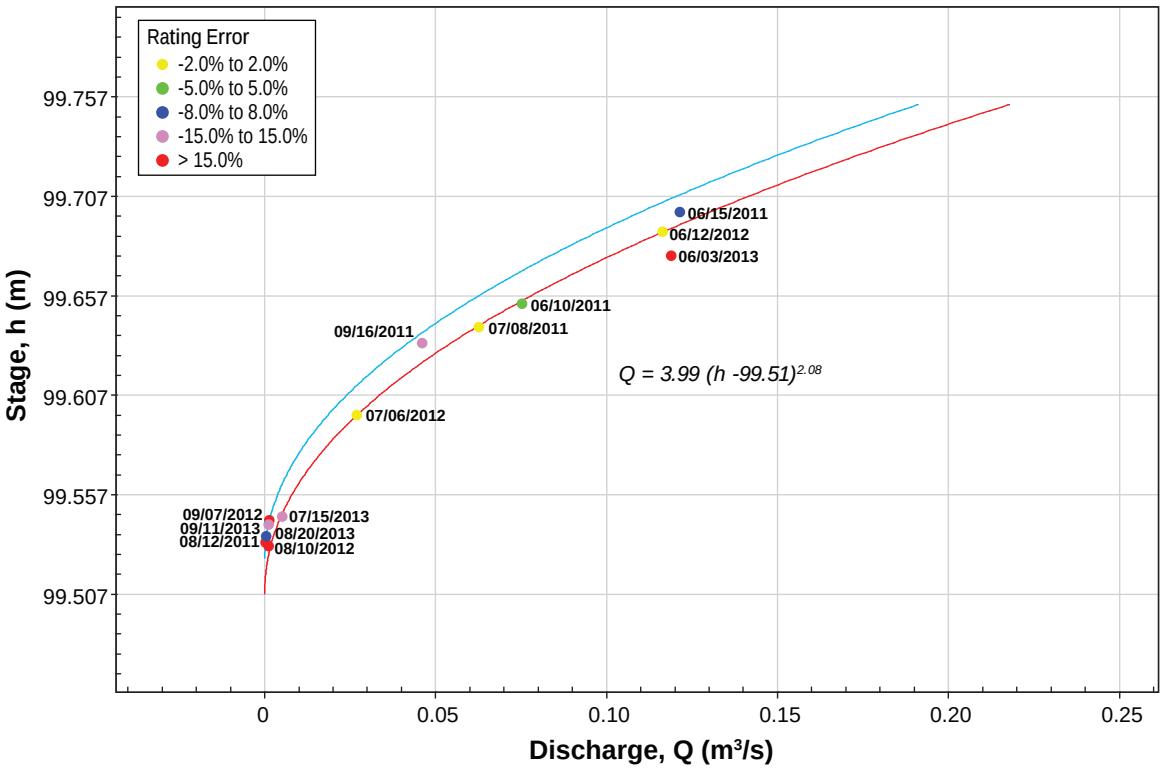


GL-H2, looking upstream toward the station. June 3, 2013.

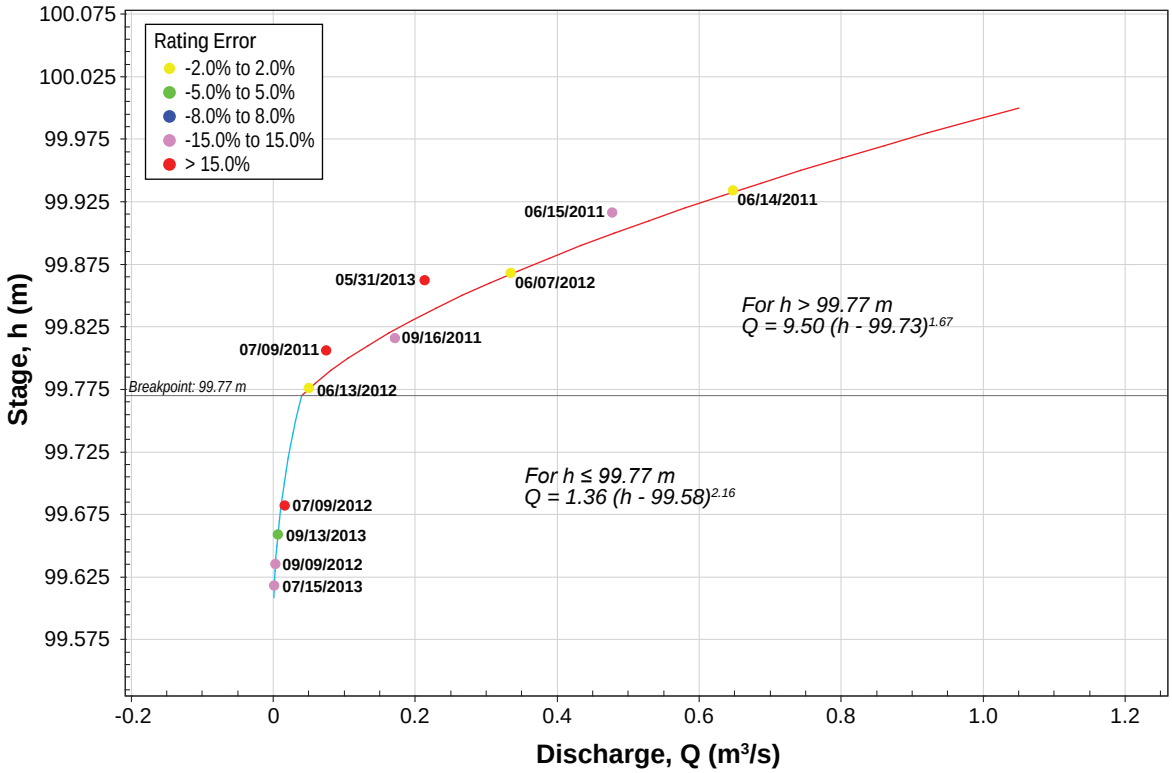


Notes: Rating period from June 10, 2011 to September 11, 2013; shift in effect between August and September for all years.
Blue line indicates shifted rating curve due to backwater effect during low flow periods.
Pressure transducer stage readings are referenced to local (non geodetic) datum.

Figure A5-2

GL-H2
Stage-Discharge Rating Curve

GL-H3, looking downstream toward the station. May 31, 2013.

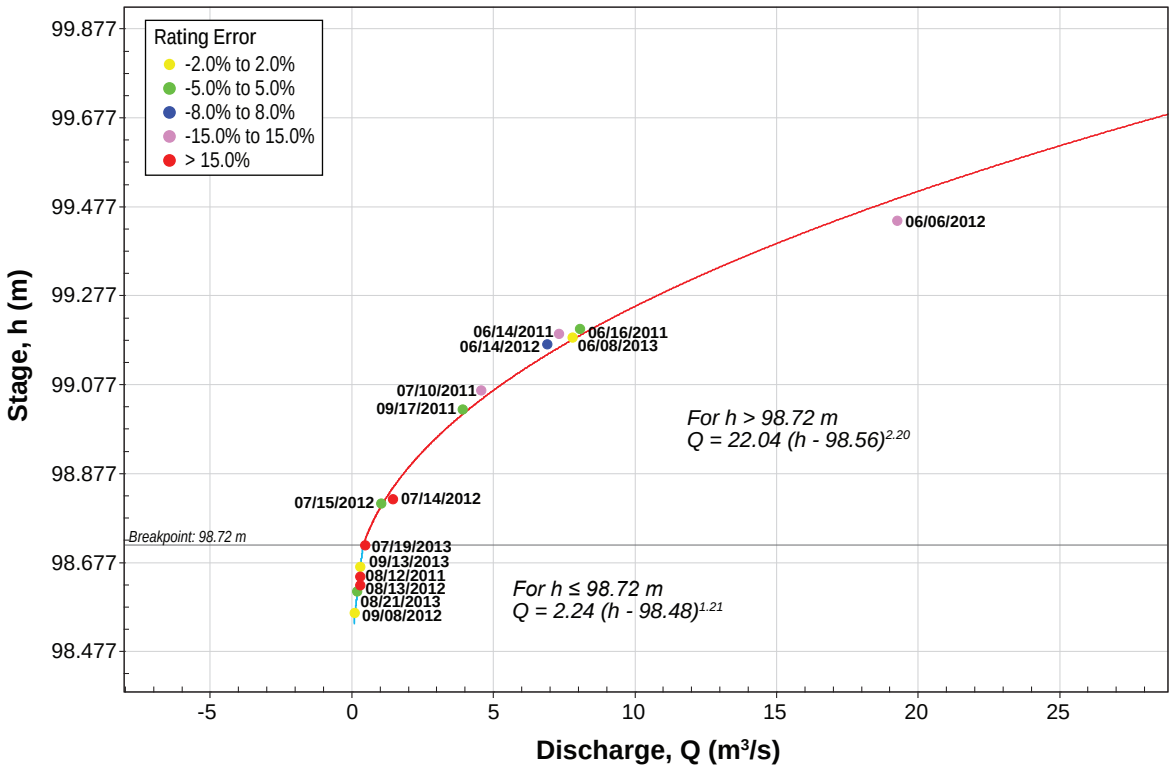


Notes: Rating period from June 14, 2011 to September 13, 2013.
Pressure transducer stage readings are referenced to local (non geodetic) datum.

Figure A5-3

GL-H3
Stage-Discharge Rating Curve

PL-H1, looking downstream toward the station and lake outlet. September 13, 2013.



Notes: Rating period from June 14, 2011 to September 13, 2013.
Pressure transducer stage readings are referenced to local (non geodetic) datum.

Figure A5-4

PL-H1
Stage-Discharge Rating Curve

Sabina GOLD & SILVER CORP.

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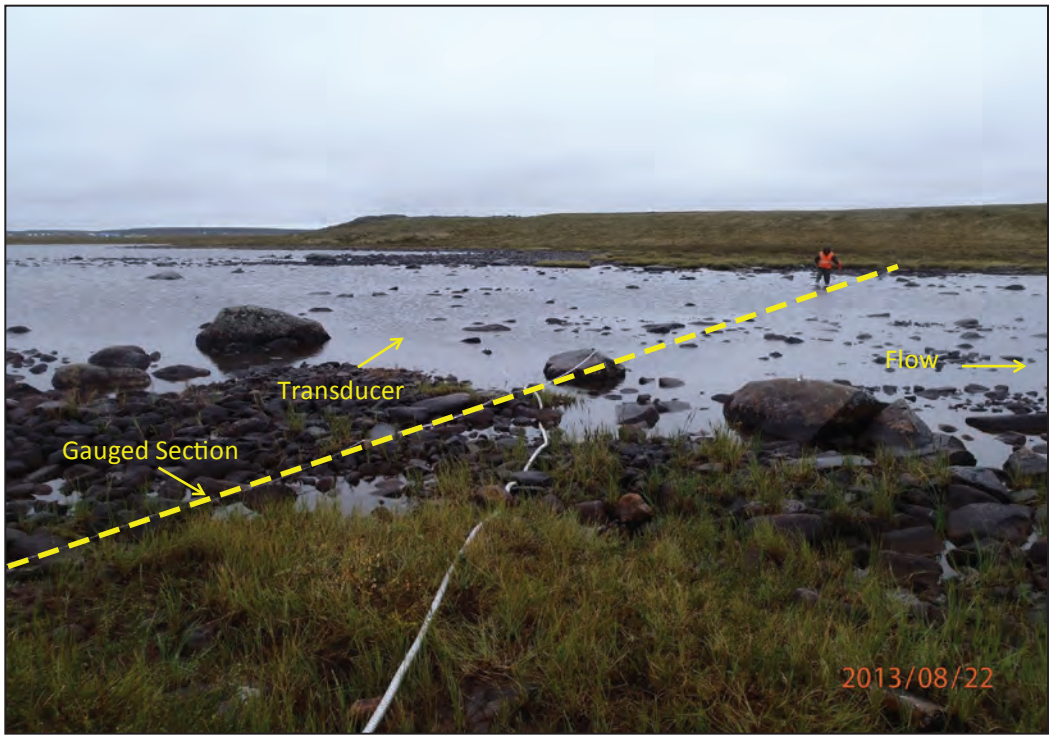
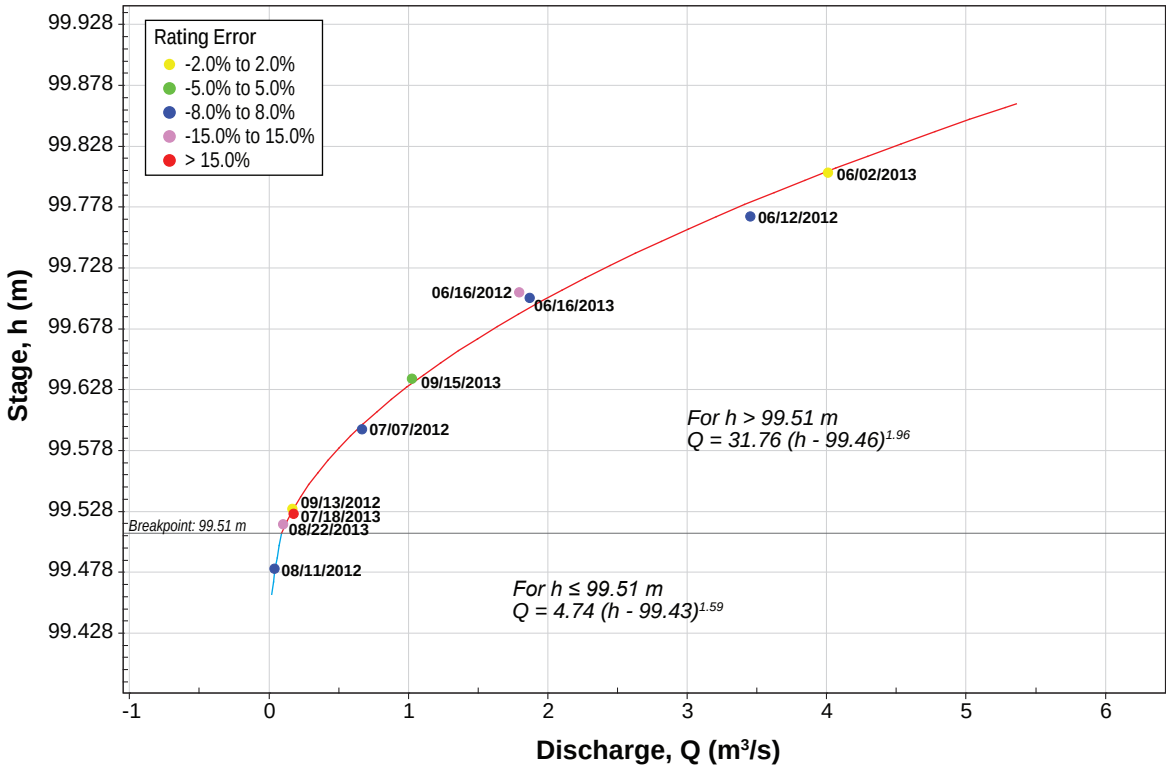


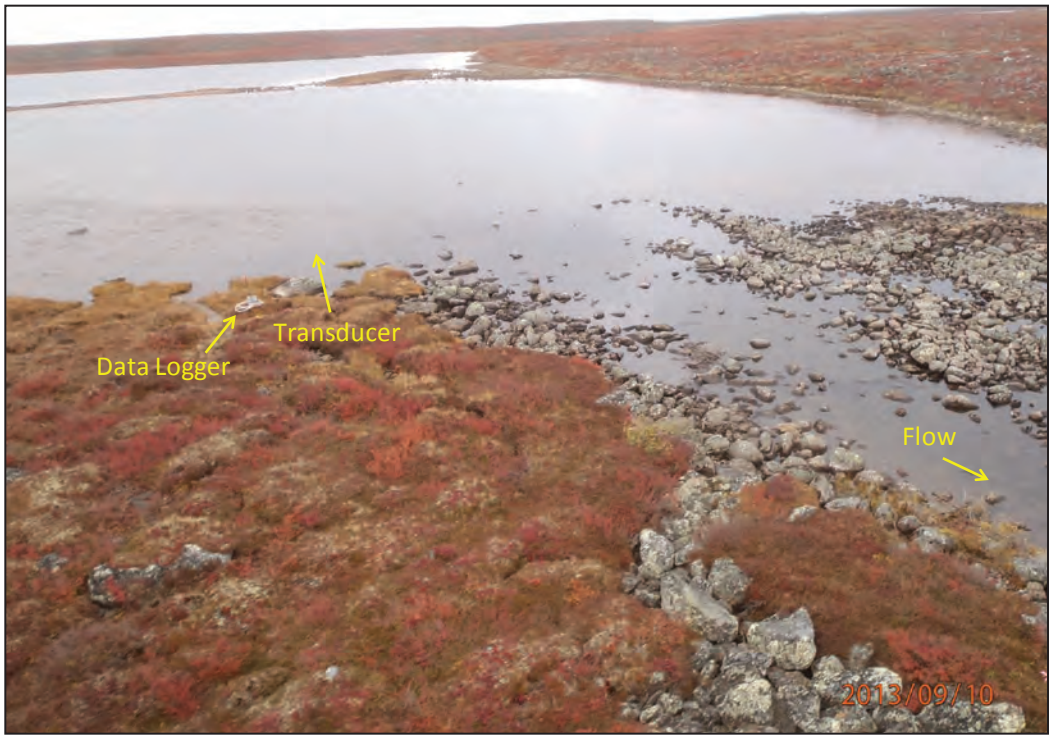
PL-H2, looking cross stream toward the station and gauged section. August 22, 2013.



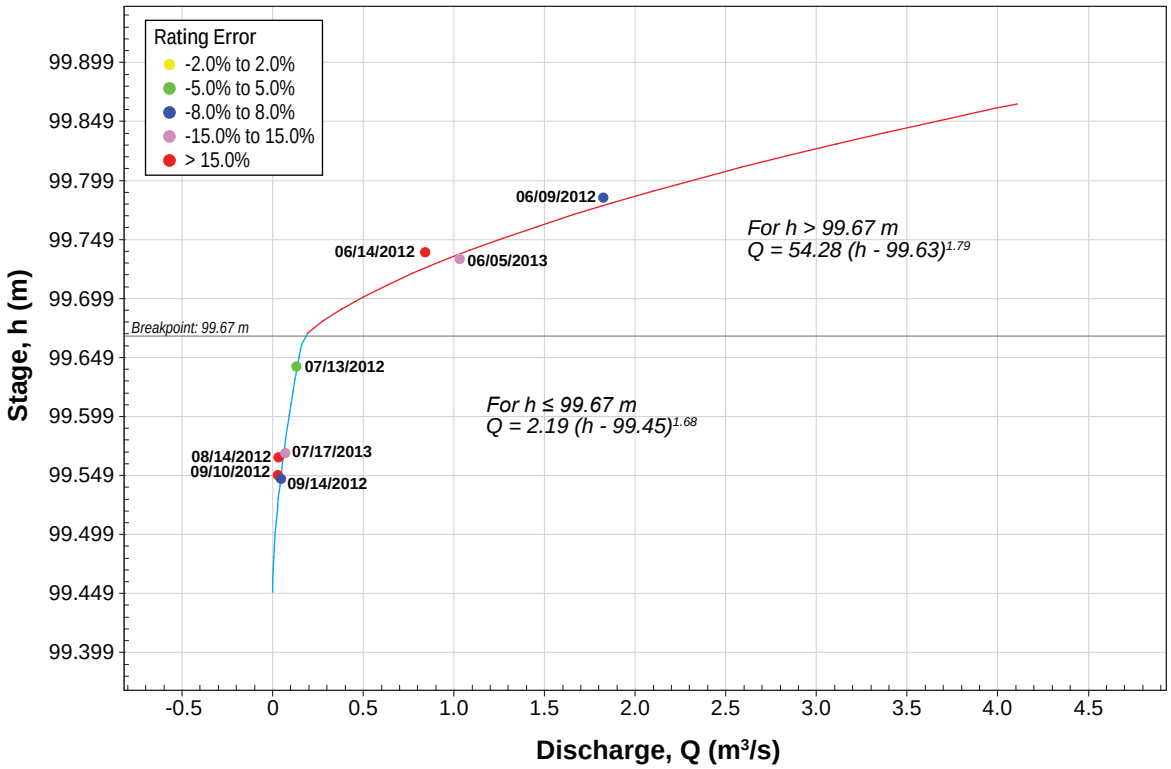
Notes: Rating period from June 12, 2012 to September 15, 2013.
Pressure transducer stage readings are referenced to local (non geodetic) datum.

Figure A5-5

PL-H2
Stage-Discharge Rating Curve



GI-H1, looking toward the station and lake outlet. September 10, 2013.



Notes: Rating period from June 09, 2012 to September 19, 2013.
Pressure transducer stage readings are referenced to local (non geodetic) datum.

Figure A5-6

GI-H1
Stage-Discharge Rating Curve

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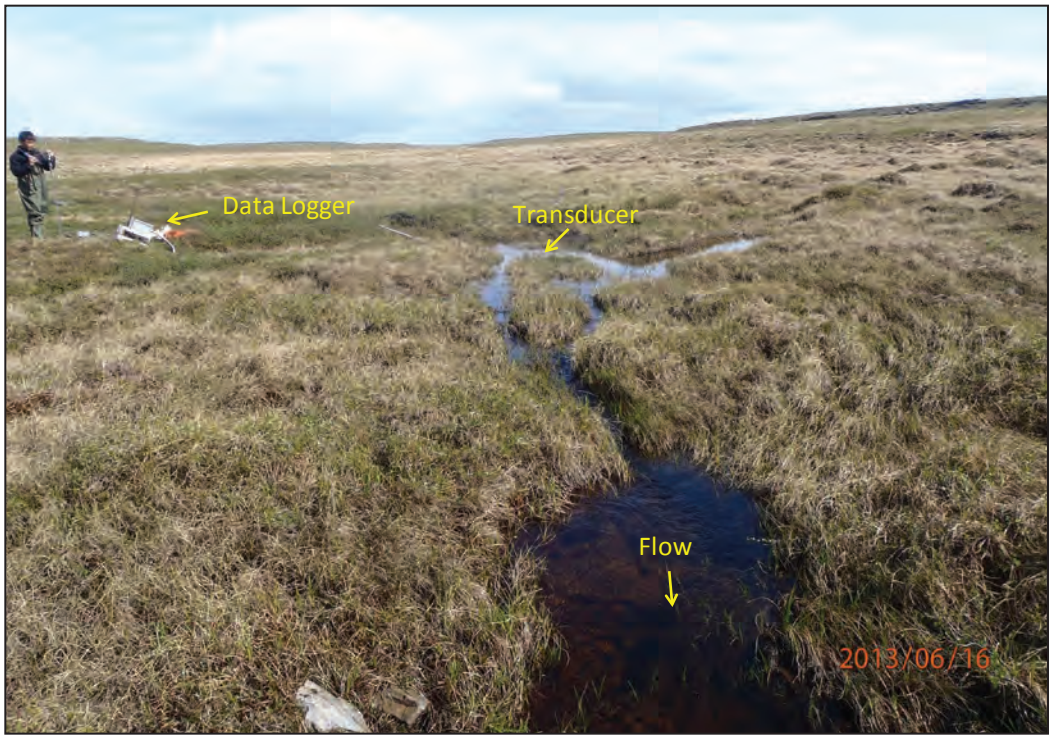
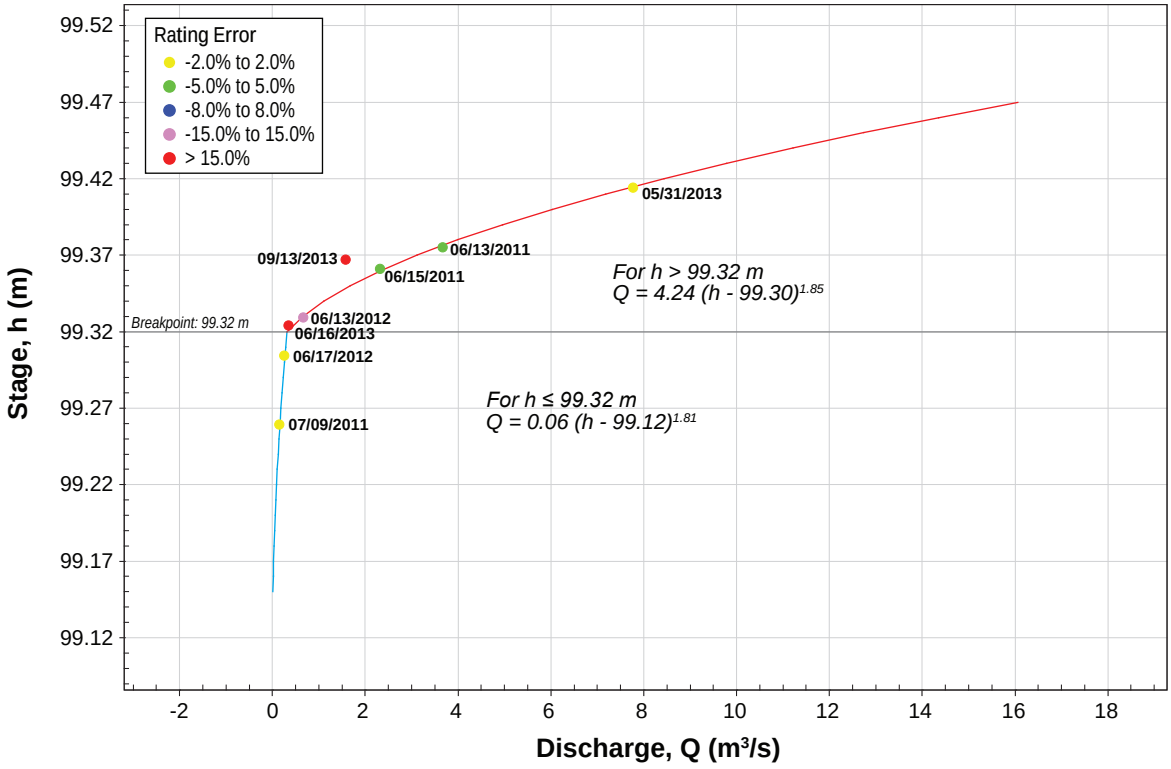


EL-H1, looking upstream toward the station. June 16, 2013.



Notes: Rating period from June 13, 2011 to September 13, 2013.
Pressure transducer stage readings are referenced to local (non geodetic) datum.

Figure A5-7

EL-H1
Stage-Discharge Rating Curve

Sabina GOLD & SILVER CORP.

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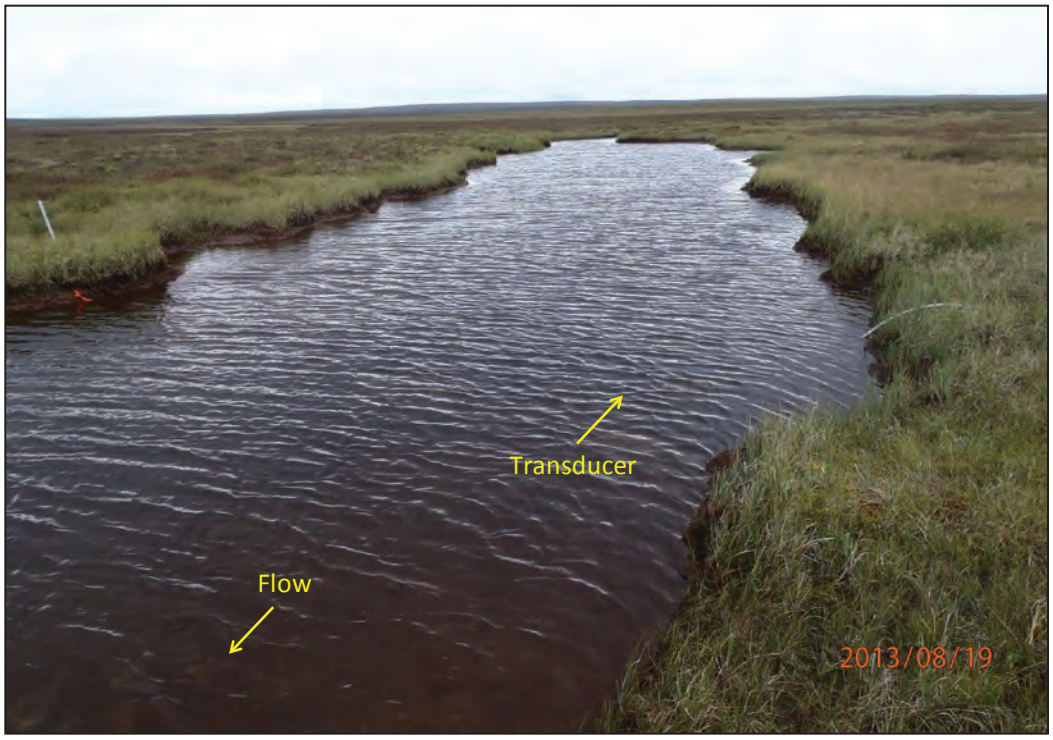
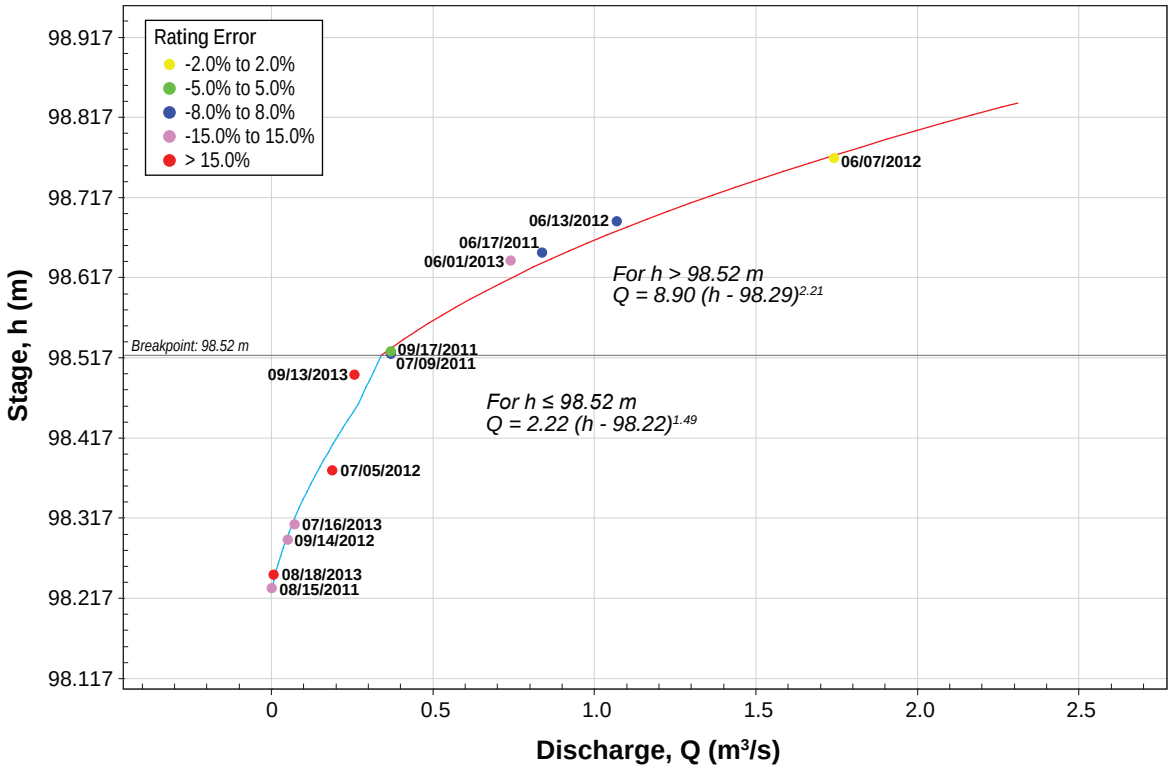


WL-H1, looking upstream toward the station. August 19, 2013.



Notes: Rating period from June 17, 2011 to September 13, 2013.
Pressure transducer stage readings are referenced to local (non geodetic) datum.

Figure A5-8

WL-H1
Stage-Discharge Rating Curve

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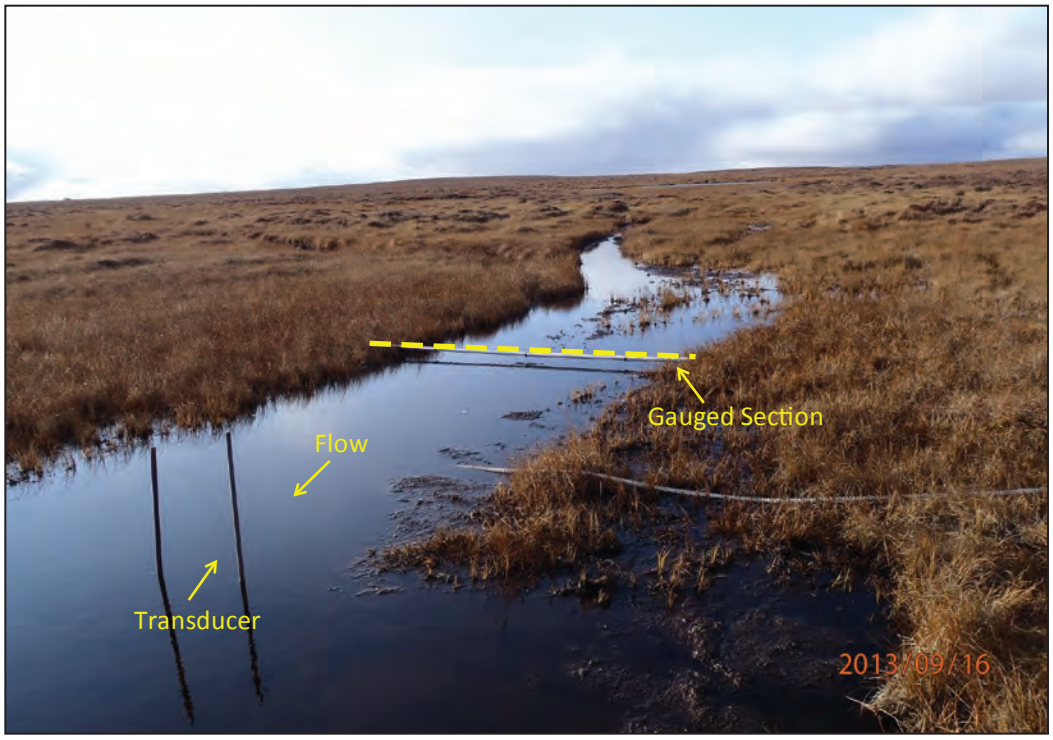
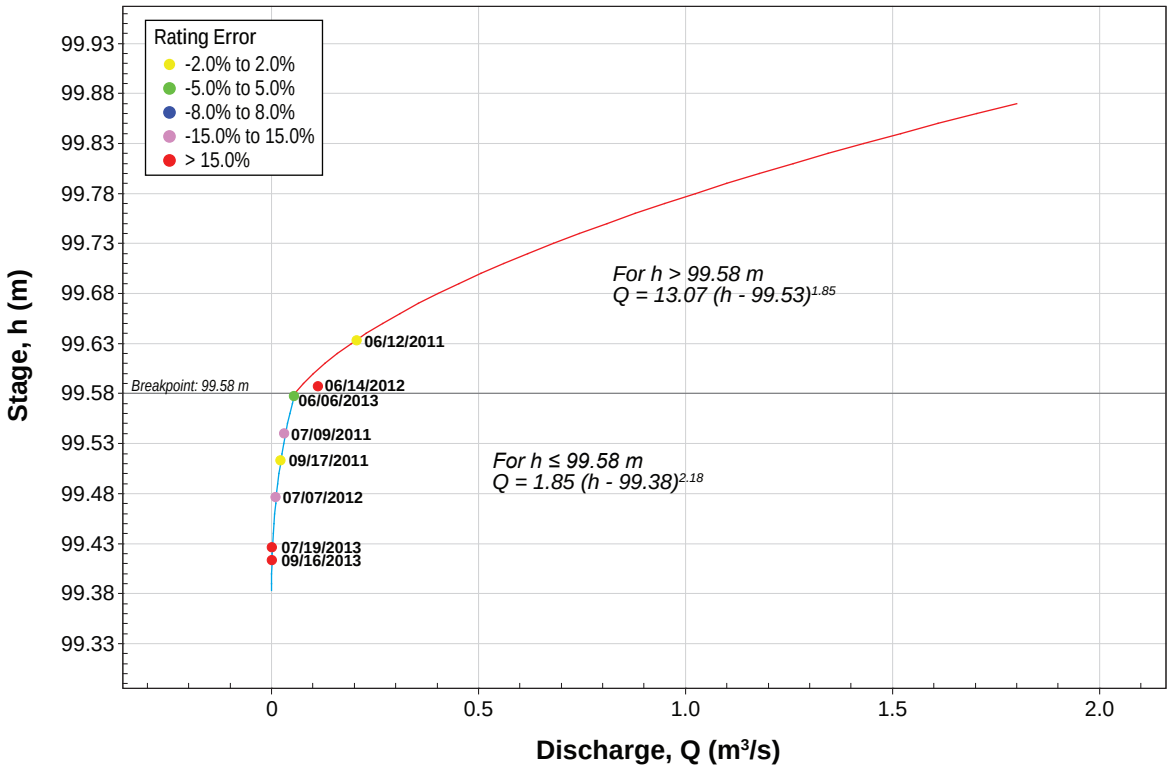


REFB-H1, looking upstream toward the station and gauged section. September 16, 2013.



Notes: Rating period from June 12, 2011 to September 16, 2013.
Pressure transducer stage readings are referenced to local (non geodetic) datum.

Figure A5-9

REFB-H1
Stage-Discharge Rating Curve

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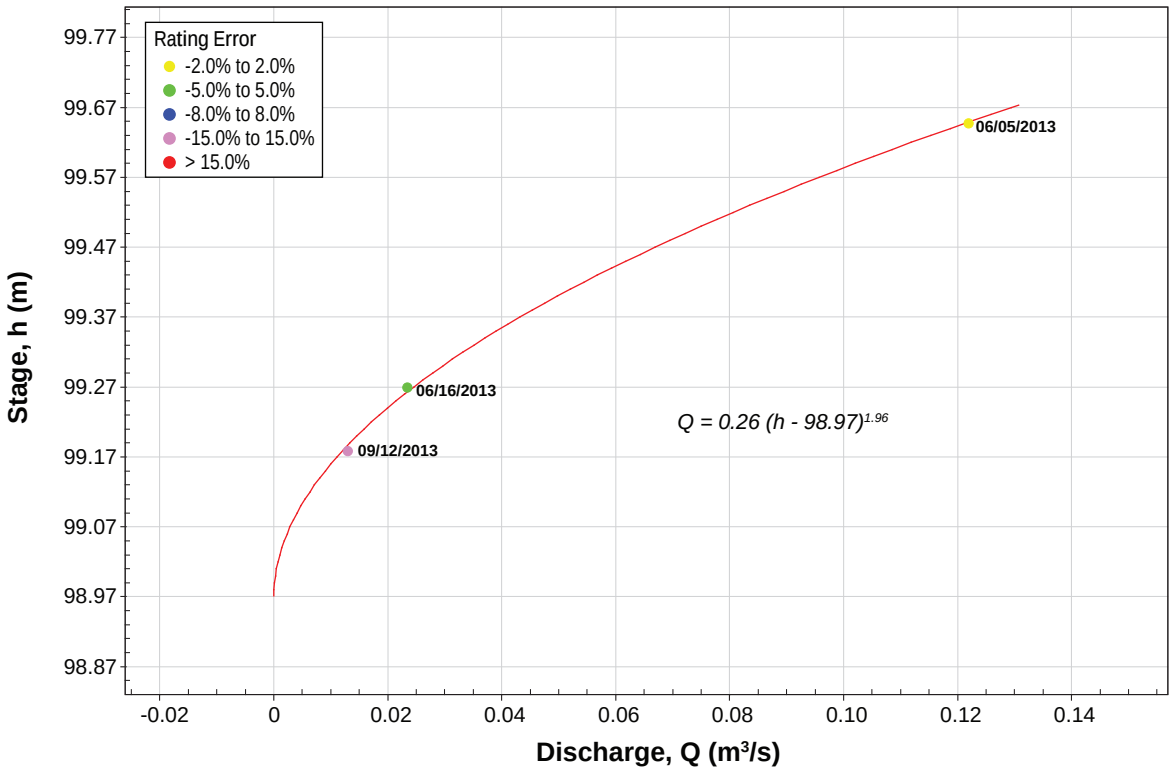
TIA-H1, looking downstream toward the station. June 5, 2013.



Notes: Rating period from June 5, 2013 to September 12, 2013.
Pressure transducer stage readings are referenced to local (non geodetic) datum.

Figure A5-10

TIA-H1 Preliminary Stage-Discharge Rating Curve

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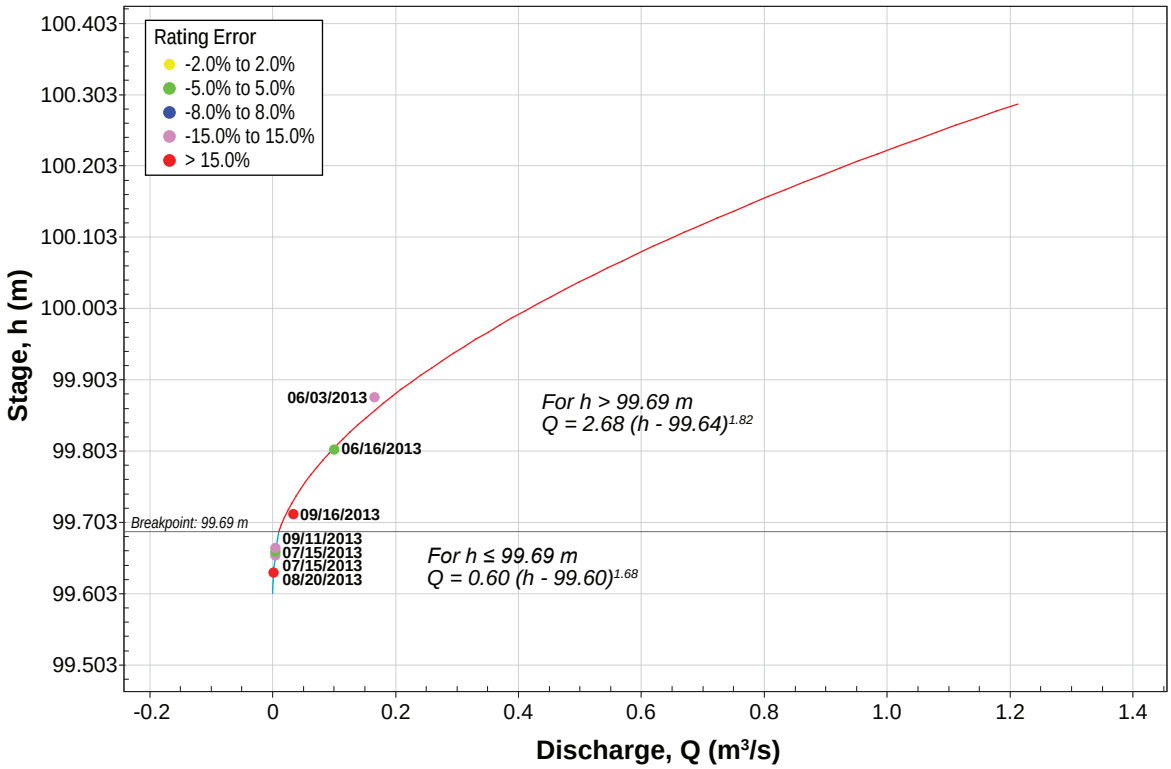
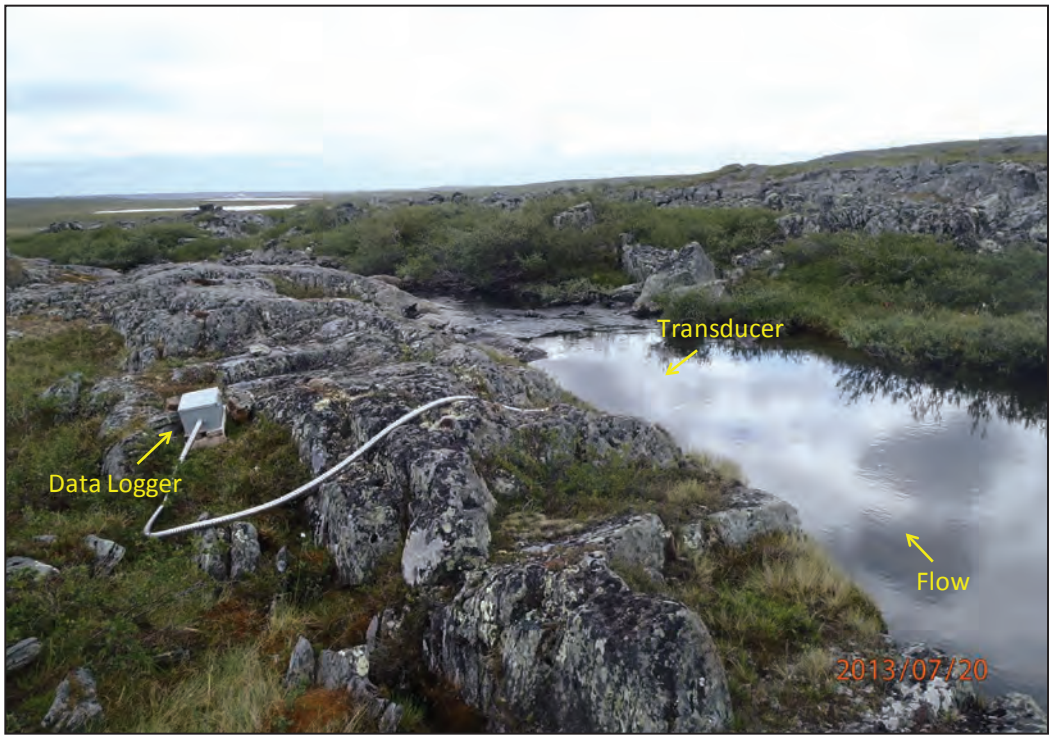
UM-H1, looking upstream toward the station. July 15, 2013.



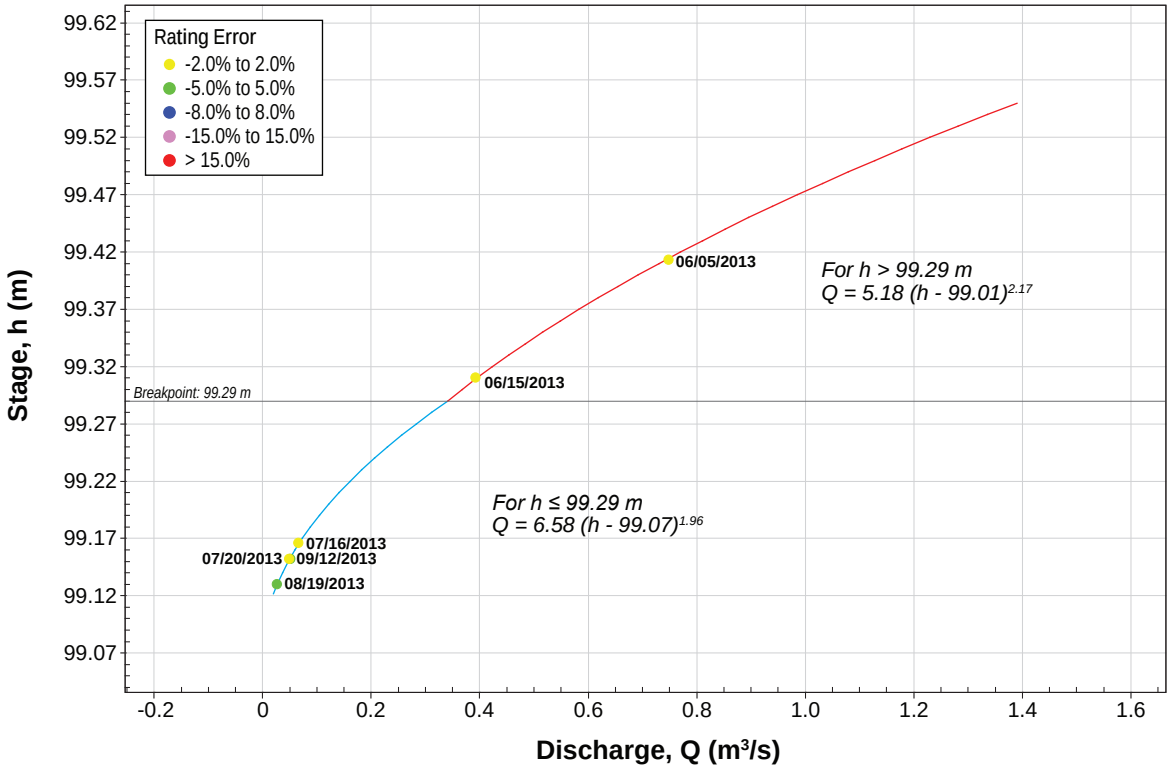
Notes: Rating period from June 3, 2013 to September 16, 2013.
Pressure transducer stage readings are referenced to local (non geodetic) datum.

Figure A5-11

UM-H1
Stage-Discharge Rating Curve



WP-H1, looking downstream toward the station. July 20, 2013.



Notes: Rating period from June 5, 2013 to September 12, 2013.
Pressure transducer stage readings are referenced to local (non geodetic) datum.

Figure A5-12

WP-H1
Stage-Discharge Rating Curve

Sabina GOLD & SILVER CORP.

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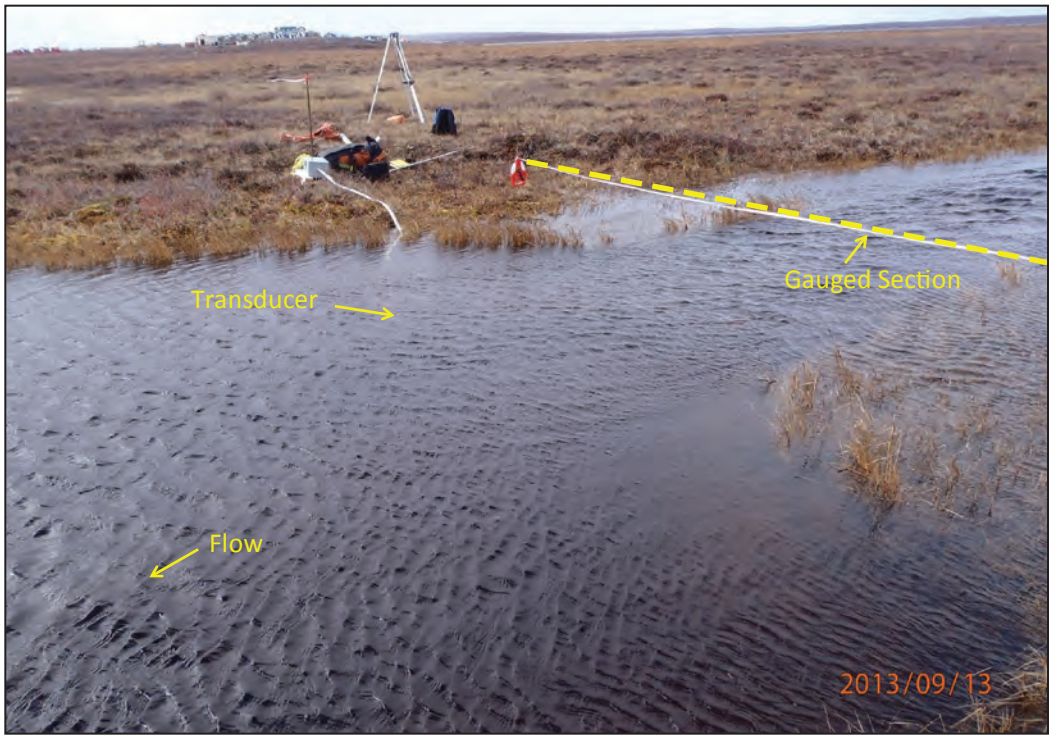
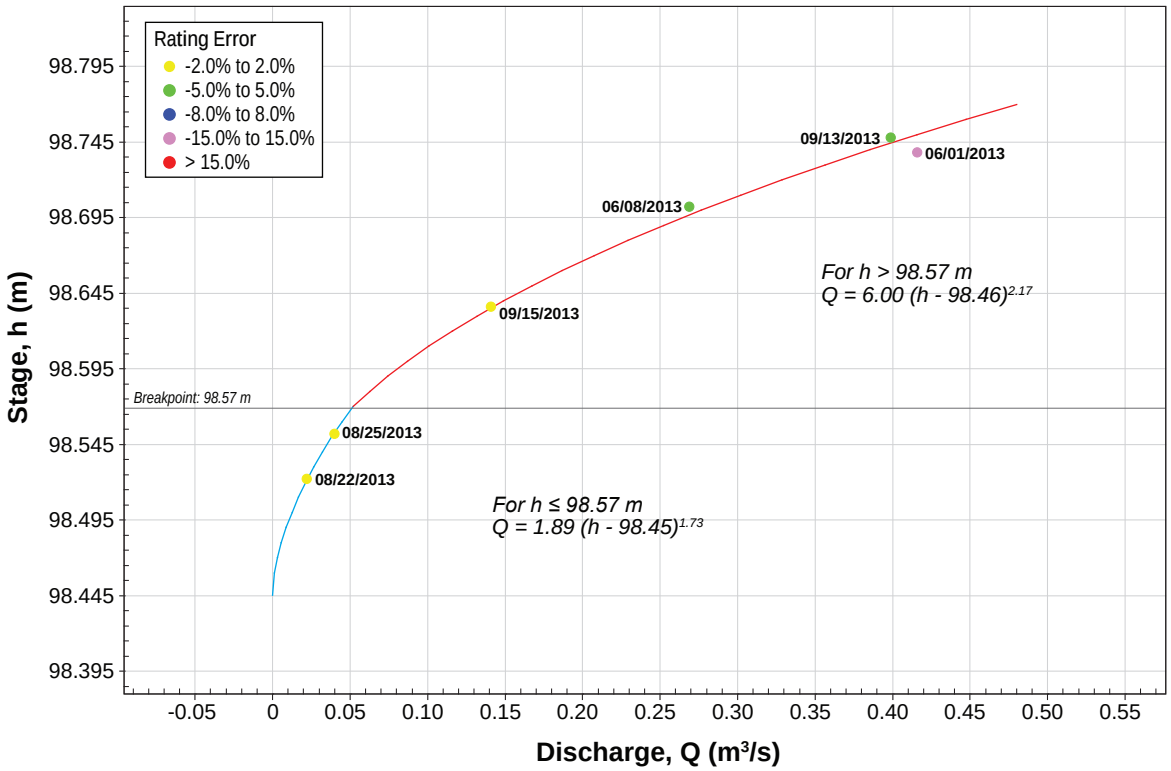


WR-H1, looking cross stream toward the station and gauged section. September 13, 2013.



Notes: Rating period from June 1, 2013 to September 15, 2013.
Pressure transducer stage readings are referenced to local (non geodetic) datum.

Figure A5-13

WR-H1
Stage-Discharge Rating Curve

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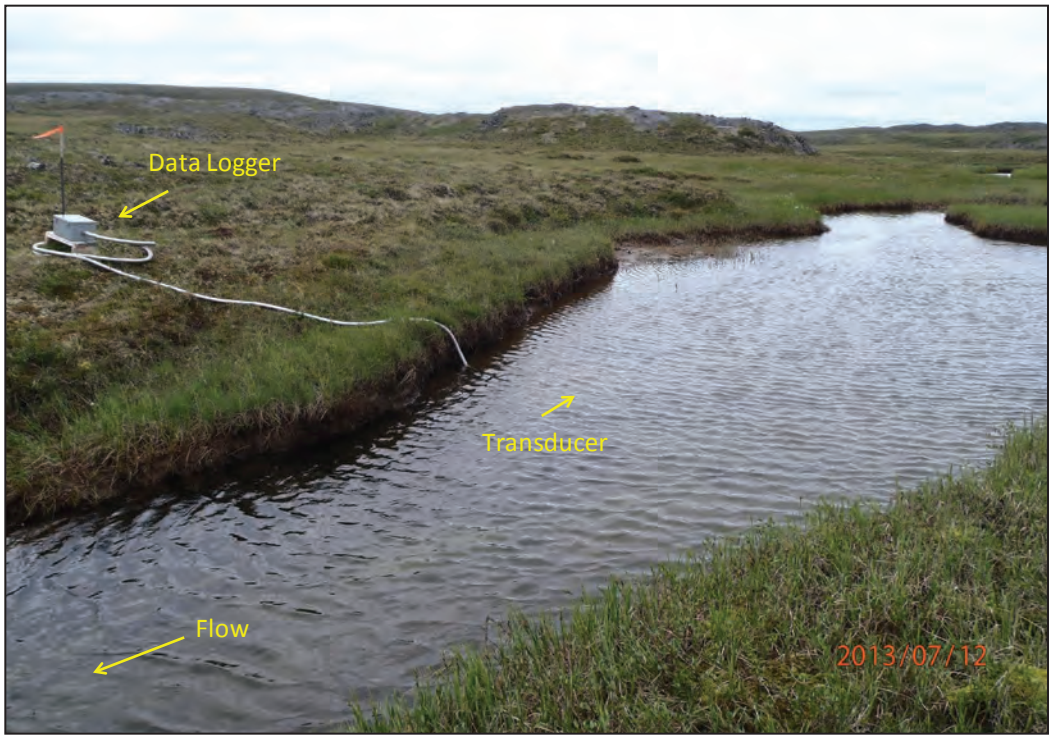
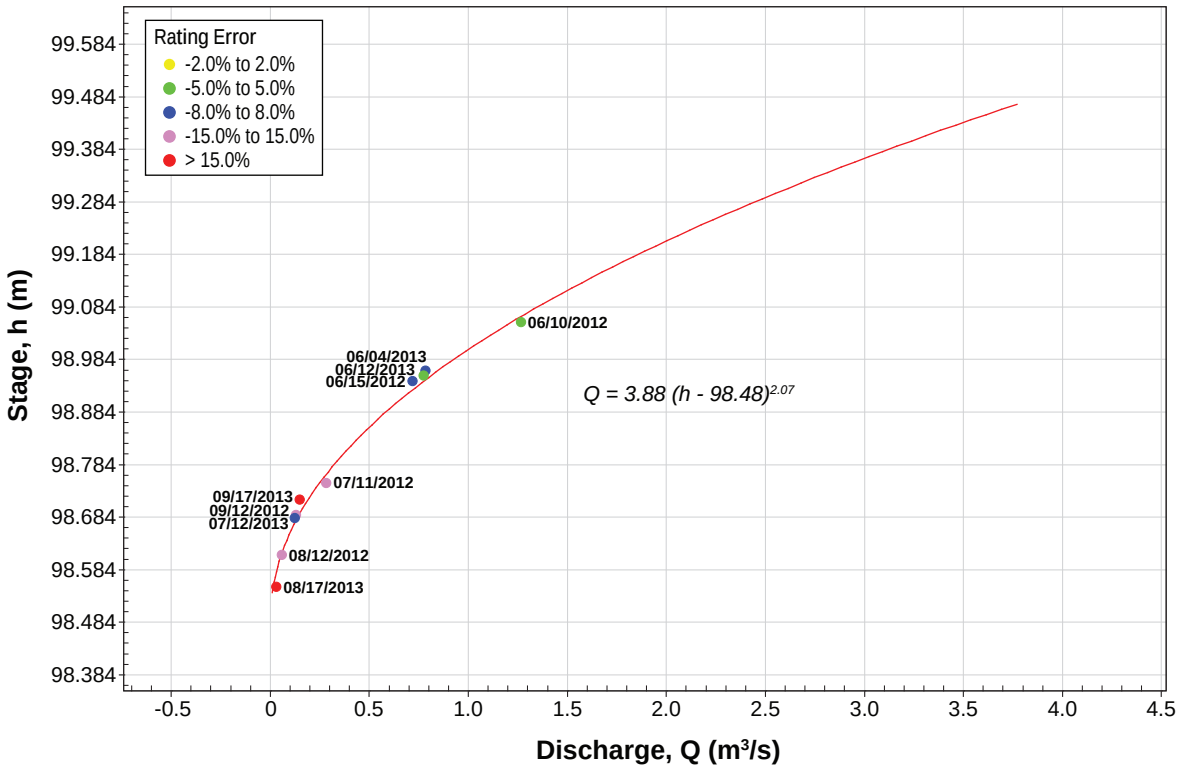


KL-H1, looking upstream toward the station. July 12, 2013.



Notes: Rating period from June 10, 2012 to September 17, 2013.
Pressure transducer stage readings are referenced to local (non geodetic) datum.

Figure A5-14

KL-H1
Stage-Discharge Rating Curve

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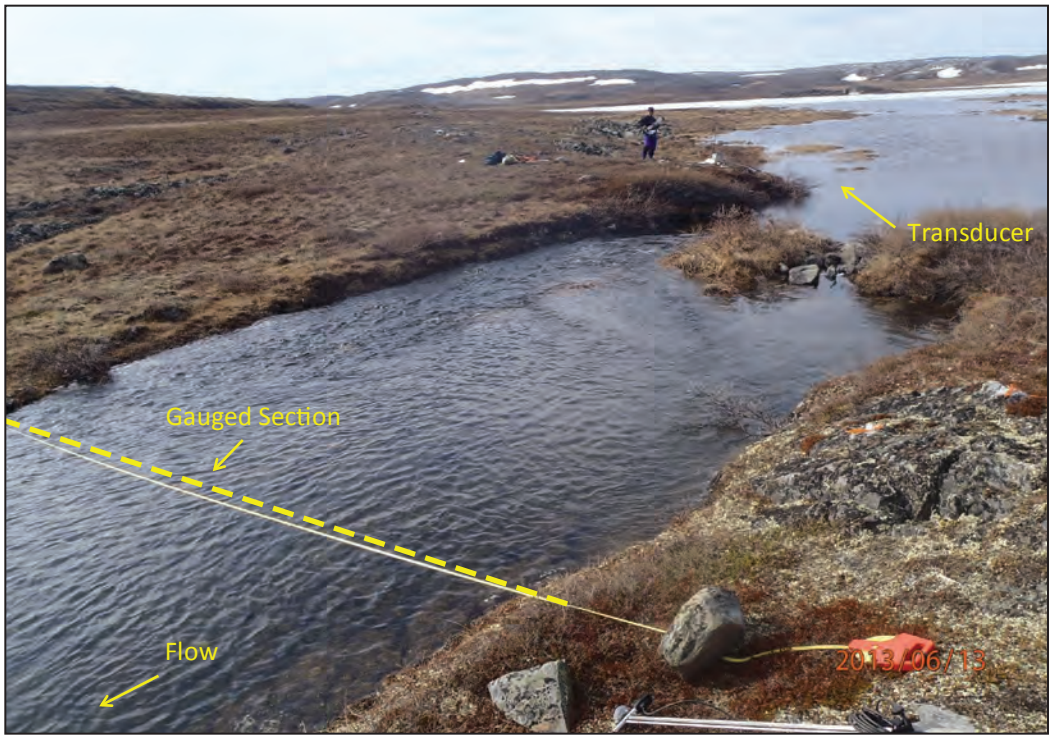
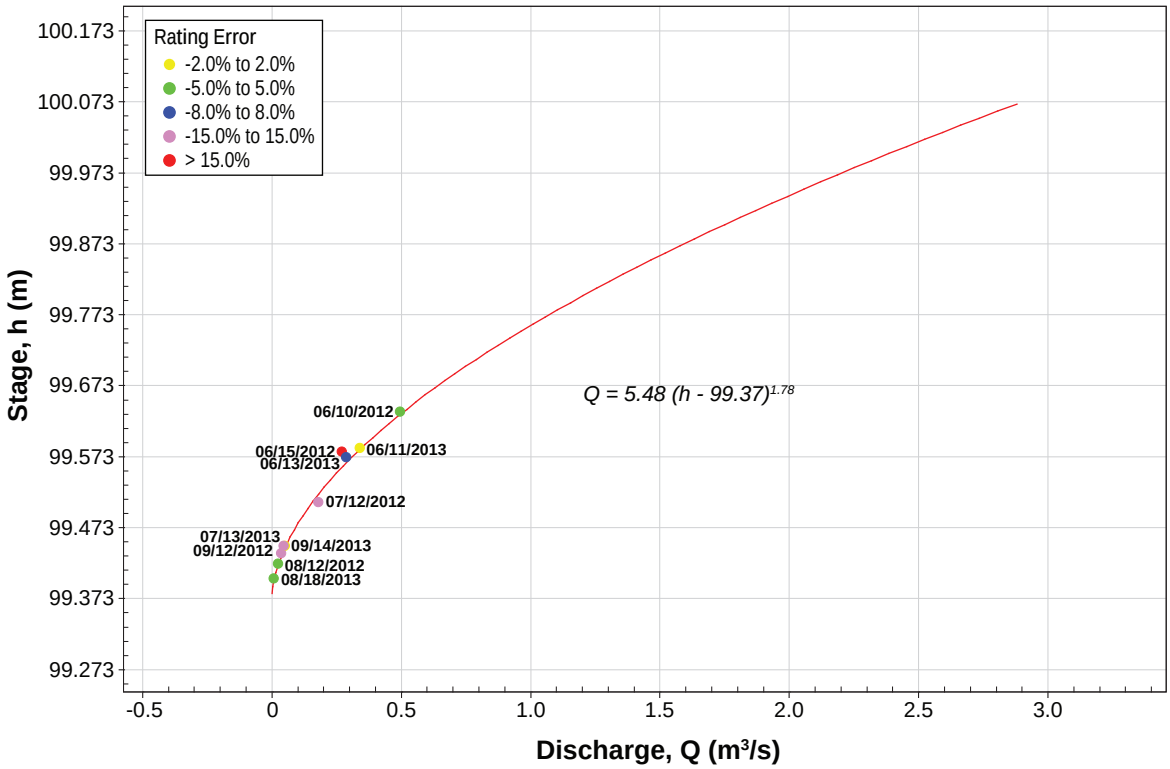


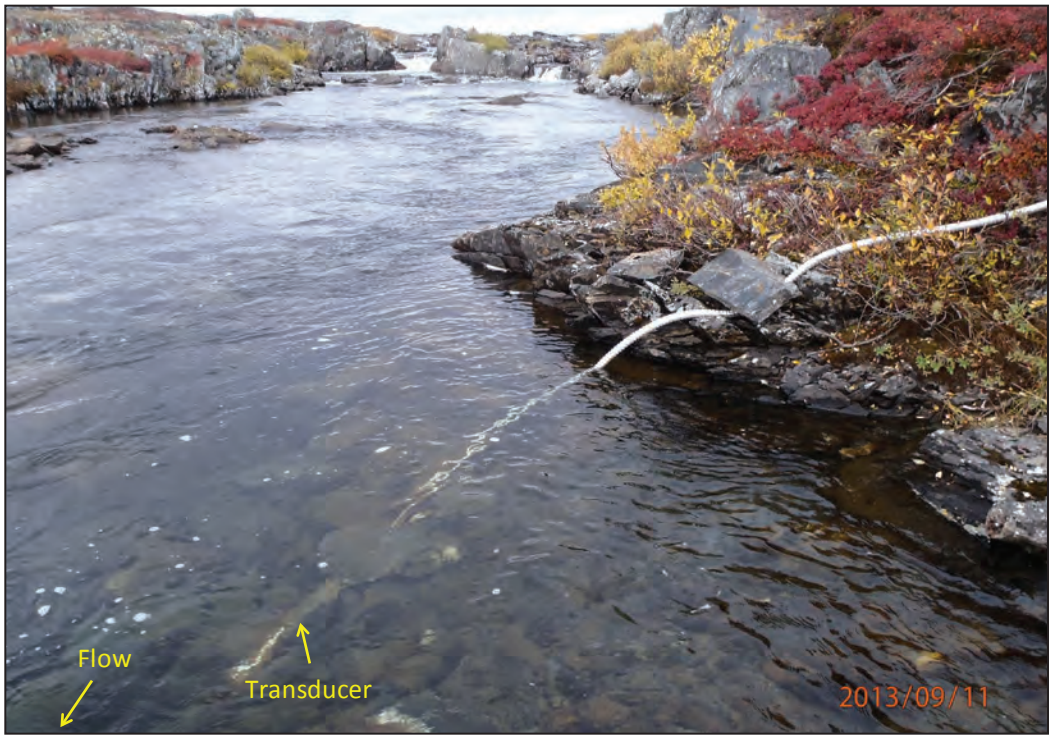
KL-H2, looking upstream toward the station and lake outlet. June 13, 2013.



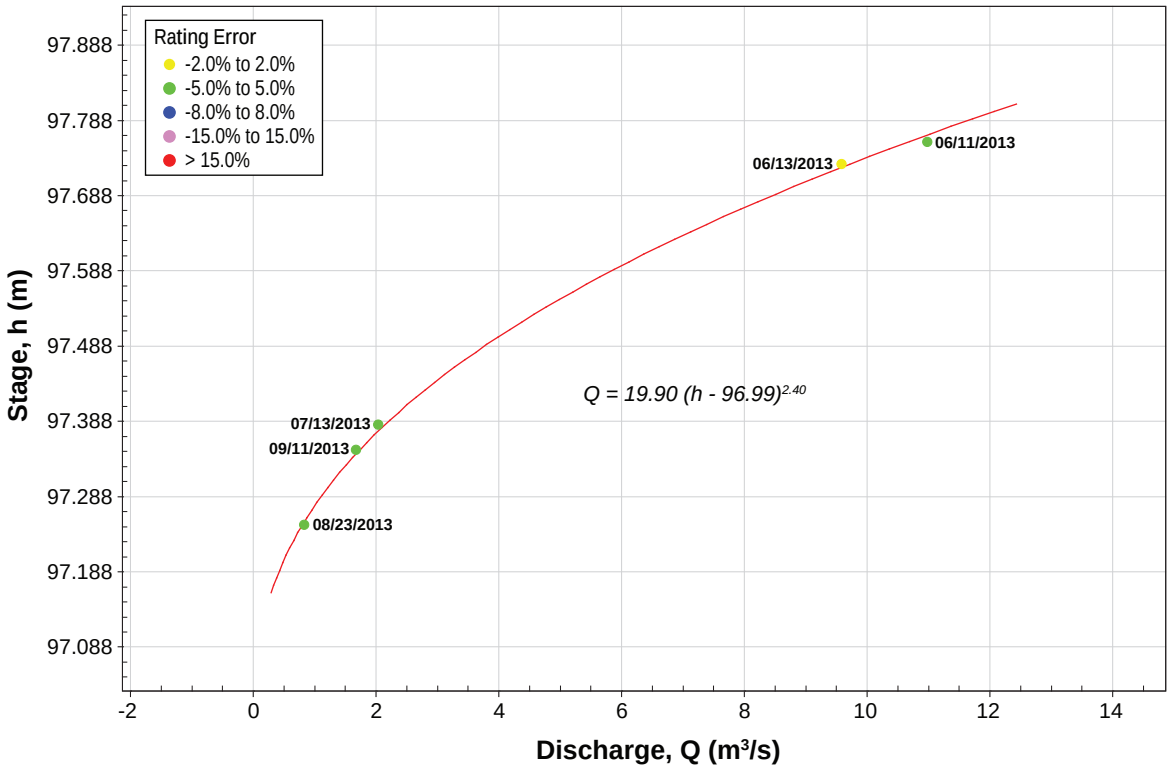
Notes: Rating period from June 10, 2012 to September 13, 2013.
Pressure transducer stage readings are referenced to local (non geodetic) datum.

Figure A5-15

KL-H2
Stage-Discharge Rating Curve



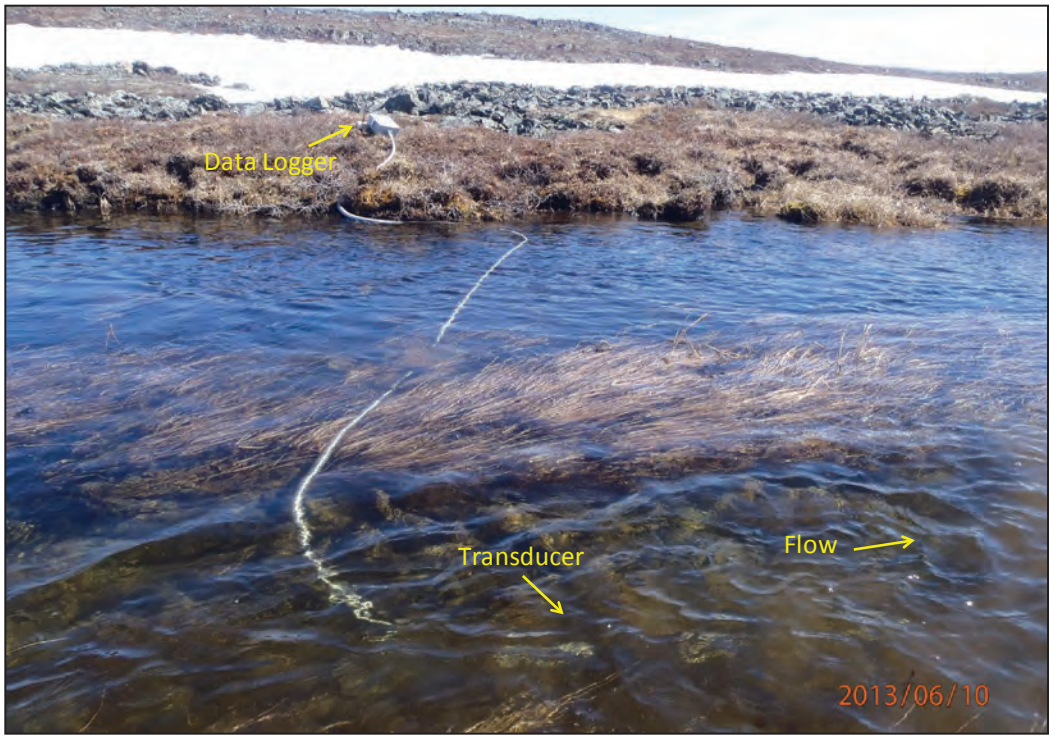
LG-H1, looking upstream toward the station. September 11, 2013.



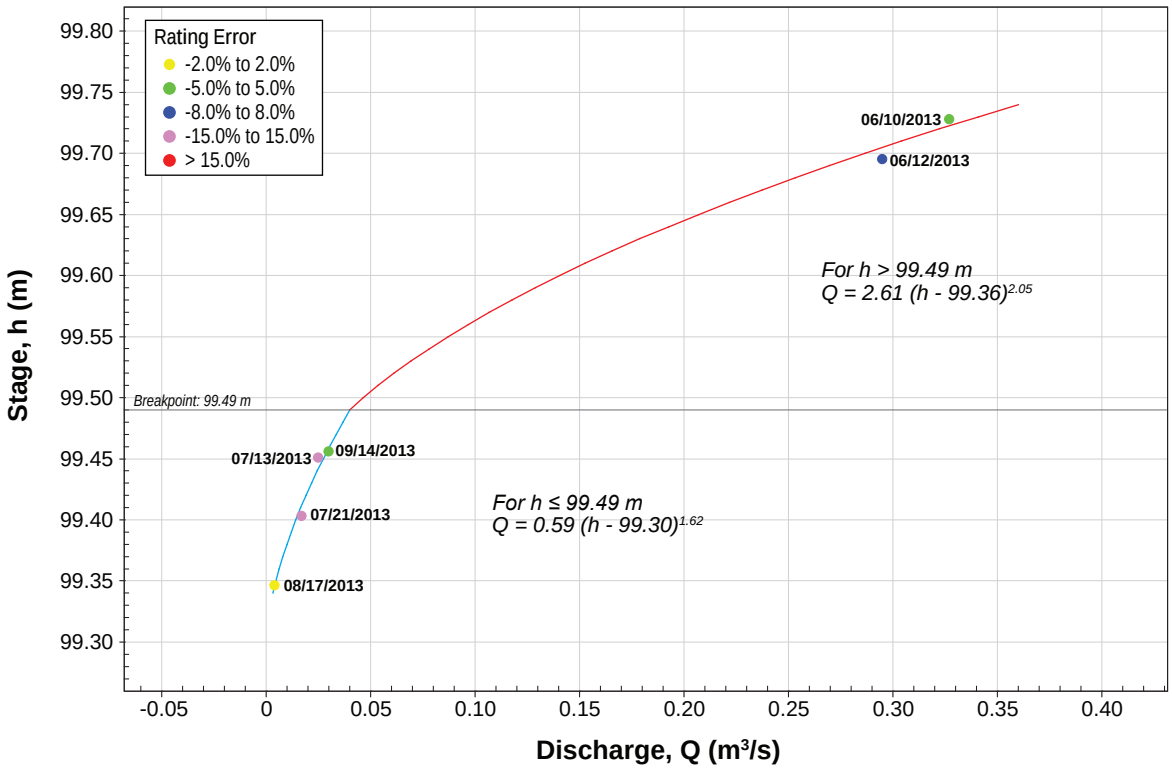
Notes: Rating period from June 13, 2013 to September 11, 2013.
Pressure transducer stage readings are referenced to local (non geodetic) datum.

Figure A5-16

LG-H1
Stage-Discharge Rating Curve



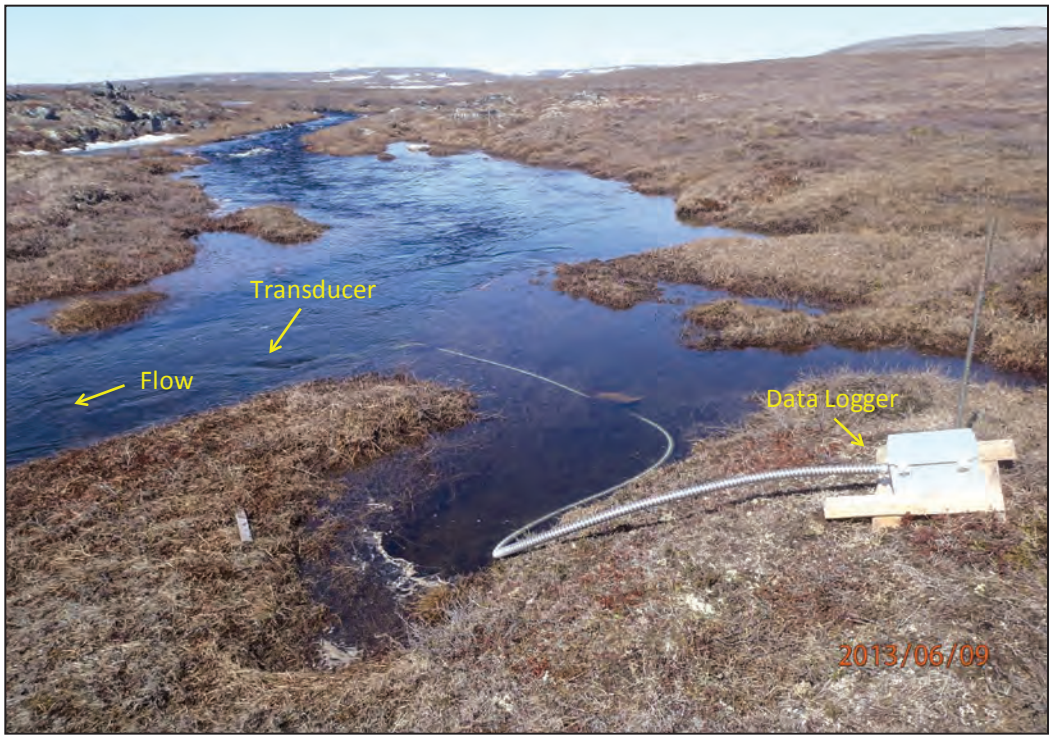
LY-H1, looking cross stream toward the station. June 10, 2013.



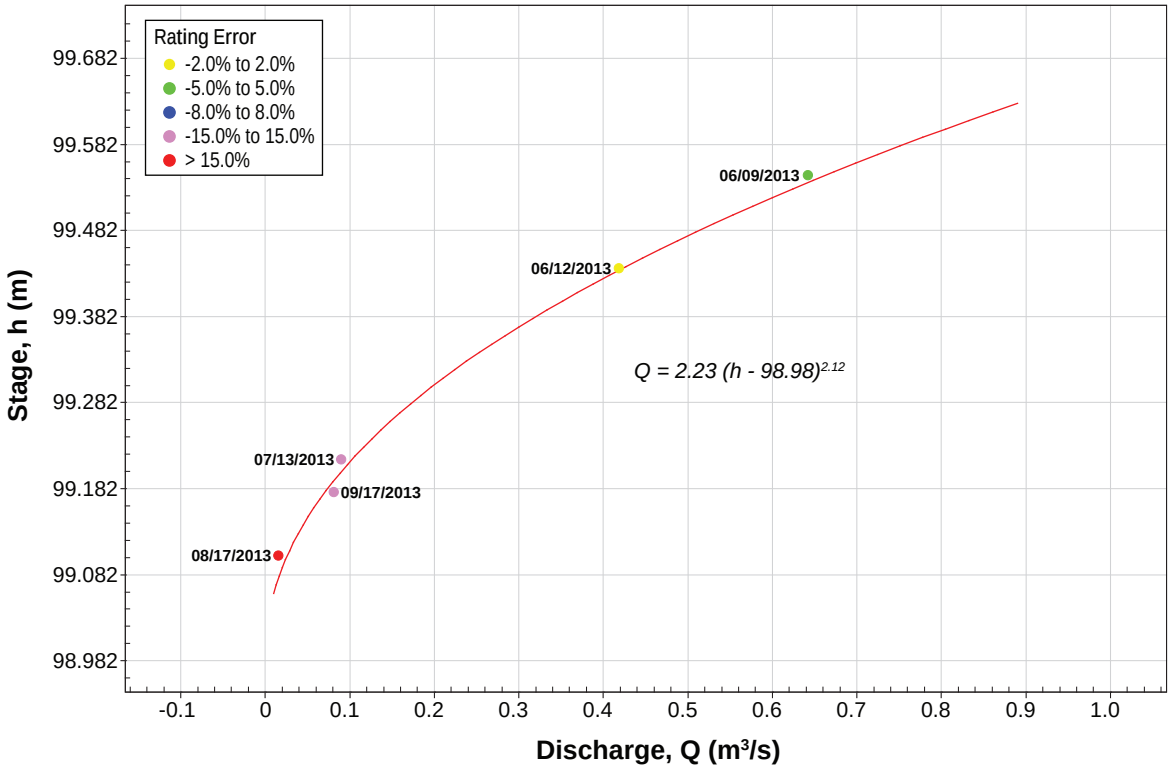
Notes: Rating period from June 10, 2013 to September 14, 2013.
Pressure transducer stage readings are referenced to local (non geodetic) datum.

Figure A5-17

LY-H1
Stage-Discharge Rating Curve



SL-H1, looking upstream toward the station. June 9, 2013.



Notes: Rating period from June 9, 2013 to September 17, 2013.
Pressure transducer stage readings are referenced to local (non geodetic) datum.

Figure A5-18

SL-H1
Stage-Discharge Rating Curve

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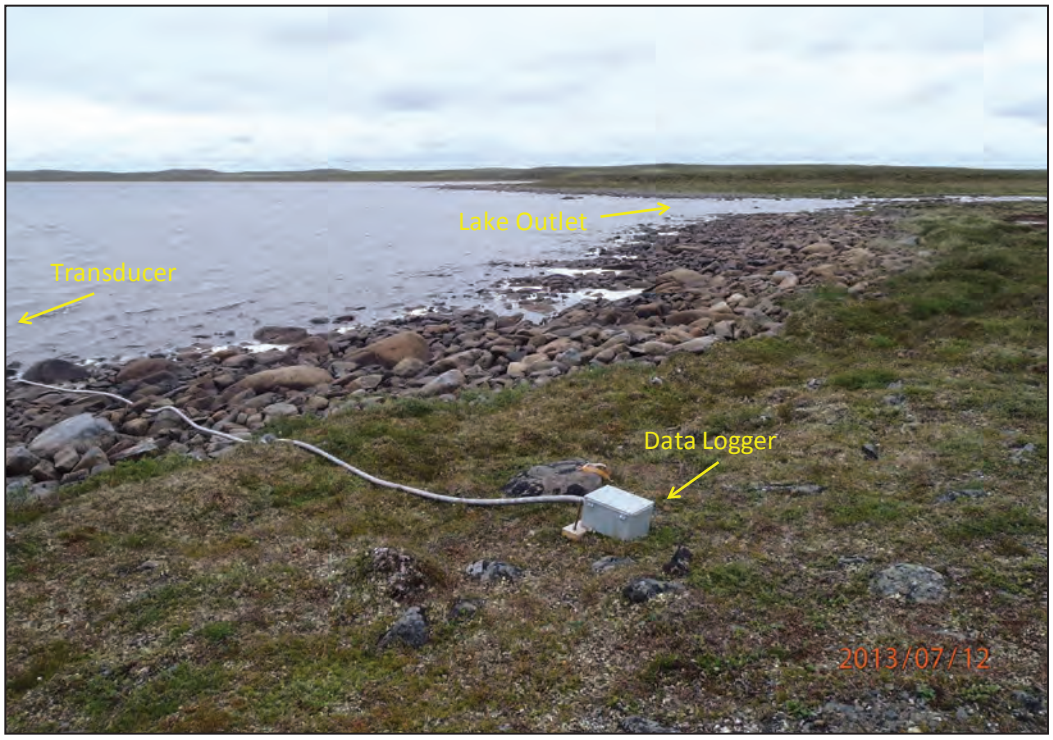
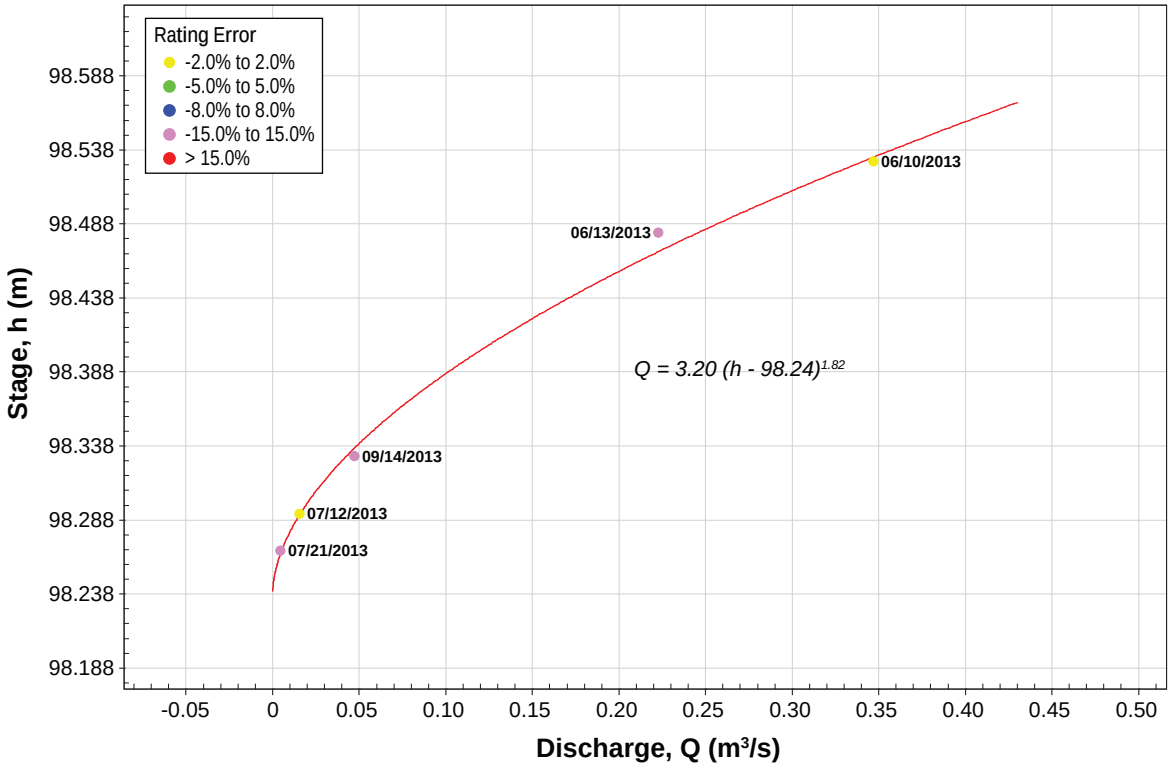


MC-H1, looking toward the station and lake outlet. July 12, 2013.



Notes: Rating period from June 10, 2013 to September 14, 2013.
Pressure transducer stage readings are referenced to local (non geodetic) datum.

Figure A5-19

MC-H1
Stage-Discharge Rating Curve

Sabina GOLD & SILVER CORP.

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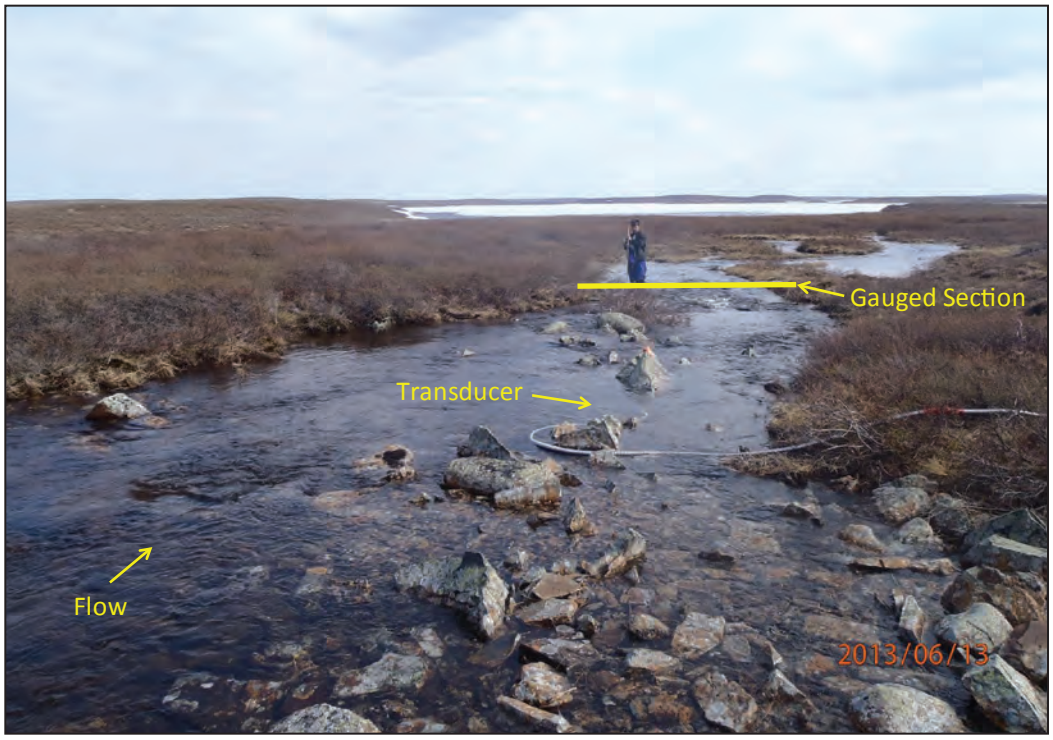
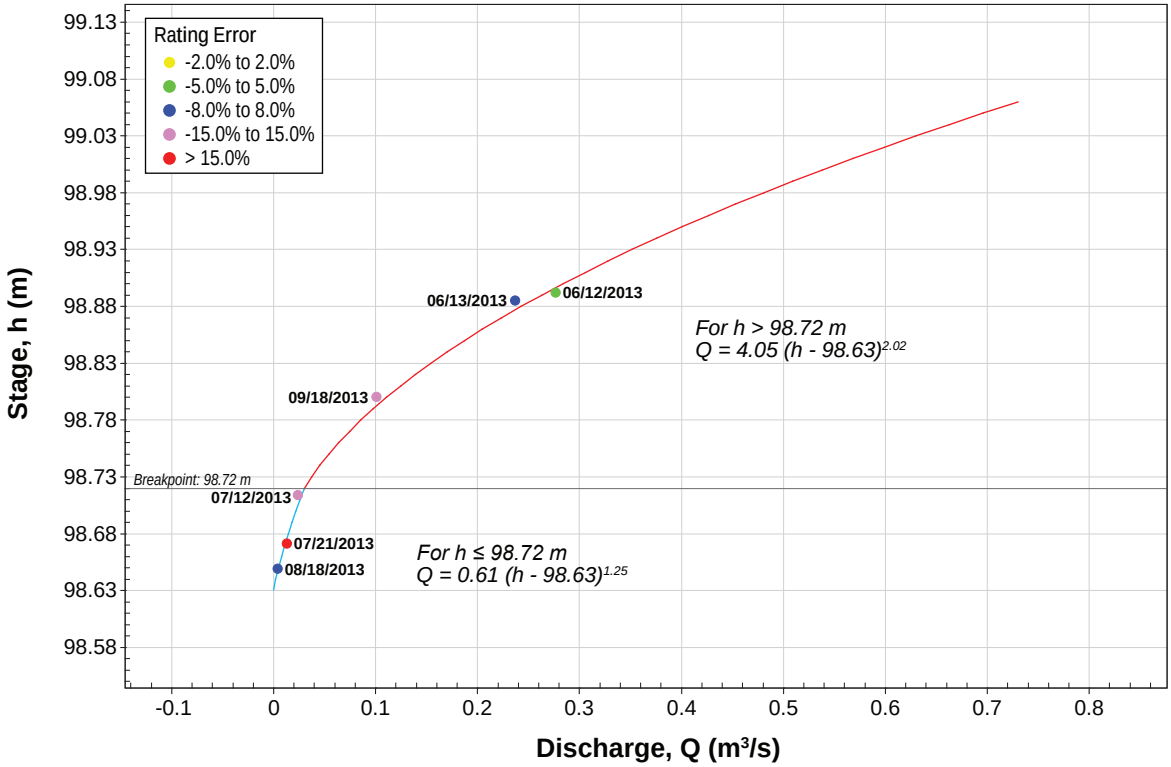


REFQ-H1, looking downstream toward the station and gauged section. June 13, 2013.



Notes: Rating period from June 12, 2013 to September 18, 2013.
Pressure transducer stage readings are referenced to local (non geodetic) datum.

Figure A5-20

REFQ-H1
Stage-Discharge Rating Curve

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Appendix 6

Annual Hydrographs and Daily Discharge Tables

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Appendix 6. Summary of Daily Discharge [Q, m^3/s] at Hydrometric Station GL-H1

Drainage Area = 18.00 km^2												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	-	-	-	*0.617*	0.143	0.009	0.013	*0.025*	-	-
2	-	-	-	-	-	*0.571*	0.141	0.009	0.012	*0.025*	-	-
3	-	-	-	-	-	0.571	0.131	0.009	0.012	*0.024*	-	-
4	-	-	-	-	-	0.571	0.119	0.009	0.012	*0.022*	-	-
5	-	-	-	-	-	0.586	0.100	0.009	0.012	*0.021*	-	-
6	-	-	-	-	-	0.563	0.080	0.008	0.012	*0.019*	-	-
7	-	-	-	-	-	0.540	0.066	0.008	0.012	*0.018*	-	-
8	-	-	-	-	-	0.627	0.055	0.008	0.012	*0.017*	-	-
9	-	-	-	-	-	0.537	0.046	0.007	0.012	*0.015*	-	-
10	-	-	-	-	-	0.474	0.038	0.007	0.014	*0.014*	-	-
11	-	-	-	-	-	0.437	0.031	0.007	0.015	*0.012*	-	-
12	-	-	-	-	-	0.406	0.024	0.007	*0.026*	*0.011*	-	-
13	-	-	-	-	-	0.383	0.018	0.006	*0.035*	*0.009*	-	-
14	-	-	-	-	-	0.366	0.015	0.006	*0.036*	*0.008*	-	-
15	-	-	-	-	-	0.354	0.014	0.006	*0.036*	*0.006*	-	-
16	-	-	-	-	-	0.341	0.013	0.006	*0.034*	*0.005*	-	-
17	-	-	-	-	-	0.338	0.012	0.006	*0.033*	*0.003*	-	-
18	-	-	-	-	-	0.321	0.011	0.005	*0.032*	*0.002*	-	-
19	-	-	-	-	-	0.284	0.011	0.006	*0.031*	*0.001*	-	-
20	-	-	-	-	-	0.250	0.010	0.005	*0.031*	-	-	-
21	-	-	-	-	-	0.225	0.010	0.006	*0.031*	-	-	-
22	-	-	-	-	*0.001*	0.207	0.010	0.009	*0.030*	-	-	-
23	-	-	-	-	*0.002*	0.200	0.010	0.010	*0.030*	-	-	-
24	-	-	-	-	*0.005*	0.202	0.009	0.010	*0.029*	-	-	-
25	-	-	-	-	*0.011*	0.223	0.009	0.010	*0.029*	-	-	-
26	-	-	-	-	*0.026*	0.252	0.009	0.010	*0.028*	-	-	-
27	-	-	-	-	*0.058*	0.217	0.010	0.011	*0.027*	-	-	-
28	-	-	-	-	*0.130*	0.194	0.010	0.012	*0.027*	-	-	-
29	-	-	-	-	*0.293*	0.174	0.010	0.012	*0.026*	-	-	-
30	-	-	-	-	*0.661*	0.155	0.010	0.012	*0.026*	-	-	-
31	-	-	-	-	*0.628*	0.143	0.010	0.012	*0.025*	-	-	-
Mean	-	-	-	-	0.182	0.365	0.038	0.008	0.024	0.014	-	-
Max	-	-	-	-	0.661	0.627	0.143	0.012	0.036	0.025	-	-
Min	-	-	-	-	0.001	0.143	0.009	0.005	0.012	0.001	-	-
Total	0.000	0.000	0.000	0.000	1.816	11.328	1.182	0.257	0.740	0.257	0.000	0.000

Note: Estimated values are italicized.

Appendix 6. Summary of Daily Discharge [Q, m^3/s] at Hydrometric Station GL-H2

Drainage Area = 1.7 km^2												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	-	-	-	0.144	0.036	0.008	0.002	0.015	-	-
2	-	-	-	-	-	0.136	0.027	0.010	0.002	0.015	-	-
3	-	-	-	-	-	0.123	0.026	0.009	0.001	0.014	-	-
4	-	-	-	-	-	0.123	0.022	0.009	0.001	0.013	-	-
5	-	-	-	-	-	0.133	0.018	0.008	0.002	0.012	-	-
6	-	-	-	-	-	0.136	0.015	0.007	0.002	0.011	-	-
7	-	-	-	-	-	0.143	0.013	0.006	0.002	0.010	-	-
8	-	-	-	-	-	0.146	0.012	0.006	0.001	0.010	-	-
9	-	-	-	-	-	0.130	0.011	0.005	0.001	0.009	-	-
10	-	-	-	-	-	0.117	0.009	0.004	0.001	0.008	-	-
11	-	-	-	-	-	0.111	0.006	0.002	0.006	0.007	-	-
12	-	-	-	-	-	0.106	0.005	0.001	0.017	0.006	-	-
13	-	-	-	-	-	0.102	0.005	0.001	0.038	0.005	-	-
14	-	-	-	-	-	0.100	0.004	0.000	0.041	0.004	-	-
15	-	-	-	-	-	0.097	0.004	0.000	0.038	0.004	-	-
16	-	-	-	-	-	0.096	0.005	0.000	0.035	0.003	-	-
17	-	-	-	-	-	0.095	0.006	0.000	0.032	0.002	-	-
18	-	-	-	-	-	0.096	0.007	0.000	0.028	0.001	-	-
19	-	-	-	-	-	0.084	0.004	0.000	0.027	0.000	-	-
20	-	-	-	-	-	0.079	0.004	0.000	0.026	-	-	-
21	-	-	-	-	-	0.073	0.005	0.000	0.025	-	-	-
22	-	-	-	-	0.001	0.070	0.004	0.003	0.024	-	-	-
23	-	-	-	-	0.002	0.067	0.003	0.004	0.023	-	-	-
24	-	-	-	-	0.004	0.063	0.003	0.003	0.022	-	-	-
25	-	-	-	-	0.007	0.065	0.003	0.002	0.021	-	-	-
26	-	-	-	-	0.012	0.055	0.003	0.002	0.019	-	-	-
27	-	-	-	-	0.023	0.048	0.008	0.002	0.018	-	-	-
28	-	-	-	-	0.043	0.043	0.010	0.002	0.017	-	-	-
29	-	-	-	-	0.081	0.037	0.008	0.002	0.016	-	-	-
30	-	-	-	-	0.151	0.033	0.009	0.001	0.016	-	-	-
31	-	-	-	-	0.146	0.036	0.011	0.001	0.015	-	-	-
Mean	-	-	-	-	0.047	0.093	0.010	0.003	0.017	0.008	-	-
Max	0.000	0.000	0.000	0.000	0.151	0.146	0.036	0.010	0.041	0.015	0.000	0.000
Min	0.000	0.000	0.000	0.000	0.001	0.033	0.003	0.000	0.001	0.000	0.000	0.000
Total	0.000	0.000	0.000	0.000	0.470	2.885	0.307	0.098	0.521	0.150	0.000	0.000

Notes: Estimated values are italicized.

Values in red denote high uncertainty based on extrapolation of the rating curve beyond 2 times the greatest measured discharge.

Appendix 6. Summary of Daily Discharge [Q, m^3/s] at Hydrometric Station GL-H3

Drainage Area = 1.80 km^2												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	-	-	-	0.362	0.033	0.004	0.004	*0.082*	-	-
2	-	-	-	-	-	0.493	0.033	0.007	0.004	*0.079*	-	-
3	-	-	-	-	-	0.484	0.031	0.007	0.004	*0.054*	-	-
4	-	-	-	-	-	0.423	0.025	0.005	0.005	*0.036*	-	-
5	-	-	-	-	-	0.383	0.020	0.004	0.004	*0.024*	-	-
6	-	-	-	-	-	0.354	0.017	0.003	0.005	*0.016*	-	-
7	-	-	-	-	-	0.352	0.015	0.002	0.005	*0.011*	-	-
8	-	-	-	-	-	0.438	0.015	0.000	0.006	*0.008*	-	-
9	-	-	-	-	-	0.435	0.013	-	*0.009*	*0.005*	-	-
10	-	-	-	-	-	0.393	0.010	-	*0.018*	*0.003*	-	-
11	-	-	-	-	-	0.348	0.008	-	*0.023*	*0.002*	-	-
12	-	-	-	-	-	0.319	0.005	-	*0.092*	*0.002*	-	-
13	-	-	-	-	-	0.290	0.003	-	*0.268*	*0.001*	-	-
14	-	-	-	-	-	0.272	0.002	-	*0.297*	*0.001*	-	-
15	-	-	-	-	-	0.277	0.002	-	*0.277*	*0.000*	-	-
16	-	-	-	-	-	0.272	0.002	-	*0.241*	*0.000*	-	-
17	-	-	-	-	-	0.269	0.001	-	*0.213*	*0.000*	-	-
18	-	-	-	-	-	0.253	0.001	-	*0.186*	*0.000*	-	-
19	-	-	-	-	-	0.227	0.001	-	*0.177*	*0.000*	-	-
20	-	-	-	-	-	0.196	-	-	*0.169*	-	-	-
21	-	-	-	-	-	0.155	-	0.000	*0.159*	-	-	-
22	-	-	-	-	*0.001*	0.124	-	0.004	*0.150*	-	-	-
23	-	-	-	-	*0.002*	0.105	-	0.009	*0.141*	-	-	-
24	-	-	-	-	*0.005*	0.103	-	0.006	*0.134*	-	-	-
25	-	-	-	-	*0.010*	0.181	-	0.004	*0.128*	-	-	-
26	-	-	-	-	*0.022*	0.119	-	0.004	*0.112*	-	-	-
27	-	-	-	-	*0.047*	0.078	0.002	0.003	*0.106*	-	-	-
28	-	-	-	-	*0.102*	0.048	0.005	0.004	*0.096*	-	-	-
29	-	-	-	-	*0.220*	0.036	0.004	0.003	*0.089*	-	-	-
30	-	-	-	-	*0.475*	0.030	0.004	0.003	*0.089*	-	-	-
31	-	-	-	-	*0.362*	0.033	0.004	0.002	*0.082*	-	-	-
Mean	-	-	-	-	0.125	0.253	0.011	0.004	0.106	0.017	-	-
Max	-	-	-	-	0.475	0.493	0.033	0.009	0.297	0.082	-	-
Min	-	-	-	-	0.001	0.030	0.001	0.000	0.004	0.000	-	-
Total	0.000	0.000	0.000	0.000	1.245	7.851	0.256	0.074	3.294	0.326	0.000	0.000

Note: Estimated values are italicized.

Appendix 6. Summary of Daily Discharge [Q, m^3/s] at Hydrometric Station PL-H1

Drainage Area = 204.40 km^2												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1	-	-	-	-	-	*8.859*	2.149	0.368	0.214	0.738	-	-
2	-	-	-	-	-	*8.200*	2.040	0.381	0.201	0.728	-	-
3	-	-	-	-	-	*7.981*	1.883	0.383	0.191	0.738	-	-
4	-	-	-	-	-	*8.134*	1.711	0.379	0.189	*0.653*	-	-
5	-	-	-	-	-	*7.786*	1.624	0.370	0.192	*0.611*	-	-
6	-	-	-	-	-	*8.287*	1.555	0.363	0.184	*0.569*	-	-
7	-	-	-	-	-	*9.031*	1.446	0.355	0.192	*0.526*	-	-
8	-	-	-	-	-	*7.911*	1.256	0.346	0.184	*0.484*	-	-
9	-	-	-	-	-	7.911	1.170	0.336	0.186	*0.442*	-	-
10	-	-	-	-	-	7.290	1.002	0.325	0.208	*0.399*	-	-
11	-	-	-	-	-	6.537	0.953	0.318	0.215	*0.357*	-	-
12	-	-	-	-	-	5.904	0.750	0.307	0.231	*0.315*	-	-
13	-	-	-	-	-	5.338	0.777	0.295	0.288	*0.272*	-	-
14	-	-	-	-	-	4.956	0.719	0.282	0.317	*0.230*	-	-
15	-	-	-	-	-	4.715	0.623	0.268	0.344	*0.188*	-	-
16	-	-	-	-	-	4.478	0.613	0.243	0.358	*0.145*	-	-
17	-	-	-	-	-	4.324	0.597	0.249	0.380	*0.103*	-	-
18	-	-	-	-	-	4.157	0.533	0.245	0.396	*0.061*	-	-
19	-	-	-	-	-	3.948	0.514	0.242	0.449	*0.018*	-	-
20	-	-	-	-	-	3.650	0.425	0.211	0.488	-	-	-
21	-	-	-	-	-	3.403	0.389	0.218	0.526	-	-	-
22	-	-	-	-	*0.001*	3.185	0.373	0.291	0.564	-	-	-
23	-	-	-	-	*0.003*	2.985	0.366	0.278	0.592	-	-	-
24	-	-	-	-	*0.010*	2.894	0.366	0.259	0.632	-	-	-
25	-	-	-	-	*0.031*	2.952	0.361	0.236	0.639	-	-	-
26	-	-	-	-	*0.097*	2.898	0.354	0.231	0.681	-	-	-
27	-	-	-	-	*0.306*	2.826	0.381	0.232	0.727	-	-	-
28	-	-	-	-	*0.962*	2.681	0.390	0.215	0.727	-	-	-
29	-	-	-	-	*3.024*	2.482	0.379	0.212	0.732	-	-	-
30	-	-	-	-	*9.500*	2.331	0.390	0.207	0.729	-	-	-
31	-	-	-	-	*9.028*	2.149	0.379	0.204	0.738	-	-	-
Mean	-	-	-	-	2.296	5.167	0.854	0.285	0.409	0.399	-	-
Max	-	-	-	-	9.500	9.031	2.149	0.383	0.738	0.738	-	-
Min	-	-	-	-	0.001	2.149	0.354	0.204	0.184	0.018	-	-
Total	0.000	0.000	0.000	0.000	22.963	160.184	26.468	8.849	12.694	7.579	0.000	0.000

Note: Estimated values are italicized.

Appendix 6. Summary of Daily Discharge [Q, m^3/s] at Hydrometric Station PL-H2

Drainage Area = 101.50 km^2												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	-	-	-	*3.717*	0.842	0.207	0.184	0.677	-	-
2	-	-	-	-	-	*3.853*	0.800	0.238	0.212	0.652	-	-
3	-	-	-	-	-	3.853	0.698	0.241	0.182	0.644	-	-
4	-	-	-	-	-	3.569	0.652	0.230	0.166	*0.569*	-	-
5	-	-	-	-	-	3.404	0.606	0.212	0.210	*0.531*	-	-
6	-	-	-	-	-	3.236	0.576	0.200	0.238	*0.493*	-	-
7	-	-	-	-	-	3.109	0.517	0.191	0.228	*0.456*	-	-
8	-	-	-	-	-	3.485	0.438	0.187	0.199	*0.418*	-	-
9	-	-	-	-	-	3.416	0.392	0.148	0.182	*0.381*	-	-
10	-	-	-	-	-	3.102	0.331	0.127	0.258	*0.343*	-	-
11	-	-	-	-	-	2.771	0.302	0.116	0.347	*0.306*	-	-
12	-	-	-	-	-	2.490	0.211	0.105	0.384	*0.268*	-	-
13	-	-	-	-	-	2.247	0.252	0.087	0.684	*0.231*	-	-
14	-	-	-	-	-	2.107	0.201	0.084	1.080	*0.193*	-	-
15	-	-	-	-	-	1.985	0.171	0.066	1.129	*0.156*	-	-
16	-	-	-	-	-	1.901	0.176	0.059	1.095	*0.118*	-	-
17	-	-	-	-	-	1.822	0.160	0.069	1.033	*0.080*	-	-
18	-	-	-	-	-	1.747	0.136	0.072	0.979	*0.043*	-	-
19	-	-	-	-	-	1.645	0.137	0.065	0.926	*0.005*	-	-
20	-	-	-	-	-	1.501	0.127	0.053	0.905	-	-	-
21	-	-	-	-	-	1.399	0.109	0.092	0.888	-	-	-
22	-	-	-	-	*0.001*	1.293	0.097	0.124	0.865	-	-	-
23	-	-	-	-	*0.003*	1.226	0.088	0.211	0.844	-	-	-
24	-	-	-	-	*0.008*	1.200	0.102	0.178	0.822	-	-	-
25	-	-	-	-	*0.022*	1.223	0.108	0.149	0.805	-	-	-
26	-	-	-	-	*0.063*	1.189	0.086	0.154	0.790	-	-	-
27	-	-	-	-	*0.178*	1.154	0.153	0.163	0.745	-	-	-
28	-	-	-	-	*0.502*	1.069	0.202	0.147	0.728	-	-	-
29	-	-	-	-	*1.414*	0.992	0.198	0.185	0.699	-	-	-
30	-	-	-	-	*3.986*	0.921	0.222	0.172	0.675	-	-	-
31	-	-	-	-	*3.788*	0.842	0.211	0.186	0.677	-	-	-
Mean	-	-	-	-	0.997	2.176	0.300	0.146	0.618	0.345	-	-
Max	-	-	-	-	3.986	3.853	0.842	0.241	1.129	0.677	-	-
Min	-	-	-	-	0.001	0.842	0.086	0.053	0.166	0.005	-	-
Total	0.000	0.000	0.000	0.000	9.965	67.471	9.303	4.518	19.158	6.564	0.000	0.000

Note: Estimated values are italicized.

Appendix 6. Summary of Daily Discharge [Q, m^3/s] at Hydrometric Station GI-H1

Drainage Area = 27.40 km^2												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1	-	-	-	-	-	*1.211*	0.137	0.022	0.030	*0.290*	-	-
2	-	-	-	-	-	*1.084*	0.115	0.031	0.028	*0.282*	-	-
3	-	-	-	-	-	*1.041*	0.121	0.032	0.020	*0.266*	-	-
4	-	-	-	-	-	*1.071*	0.112	0.028	0.012	*0.249*	-	-
5	-	-	-	-	-	*1.094*	0.100	0.022	0.032	*0.233*	-	-
6	-	-	-	-	-	1.094	0.091	0.016	0.048	*0.216*	-	-
7	-	-	-	-	-	1.097	0.085	0.013	0.029	*0.199*	-	-
8	-	-	-	-	-	1.200	0.080	0.011	0.026	*0.183*	-	-
9	-	-	-	-	-	1.087	0.075	0.006	0.019	*0.166*	-	-
10	-	-	-	-	-	0.872	0.067	0.003	*0.078*	*0.150*	-	-
11	-	-	-	-	-	0.691	0.055	0.002	*0.097*	*0.133*	-	-
12	-	-	-	-	-	0.563	0.050	0.002	*0.321*	*0.116*	-	-
13	-	-	-	-	-	0.471	0.051	0.001	*0.825*	*0.100*	-	-
14	-	-	-	-	-	0.415	0.031	0.001	*0.903*	*0.083*	-	-
15	-	-	-	-	-	0.374	0.036	0.001	*0.848*	*0.067*	-	-
16	-	-	-	-	-	0.360	0.050	0.001	*0.752*	*0.050*	-	-
17	-	-	-	-	-	0.357	0.052	0.002	*0.673*	*0.033*	-	-
18	-	-	-	-	-	0.300	0.061	0.002	*0.599*	*0.017*	-	-
19	-	-	-	-	-	0.224	0.002	0.003	*0.572*	*0.000*	-	-
20	-	-	-	-	-	0.186	0.001	0.006	*0.549*	-	-	-
21	-	-	-	-	-	0.174	0.008	0.003	*0.521*	-	-	-
22	-	-	-	-	*0.001*	0.167	0.005	0.028	*0.494*	-	-	-
23	-	-	-	-	*0.002*	0.163	0.002	0.034	*0.468*	-	-	-
24	-	-	-	-	*0.006*	0.161	0.002	0.025	*0.449*	-	-	-
25	-	-	-	-	*0.015*	0.164	0.003	0.014	*0.431*	-	-	-
26	-	-	-	-	*0.037*	0.147	0.004	0.011	*0.382*	-	-	-
27	-	-	-	-	*0.090*	0.141	0.037	0.017	*0.364*	-	-	-
28	-	-	-	-	*0.221*	0.139	0.050	0.017	*0.335*	-	-	-
29	-	-	-	-	*0.543*	0.133	0.037	0.017	*0.312*	-	-	-
30	-	-	-	-	*1.335*	0.130	0.032	0.014	*0.314*	-	-	-
31	-	-	-	-	*1.244*	0.137	0.047	0.016	*0.290*	-	-	-
Mean	-	-	-	-	0.349	0.531	0.052	0.013	0.349	0.149	-	-
Max	-	-	-	-	1.335	1.211	0.137	0.034	0.903	0.290	-	-
Min	-	-	-	-	0.001	0.130	0.001	0.001	0.012	0.000	-	-
Total	0.000	0.000	0.000	0.000	3.493	16.450	1.601	0.399	10.822	2.833	0.000	0.000

Note: Estimated values are italicized.

Appendix 6. Summary of Daily Discharge [Q, m^3/s] at Hydrometric Station EL-H1

Drainage Area = 1.40 km^2												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	-	-	-	0.079	0.003	0.002	0.013	*0.064*	-	-
2	-	-	-	-	-	0.071	0.003	0.002	0.008	*0.062*	-	-
3	-	-	-	-	-	0.046	0.003	0.002	0.004	*0.043*	-	-
4	-	-	-	-	-	0.040	0.002	0.002	0.005	*0.029*	-	-
5	-	-	-	-	-	0.044	0.002	0.002	0.008	*0.020*	-	-
6	-	-	-	-	-	0.035	0.002	0.002	0.007	*0.014*	-	-
7	-	-	-	-	-	0.049	0.002	0.002	0.007	*0.009*	-	-
8	-	-	-	-	-	0.079	0.002	0.001	0.005	*0.006*	-	-
9	-	-	-	-	-	0.037	0.002	0.001	0.004	*0.004*	-	-
10	-	-	-	-	-	0.018	0.001	0.001	0.026	*0.003*	-	-
11	-	-	-	-	-	0.009	0.001	0.001	0.041	*0.002*	-	-
12	-	-	-	-	-	0.005	0.001	0.001	0.029	*0.001*	-	-
13	-	-	-	-	-	0.003	0.001	0.001	*0.154*	*0.001*	-	-
14	-	-	-	-	-	0.003	0.001	0.001	*0.166*	*0.001*	-	-
15	-	-	-	-	-	0.004	0.001	0.001	*0.157*	*0.000*	-	-
16	-	-	-	-	-	0.005	0.001	0.001	*0.142*	*0.000*	-	-
17	-	-	-	-	-	0.010	0.001	0.001	*0.129*	*0.000*	-	-
18	-	-	-	-	-	0.004	0.001	0.001	*0.117*	*0.000*	-	-
19	-	-	-	-	-	0.003	0.000	0.001	*0.113*	*0.000*	-	-
20	-	-	-	-	-	0.002	0.000	0.001	*0.109*	-	-	-
21	-	-	-	-	-	0.002	0.000	0.001	*0.104*	-	-	-
22	-	-	-	-	*0.001*	0.002	0.000	0.023	*0.100*	-	-	-
23	-	-	-	-	*0.002*	0.002	-	0.025	*0.095*	-	-	-
24	-	-	-	-	*0.003*	0.005	-	0.011	*0.092*	-	-	-
25	-	-	-	-	*0.006*	0.047	-	0.006	*0.089*	-	-	-
26	-	-	-	-	*0.010*	0.021	-	0.004	*0.080*	-	-	-
27	-	-	-	-	*0.019*	0.006	0.002	0.006	*0.077*	-	-	-
28	-	-	-	-	*0.033*	0.003	0.002	0.005	*0.072*	-	-	-
29	-	-	-	-	*0.060*	0.002	0.002	0.003	*0.068*	-	-	-
30	-	-	-	-	*0.107*	0.002	0.002	0.003	*0.068*	-	-	-
31	-	-	-	-	0.107	0.003	0.002	0.003	*0.064*	-	-	-
Mean	-	-	-	-	0.035	0.021	0.001	0.004	0.069	0.014	-	-
Max	-	-	-	-	0.107	0.079	0.003	0.025	0.166	0.064	-	-
Min	-	-	-	-	0.001	0.002	0.000	0.001	0.004	0.000	-	-
Total	0.000	0.000	0.000	0.000	0.349	0.641	0.036	0.119	2.152	0.261	0.000	0.000

Notes: Estimated values are italicized.

Values in red denote high uncertainty based on extrapolation of the rating curve beyond 2 times the greatest measured discharge.

Appendix 6. Summary of Daily Discharge [Q, m^3/s] at Hydrometric Station WL-H1

Drainage Area = 32.70 km^2												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1	-	-	-	-	-	*1.082*	0.263	0.061	0.055	*0.214*	-	-
2	-	-	-	-	-	1.082	0.260	0.083	0.053	*0.211*	-	-
3	-	-	-	-	-	1.025	0.225	0.081	0.049	*0.199*	-	-
4	-	-	-	-	-	0.951	0.188	0.073	0.054	*0.186*	-	-
5	-	-	-	-	-	0.896	0.169	0.065	0.062	*0.174*	-	-
6	-	-	-	-	-	0.855	0.159	0.057	0.057	*0.162*	-	-
7	-	-	-	-	-	0.846	0.147	0.052	0.062	*0.149*	-	-
8	-	-	-	-	-	0.996	0.136	0.046	0.062	*0.137*	-	-
9	-	-	-	-	-	0.964	0.127	0.038	0.067	*0.125*	-	-
10	-	-	-	-	-	0.883	0.109	0.035	0.102	*0.112*	-	-
11	-	-	-	-	-	0.803	0.097	0.031	0.131	*0.100*	-	-
12	-	-	-	-	-	0.738	0.083	0.027	0.154	*0.088*	-	-
13	-	-	-	-	-	0.676	0.067	0.022	0.310	*0.075*	-	-
14	-	-	-	-	-	0.643	0.060	0.019	0.297	*0.063*	-	-
15	-	-	-	-	-	0.646	0.061	0.018	*0.361*	*0.051*	-	-
16	-	-	-	-	-	0.640	0.059	0.014	*0.340*	*0.038*	-	-
17	-	-	-	-	-	0.647	0.057	0.017	*0.323*	*0.026*	-	-
18	-	-	-	-	-	0.599	0.046	0.015	*0.305*	*0.014*	-	-
19	-	-	-	-	-	0.570	0.037	0.017	*0.298*	*0.001*	-	-
20	-	-	-	-	-	0.498	0.047	0.013	*0.292*	-	-	-
21	-	-	-	-	-	0.445	0.047	0.017	*0.285*	-	-	-
22	-	-	-	-	*0.001*	0.394	0.040	0.061	*0.277*	-	-	-
23	-	-	-	-	*0.002*	0.368	0.037	0.068	*0.270*	-	-	-
24	-	-	-	-	*0.006*	0.402	0.038	0.059	*0.265*	-	-	-
25	-	-	-	-	*0.014*	0.452	0.035	0.051	*0.260*	-	-	-
26	-	-	-	-	*0.033*	0.369	0.036	0.049	*0.245*	-	-	-
27	-	-	-	-	*0.079*	0.328	0.080	0.051	*0.239*	-	-	-
28	-	-	-	-	*0.189*	0.300	0.080	0.047	*0.230*	-	-	-
29	-	-	-	-	*0.453*	0.281	0.068	0.044	*0.222*	-	-	-
30	-	-	-	-	*1.087*	0.259	0.075	0.041	*0.222*	-	-	-
31	-	-	-	-	*1.040*	0.263	0.070	0.040	*0.214*	-	-	-
Mean	-	-	-	-	0.290	0.642	0.097	0.042	0.199	0.112	-	-
Max	-	-	-	-	1.087	1.082	0.263	0.083	0.361	0.214	-	-
Min	-	-	-	-	0.001	0.259	0.035	0.013	0.049	0.001	-	-
Total	0.000	0.000	0.000	0.000	2.904	19.901	3.003	1.310	6.161	2.125	0.000	0.000

Note: Estimated values are italicized.

Appendix 6. Summary of Daily Discharge [Q, m^3/s] at Hydrometric Station REFB-H1

Drainage Area = 5.30 km^2												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	-	-	-	*0.124*	0.015	0.001	0.000	*0.002*	-	-
2	-	-	-	-	-	*0.088*	0.010	0.001	0.000	*0.002*	-	-
3	-	-	-	-	-	*0.080*	0.010	0.001	0.000	*0.002*	-	-
4	-	-	-	-	-	*0.086*	0.009	0.001	0.000	*0.001*	-	-
5	-	-	-	-	-	*0.073*	0.007	0.000	0.001	*0.001*	-	-
6	-	-	-	-	-	*0.083*	0.006	0.000	0.001	*0.001*	-	-
7	-	-	-	-	-	0.083	0.005	0.000	0.001	*0.001*	-	-
8	-	-	-	-	-	0.129	0.005	0.000	0.001	*0.001*	-	-
9	-	-	-	-	-	0.097	0.004	-	0.001	*0.001*	-	-
10	-	-	-	-	-	0.058	0.003	-	0.002	*0.000*	-	-
11	-	-	-	-	-	0.046	0.003	-	0.002	*0.000*	-	-
12	-	-	-	-	-	0.039	0.002	-	0.001	*0.000*	-	-
13	-	-	-	-	-	0.034	0.002	-	0.004	*0.000*	-	-
14	-	-	-	-	-	0.032	0.001	-	0.002	*0.000*	-	-
15	-	-	-	-	-	0.033	0.001	-	0.001	*0.000*	-	-
16	-	-	-	-	-	0.032	0.002	-	*0.002*	*0.000*	-	-
17	-	-	-	-	-	0.032	0.001	-	*0.002*	*0.000*	-	-
18	-	-	-	-	-	0.033	0.002	-	*0.002*	*0.000*	-	-
19	-	-	-	-	-	0.024	0.002	-	*0.002*	*0.000*	-	-
20	-	-	-	-	-	0.021	0.002	-	*0.002*	-	-	-
21	-	-	-	-	-	0.018	0.001	-	*0.002*	-	-	-
22	-	-	-	-	*0.001*	0.016	0.001	0.000	*0.002*	-	-	-
23	-	-	-	-	*0.002*	0.017	0.001	0.000	*0.002*	-	-	-
24	-	-	-	-	*0.004*	0.018	0.001	0.000	*0.002*	-	-	-
25	-	-	-	-	*0.007*	0.024	0.000	0.000	*0.002*	-	-	-
26	-	-	-	-	*0.013*	0.019	0.000	0.000	*0.002*	-	-	-
27	-	-	-	-	*0.025*	0.015	0.001	0.000	*0.002*	-	-	-
28	-	-	-	-	*0.048*	0.014	0.001	0.000	*0.002*	-	-	-
29	-	-	-	-	*0.092*	0.012	0.001	0.000	*0.002*	-	-	-
30	-	-	-	-	*0.176*	0.011	0.001	0.000	*0.002*	-	-	-
31	-	-	-	-	*0.135*	0.015	0.001	0.000	*0.002*	-	-	-
Mean	-	-	-	-	0.050	0.045	0.003	0.000	0.002	0.001	-	-
Max	-	-	-	-	0.176	0.129	0.015	0.001	0.004	0.002	-	-
Min	-	-	-	-	0.001	0.011	0.000	0.000	0.000	0.000	-	-
Total	0.000	0.000	0.000	0.000	0.504	1.407	0.098	0.005	0.050	0.013	0.000	0.000

Note: Estimated values are italicized.

Appendix 6. Summary of Daily Discharge [Q, m^3/s] at Hydrometric Station TIA-H1

Drainage Area = 5.00 km^2												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1	-	-	-	-	-	*0.100*	0.009	0.003	*0.003*	*0.004*	-	-
2	-	-	-	-	-	*0.089*	0.008	0.003	*0.003*	*0.004*	-	-
3	-	-	-	-	-	*0.085*	0.008	0.003	*0.003*	*0.003*	-	-
4	-	-	-	-	-	*0.088*	0.007	*0.003*	*0.003*	*0.003*	-	-
5	-	-	-	-	-	*0.100*	0.006	*0.003*	*0.003*	*0.003*	-	-
6	-	-	-	-	-	0.100	0.004	*0.003*	*0.003*	*0.003*	-	-
7	-	-	-	-	-	0.090	0.003	*0.003*	*0.003*	*0.003*	-	-
8	-	-	-	-	-	0.094	0.003	*0.003*	*0.003*	*0.002*	-	-
9	-	-	-	-	-	0.099	0.003	*0.003*	*0.003*	*0.002*	-	-
10	-	-	-	-	-	0.067	0.003	*0.003*	*0.003*	*0.002*	-	-
11	-	-	-	-	-	0.049	0.003	*0.003*	*0.003*	*0.002*	-	-
12	-	-	-	-	-	0.038	0.003	*0.003*	*0.004*	*0.002*	-	-
13	-	-	-	-	-	0.032	0.003	*0.003*	*0.004*	*0.001*	-	-
14	-	-	-	-	-	0.029	0.003	*0.003*	*0.004*	*0.001*	-	-
15	-	-	-	-	-	0.026	0.003	*0.003*	*0.004*	*0.001*	-	-
16	-	-	-	-	-	0.024	0.003	*0.003*	*0.004*	*0.001*	-	-
17	-	-	-	-	-	0.023	0.003	*0.003*	*0.004*	*0.001*	-	-
18	-	-	-	-	-	0.022	0.003	*0.003*	*0.004*	*0.000*	-	-
19	-	-	-	-	-	0.019	0.003	*0.003*	*0.004*	*0.000*	-	-
20	-	-	-	-	-	0.017	0.003	*0.003*	*0.004*	-	-	-
21	-	-	-	-	-	0.015	0.003	*0.003*	*0.004*	-	-	-
22	-	-	-	-	*0.001*	0.013	0.003	*0.003*	*0.004*	-	-	-
23	-	-	-	-	*0.002*	0.011	0.003	*0.003*	*0.004*	-	-	-
24	-	-	-	-	*0.003*	0.009	0.003	*0.003*	*0.004*	-	-	-
25	-	-	-	-	*0.006*	0.008	0.003	*0.003*	*0.004*	-	-	-
26	-	-	-	-	*0.011*	0.009	0.003	*0.003*	*0.004*	-	-	-
27	-	-	-	-	*0.019*	0.009	0.003	*0.003*	*0.004*	-	-	-
28	-	-	-	-	*0.034*	0.009	0.003	*0.003*	*0.004*	-	-	-
29	-	-	-	-	*0.061*	0.008	0.003	*0.003*	*0.004*	-	-	-
30	-	-	-	-	*0.111*	0.009	0.003	*0.003*	*0.004*	-	-	-
31	-	-	-	-	*0.103*	0.009	0.003	*0.003*	*0.004*	-	-	-
Mean	-	-	-	-	0.035	0.042	0.004	0.003	0.004	0.002	-	-
Max	-	-	-	-	0.111	0.100	0.009	0.003	0.004	0.004	-	-
Min	-	-	-	-	0.001	0.008	0.003	0.003	0.003	0.000	-	-
Total	0.000	0.000	0.000	0.000	0.351	1.302	0.111	0.091	0.111	0.037	0.000	0.000

Note: Estimated values are italicized.

Appendix 6. Summary of Daily Discharge [Q, m^3/s] at Hydrometric Station UM-H1

Drainage Area = 4.10 km^2												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1	-	-	-	-	-	*0.207*	0.029	0.005	0.004	*0.011*	-	-
2	-	-	-	-	-	*0.190*	0.022	0.006	0.004	*0.011*	-	-
3	-	-	-	-	-	*0.184*	0.022	0.006	0.003	*0.010*	-	-
4	-	-	-	-	-	*0.195*	0.019	0.006	0.002	*0.010*	-	-
5	-	-	-	-	-	0.195	0.015	0.005	0.004	*0.009*	-	-
6	-	-	-	-	-	0.191	0.012	0.004	0.004	*0.008*	-	-
7	-	-	-	-	-	0.193	0.010	0.004	0.003	*0.008*	-	-
8	-	-	-	-	-	0.208	0.009	0.004	0.003	*0.007*	-	-
9	-	-	-	-	-	0.181	0.008	0.003	0.003	*0.007*	-	-
10	-	-	-	-	-	0.151	0.008	0.002	0.005	*0.006*	-	-
11	-	-	-	-	-	0.130	0.007	0.002	0.006	*0.005*	-	-
12	-	-	-	-	-	0.116	0.006	0.002	0.006	*0.005*	-	-
13	-	-	-	-	-	0.107	0.006	0.002	0.015	*0.004*	-	-
14	-	-	-	-	-	0.103	0.005	0.001	0.017	*0.003*	-	-
15	-	-	-	-	-	0.098	0.005	0.001	0.019	*0.003*	-	-
16	-	-	-	-	-	0.097	0.005	0.001	*0.018*	*0.002*	-	-
17	-	-	-	-	-	0.098	0.006	0.001	*0.017*	*0.001*	-	-
18	-	-	-	-	-	0.097	0.006	0.001	*0.016*	*0.001*	-	-
19	-	-	-	-	-	0.082	0.003	0.001	*0.015*	*0.000*	-	-
20	-	-	-	-	-	0.073	0.003	0.001	*0.015*	-	-	-
21	-	-	-	-	-	0.065	0.003	0.001	*0.015*	-	-	-
22	-	-	-	-	*0.001*	0.059	0.003	0.004	*0.014*	-	-	-
23	-	-	-	-	*0.002*	0.057	0.002	0.005	*0.014*	-	-	-
24	-	-	-	-	*0.004*	0.054	0.002	0.004	*0.014*	-	-	-
25	-	-	-	-	*0.008*	0.056	0.002	0.004	*0.013*	-	-	-
26	-	-	-	-	*0.015*	0.045	0.002	0.003	*0.013*	-	-	-
27	-	-	-	-	*0.029*	0.039	0.006	0.003	*0.012*	-	-	-
28	-	-	-	-	*0.058*	0.035	0.007	0.003	*0.012*	-	-	-
29	-	-	-	-	*0.114*	0.029	0.006	0.003	*0.012*	-	-	-
30	-	-	-	-	*0.224*	0.027	0.006	0.003	*0.012*	-	-	-
31	-	-	-	-	*0.211*	0.029	0.007	0.003	*0.011*	-	-	-
Mean	-	-	-	-	0.067	0.109	0.008	0.003	0.010	0.006	-	-
Max	-	-	-	-	0.224	0.208	0.029	0.006	0.019	0.011	-	-
Min	-	-	-	-	0.001	0.027	0.002	0.001	0.002	0.000	-	-
Total	0.000	0.000	0.000	0.000	0.665	3.390	0.254	0.095	0.320	0.112	0.000	0.000

Note: Estimated values are italicized.

Appendix 6. Summary of Daily Discharge [Q, m^3/s] at Hydrometric Station WP-H1

Drainage Area = 17.60 km^2												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1	-	-	-	-	-	*0.791*	0.149	0.041	0.039	*0.079*	-	-
2	-	-	-	-	-	*0.728*	0.130	0.044	0.040	*0.078*	-	-
3	-	-	-	-	-	*0.707*	0.128	0.043	0.038	*0.073*	-	-
4	-	-	-	-	-	*0.771*	0.120	0.042	0.035	*0.069*	-	-
5	-	-	-	-	-	0.771	0.112	0.041	0.043	*0.065*	-	-
6	-	-	-	-	-	0.752	0.107	0.040	0.045	*0.060*	-	-
7	-	-	-	-	-	0.733	0.102	0.039	0.043	*0.056*	-	-
8	-	-	-	-	-	0.760	0.097	0.039	0.042	*0.051*	-	-
9	-	-	-	-	-	0.687	0.092	0.037	0.041	*0.047*	-	-
10	-	-	-	-	-	0.600	0.087	0.035	0.048	*0.042*	-	-
11	-	-	-	-	-	0.539	0.082	0.035	0.051	*0.038*	-	-
12	-	-	-	-	-	0.496	0.077	0.034	0.050	*0.034*	-	-
13	-	-	-	-	-	0.458	0.075	0.032	*0.117*	*0.029*	-	-
14	-	-	-	-	-	0.428	0.068	0.030	*0.121*	*0.025*	-	-
15	-	-	-	-	-	0.401	0.065	0.029	*0.118*	*0.020*	-	-
16	-	-	-	-	-	0.385	0.064	0.026	*0.113*	*0.016*	-	-
17	-	-	-	-	-	0.370	0.063	0.026	*0.108*	*0.011*	-	-
18	-	-	-	-	-	0.356	0.063	0.025	*0.103*	*0.007*	-	-
19	-	-	-	-	-	0.323	0.051	0.027	*0.101*	*0.003*	-	-
20	-	-	-	-	-	0.294	0.050	0.026	*0.100*	-	-	-
21	-	-	-	-	-	0.268	0.049	0.026	*0.098*	-	-	-
22	-	-	-	-	*0.001*	0.248	0.045	0.034	*0.096*	-	-	-
23	-	-	-	-	*0.002*	0.229	0.043	0.034	*0.094*	-	-	-
24	-	-	-	-	*0.005*	0.218	0.042	0.033	*0.092*	-	-	-
25	-	-	-	-	*0.013*	0.216	0.041	0.031	*0.091*	-	-	-
26	-	-	-	-	*0.029*	0.191	0.040	0.031	*0.087*	-	-	-
27	-	-	-	-	*0.068*	0.177	0.045	0.033	*0.085*	-	-	-
28	-	-	-	-	*0.158*	0.169	0.045	0.034	*0.083*	-	-	-
29	-	-	-	-	*0.367*	0.158	0.042	0.035	*0.081*	-	-	-
30	-	-	-	-	*0.852*	0.150	0.043	0.035	*0.081*	-	-	-
31	-	-	-	-	*0.807*	0.149	0.044	0.036	*0.079*	-	-	-
Mean	-	-	-	-	0.230	0.436	0.073	0.034	0.076	0.042	-	-
Max	-	-	-	-	0.852	0.791	0.149	0.044	0.121	0.079	-	-
Min	-	-	-	-	0.001	0.149	0.040	0.025	0.035	0.003	-	-
Total	0.000	0.000	0.000	0.000	2.302	13.524	2.259	1.053	2.361	0.802	0.000	0.000

Note: Estimated values are italicized.

Appendix 6. Summary of Daily Discharge [Q, m^3/s] at Hydrometric Station WR-H1

Drainage Area = 2.70 km^2												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1	-	-	-	-	-	*0.257*	0.029	0.007	0.026	*0.138*	-	-
2	-	-	-	-	-	0.257	0.038	0.012	0.034	*0.136*	-	-
3	-	-	-	-	-	0.174	0.041	0.018	0.031	*0.128*	-	-
4	-	-	-	-	-	0.129	0.034	0.017	0.028	*0.120*	-	-
5	-	-	-	-	-	0.115	0.024	0.012	0.032	*0.112*	-	-
6	-	-	-	-	-	0.113	0.015	0.008	0.034	*0.104*	-	-
7	-	-	-	-	-	0.130	0.008	0.004	0.032	*0.096*	-	-
8	-	-	-	-	-	0.254	0.005	0.001	0.032	*0.088*	-	-
9	-	-	-	-	-	0.208	0.002	0.000	0.029	*0.080*	-	-
10	-	-	-	-	-	0.148	0.000	-	0.046	*0.072*	-	-
11	-	-	-	-	-	0.108	-	-	0.086	*0.064*	-	-
12	-	-	-	-	-	0.082	-	-	0.088	*0.056*	-	-
13	-	-	-	-	-	0.065	-	-	0.312	*0.048*	-	-
14	-	-	-	-	-	0.052	-	-	0.224	*0.040*	-	-
15	-	-	-	-	-	0.064	-	-	0.158	*0.032*	-	-
16	-	-	-	-	-	0.075	-	-	*0.221*	*0.024*	-	-
17	-	-	-	-	-	0.083	-	-	*0.210*	*0.016*	-	-
18	-	-	-	-	-	0.076	-	-	*0.198*	*0.008*	-	-
19	-	-	-	-	-	0.057	-	-	*0.193*	*0.000*	-	-
20	-	-	-	-	-	0.042	-	-	*0.190*	-	-	-
21	-	-	-	-	-	0.031	-	0.000	*0.185*	-	-	-
22	-	-	-	-	*0.001*	0.022	-	0.020	*0.180*	-	-	-
23	-	-	-	-	*0.002*	0.019	-	0.055	*0.175*	-	-	-
24	-	-	-	-	*0.004*	0.022	-	0.050	*0.172*	-	-	-
25	-	-	-	-	*0.009*	0.181	-	0.039	*0.168*	-	-	-
26	-	-	-	-	*0.018*	0.171	-	0.031	*0.158*	-	-	-
27	-	-	-	-	*0.037*	0.099	-	0.029	*0.155*	-	-	-
28	-	-	-	-	*0.077*	0.057	0.000	0.030	*0.148*	-	-	-
29	-	-	-	-	*0.159*	0.037	0.003	0.026	*0.143*	-	-	-
30	-	-	-	-	*0.328*	0.024	0.005	0.023	*0.144*	-	-	-
31	-	-	-	-	*0.253*	0.029	0.007	0.021	*0.138*	-	-	-
Mean	-	-	-	-	0.089	0.103	0.015	0.020	0.128	0.072	-	-
Max	-	-	-	-	0.328	0.257	0.041	0.055	0.312	0.138	-	-
Min	-	-	-	-	0.001	0.019	0.000	0.000	0.026	0.000	-	-
Total	0.000	0.000	0.000	0.000	0.888	3.180	0.208	0.400	3.970	1.366	0.000	0.000

Note: Estimated values are italicized.

Appendix 6. Summary of Daily Discharge [Q, m^3/s] at Hydrometric Station KL-H1

Drainage Area = 24.20 km^2												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1	-	-	-	-	-	*0.153*	0.343	0.045	0.084	*0.007*	-	-
2	-	-	-	-	-	*0.287*	0.293	0.047	0.096	*0.006*	-	-
3	-	-	-	-	-	*0.538*	0.292	0.045	0.086	*0.004*	-	-
4	-	-	-	-	-	*1.008*	0.281	0.041	0.073	*0.004*	-	-
5	-	-	-	-	-	1.008	0.248	0.036	0.101	*0.003*	-	-
6	-	-	-	-	-	1.293	0.219	0.032	0.118	*0.002*	-	-
7	-	-	-	-	-	1.489	0.200	0.030	0.100	*0.002*	-	-
8	-	-	-	-	-	1.416	0.184	0.029	0.087	*0.002*	-	-
9	-	-	-	-	-	1.165	0.168	0.026	0.072	*0.001*	-	-
10	-	-	-	-	-	0.978	0.153	0.023	0.097	-	-	-
11	-	-	-	-	-	0.871	0.135	0.022	0.105	-	-	-
12	-	-	-	-	-	0.812	0.123	0.021	0.107	-	-	-
13	-	-	-	-	-	0.762	0.121	0.018	0.179	-	-	-
14	-	-	-	-	-	0.747	0.102	0.016	0.191	-	-	-
15	-	-	-	-	-	0.744	0.093	0.016	0.188	-	-	-
16	-	-	-	-	-	0.853	0.092	0.013	0.198	-	-	-
17	-	-	-	-	-	0.856	0.086	0.015	*0.130*	-	-	-
18	-	-	-	-	-	0.823	0.095	0.017	*0.105*	-	-	-
19	-	-	-	-	-	0.752	0.058	0.021	*0.085*	-	-	-
20	-	-	-	-	-	0.683	0.048	0.022	*0.069*	-	-	-
21	-	-	-	-	-	0.615	0.047	0.026	*0.056*	-	-	-
22	-	-	-	-	-	0.566	0.041	0.056	*0.045*	-	-	-
23	-	-	-	-	-	0.559	0.035	0.073	*0.037*	-	-	-
24	-	-	-	-	*0.001*	0.553	0.036	0.069	*0.030*	-	-	-
25	-	-	-	-	*0.002*	0.546	0.036	0.052	*0.024*	-	-	-
26	-	-	-	-	*0.004*	0.497	0.038	0.041	*0.019*	-	-	-
27	-	-	-	-	*0.007*	0.448	0.046	0.058	*0.016*	-	-	-
28	-	-	-	-	*0.012*	0.416	0.048	0.070	*0.013*	-	-	-
29	-	-	-	-	*0.023*	0.384	0.040	0.069	*0.010*	-	-	-
30	-	-	-	-	*0.043*	0.356	0.041	0.063	*0.008*	-	-	-
31	-	-	-	-	*0.082*	0.343	0.054	0.061	*0.007*	-	-	-
Mean	-	-	-	-	0.022	0.727	0.122	0.038	0.082	0.003	-	-
Max	-	-	-	-	0.082	1.489	0.343	0.073	0.198	0.007	-	-
Min	-	-	-	-	0.001	0.153	0.035	0.013	0.007	0.001	-	-
Total	0.000	0.000	0.000	0.000	0.174	22.522	3.795	1.173	2.535	0.030	0.000	0.000

Note: Estimated values are italicized.

Appendix 6. Summary of Daily Discharge [Q, m^3/s] at Hydrometric Station KL-H2

Drainage Area = 24.22 km^2												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	-	-	-	*0.045*	0.188	0.039	0.014	*0.003*	-	-
2	-	-	-	-	-	*0.078*	0.194	0.032	0.021	*0.002*	-	-
3	-	-	-	-	-	*0.134*	0.175	0.036	0.018	*0.002*	-	-
4	-	-	-	-	-	*0.231*	0.183	0.035	0.018	*0.002*	-	-
5	-	-	-	-	-	*0.398*	0.167	0.034	0.018	*0.002*	-	-
6	-	-	-	-	-	*0.484*	0.149	0.032	0.022	*0.001*	-	-
7	-	-	-	-	-	*0.544*	0.133	0.029	0.023	*0.001*	-	-
8	-	-	-	-	-	*0.522*	0.129	0.027	0.025	*0.001*	-	-
9	-	-	-	-	-	*0.445*	0.124	0.025	0.025	*0.001*	-	-
10	-	-	-	-	-	*0.388*	0.119	0.024	0.024	*0.001*	-	-
11	-	-	-	-	-	*0.356*	0.109	0.023	0.025	-	-	-
12	-	-	-	-	-	0.346	0.097	0.022	0.023	-	-	-
13	-	-	-	-	-	0.329	0.092	0.020	0.027	-	-	-
14	-	-	-	-	-	0.308	0.072	0.019	0.044	-	-	-
15	-	-	-	-	-	0.301	0.067	0.015	0.037	-	-	-
16	-	-	-	-	-	0.308	0.066	0.018	*0.031*	-	-	-
17	-	-	-	-	-	0.359	0.059	0.009	*0.027*	-	-	-
18	-	-	-	-	-	0.358	0.058	0.009	*0.023*	-	-	-
19	-	-	-	-	-	0.346	0.068	0.008	*0.019*	-	-	-
20	-	-	-	-	-	0.307	0.044	0.011	*0.017*	-	-	-
21	-	-	-	-	-	0.288	0.046	0.008	*0.014*	-	-	-
22	-	-	-	-	-	0.261	0.045	0.008	*0.012*	-	-	-
23	-	-	-	-	-	0.249	0.039	0.018	*0.010*	-	-	-
24	-	-	-	-	-	0.249	0.035	0.011	*0.009*	-	-	-
25	-	-	-	-	*0.001*	0.251	0.037	0.009	*0.007*	-	-	-
26	-	-	-	-	*0.002*	0.259	0.035	0.008	*0.006*	-	-	-
27	-	-	-	-	*0.003*	0.233	0.042	0.007	*0.005*	-	-	-
28	-	-	-	-	*0.005*	0.214	0.042	0.013	*0.005*	-	-	-
29	-	-	-	-	*0.009*	0.206	0.042	0.014	*0.004*	-	-	-
30	-	-	-	-	*0.015*	0.194	0.034	0.014	*0.003*	-	-	-
31	-	-	-	-	*0.026*	0.188	0.036	0.014	*0.003*	-	-	-
Mean	-	-	-	-	0.009	0.296	0.088	0.019	0.018	0.002	-	-
Max	-	-	-	-	0.026	0.544	0.194	0.039	0.044	0.003	-	-
Min	-	-	-	-	0.001	0.045	0.034	0.007	0.003	0.001	-	-
Total	0.000	0.000	0.000	0.000	0.061	9.179	2.726	0.592	0.558	0.016	0.000	0.000

Note: Estimated values are italicized.

Appendix 6. Summary of Daily Discharge [Q, m^3/s] at Hydrometric Station LG-H1

Drainage Area = 271.28 km^2												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1	-	-	-	-	-	*0.917*	5.298	1.185	1.326	*0.232*	-	-
2	-	-	-	-	-	*2.152*	4.664	1.242	1.412	*0.199*	-	-
3	-	-	-	-	-	*5.048*	4.604	1.228	1.469	*0.170*	-	-
4	-	-	-	-	-	*11.843*	4.217	1.203	1.452	*0.146*	-	-
5	-	-	-	-	-	*14.665*	3.845	1.144	1.611	*0.125*	-	-
6	-	-	-	-	-	*16.618*	3.541	1.093	1.775	*0.107*	-	-
7	-	-	-	-	-	*15.892*	3.376	1.074	1.807	*0.092*	-	-
8	-	-	-	-	-	*13.402*	3.211	1.050	1.776	*0.079*	-	-
9	-	-	-	-	-	*11.546*	3.030	1.031	1.684	*0.068*	-	-
10	-	-	-	-	-	*10.476*	2.830	1.004	1.753	-	-	-
11	-	-	-	-	-	*10.154*	2.579	0.978	*1.636*	-	-	-
12	-	-	-	-	-	10.154	2.448	0.951	*2.489*	-	-	-
13	-	-	-	-	-	9.684	2.275	0.926	*2.638*	-	-	-
14	-	-	-	-	-	9.546	2.154	0.853	*2.595*	-	-	-
15	-	-	-	-	-	9.564	2.123	0.890	*2.715*	-	-	-
16	-	-	-	-	-	9.678	2.079	0.731	*2.328*	-	-	-
17	-	-	-	-	-	9.898	2.051	0.703	*1.996*	-	-	-
18	-	-	-	-	-	9.852	2.220	0.677	*1.711*	-	-	-
19	-	-	-	-	-	9.368	1.769	0.745	*1.467*	-	-	-
20	-	-	-	-	-	8.854	1.640	0.705	*1.258*	-	-	-
21	-	-	-	-	-	8.237	1.587	0.687	*1.079*	-	-	-
22	-	-	-	-	-	7.710	1.468	0.878	*0.925*	-	-	-
23	-	-	-	-	-	7.314	1.348	0.817	*0.793*	-	-	-
24	-	-	-	-	*0.001*	7.233	1.322	0.792	*0.680*	-	-	-
25	-	-	-	-	*0.002*	6.850	1.266	0.744	*0.583*	-	-	-
26	-	-	-	-	*0.006*	6.736	1.315	0.721	*0.500*	-	-	-
27	-	-	-	-	*0.013*	6.242	1.332	0.854	*0.429*	-	-	-
28	-	-	-	-	*0.030*	5.914	1.317	0.939	*0.368*	-	-	-
29	-	-	-	-	*0.071*	5.566	1.190	0.981	*0.315*	-	-	-
30	-	-	-	-	*0.167*	5.303	1.183	1.034	*0.270*	-	-	-
31	-	-	-	-	*0.391*	5.298	1.269	1.109	*0.232*	-	-	-
Mean	-	-	-	-	0.085	8.765	2.405	0.934	1.389	0.135	-	-
Max	-	-	-	-	0.391	16.618	5.298	1.242	2.715	0.232	-	-
Min	-	-	-	-	0.001	0.917	1.183	0.677	0.232	0.068	-	-
Total	0.000	0.000	0.000	0.000	0.681	271.714	74.552	28.968	43.073	1.218	0.000	0.000

Note: Estimated values are italicized.

Appendix 6. Summary of Daily Discharge [Q, m^3/s] at Hydrometric Station LY-H1

Drainage Area = 10.64 km^2												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1	-	-	-	-	-	*0.060*	0.073	0.012	0.015	*0.001*	-	-
2	-	-	-	-	-	*0.100*	0.065	0.014	0.014	*0.001*	-	-
3	-	-	-	-	-	*0.168*	0.066	0.014	0.013	*0.001*	-	-
4	-	-	-	-	-	*0.280*	0.059	0.013	0.015	*0.001*	-	-
5	-	-	-	-	-	*0.373*	0.050	0.012	0.017	*0.001*	-	-
6	-	-	-	-	-	*0.438*	0.044	0.012	0.017	*0.001*	-	-
7	-	-	-	-	-	*0.414*	0.039	0.011	0.017	*0.001*	-	-
8	-	-	-	-	-	*0.331*	0.038	0.010	0.018	*0.000*	-	-
9	-	-	-	-	-	*0.313*	0.037	0.009	0.019	*0.000*	-	-
10	-	-	-	-	-	0.313	0.035	0.008	0.020	-	-	-
11	-	-	-	-	-	0.281	0.032	0.008	0.019	-	-	-
12	-	-	-	-	-	0.244	0.030	0.007	0.020	-	-	-
13	-	-	-	-	-	0.209	0.027	0.006	0.029	-	-	-
14	-	-	-	-	-	0.182	0.023	0.006	0.028	-	-	-
15	-	-	-	-	-	0.184	0.023	0.005	*0.020*	-	-	-
16	-	-	-	-	-	0.209	0.022	0.005	*0.017*	-	-	-
17	-	-	-	-	-	0.198	0.020	0.005	*0.015*	-	-	-
18	-	-	-	-	-	0.189	0.022	0.005	*0.012*	-	-	-
19	-	-	-	-	-	0.170	0.018	0.004	*0.011*	-	-	-
20	-	-	-	-	-	0.156	0.016	0.004	*0.009*	-	-	-
21	-	-	-	-	-	0.141	0.015	0.005	*0.008*	-	-	-
22	-	-	-	-	-	0.133	0.013	0.009	*0.006*	-	-	-
23	-	-	-	-	-	0.131	0.012	0.010	*0.005*	-	-	-
24	-	-	-	-	*0.001*	0.130	0.013	0.008	*0.005*	-	-	-
25	-	-	-	-	*0.002*	0.128	0.012	0.007	*0.004*	-	-	-
26	-	-	-	-	*0.003*	0.114	0.012	0.007	*0.003*	-	-	-
27	-	-	-	-	*0.005*	0.102	0.015	0.010	*0.003*	-	-	-
28	-	-	-	-	*0.008*	0.093	0.014	0.011	*0.002*	-	-	-
29	-	-	-	-	*0.013*	0.085	0.013	0.012	*0.002*	-	-	-
30	-	-	-	-	*0.022*	0.076	0.013	0.011	*0.002*	-	-	-
31	-	-	-	-	*0.036*	0.073	0.014	0.011	*0.001*	-	-	-
Mean	-	-	-	-	0.011	0.194	0.029	0.009	0.013	0.001	-	-
Max	-	-	-	-	0.036	0.438	0.073	0.014	0.029	0.001	-	-
Min	-	-	-	-	0.001	0.060	0.012	0.004	0.001	0.000	-	-
Total	0.000	0.000	0.000	0.000	0.088	6.017	0.884	0.271	0.390	0.008	0.000	0.000

Note: Estimated values are italicized.

Appendix 6. Summary of Daily Discharge [Q, m^3/s] at Hydrometric Station SL-H1

Drainage Area = 13.01 km^2												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1	-	-	-	-	-	*0.095*	0.195	0.072	0.042	*0.009*	-	-
2	-	-	-	-	-	*0.168*	0.181	0.057	0.051	*0.008*	-	-
3	-	-	-	-	-	*0.297*	0.160	0.061	0.050	*0.007*	-	-
4	-	-	-	-	-	*0.525*	0.170	0.061	0.043	*0.006*	-	-
5	-	-	-	-	-	*0.673*	0.163	0.059	0.037	*0.005*	-	-
6	-	-	-	-	-	*0.774*	0.146	0.055	0.057	*0.004*	-	-
7	-	-	-	-	-	*0.737*	0.136	0.053	0.057	*0.004*	-	-
8	-	-	-	-	-	*0.607*	0.130	0.053	0.045	*0.003*	-	-
9	-	-	-	-	-	*0.528*	0.120	0.051	0.041	*0.003*	-	-
10	-	-	-	-	-	0.528	0.115	0.047	0.036	-	-	-
11	-	-	-	-	-	0.484	0.108	0.045	0.053	-	-	-
12	-	-	-	-	-	0.447	0.099	0.043	0.053	-	-	-
13	-	-	-	-	-	0.421	0.100	0.042	0.052	-	-	-
14	-	-	-	-	-	0.394	0.102	0.038	0.078	-	-	-
15	-	-	-	-	-	0.380	0.082	0.034	0.068	-	-	-
16	-	-	-	-	-	0.384	0.086	0.036	0.071	-	-	-
17	-	-	-	-	-	0.435	0.087	0.028	0.076	-	-	-
18	-	-	-	-	-	0.423	0.084	0.029	0.070	-	-	-
19	-	-	-	-	-	0.399	0.088	0.031	*0.052*	-	-	-
20	-	-	-	-	-	0.360	0.057	0.037	*0.045*	-	-	-
21	-	-	-	-	-	0.327	0.062	0.032	*0.039*	-	-	-
22	-	-	-	-	-	0.295	0.064	0.034	*0.034*	-	-	-
23	-	-	-	-	-	0.276	0.058	0.048	*0.029*	-	-	-
24	-	-	-	-	*0.001*	0.266	0.054	0.048	*0.025*	-	-	-
25	-	-	-	-	*0.002*	0.266	0.058	0.044	*0.022*	-	-	-
26	-	-	-	-	*0.003*	0.262	0.058	0.033	*0.019*	-	-	-
27	-	-	-	-	*0.006*	0.237	0.061	0.031	*0.016*	-	-	-
28	-	-	-	-	*0.010*	0.223	0.062	0.042	*0.014*	-	-	-
29	-	-	-	-	*0.017*	0.215	0.064	0.041	*0.012*	-	-	-
30	-	-	-	-	*0.030*	0.201	0.056	0.041	*0.010*	-	-	-
31	-	-	-	-	*0.054*	0.195	0.062	0.040	*0.009*	-	-	-
Mean	-	-	-	-	0.015	0.381	0.099	0.044	0.042	0.005	-	-
Max	-	-	-	-	0.054	0.774	0.195	0.072	0.078	0.009	-	-
Min	-	-	-	-	0.001	0.095	0.054	0.028	0.009	0.003	-	-
Total	0.000	0.000	0.000	0.000	0.123	11.825	3.069	1.364	1.307	0.049	0.000	0.000

Note: Estimated values are italicized.

Appendix 6. Summary of Daily Discharge [Q, m^3/s] at Hydrometric Station MC-H1

Drainage Area = 10.84 km^2												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	-	-	-	*0.065*	0.060	0.004	0.012	*0.000*	-	-
2	-	-	-	-	-	*0.109*	0.054	0.007	0.012	*0.000*	-	-
3	-	-	-	-	-	*0.183*	0.051	0.007	0.013	*0.000*	-	-
4	-	-	-	-	-	*0.308*	0.044	0.007	0.016	*0.000*	-	-
5	-	-	-	-	-	*0.421*	0.037	0.006	0.018	*0.000*	-	-
6	-	-	-	-	-	*0.498*	0.032	0.005	0.020	*0.000*	-	-
7	-	-	-	-	-	*0.469*	0.029	0.005	0.022	*0.000*	-	-
8	-	-	-	-	-	*0.370*	0.027	0.004	0.026	*0.000*	-	-
9	-	-	-	-	-	*0.317*	0.025	0.004	0.027	*0.000*	-	-
10	-	-	-	-	-	0.317	0.022	0.004	0.026	-	-	-
11	-	-	-	-	-	0.294	0.017	0.003	0.023	-	-	-
12	-	-	-	-	-	0.267	0.014	0.003	0.026	-	-	-
13	-	-	-	-	-	0.243	0.010	0.003	0.036	-	-	-
14	-	-	-	-	-	0.224	0.009	0.002	0.034	-	-	-
15	-	-	-	-	-	0.211	0.008	0.002	*0.021*	-	-	-
16	-	-	-	-	-	0.217	0.007	0.001	*0.016*	-	-	-
17	-	-	-	-	-	0.216	0.007	0.001	*0.013*	-	-	-
18	-	-	-	-	-	0.203	0.008	0.001	*0.010*	-	-	-
19	-	-	-	-	-	0.181	0.005	0.001	*0.008*	-	-	-
20	-	-	-	-	-	0.162	0.005	0.001	*0.006*	-	-	-
21	-	-	-	-	-	0.145	0.005	0.001	*0.005*	-	-	-
22	-	-	-	-	-	0.131	0.004	0.001	*0.004*	-	-	-
23	-	-	-	-	-	0.126	0.003	0.001	*0.003*	-	-	-
24	-	-	-	-	*0.001*	0.120	0.004	0.001	*0.002*	-	-	-
25	-	-	-	-	*0.002*	0.112	0.004	0.001	*0.002*	-	-	-
26	-	-	-	-	*0.003*	0.100	0.004	0.001	*0.001*	-	-	-
27	-	-	-	-	*0.005*	0.089	0.005	0.003	*0.001*	-	-	-
28	-	-	-	-	*0.008*	0.081	0.005	0.005	*0.001*	-	-	-
29	-	-	-	-	*0.014*	0.074	0.004	0.005	*0.001*	-	-	-
30	-	-	-	-	*0.023*	0.066	0.005	0.006	*0.001*	-	-	-
31	-	-	-	-	*0.038*	0.060	0.005	0.007	*0.000*	-	-	-
Mean	-	-	-	-	0.012	0.206	0.017	0.003	0.013	0.000	-	-
Max	-	-	-	-	0.038	0.498	0.060	0.007	0.036	0.000	-	-
Min	-	-	-	-	0.001	0.060	0.003	0.001	0.000	0.000	-	-
Total	0.000	0.000	0.000	0.000	0.093	6.375	0.522	0.100	0.403	0.002	0.000	0.000

Note: Estimated values are italicized.

Appendix 6. Summary of Daily Discharge [Q, m^3/s] at Hydrometric Station REFQ-H1

Drainage Area = 14.66 km^2												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	-	-	-	*0.077*	0.115	0.012	0.112	*0.000*	-	-
2	-	-	-	-	-	*0.132*	0.090	0.013	0.082	*0.000*	-	-
3	-	-	-	-	-	*0.228*	0.093	0.013	0.067	*0.000*	-	-
4	-	-	-	-	-	*0.391*	0.091	0.011	0.081	*0.000*	-	-
5	-	-	-	-	-	*0.511*	0.076	0.009	0.119	*0.000*	-	-
6	-	-	-	-	-	*0.593*	0.063	0.007	0.091	*0.000*	-	-
7	-	-	-	-	-	*0.562*	0.056	0.007	0.090	*0.000*	-	-
8	-	-	-	-	-	*0.457*	0.050	0.007	0.073	*0.000*	-	-
9	-	-	-	-	-	*0.379*	0.044	0.005	0.062	*0.000*	-	-
10	-	-	-	-	-	*0.334*	0.039	0.004	0.070	-	-	-
11	-	-	-	-	-	*0.280*	0.032	0.004	0.069	-	-	-
12	-	-	-	-	-	0.280	0.029	0.003	0.103	-	-	-
13	-	-	-	-	-	0.263	0.030	0.002	0.117	-	-	-
14	-	-	-	-	-	0.261	0.025	0.001	0.117	-	-	-
15	-	-	-	-	-	0.266	0.023	0.002	0.150	-	-	-
16	-	-	-	-	-	0.341	0.024	0.000	0.146	-	-	-
17	-	-	-	-	-	0.350	0.023	0.002	0.119	-	-	-
18	-	-	-	-	-	0.337	0.028	0.003	*0.056*	-	-	-
19	-	-	-	-	-	0.299	0.014	0.005	*0.038*	-	-	-
20	-	-	-	-	-	0.261	0.010	0.005	*0.026*	-	-	-
21	-	-	-	-	-	0.226	0.010	0.006	*0.018*	-	-	-
22	-	-	-	-	-	0.202	0.008	0.019	*0.012*	-	-	-
23	-	-	-	-	-	0.204	0.006	0.026	*0.008*	-	-	-
24	-	-	-	-	*0.001*	0.205	0.006	0.023	*0.006*	-	-	-
25	-	-	-	-	*0.002*	0.208	0.007	0.018	*0.004*	-	-	-
26	-	-	-	-	*0.003*	0.183	0.008	0.023	*0.003*	-	-	-
27	-	-	-	-	*0.005*	0.158	0.012	0.040	*0.002*	-	-	-
28	-	-	-	-	*0.009*	0.144	0.012	0.041	*0.001*	-	-	-
29	-	-	-	-	*0.015*	0.130	0.009	0.050	*0.001*	-	-	-
30	-	-	-	-	*0.026*	0.118	0.010	0.066	*0.001*	-	-	-
31	-	-	-	-	*0.045*	0.115	0.016	0.092	*0.000*	-	-	-
Mean	-	-	-	-	0.013	0.274	0.034	0.017	0.059	0.000	-	-
Max	-	-	-	-	0.045	0.593	0.115	0.092	0.150	0.000	-	-
Min	-	-	-	-	0.001	0.077	0.006	0.000	0.000	0.000	-	-
Total	0.000	0.000	0.000	0.000	0.105	8.492	1.059	0.519	1.843	0.001	0.000	0.000

Notes: Estimated values are italicized.

Values in red denote high uncertainty based on extrapolation of the rating curve beyond 2 times the greatest measured discharge.

Appendix V6-1D

Back River Project: 2014 Hydrology Baseline Report

Sabina
GOLD & SILVER CORP.

Sabina Gold & Silver Corp.

BACK RIVER PROJECT
2014 Hydrology Baseline Report

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December 2014

BACK RIVER PROJECT
2014 HYDROLOGY BASELINE REPORT

December 2014
Project #0234411-0022

Citation:
Rescan. 2014. *Back River Project: 2014 Hydrology Baseline Report*. Prepared for Sabina Gold & Silver Corp. by Rescan Environmental Services Ltd., an ERM company.

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Executive Summary

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Executive Summary

The Back River Project (the Project) is a proposed gold mine in the West Kitikmeot region of Nunavut and is situated within the continuous permafrost zone of the continental Canadian Arctic. The hydrology baseline work in 2014 focused on water bodies in the Goose Property and George Property that may be used as water sources during operation or closure activities.

The 2014 baseline network on the Goose Property included five hydrometric stations, consisting of three streamflow stations and two lake water level stations. The baseline network on the George Property consisted of four hydrometric stations, including two streamflow stations and two lake water level stations. The hydrometric networks were installed on June 6, 2014, after the onset of flow in the streams and when site access was available. Stations were operated until July 12, 2014, after which site access was restricted due to the closure of camp. During this time period, continuous time-series water level (stage) data were collected at each hydrometric station and more than 40 manual discharge measurements were completed at streamflow stations. Based on the stage and discharge data collected, stage-discharge relationships were developed and discharge hydrographs produced. Regressions with regional stations and the application of a logarithmic decay function were used to extend the discharge time-series to provide an estimated annual discharge hydrograph.

The hydrometric data collected in 2014 included 30 to 35 days of continuous sampling. Of the possible range of flows and lake water levels normally observed in a year, only a portion were documented. Consequently, regressions were performed with nearby Water Survey of Canada stations in order to provide estimates for the remainder of the 2014 period. The reduced set of measured data, and expanded period of estimated synthetic records, increases the uncertainty in parameters presented in this report.

The 2014 hydrograph was similar to previous years, characterized by snowmelt-driven high flows during the spring freshet. A snowmelt-driven high flow event occurred in each of the hydrographs during the freshet period in late May to early June.

Estimated daily peak flows varied substantially between gauged streams. Daily peak flows in the Goose Property area ranged from 3.78 m^3/s at streamflow monitoring station PL-H2 (Propeller Lake Inflow) to 9.00 m^3/s at station PL-H1 (Propeller Lake Outflow). Daily peak flows in the George Property area ranged from 0.42 m^3/s at streamflow monitoring station KL-H2 (George Lake Outflow) to 14.88 m^3/s at station LG-H1 (Long Lake Outflow).

Volumetric outflows from each of the monitored drainages were generally found to be a function of drainage area. In the Goose Property area, the minimum volumetric outflows were observed at PL-H2 (Propeller Lake Inflow; drainage area = 101.6 km^2) which had a total annual water output of 8.40 million m^3. The maximum annual volumetric output was 20.98 million m^3 at PL-H1 (Propeller Lake Outflow; drainage area = 204.6 km^2). In the George Property area, the minimum volumetric outflows were observed at KL-H2 (George Lake Outflow; drainage area = 9.6 km^2) which had a total annual water output of 0.82 million m^3. The maximum annual volumetric output was 32.69 million m^3 at LG-H1 (Long Lake Outflow; drainage area = 271.1 km^2).

Estimated annual runoff was similar to what was observed in 2013 and less than 2011 and 2012 at most stations. The highest annual runoff was 121 mm at LG-H1 (Long Lake Outflow in the George Property area) and the lowest was 83 mm at PL-H2 (Propeller Lake Inflow in the Goose Property area). In all

drainages the maximum monthly runoff occurred in June (60 to 64% at Goose Property area stations and 57 to 59% at George Property area stations).

Acknowledgements

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Acknowledgements

This report was prepared by ERM Rescan for Sabina Gold and Silver Corp. (Sabina). Field data collection was conducted by Emerson Belland (B.Sc.), Jaclyn Bowman (B.A.Sc., EIT), and Jem Morrison (B.Sc.). The report was prepared and written by Jaclyn Bowman and Ali Naghibi (Ph.D., P.Eng.), and reviewed by Cameron McCarthy (M.A.Sc., P.Eng., P.Geo., PMP) and Deborah Muggli (Ph.D., M.Sc., R.P.Bio.). Michael Soloducha (B.Sc.) contributed to analysis, QA/QC, presentation, budgeting, and field planning. The project was managed by Deborah Muggli. Field assistance and on-site logistical support were gratefully provided by Sabina personnel and Great Slave Lake Helicopters.

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Glossary and Abbreviations

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Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

ADCP	Acoustic Doppler Current Profiler.
Annual runoff	Annual runoff is a measure of the hydrologic response of a watershed. It is often presented as a depth of water, in mm, over an entire watershed allowing direct comparison with precipitation totals.
Arctic nival	A hydrological regime in which snowmelt is the major hydrological event producing runoff and continuous permafrost impedes deep infiltration reducing baseflow and winter flow.
Baseflow	The groundwater component of flow discharge that is attributed to soil moisture and groundwater drainage into a channel.
Break-up	The melting and dissipation of the ice cover on a water body.
Canadian Shield	A vast geologic area of exposed Precambrian crystalline igneous and high-grade metamorphic rocks that form tectonically stable areas covered by a thin layer of soil. It has a deep, common, joined bedrock region in eastern and central Canada and stretches North from the Great Lakes to the Arctic Ocean, covering over half of Canada.
Hydrograph	A graphic presentation of the variation of a hydrologic parameter with elapsed time.
Drainage Basin	The zone or portion of land that contributes water to the surface water runoff that flows past a given point along a stream channel.
Ephemeral	A stream which flows only during or after rain or snowmelt and has no baseflow component.
Freeze-up	The formation of an ice cover on a water body.
Freshet	In channels, the relatively high water discharge period resulting from spring/summer meltwater runoff of the snowpack accumulated over the winter.
Intermittent	A stream which flows only part of the year.
ISO	International Organization for Standardization
LSA	Local Study Area
MAD	The mean annual discharge, computed as an average discharge over the year.
NAD 83	North American Datum 1983. A datum is a reference system for computing or correlating the results of a survey. The NAD83 datum is based on the spheroid (GRS80).
Permafrost	Bedrock, organic or earth material that has temperatures below 0°C persisting over at least two consecutive years.

Rating Curve	A curve derived from concurrently measured stage and discharge data that is used to estimate the discharge for any given observed stage. Often referred to as a stage-discharge relationship for a streamflow monitoring station.
RSA	Regional Study Area
Stage	The height of the water surface in a water course or channel above a fixed datum.
Talik	An unfrozen section of ground within a layer of discontinuous permafrost. Taliks can also be found underneath water bodies in a layer of continuous permafrost.
The Project	The Back River Project
Unit Yield	It is a ratio of water discharges normalized to the drainage area for a basin. This parameter allows for direct comparison of the hydrological response of basins with different size drainage areas.
UTM	Universal Transverse Mercator. A mathematical transformation (map projection) of the earth's surface to create a flat map sheet.
WSC	Water Survey of Canada.

1. Introduction

1. Introduction

The Back River Project (the Project) is a proposed gold project owned by Sabina Gold and Silver Corp. (Sabina) located in the West Kitikmeot region of Nunavut (Figure 1-1). The 2014 hydrology baseline program was designed to monitor water level and discharge at select lakes and lake outflow locations within the Goose Property and George Property areas. Hydrometric baseline sampling was focused on areas that may be used as water sources during operation or closure activites.This report provides a summary of the methods and results of the 2014 baseline hydrology program.

The objectives of the 2014 program were:

- Goose Property Area:
  - continued operation of four hydrometric stations established in previous years;
  - installation and operation of one additional hydrometric station on Big Lake;
- George Property Area:
  - continued operation of two hydrometric stations established in previous years;
  - installation and operation of two additional stations on George Lake and Long Lake;
- Data processing and analysis:
  - the development and improvement of stage-discharge relationships for each of the streamflow stations;
  - the production of annual lake water fluctuation time-series for each of the lake water level stations;
  - the calculation of water discharges and production of annual discharge hydrographs for each of the streamflow stations;
  - the calculation of regression equations with regional stations to infill missing records; and
  - the calculation of hydrologic indices, including annual runoff, monthly runoff distribution, peak flows, and low flows.

A description of the hydrological setting is presented in Chapter 2 of this report. Overall sampling locations and methods used for data collection are provided in Chapter 3. Results of the 2014 hydrology baseline program are presented in Chapter 4. All raw data collected in 2014 are provided as appendices to this report.

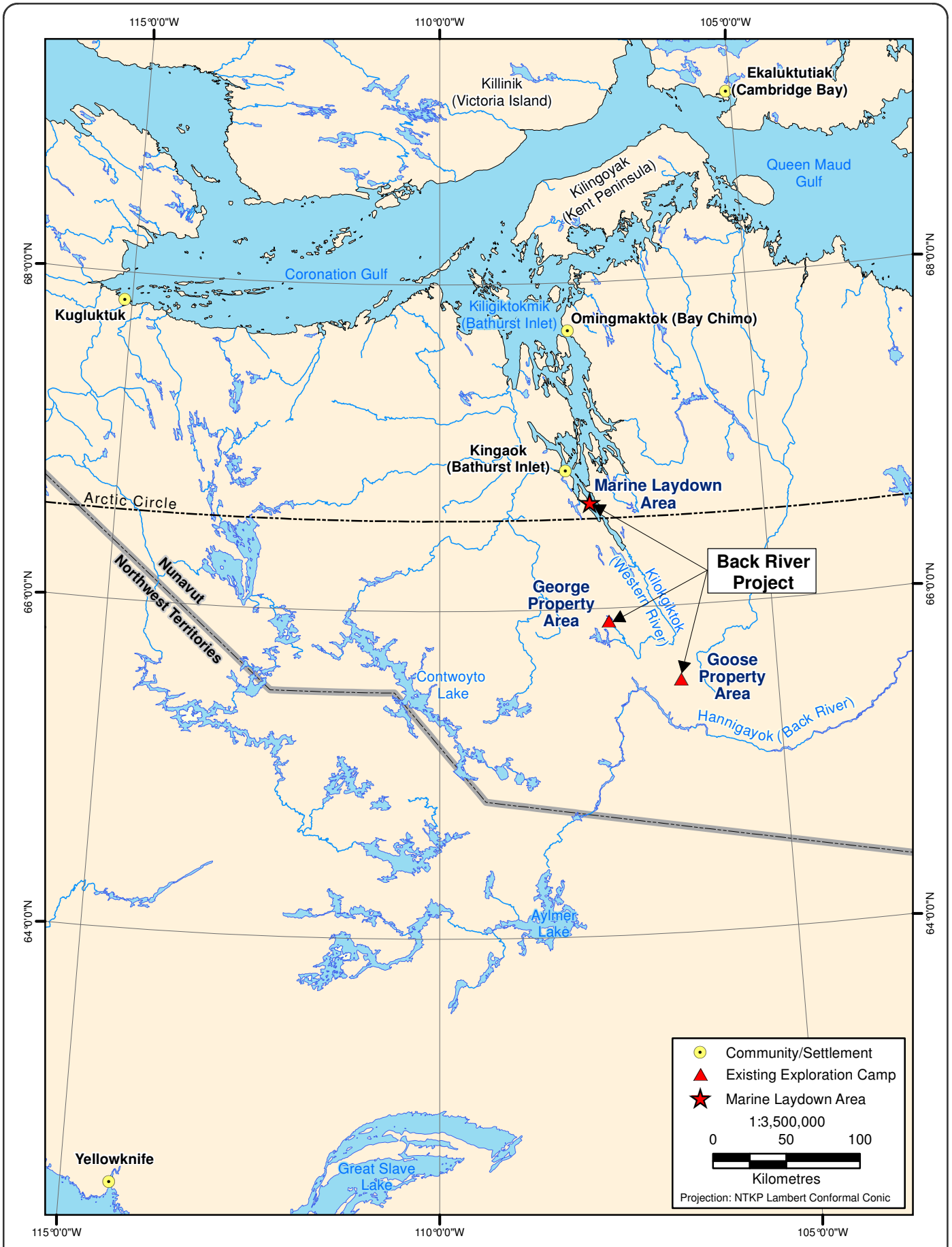

Figure 1-1

Back River Project Location

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2. Hydrological Setting

2. Hydrological Setting

2.1 ARCTIC HYDROLOGY

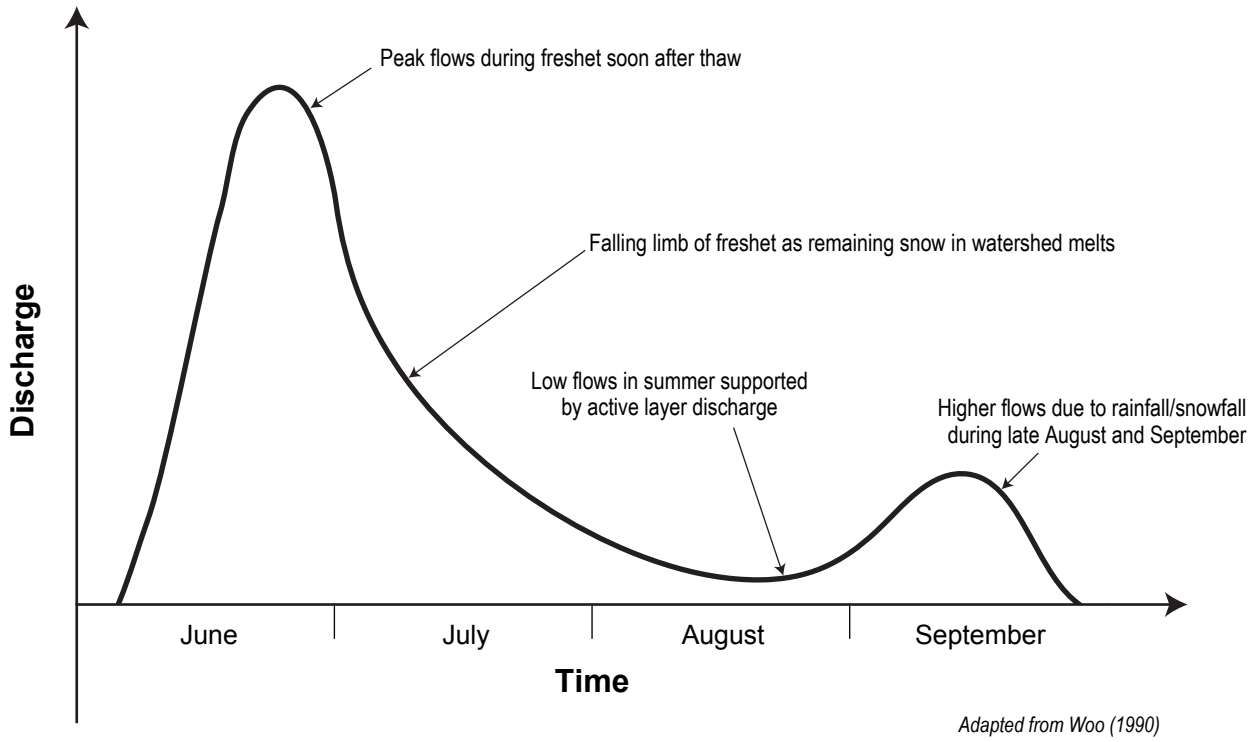
The hydrologic regime within the Project area is characterized by its geographic location within the continuous permafrost zone of the continental Canadian Arctic. The physiography of the region is dominated by vegetated tundra hillslopes with lakes and scattered wetlands. The presence of permafrost is hydrologically significant as it has a very low hydraulic conductivity and thus acts as a barrier to deep groundwater recharge. This physical restriction tends to increase surface runoff and high flows, and decrease subsurface flow and baseflow (Kane et al. 1997).

Hydrologic processes in permafrost watersheds are generally dominated by snow accumulation and melt, surface runoff, and runoff routed through lakes. The annual flow hydrograph is defined by the long cold winters and the short summers. Most of the annual runoff occurs during spring freshet and is derived from the melting snow pack. Additionally, frontal systems may generate precipitation events that produce moderate runoff. Following the freshet, a low flow period typically develops through July and August. Due to the presence of permafrost, there is limited groundwater support for smaller streams; however, there may be interaction between groundwater systems and larger rivers and/or lakes through taliks or openings in the permafrost. As a result of the permafrost, baseflow in streams is supported only by flow through the shallow upper active layer of the soil and release from storage features including lakes and wetlands. Overall, surface runoff in Arctic basins is largely controlled by snowmelt and the presence of permafrost, which accentuates runoff peaks while reducing baseflow conditions (Woo 1990).

The hydrologic year for the region is defined by break-up and freeze-up. According to regional data from Water Survey of Canada (WSC), break-up typically occurs in late-May or early-June, and freeze-up in October. Water is stored in the snowpack during winter and is released as temperatures increase during the spring freshet. Small to medium sized streams typically freeze dry during the winter, due to the limited storage capacity of the surrounding landscape. Even some large rivers in the continuous permafrost region cease to flow after freeze-up (Woo 1990).

Arctic hydrographs are characterized by a steep rising limb leading to a peak during the freshet period, and a second rainfall-generated peak that can be observed in certain years in late August or early to mid-September. Generally, within the continuous permafrost region discharge is dominated by snowmelt floods, referred to as a nival regime. A conceptual hydrograph showing typical annual discharge patterns for small watersheds is shown in Figure 2.1-1.

In very small basins the freshet can be as short as a few days and will often occur immediately after ice break-up in the lakes, if lakes are present in the basin. Streamflow in these basins may cease after freshet and streams remain dry until the late summer rains begin. In contrast to smaller basins, in rivers draining larger watersheds the freshet peak may be delayed after ice break-up. The delay occurs as snowmelt from upper portions of the larger watershed is routed through the drainage network. Smaller basins can also have more dramatic responses to precipitation than larger watersheds. In larger watersheds the presence of lakes creates significant flow attenuation, which may diminish the magnitude of peak flows.



Adapted from Woo (1990)

Note: Approximate scale only

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Theoretical Typical Annual Flow Hydrograph for a Small Arctic Watershed

Figure 2.1-1

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A number of factors influence the volume of freshet runoff in Arctic watersheds, these factors include:

- *Amount of snowpack available to be melted in spring*. Snowpack depth is dependent on the amount of snowfall during the previous winter and the amount of snow remaining in each watershed prior to freshet. Snow can be lost or redistributed due to sublimation, melting, or wind;
- *Air temperature*. Above freezing air temperatures combined with a rapid air temperature increase can greatly affect peak flow rates as a rapid increase in temperature after the snowpack is already saturated can produce high melt rates. Differential melt rates on north and south facing slopes can also occur which may affect the size of the area contributing to the melt. Warm air temperatures can increase evapotranspiration and sublimation, reducing surface water availability;
- *Timing of opening of stream channels linking lakes*. Snowmelt from hillslopes surrounding lakes can occur before the stream channels draining the lakes become ice free. In this case, meltwater can be stored in the lake and then released once the channels are open to flow; and,
- *Soil moisture conditions and lake levels at the end of the previous summer*. If there was a dry summer during the previous year, lake levels could have been lowered and a soil moisture deficit could have developed within the hillslopes surrounding the lakes. As a result, a portion of the annual runoff will recharge the lakes and soil moisture and not be transmitted from the watershed as streamflow.

After snowmelt-generated runoff ends, the remaining runoff in summer and fall is controlled by rainfall, evaporation, and release of stored water in lakes and the active layer. Smaller basins with minimal lake area tend to exhibit a more rapid response to precipitation than larger basins. Open-water evaporation rates in summer often exceed total rainfall, causing soil moisture deficits in the shallow active layer of the soil. Studies of hillslope processes in northern watersheds have shown that summer rainfall can produce little or no runoff from hillslopes in the permafrost zone (Quinton and Marsh 1998). In this case, streamflow increases only due to rain falling directly onto lake surfaces or when there is significant rainfall from short-term/high-intensity events, or long-term (sustained) low-intensity events (Dugan et al. 2009)

2.2 AVAILABLE REGIONAL HYDROLOGIC DATA

Historical data are available from hydrometric stations operated by WSC and by mining projects in the region (Figure 2.2-1; Rescan 2013, Volume 6, Chapter 1). Data from these stations with the closest proximity to the Project area were previously analyzed to provide background information on the regional surface water hydrology (for details and a comprehensive list of stations, see Rescan 2013, Volume 6, Chapter 1).

Provisional 2014 streamflow data from select regional stations were publicly available at the time this report was written (Table 2.2-1). Regional WSC stations with partial 2014 data that had unit discharge hydrographs similar to those of the Project were selected for comparison with 2014 Project baseline data; Back River below Beechey Lake (10RA001), Baillie River near the mouth (10RA002), Burnside River near the mouth (10QC001) and Ellice River near the mouth (10QD001). A 2014 freshet peak was recorded at two of the stations: Baillie River near the mouth and Back River below Beechey Lake. Provisional late-summer low flows were captured and available at three stations: Baillie River near the mouth, Burnside River near the mouth and Ellice River near the mouth.

Analysis of historical data revealed that break-up in these rivers has typically occurred in May (Figure 2.2-2). Peak flows were typically observed in early-June during freshet and some stations recorded a second or third smaller peak in late summer.

Table 2.2-1. Regional Water Survey of Canada (WSC) Stations Used in 2014 Baseline Analysis

WSC Station ID	Station Name	Latitude	Longitude	Drainage Area (km^2)	Period of Record
10RA001	Back River below Beechey Lake	65°11'14" N	106°05'09" W	19,600	1978–2014
10RA002	Baillie River near the mouth	65°00'38" N	104°29'26" W	14,500	1978–2014
10QC001	Burnside River near the mouth	66°43'34" N	108°48'47" W	16,800	1976–2014
10QD001	Ellice River near the mouth	67°42'30" N	104°8'21" W	16,900	1971-2014

2.3 GENERAL STUDY AREA

The study area is located near the watershed boundaries of the Ellice River, the Back River, and the Western River (Figure 2.2-1). The Ellice River discharges north to the Arctic Ocean into the Queen Maud Gulf approximately 300 km from the Project area. The Western River discharges north to the Bathurst Inlet approximately 80 km from the Project area. The Back River flows northeast to its mouth at Cockburn Bay on the Arctic Ocean in the eastern portion of the Kitikmeot Region, south of Gjoa Haven. The basins within the Project area are characterized by extensive networks of lakes, low relief hummocky topography, and exposed bedrock uplands (Plates 2.3-1 and 2.3-2).

Plate 2.3-1. Low angle view showing the exposed bedrock uplands typical of the Goose and George Property areas. This photograph was taken in the area of station LG-H1 (Long Lake Outflow) on July 6, 2014.

PROJECT # 0194096-0002 GIS # BAC-10-101 November 10, 2014

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Figure 2.2-1

Regional Hydrometric Stations Relevant to the Study Area

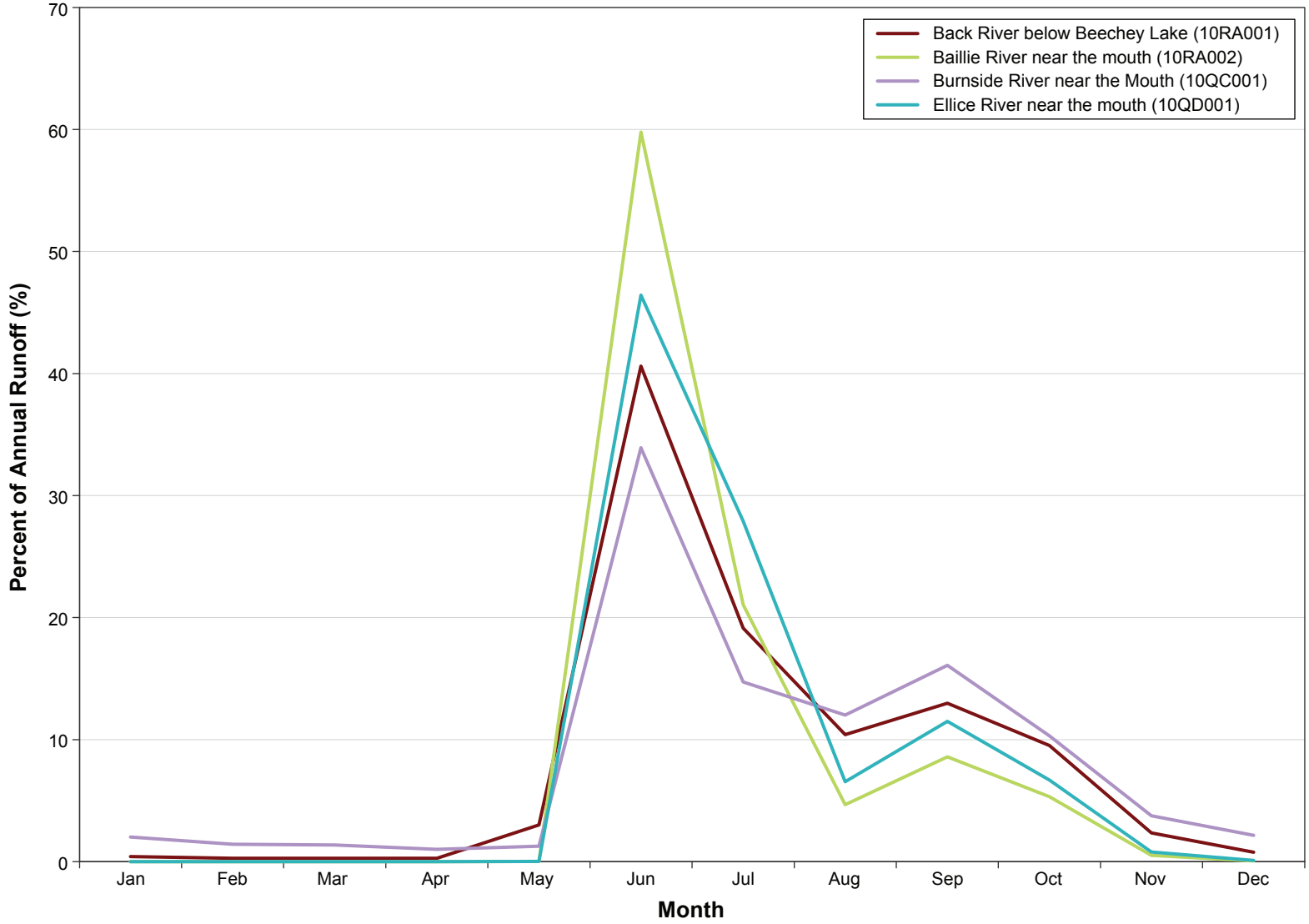

Figure 2.2-2

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Monthly Average Distribution of Annual Runoff at Regional Stations 2011 to 2013

Figure 2.2-2

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Plate 2.3-2. High angle oblique view showing the low relief hummocky topography typical of the Goose and the George Property areas. This photograph was taken in the area of station BL-H2 on June 8, 2014.

3. Methodology

3. Methodology

The hydrometric baseline program commenced in 2010 and was gradually expanded in the following years.

3.1 HISTORICAL DATA COLLECTION

3.1.1 Goose Property Area (2010-2013)

Two hydrometric stations were initially established in the Goose Property area, and were operated from July 3 to September 13, 2010 (Rescan, 2010). In 2011, this network expanded, with nine hydrometric stations operated from June 10 to September 17, 2011 (Rescan 2012a). The 2011 network included the remobilization of the two stations established in 2010, plus the installation of six new stations (EL-H1, GI-H1, GL-H3, PL-H1, PL-H2 and WL-H1), and one reference station (REFB-H1), located south of the Project drainage boundary. The 2011 network focused on monitoring basins and sub-basins around the known deposits in the Project area, and the farthest downstream river associated with the property at Propeller Lake outflow (Table 3.1-1). The 2012 network included the nine stations established in 2011, plus the installation of three new stations located within the Back River Watershed (BL-H1, BL-H2, and BL-H3) (Rescan, 2012b). In 2013, the network within the Goose Property area included thirteen streamflow stations and two lake level stations. A total of four new streamflow stations were installed, in addition to the nine stations operated in 2012 and two lake level stations were installed in Goose Lake and Propeller Lake (GC-L1 and PROP-L1) (Rescan, 2014).

Table 3.1-1. Hydrometric Stations in the Goose Property Area (2010-2014)

Hydrometric Station	Location	Geographic Coordinates*		Drainage Area (km^2)	Lake Coverage (%)	Monitoring Years	Period of Operation in 2014	Monitoring Type
		Easting	Northing					
BIG-L1	Big Lake	425,992	7,269,783	n/a†	n/a†	2014	Jun 9 to Jul 12	lake water level
BL-H1	Big Lake Inflow	429,044	7,268,478	3.6	2.5	2012	n/a	stream water level
BL-H2	Big Lake and Swan Lake Outflow	424,379	7,265,620	158.5	19.1	2012, 2014	Jun 9 to Jul 12	stream water level
BL-H3	Moby Lake Outflow	423,467	7,264,998	21.4	4.7	2012	n/a	stream water level
EL-H1	Echo Drainage Outflow	432,091	7,269,573	1.4	2.2	2011-2013	n/a	stream water level
GC-L1	Goose Camp	434,227	7.269,886	n/a†	n/a†	2013	n/a	lake water level
GI-H1	Giraffe Lake Outflow	432,744	7,271,610	27.4	13.3	2011-2013	n/a	stream water level
GL-H1	Goose Lake Inflow	430,772	7,270,016	18.0	10.6	2010-2013	n/a	stream water level
GL-H2	Llama Lake Outflow	428,746	7,271,567	1.7	23.1	2010-2013	n/a	stream water level
GL-H3	Goose Lake Inflow	432,891	7,269,919	1.8	7.5	2011-2013	n/a	stream water level

(continued)

Table 3.1-1. Hydrometric Stations in the Goose Property Area (2010-2014) (completed)

Hydrometric Station	Location	Geographic Coordinates*		Drainage Area (km^2)	Lake Coverage (%)	Monitoring Years	Period of Operation in 2014	Monitoring Type
		Easting	Northing					
PL-H1	Propeller Lake Outflow	436,094	7,279,939	204.6	18.9	2011-2014	Jun 8 to Jul 12	stream water level
PL-H2	Propeller Lake Inflow	435,007	7,272,014	101.6	15.1	2011-2014	Jun 8 to Jul 12	stream water level
PROP-L1	Propeller Lake	434,782	7,279,265	n/a†	n/a†	2013-2014	Jun 8 to Jul 12	lake water level
REFB-H1	Reference B Lake Outflow	442,573	7,257,794	5.3	19.1	2011-2013	n/a	stream water level
TIA-H1	Tailings Impoundment Outflow	431,074	7,273,105	5	4.4	2013	n/a	stream water level
UM-H1	Umwelt Lake Outflow	429,166	7,270,648	4.1	17	2013	n/a	stream water level
WL-H1	Wolf Drainage Outflow	434,269	7,269,719	32.7	16.6	2011-2013	n/a	stream water level
WP-H1	Wasp Lake Outflow	431,087	7,274,467	17.6	14	2013	n/a	stream water level
WR-H1	WRSA B Outflow	434,688	7,269,634	2.7	2.4	2013	n/a	stream water level

** UTM, Datum NAD 83, Zone 13 W*

† Drainage area and lake coverage not applicable for lake water level stations.

3.1.2 George Property Area (2012-2013)

Baseline hydrometric monitoring in the George Property area commenced in 2012 with the installation of three stations (Rescan, 2012b). The drainage areas of two of the stations, KL-H1 and KL-H2, encompassed the entirety of the George Property, and the other, REFC-H1, was operated as a reference station. In 2013, eight hydrometric stations were operated in the George Property area (Rescan, 2014). Six new stations were installed and two stations from the 2012 network were remobilized (Table 3.1-2). Stations LY-H1 and SL-H1 were installed within the watershed monitored by KL-H1 and the McCoy Watershed was monitored with the addition of stations MC-H1 and MC-H2. Finally, station LG-H1 was located on Long Lake Outflow and REFQ-H1 was added to the network as a reference station.

3.2 2014 HYDROLOGY BASELINE PROGRAM

3.2.1 Goose Property Area

The 2014 hydrology baseline program for the Goose Property was designed to monitor the lake level and lake outflow rates for Propeller Lake and Big Lake, which are located within the Ellice River and Back River watersheds, respectively. A hydrometric station on Goose Lake Outflow was reinstalled and operated to augment streamflow data collected from Propeller Lake and Big Lake outflows. The hydrology baseline program was reduced from previous years to a total of 9 sites in 2014. Figure 3.2-1 shows the locations of the hydrometric stations within the sub-watershed boundaries of the Goose Property area. The Goose Property area included monitoring at stations PL-H1, PL-H2, PROP-L1, and BL-H2 (the latter station was relocated 800 m upstream of the 2012 location). A new monitoring station was installed to monitor water level in Big Lake (BIG-L1). Station details are provided in Table 3.1-1.

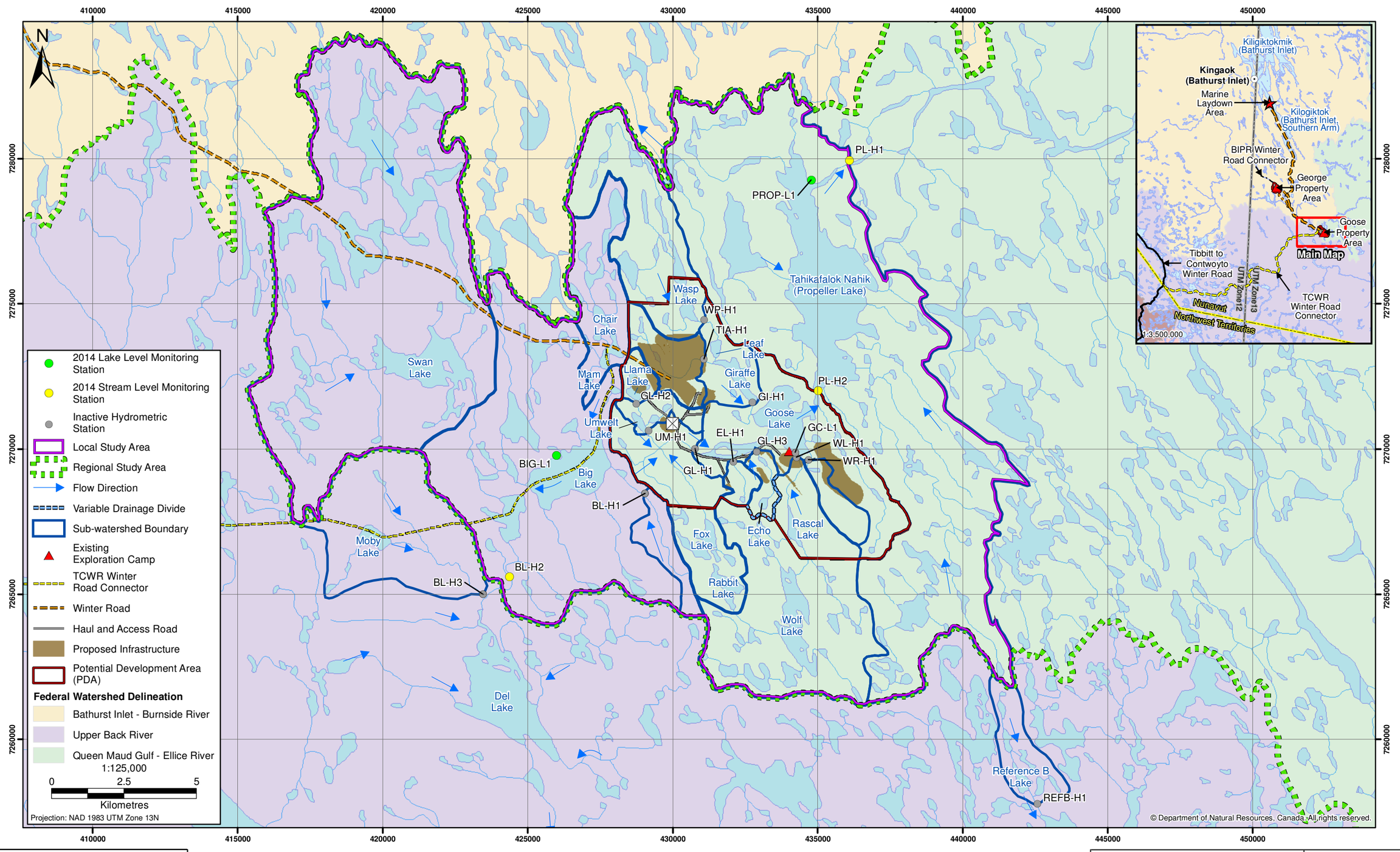

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Figure 3.2-1

2014 Hydrology Baseline Sampling Locations - Goose Property Area

Table 3.1-2. Hydrometric Stations in the George Property Area (2010-2014)

Hydrometric Station	Location	Geographic Coordinates*		Drainage Area (km^2)	Lake Coverage (%)	Monitoring Years	Period of Operation in 2014	Monitoring Type
		Easting	Northing					
GRG-L1	George Lake	386,771	7,314,895	n/a†	n/a†	2014	Jun 12 to Jul 12	lake water level
KL-H1	Komatic Lake Inflow	390,592	7,309,400	24.2	19.7	2012-2013	n/a	stream water level
KL-H2	George Lake Outflow	386,687	7,314,673	9.6	24.6	2012-2014	Jun 6 to Jul 12	stream water level
LG-H1	Long Lake Outflow	394,280	7,305,113	271.1	17	2013-2014	Jun 7 to Jul 12	stream water level
LONG-L1	Long Lake	387,112	7,316,752	n/a†	n/a†	2014	Jun 7 to Jul 12	lake water level
SL-H1	Sleigh Lake Outflow	388,274	7,312,296	13	23.2	2013	n/a	stream water level
LY-H1	Lytle Lake Outflow	387,172	7,313,489	10.6	23.4	2013	n/a	stream water level
MC-H1	McCoy Lake	385,983	7,310,949	10.8	12.6	2013	n/a	stream water level
MC-H2	McCoy Outflow	385,070	7,310,204	15.8	11.6	2013	n/a	stream water level
REFQ-H1	Reference Q Lake	385,551	7,303,203	14.7	9.4	2013	n/a	stream water level

** UTM, Datum NAD 83, Zone 13 W*
†Drainage area and lake coverage not applicable for lake water level stations.

3.2.2 George Property Area

The 2014 hydrology baseline program for the George Property was designed to monitor the lake level and lake outflow rates for George Lake and Lower Long Lake, which are located within the Western River Watershed. The study area includes the George Lake Outflow Watershed as well as the Lower Long Lake Outflow Watershed, with streamflow stations KL-H2 and LG-H1, as well as two new lake level stations, Long Lake Outflow (LONG-L1) and George Lake Outflow (GRG-L1). Figure 3.2-2 shows the locations of the hydrometric stations and their associated sub-watershed boundaries of the George Property area.

3.3 HYDROMETRIC STATION SET-UPS

Hydrometric monitoring stations were set-up within the Project area to obtain water level (stage) data at selected stream and lake sites. Specific station locations for new installations were determined during initial field reconnaissance conducted in early June 2014. Sites were selected to satisfy basic site selection criteria, including: the ability to obtain accurate water level data and to measure discharge at all stages; a stable natural control of water elevation at the site; and accessibility during the entire operational period (RISC, 2009).

Each hydrometric monitoring station consisted of an Instrumentation Northwest Inc. (INW) PT2X integrated datalogger and pressure transducer. This instrument measures and records water level at 10 minute intervals. Instruments were encased within aluminum flex conduit which was secured to angle iron (1.5 m lengths by 50 mm width and 6 mm thickness) and laid flat on the stream/lake bed. At sites

where bedrock was available, the transducer and conduit were bolted to the rock. The flex conduit housing the transducer cable was routed to a steel weather proof enclosure. The box was securely installed above the high water mark. Examples of typical station set-ups are shown in Plate 3.3-1.

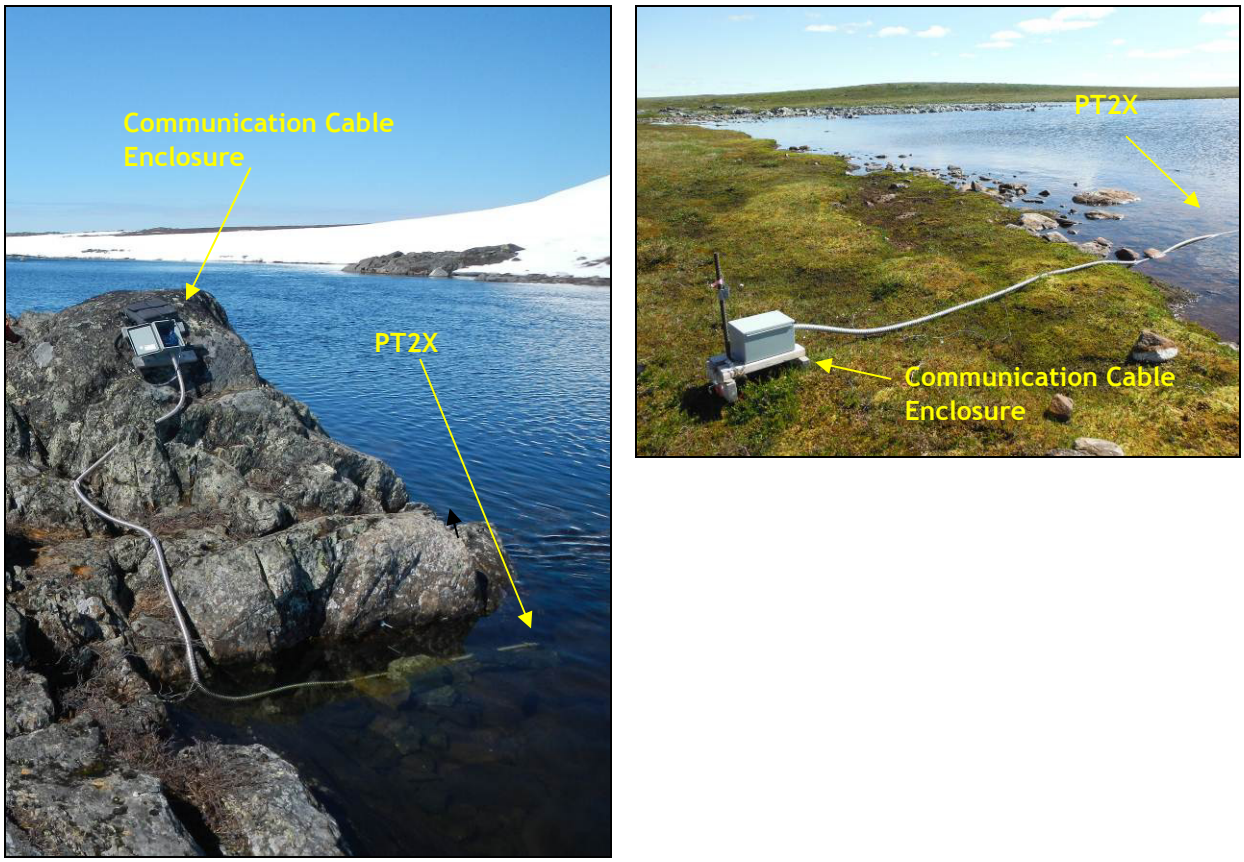

Plate 3.3-1. Photographs illustrating the hydrometric monitoring station design.

3.4 DISCHARGE MEASUREMENTS

At each streamflow monitoring station, manual measurements of discharge were performed. These measurements were taken throughout the operating period (June and July), and across a range of discharges (details provided in Section 4.1). Manual discharge measurements were undertaken at each site using two different methods, depending on flow conditions and stream morphology. At PL-H1 (Propeller Lake Outflow), where the channel was too deep to wade, an Acoustic Doppler Current Profiler (ADCP) was used to measure discharge. At all other sites, where the stream channels could be safely waded, a handheld current velocity meter was used.

3.4.1 ADCP Measurements

At one hydrometric station (i.e., PL-H1), water depth was too high during the spring freshet to allow field personnel to safely wade and measure discharge with a handheld current velocity meter. Therefore, discharge was measured at this site by means of a StreamPro® (Teledyne RD Instruments) ADCP. All measurements were conducted according to standard operating procedures (Rehmel et al. 2003, WSC 2004).

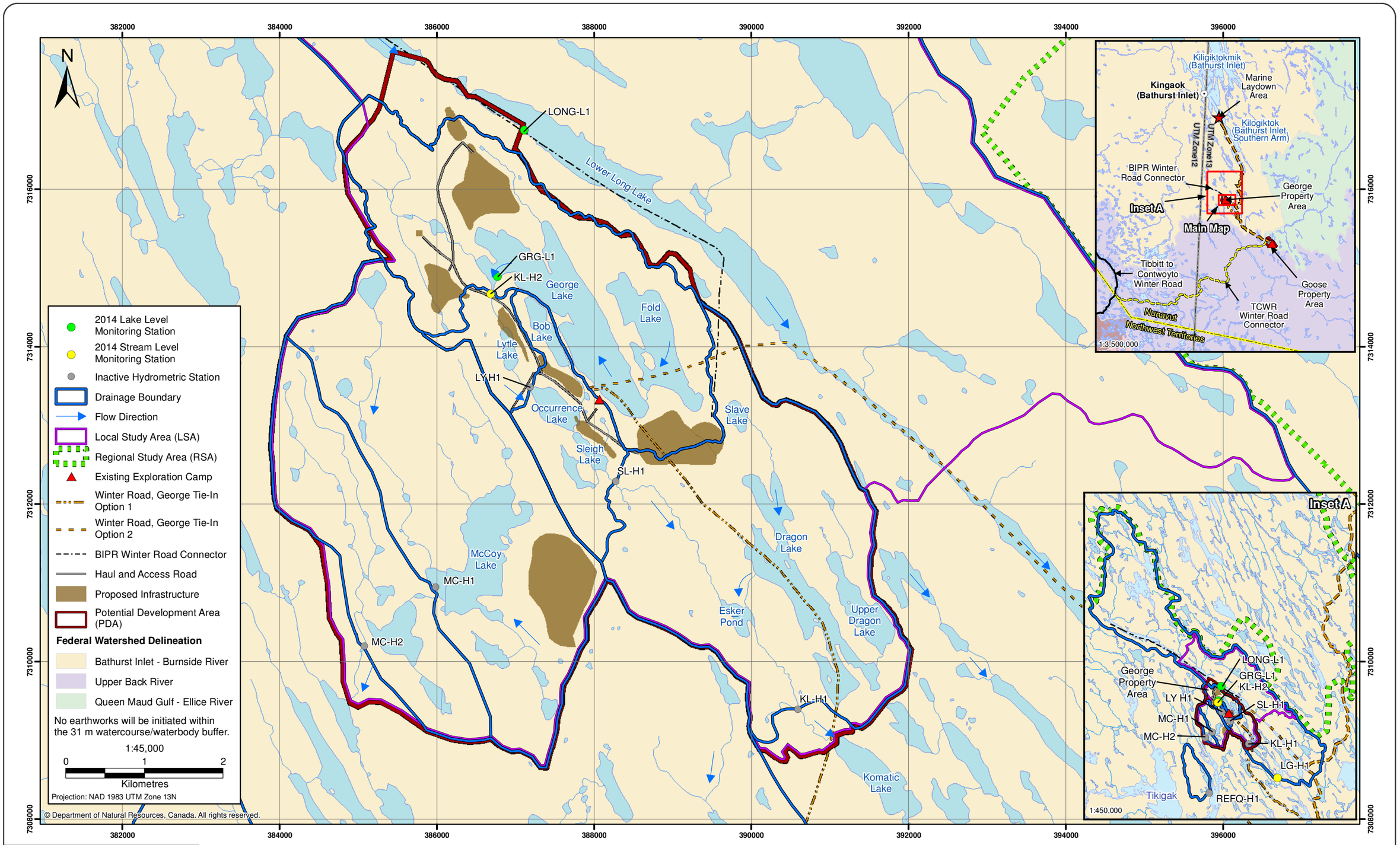

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Figure 3.2-2

2014 Hydrology Baseline Sampling Locations - George Property Area

The location of the ADCP measurements was selected following the same general principles as with the handheld current velocity meter. In addition, the section was chosen where the channel was relatively narrow to allow for better instrument control during the ADCP measurements.

At the selected location personnel walked to an upstream location to cross the channel with a rope system. A cableway was used to manoeuvre the ADCP in controlled transects perpendicular to the direction of flow (Plate 3.4-1). Typically multiple transects are conducted until a minimum of four transects record discharges that are all within 5% of the mean value of the four measurements. The total discharge measurement is computed by taking the average of the four valid measurements.

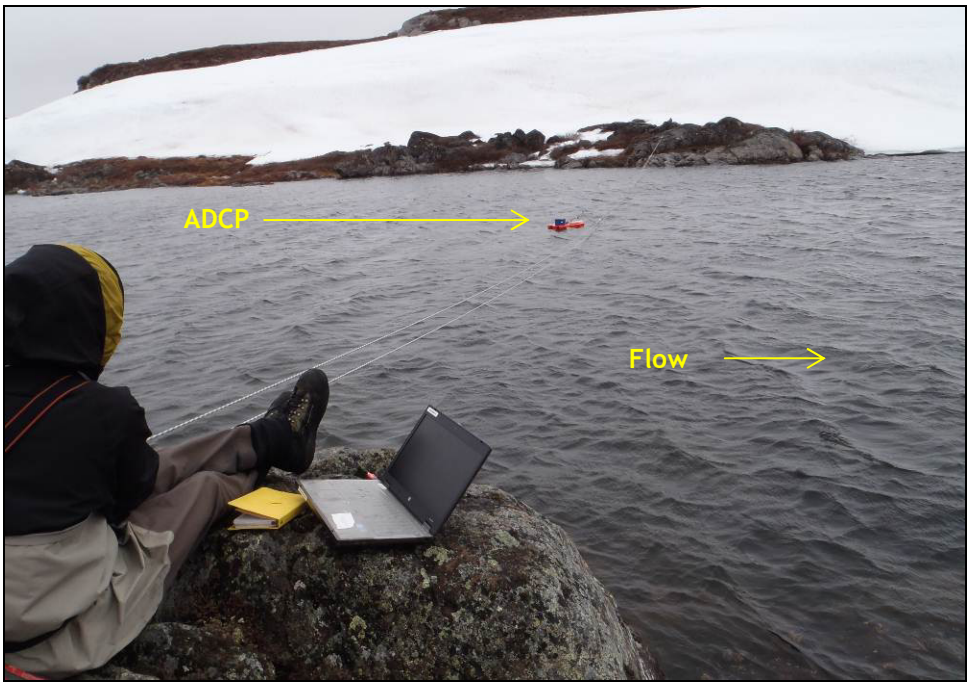


Plate 3.4-1. Discharge measurements at hydrometric station PL-H1 (Propeller Lake Outflow) using an Acoustic Doppler Current Profiler (ADCP). Photograph taken on June 15, 2014.

3.4.2 Current Velocity Measurements

The location of the measured transect at each station was determined based on channel geometry and flow conditions at the time of the measurement. Generally, the stream was measured along a straight reach near the station where the bed and flow conditions were as uniform as possible. Wherever possible, sections of the stream with submerged vegetation and/or immovable rocks were avoided.

Current velocities were measured using an electromagnetic current meter (Hach FH950 Portable Flow Meter™). A fixed sampling interval of 40 seconds was selected for each velocity measurement, during which an average velocity was determined.

Water discharge was computed from stream velocity measurements by employing the velocity-area method, which determines discharge across the channel between observation verticals. In this method it is assumed that the velocity sampled at each vertical represents the mean velocity in a segment. The segment area extends laterally from half the distance from the preceding vertical to half the distance to the next, and vertically from the water surface to the sounded depth. The partial discharges across the channel are then summed to obtain the estimated total discharge measurement. Typically a

minimum of 20 current velocity measurements are obtained across the width of a channel with the aim of having each measurement interval accounting for approximately 5%, but no more than 10%, of the total discharge (Plate 3.4-2).

Plate 3.4-2. Velocity-area discharge measurements at hydrometric station PL-H2 (Propeller Lake Inflow) using a handheld current velocity meter, June 18, 2014.

At each interval along the cross-section, water velocity was measured at 60% of the flow depth of water (measured from the surface). The measurement of velocity at 60% of the flow depth is generally accepted as representing the mean velocity of the vertical water section (Herschy 2009). When water depths were greater than 0.75 m, current velocities were measured at 20% and 80% of the flow depth of water and the average of the two readings were taken as the mean velocity for the vertical. In all cases, the adopted methods followed standard WSC operating procedures (Terzi 1981).

3.5 HYDROMETRIC STATION SURVEYS

The water surface elevation or stage is measured above a specific reference or gauge datum at each of the hydrometric stations. In order to check for the accuracy and consistency of the recorded data, it is necessary to periodically verify the elevation of the gauge in relation to the established station datum.

To establish and maintain vertical elevation control at the Project hydrometric monitoring locations, three local bench marks were installed at each station. Bench marks generally consist of concrete expansion bolts secured in bedrock or large stable boulders found in the vicinity of the stations. One bench mark at each station was assigned to be the primary reference point, and given an arbitrary local elevation of 100.000 m. All recorded water levels were then referenced to this primary bench mark by adding the height of observed water to the surveyed height of the PT2X relative to the bench marks in the area.

Throughout the 2014 monitoring period, hydrometric levelling surveys were conducted during each site visit. Each survey was completed using an engineer's level and levelling rod.

3.6 STAGE – DISCHARGE RELATIONSHIPS

In 2014, stage-discharge relationships were developed for each streamflow monitoring station. Stage-discharge relationships are generally expressed as rating curves. These rating curves are used to convert water level (stage) data recorded by the streamflow monitoring stations into a continuous discharge time-series or discharge hydrograph.

The quality of a rating curve is a function of the number and accuracy of the individual data points that are used to generate the curve, as well as the hydraulic characteristics of the monitoring location. To develop a robust rating curve a minimum of 10 streamflow measurements are recommended across the full range of stage (RISC 2009). High flow measurements are important as they help to define the upper end of the rating curve, which is particularly relevant for the design of water management infrastructure and undertaking peak flow assessments. The rating curve is a mathematical simplification of what is a complex relationship. Sometimes a single curve is not sufficient and the relationship between stage and discharge can change from low flow periods to high flow periods. This change can be due to a number of factors, but is typically due to changes in the geometry of the channel. When this is the case, a two-stage rating curve may be developed. One curve reflects low stage conditions, while the other represents high stage conditions.

Where possible, 2014 rating curves for the Project area incorporated both discharge measurements collected in previous years (2011-2013), as well as measurements undertaken in 2014. This reduces the uncertainty in the rating curves that are presented by providing a range of stage and discharge measurements. Rating curves are frequently extrapolated beyond the range of the measured discharge, in order to generate a rating curve that covers the entire range of recorded stage. In such cases, extrapolation beyond twice the greatest manually measured discharge is not recommended without an appropriate quality flag, as the resulting value has a high associated uncertainty (Rantz et al. 1982). No stage-discharge relationships developed in this study were required to be extrapolated to this extent, thereby reducing uncertainty in the resultant discharge.

Rating curves were developed using Aquarius™ Time-Series hydrologic software (Aquatics Informatics Inc.). The software uses standard methods outlined by the United States Geological Survey and the International Organization for Standardization (Kennedy 1984; ISO 2010). The concurrently measured water level (stage) and water discharge data, i.e., rating points, were plotted on a logarithmic scale. The rating curve is typically represented as a power function equation (Equation 1). This equation, which can be represented as a line on log-log scaling, was fitted to the rating points, and the root mean square error was assessed (Equation 2).

$$Q = C\,(h - a)^{b} \qquad (1)$$

Where Q is the discharge (m^3/s), C and b are regression coefficients; h is the stage (water level; m). Variable a represents a datum correction for stage at zero flow (m), assuming that the gauge is positioned at a level below the point of zero flow. By convention, the rating curve is defined by a two dimensional graph whereby the dependent variable (Q) is plotted as the x-coordinate along the abscissa and the independent variable (h) is plotted as the y-coordinate along the ordinate (Herschy 2009).

The reliability of developed rating curves can be evaluated by comparing manually measured discharges with discharge values calculated from the rating curve. Statistical error measures for modelled discharge values in general, and for rating curves in particular, are usually in the form of quadratic mean (i.e., root mean square) of difference between measured and calculated discharge values (Maidment 1993; ISO 2010).

Aquarius Time-series™ software calculates the root mean square deviation (RMSD) between the measured and calculated discharge values (Equation 2). The error is normalized (i.e., divided by the discharge value) in order to account for error in both high and low discharge measurements. Moreover, by normalizing the error, the RMSD provides a dimensionless and comparable measure for different hydrometric stations. The lower the RMSD, the better the estimated values provided by the rating curve.

$$RMSD = \sqrt{\frac{\sum_{i=1}^{n}\left(\frac{Q_m - Q_o}{Q_m}\right)^2}{n}} \qquad (2)$$

Where n is the number of rating points used to develop the stage-discharge relation, Q_o is the observed discharge during the manual discharge measurement, and Q_m is the discharge calculated by the developed rating equation.

3.7 DAILY DISCHARGE HYDROGRAPHS

Annual hydrographs, presented as mean daily discharge, were generated for each of the streamflow monitoring stations operated in 2014. For the operational period at each hydrometric station, water discharges were calculated at 10 minute intervals by applying the developed rating curve to the recorded stage data. The 10 minute discharge data were averaged over a 24 hour period to calculate mean daily discharge.

By normalizing daily discharge values to the drainage area for a basin, unit discharge hydrographs were developed. Unit discharge values allow for direct comparison of the hydrological response of basins with different size drainage areas.

All hydrometric stations had been demobilized through the 2013-2014 winter months to protect the pressure transducers from damage due to freezing. Prior to annual remobilization, the rising limbs of hydrographs, and the onset of the spring freshet, were determined using available temperature data from the Environment Canada Lupin CS station (located approximately 170 km west of the Project at an elevation of 488 masl, Figure 2.2-1) along with provisional streamflow data at regional WSC stations (Table 2.2-1, Figure 2.2-1). Peak flow was estimated to have occurred on May 29 for the Goose Property area and May 31-June 1 for the George Property area. Hydrometric stations were installed between June 6 and 12 due to site access restrictions and snow and ice in the channels and lakes.

All hydrometric stations were demobilized in July, prior to the end of the open-water season, to prepare for the closure of Goose Camp. As a consequence, less than 36 days of continuous data logging occurred at each of the hydrometric stations. Estimations of the open-water season prior to and after the station operation were made through frequency and chronological pairing with regional WSC stations (Table 4.4-1).

Historical daily unit discharges at Ellice River generally match with unit discharge at the Project stations (Figures 2.2-2, 4.4-1 and 4.4-2). However, provisional 2014 flow data at Ellice River do not capture the annual peak flow, and Baillie River was determined to be the next most relevant regional station to build the frequency and chronological pairing relationship for this period.

Individual pairing relationships were determined between daily discharges at Baille River with daily discharges at stations PL-H1 and LG-H1 for the 2014 freshet season (Table 4.4-1). Equations to relate the estimated PL-H1 and LG-H1 data to other stations within each of their respective property areas

were also created (Table 4.4-1). Similarily, individual regressions were determined for Ellice River with PL-H1 and LG-H1 for portions of the period following station demobilization which were subsequently related to other stations within each of their respective property areas (Table 4.4-1).

The recession limb of each hydrograph was extended down to a zero flow date based on a logarithmic decay function. The shape of a hydrograph often follows a logarithmic decay shape as streamflow begins to recede and temperatures freeze in the fall. For the decay functions, based on site observations and Lupin CS air temperature data, it was assumed that the streams froze on September 24 to 27, 2014.

3.8 VOLUMETRIC OUTFLOW

At each streamflow station, the monthly and annual volumetric water outflows were determined. Volumetric outflows are expressed in millions of cubic meters per month for each of the monitored basins.

3.9 HYDROLOGIC INDICES

Annual runoff, monthly distribution of annual runoff, mean annual discharge (MAD), peak flow, and low flow indices were calculated for use in water management planning.

3.9.1 Annual Runoff

Annual runoff is the total quantity of water that is discharged (runs off) from a drainage basin in a year and is determined by dividing the volume of annual streamflow observed at a station by the drainage area upstream of that station. Runoff represents the difference between total inputs (annual rain and snow) and losses (e.g., evaporation and the difference between groundwater recharge and discharge). It is commonly presented as a depth of water over a drainage basin. Runoff is valuable for obtaining gross estimates of the water available in a basin. Because it is standardized by drainage area, it is also a useful index for comparing the hydrologic response of basins of different sizes. Total annual runoff for each streamflow monitoring station is an estimated value, because the monitoring program did not capture the entire open-water season.

3.9.2 Monthly Runoff Distribution

Monthly runoff distribution was determined by summing the daily runoff by month for each basin. Monthly runoff as a depth and as a percent of the total annual runoff was calculated and presented to illustrate the spatial and temporal distribution of runoff in the Project area.

3.9.3 Mean Annual Discharge

An additional indicator, mean annual discharge, computed as an average discharge over the year, gives an indication of the potential amount of water a basin can provide as a function of drainage area, geology, and climate.

3.9.4 Annual Peak and Low Flow

Peak flows represent the maximum flow rate of a catchment during a year in response to precipitation events or snowmelt. Peak flows are used in combination with flood frequency analysis techniques in order to estimate design flows used in the sizing of ditches, diversion channels, or stream crossings. Conversely, low flows provide an estimate of the normal baseflow conditions during the open-water season, which is important to the sustained health of a stream's aquatic community.

4. Results

4. Results

Results from the 2014 hydrology program are presented as follows: (1) completed discharge measurements, (2) hydrometric surveys, (3) determined stage-discharge relations, (4) daily discharge hydrographs and volumetric outflows, and (5) hydrologic indices for the Project area.

4.1 DISCHARGE MEASUREMENT SUMMARY

Discharge measurements were taken in early to mid-June at each hydrometric station with additional measurements conducted in July, for a total of 42 measurements. The measurements were collected throughout June and July in order to obtain a range of discharges (Tables 4.1-1 and 4.1-2, and Appendix 3). At least three discharge measurements were taken at each of the streamflow monitoring stations in June. Five measurements were taken at each of the stream stations in July.

Table 4.1-1. Summary of Discharge Measurements in the Goose Property Area in 2014

Hydrometric Station	Date Measured	Stage (m)*	Measured Discharge (m^3/s)	Method (Equipment Used)
BL-H2	June 9	99.480[b]	3.394	Velocity-Area (FH950)
	June 11	99.485[b]	3.979	Velocity-Area (FH950)
	June 14	99.470[b]	3.554	Velocity-Area (FH950)
	June 18	99.500[b]	4.098	Velocity-Area (FH950)
	July 2	99.332[b]	1.491	Velocity-Area (FH950)
	July 6	99.290[b]	0.982	Velocity-Area (FH950)
	July 7	99.268[b]	0.992	Velocity-Area (FH950)
	July 8	99.267[b]	0.949	Velocity-Area (FH950)
	July 11	99.287[b]	1.092	Velocity-Area (FH950)
PL-H1	June 8	99.100[b]	-	n/a
	June 10	99.086[b]	5.339[d]	Velocity-Area (ADCP)
	June 15	99.078[b]	5.336	Velocity-Area (ADCP)
	June 17	99.062[b]	4.920	Velocity-Area (ADCP)
	July 3[†]	98.913[b]	1.308	Velocity-Area (FH950)
	July 5	98.887[b]	1.443	Velocity-Area (FH950)
	July 7	98.853[b]	1.181	Velocity-Area (FH950)
	July 9	98.842[b]	1.022	Velocity-Area (FH950)
	July 11	98.817[b]	0.839	Velocity-Area (FH950)
PL-H2	June 8	99.722[b]	2.036	Velocity-Area (FH950)
	June 11	99.716[b]	2.092	Velocity-Area (FH950)
	June 14	99.713[b]	2.009	Velocity-Area (FH950)
	June 18	99.706[b]	1.906	Velocity-Area (FH950)
	July 3	99.610[b]	0.642	Velocity-Area (FH950)
	July 5	99.597[b]	0.466	Velocity-Area (FH950)
	July 7[†]	99.583[b]	0.399	Velocity-Area (FH950)
	July 9	99.577[b]	0.406	Velocity-Area (FH950)
	July 11[†]	99.567[b]	0.398	Velocity-Area (FH950)

** Stage values corrected during rating curve development, a = surveyed stage, b = pressure transducer corrected stage. See Appendix 3.*

[†]Measurement was not used in 2014 rating curve.

[d]Due to weather conditions, only three transects of the ADCP measurement were within 5% of each other. This measurement does not meet the standard and should be treated as estimated.

Table 4.1-2. Summary of Discharge Measurements in the George Property Area in 2014

Hydrometric Station	Date Measured	Stage (m)*	Measured Discharge (m^3/s)	Method (Equipment Used)
KL-H2	June 6	99.495[b]	0.114	Velocity-Area (FH950)
	June 12	99.501[b]	0.129	Velocity-Area (FH950)
	June 13	99.510[b]	0.135	Velocity-Area (FH950)
	June 16	99.519[b]	0.165	Velocity-Area (FH950)
	July 1	99.517[b]	0.148	Velocity-Area (FH950)
	July 4[†]	99.501[b]	0.150	Velocity-Area (FH950)
	July 6	99.485[b]	0.105	Velocity-Area (FH950)
	July 8	99.468[b]	0.077	Velocity-Area (FH950)
	July 10	99.465[b]	0.074	Velocity-Area (FH950)
LG-H1	June 7	97.498[b]	3.252	Velocity-Area (FH950)
	June 13	97.543[b]	4.786	Velocity-Area (FH950)
	June 16	97.621[b]	6.102	Velocity-Area (FH950)
	July 2	97.611[b]	5.838	Velocity-Area (FH950)
	July 4	97.568[b]	5.369	Velocity-Area (FH950)
	July 6	97.536[b]	4.913	Velocity-Area (FH950)
	July 8	97.494[b]	4.107	Velocity-Area (FH950)
	July 10	97.460[b]	3.449	Velocity-Area (FH950)
	July 12	97.447[b]	-	-

** Stage values corrected during rating curve development, a = surveyed stage, b = pressure transducer corrected stage. See Appendix 3.*
[†]Measurement was not used in 2014 rating curve.
n/a - Discharge measurements are not conducted at lake level monitoring stations.

4.2 HYDROMETRIC STATION SURVEYS

A minimum of two levelling surveys were completed during each of the four 2014 field visits at every hydrometric station. A summary of the survey bench marks at each station is provided in the station information sheets (Appendix 1). Survey data from the five re-established stations were used to reference the 2014 stage data to existing bench marks installed in previous years.

Frost heave in the near-surface permafrost layer can create instability in the elevation of bench marks and pressure transducers at some hydrometric stations. Where possible, additional bench marks were installed in bedrock in order to mitigate this instability.

At the majority of stations the surveys confirmed that the pressure transducers measuring water level remained stationary and properly calibrated during the monitoring period. The pressure transducers at stations KL-H2 (George Lake Outflow) and GRG-L1 (George Lake) moved down vertically in mid-June and stage data were corrected to account for this. It is expected that the vertical shift, which occurred on the same day at both stations, was likely due to a layer of ice on the bed of the lake that prevented the transducer from sitting on the bed until it melted.

4.3 STAGE-DISCHARGE RELATIONSHIPS

As discussed in the methods, reliable discharge data from streamflow monitoring stations established in 2011-2013 were integrated with data collected in 2014 to develop stage-discharge relationships. At

BL-H2 discharge measurements during the 2014 open-water season were used in the development of a preliminary rating equation. Data were collected along the same stream in 2012, however, because the location of the station had changed to a different reach, a new rating curve was required. Additional discharge measurements will continue to increase the range and confidence in stage-discharge relationships at all hydrometric stations.

For stations where no substantial break points were observed, a single rating curve was fit to the full range of flows measured. A two stage (Low/High) rating curve was developed for stations where a change in the relationship between stage and discharge was observed. Rating equations are summarized in Tables 4.3-1 and 4.3-2, and rating curves are provided in Appendix 5.

Table 4.3-1. Summary of 2014 Rating Equations for the Hydrometric Stations in the Goose Property Area

Hydrometric Station		Rating Equation $Q = C (h-a)^b$	Root Mean Square Deviation
BL-H2		$Q = 19.81 (h - 99.00)^{2.31}$	5.8
PL-H1	Low Stage ($h \leq 98.795$)	$Q = 1.28 (h - 98.59)^{0.470}$	6.3
	High Stage ($h > 98.795$)	$Q = 29.41 (h - 98.59)^{2.45}$	
PL-H2	Low Stage ($h \leq 99.502$)	$Q = 12.53 (h - 99.42)^{2.00}$	10.6
	High Stage ($h > 99.502$)	$Q = 42.64 (h - 99.42)^{2.51}$	

Q = discharge (m^3/s); h = recorded stage (m)

Table 4.3-2. Summary of 2014 Rating Equations for the Hydrometric Stations in the George Property Area

Hydrometric Station	Rating Equation $Q = C (h-a)^b$	Root Mean Square Deviation
KL-H2	$Q = 4.56 (h - 99.37)^{1.76}$	8.8
LG-H1	$Q = 19.91 (h - 96.99)^{2.40}$	6.7

Q = discharge (m^3/s); h = recorded stage (m)

4.4 ANNUAL HYDROGRAPHS AND LAKE LEVEL FLUCTUATION

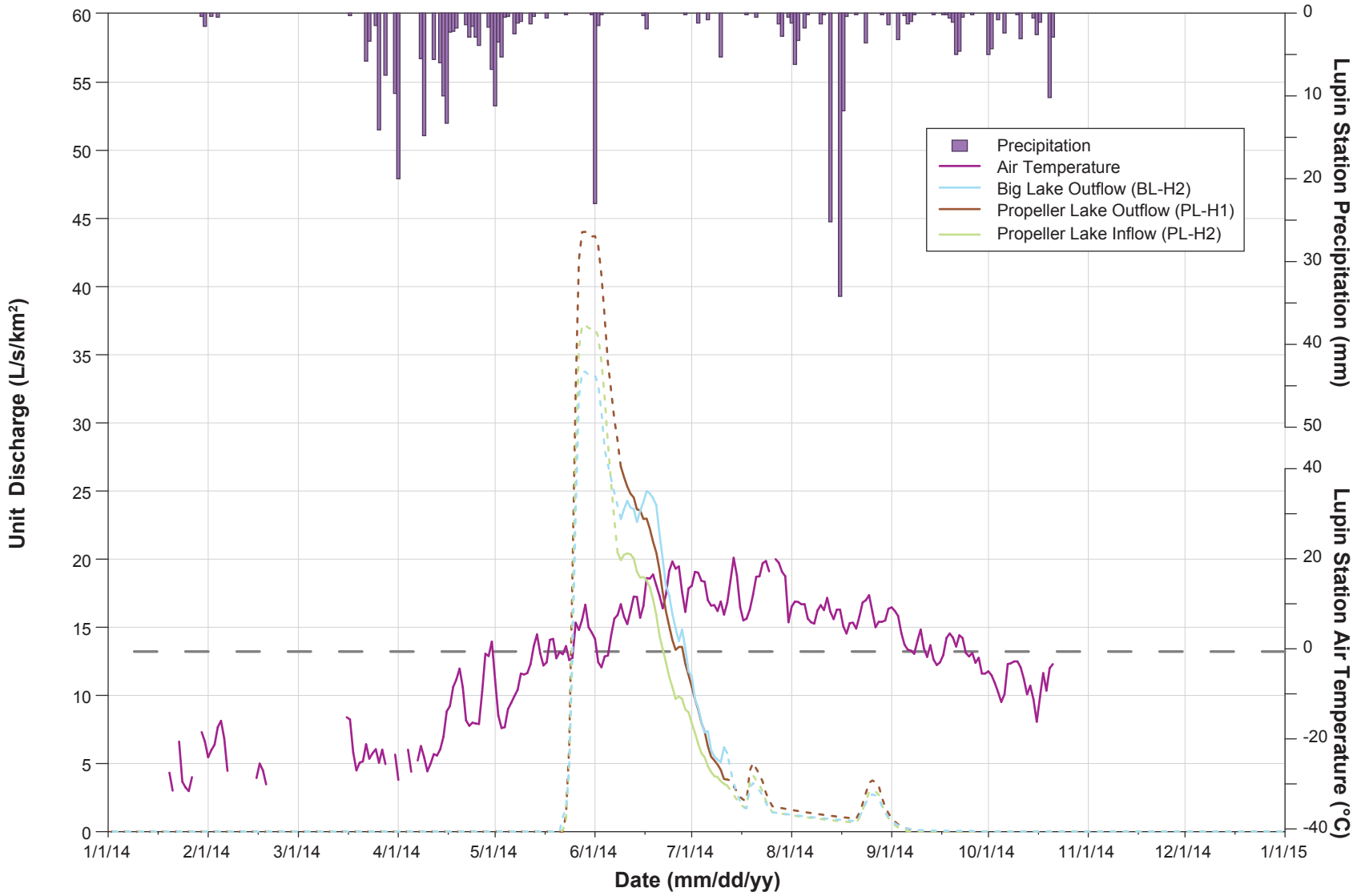
4.4.1 Lake Water Level Monitoring Stations

Lake levels tend to follow a similar hydrograph shape to that of streams in the Project area. The timing and magnitude of peak and low flows are often attenuated by the storage capacity of the lake. The 2014 measured lake water levels are presented in Appendix 5.

4.4.2 Streamflow Hydrographs

The 2014 daily unit discharge hydrographs presented in Figures 4.4-1 and 4.4-2 show similar trends over the monitoring period. Daily discharge tables and individual hydrographs are provided in Appendix 5.

The annual peak in water levels was not observed at any of the stations in 2014. The peak discharge occurred prior to station installation at all sites and only a portion of the recession limb of the hydrograph was captured within the monitoring period. Pressure transducers were installed as soon as conditions in the streams and lakes made site access possible. Based on provisional data from the WSC stations, and on-site data from previous years, peak discharge in the George Property area is estimated to have occurred on May 31 at LG-H1 and June 1 at KL-H1. Peak discharge in the Goose Property area is estimated to have occurred on May 29 at BL-H2, PL-H1 and PL-H2.



Notes: Precipitation and temperature data are based on Environment Canada Lupin CS station.
The dashed unit discharge lines represents data that are estimated.

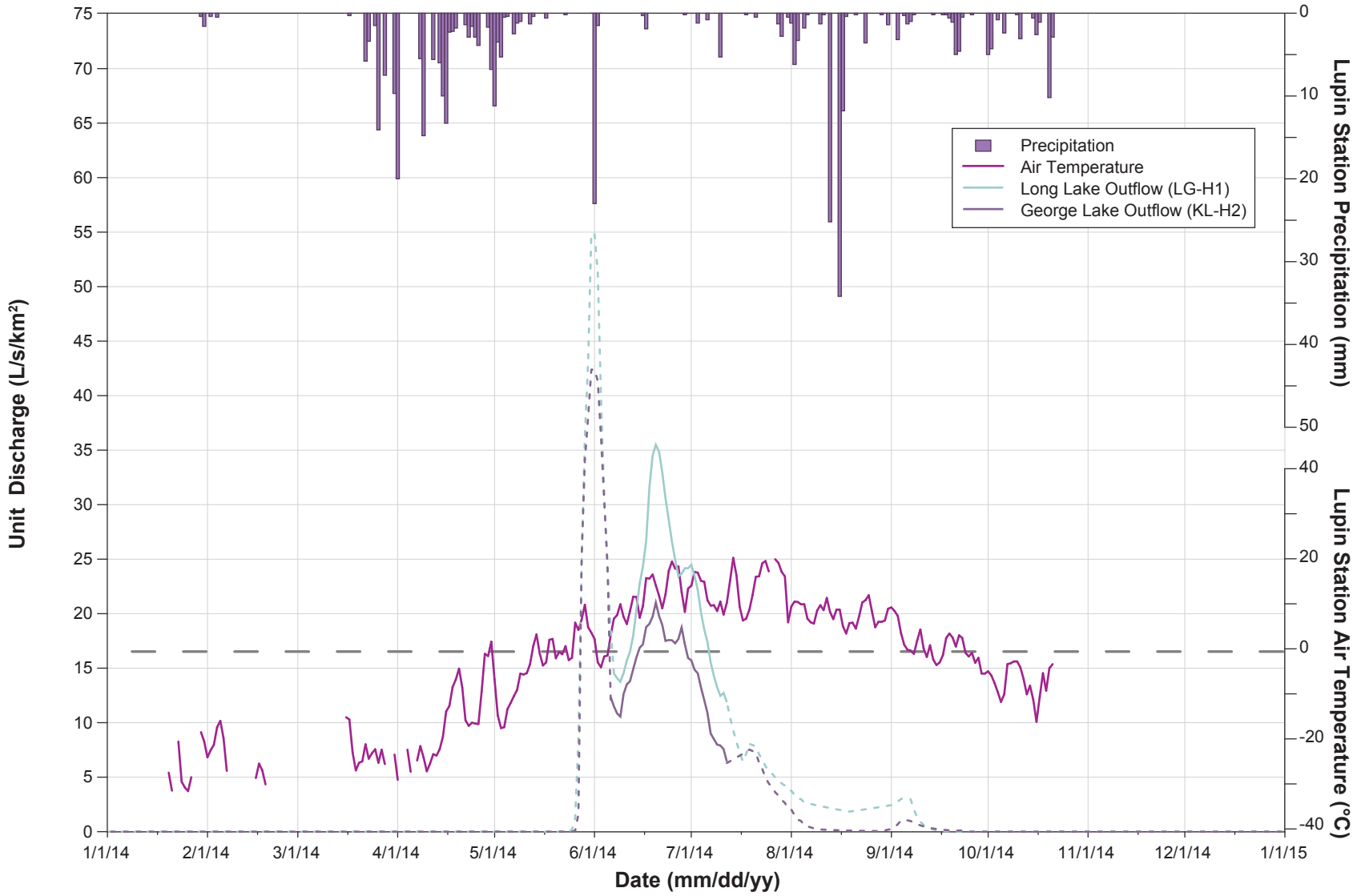
Figure 4.4-1

Sabina GOLD & SILVER CORP.

Annual Unit Hydrographs of Hydrometric Stations in 2014 - Goose Property Area

Figure 4.4-1

Rescan an ERM company



Notes: Precipitation and temperature data are based on Environment Canada Lupin CS station.
The dashed unit discharge lines represents data that are estimated.

Figure 4.4-2

Sabina GOLD & SILVER CORP.

Annual Unit Hydrographs of Hydrometric Stations in 2014 - George Property Area

Figure 4.4-2

Rescan an ERM company

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The 2014 discharge hydrographs (Appendix 5) demonstrate prominent high flows due to snowmelt in June that were based on the synthetic records developed from frequency and chronological pairing relationships presented in Tables 4.4-1 and 4.4-2. The Baillie River hydrograph was used to estimate flows prior to station installation and as such, has the same hydrograph shape across all stations, with the magnitude and timing of the peak scaled to each station. Similarily, the Ellice River hydrograph was used to estimate portions of low flow in the fall and as such, smaller peaks due to rain events can be seen across all stations at the end of July and beginning of September. Discharge hydrographs are normalized into unit discharge hydrographs (Figures 4.4-1 and 4.4-2) to better demonstrate the temporal and spatial variations of runoff at stations in 2014.

Table 4.4-1. Regression Equations Used to Extend the Hydrographs for Stations in the Goose Property Area

Hydrometric Station	Regression Type	Reference Station Lag Time (days)	Reference Station	Regression Equation
BL-H2	Chronological	0	PL-H1	Freshet Period $Q_{BL-H2} = 0.0166(Q_{PL-H1})^2 + 0.4266(Q_{PL-H1}) + 0.1681$
	Frequency Paired	0	PL-H1	Recession Limb $Q_{BL-H2} = 0.0021(Q_{PL-H1})^3 - 0.0487(Q_{PL-H1})^2 + 0.5866(Q_{PL-H1}) + 0.01$
PL-H1	Frequency Paired	-2	Baillie River near the mouth	Freshet Period $Q_{PL-H1} = 6.031E\text{-}09(Q_{Baillie})^3 - 2.079E\text{-}05(Q_{Baillie})^2 + 2.422E\text{-}02(Q_{Baillie}) - 0.5697$
	Frequency Paired	0	Ellice River near the mouth	Recession Period $Q_{PL-H1} = -4.094E\text{-}11(Q_{Ellice})^6 + 2.024E\text{-}08(Q_{Ellice})^5 - 4.005E\text{-}06(Q_{Ellice})^4 + 4.028E\text{-}04(Q_{Ellice})^3 - 2.149E\text{-}02(Q_{Ellice})^2 + 5.791E\text{-}01(Q_{Ellice}) - 5.843$
PL-H2	Chronological	0	PL-H1	Freshet Period $Q_{PL-H2} = 0.4215(Q_{PL-H1}) - 0.0151$
	Chronological	0	PL-H1	Recession Limb $Q_{PL-H2} = 0.4215(Q_{PL-H1}) - 0.0151$

Table 4.4-2. Regression Equations Used to Extend the Hydrographs for Stations in the George Property Area

Hydrometric Station	Regression Type	Reference Station Lag Time (days)	Reference Station	Regression Equation
KL-H2	Chronological	0	LG-H1	Freshet Period $Q_{KL-H2} = -0.0014(Q_{LG-H1})^2 + 0.0508(Q_{LG-H1}) - 0.0305$
	Chronological	0	LG-H1	Recession Limb $Q_{KL-H2} = -0.0014(Q_{LG-H1})^2 + 0.0508(Q_{LG-H1}) - 0.0305$
LG-H1	Chronological	-7	Baillie River near the mouth	Freshet Period $Q_{LG-H1} = -2.454E\text{-}11(Q_{Baillie})^4 + 8.370E\text{-}08(Q_{Baillie})^3 - 1.006E\text{-}04(Q_{Baillie})^2 + 5.617E\text{-}02(Q_{Baillie}) - 1.644$
	Chronological	0	Ellice River near the mouth	Recession Limb $Q_{LG-H1} = 4E\text{-}05(Q_{Ellice})^3 - 0.0064(Q_{Ellice})^2 + 0.3211(Q_{Ellice}) - 4.1529$

Prominent secondary peaks were observed at the George Lake streamflow stations. The secondary peak occurred on June 19 and 20 at stations LG-H1 and KL-H2, respectively. This followed a period after the estimated freshet peak when mean daily temperatures were below zero degrees. Temperatures warmed above freezing again, and snow was available to melt at a faster rate and runoff. The tertiary peak that occurred on June 29 and 28 at stations LG-H1 and KL-H2, respectively, was smaller than the preceeding peaks and may have been due to a combination of rapidly warming temperatures and remnant snowmelt.

The total monthly and annual volumetric water outflows for each of the drainages are presented in Tables 4.4-3 and 4.4-4. Outflows from each of the monitored drainages were generally found to be a function of drainage area. In the Goose Property area, the minimum volumetric outflows were

observed at PL-H2 (drainage area = 101.6 km^2) which had a total annual water output of 8.40 million cubic meters. The maximum annual volumetric output was approximately 21 million cubic meters at PL-H1 (drainage area = 204.6 km^2). In the George Property area, the minimum volumetric outflows were observed at KL-H2 (drainage area = 9.6 km^2) which had a total annual water output of approximately 0.8 million cubic meters. The maximum annual volumetric output was approximately 32.7 million cubic meters at LG-H1 (drainage area = 271.1 km^2).

Table 4.4-3. 2014 Volumetric Water Yield in Millions of Cubic Meters (million m^3) for Hydrometric Stations in the Goose Property Area

Hydrometric Station	Drainage Area (km^2)	January - April	May	June	July	August	September	October - December	Total Annual
BL-H2	158.5	0.00	2.88	9.27	1.80	0.55	0.06	0.00	14.56
PL-H1	204.6	0.00	4.88	12.75	2.36	0.93	0.07	0.00	20.98
PL-H2	101.6	0.00	2.04	5.07	0.92	0.35	0.02	0.00	8.40

Note: All monthly totals are estimated. Partial months of stage data were recorded in June and July.

Table 4.4-4. 2014 Volumetric Water Yield in Millions of Cubic Meters (million m^3) for Hydrometric Stations in the George Property Area

Hydrometric Station	Drainage Area (km^2)	January - April	May	June	July	August	September	October - December	Total Annual
KL-H2	9.6	0.00	0.12	0.49	0.19	0.01	0.01	0.00	0.82
LG-H1	271.1	0.00	3.96	18.66	7.78	1.69	0.61	0.00	32.69

Note: All monthly totals are estimated. Partial months of stage data were recorded in June and July.

4.5 HYDROLOGIC INDICIES

4.5.1 Annual Runoff

In the Arctic, the winter snowpack drives the annual runoff (Woo, 1990). The winter precipitation in the Arctic Tundra Climatic Region was 5.4% below the 1948-2014 average during the 2014 winter (Environment Canada, 2014). More snowpack was available in 2014 than in 2013 when the winter precipitation was 25.3% below the 1948-2014 average, however it was still below recent years with higher snowpacks (+53.4 in 2010, +41.9 in 2011, +26.0 in 2012).

For the gauged drainages in the Goose Property area, the estimated 2014 annual runoff ranged from 83 mm at PL-H2 to 103 mm at PL-H1 (Table 4.5-1). For the gauged drainages in the George Property area, the estimated 2014 annual runoff ranged from 85 mm at KL-H2 to 121 mm at LG-H1 (Table 4.5-2).

Annual runoff estimates for 2014 were within 28% of 2013 runoff estimates at all stations (Tables 4.5-1 and 4.5-2). The 2014 estimated annual runoff was lower than in 2013 at all stations except PL-H1, although the regional snowpack was generally higher in 2014 than 2013. The local annual runoff estimate is supported by provisional streamflow data from WSC stations that show the 2014 freshet flows are slightly less than the the 2013 flows. At Baillie River near the mouth the freshet peak flows were 1,450 and 1,103 m^3/s in 2013 and 2014, respectively.

Table 4.5-1. 2014 Estimated Annual Runoff and Mean Annual Discharge in the Goose Property Area

Hydrometric Station	Drainage Area (km^2)	Previous Years Results			2014 Results				
		2011 Annual Runoff[+] (mm)	2012 Annual Runoff[+] (mm)	2013 Annual Runoff (mm)	Annual Runoff [a] (mm)	Observed Runoff [b] (mm)	Jun - Sep Runoff [c] (mm)	Mean Annual Discharge (m^3/s)	Mean Jun - Sep Discharge (m^3/s)
BL-H2	158.5	n/a	68*	n/a	92	46	74	0.462	1.108
PL-H1	204.6	123	134	100	103	47	79	0.665	1.528
PL-H2	101.6	108	72	98	83	36	63	0.266	0.603

** The location of the 2012 station at BL-H2 drainage area was 1.5 km^2 larger than the 2014 location of the station.*
[a] Annual runoff includes data from within the monitoring period and estimated values.
[b] Observed runoff is the total runoff during the monitoring period.
[c] Jun-Sep runoff includes data from within the monitoring period and estimated values.

Table 4.5-2. 2014 Estimated Annual Runoff and Mean Annual Discharge in the George Property Area

Hydrometric Station	Drainage Area (km^2)	Previous Years Results			2014 Results				
		2011 Annual Runoff (mm)	2012 Annual Runoff (mm)	2013 Annual Runoff (mm)	Annual Runoff [a] (mm)	Observed Runoff [b] (mm)	Jun - Sep Runoff [c] (mm)	Mean Annual Discharge (m^3/s)	Mean Jun - Sep Discharge (m^3/s)
KL-H2	9.6	n/a	143	116	85	46	73	0.026	0.066
LG-H1	271.1	n/a	n/a	132	121	68	106	1.036	2.726

[a] Annual runoff includes data from within the monitoring period and estimated values.
[b] Observed runoff is the total runoff during the monitoring period.
[c] Jun-Sep runoff includes data from within the monitoring period and estimated values.

4.5.2 Mean Annual Discharge

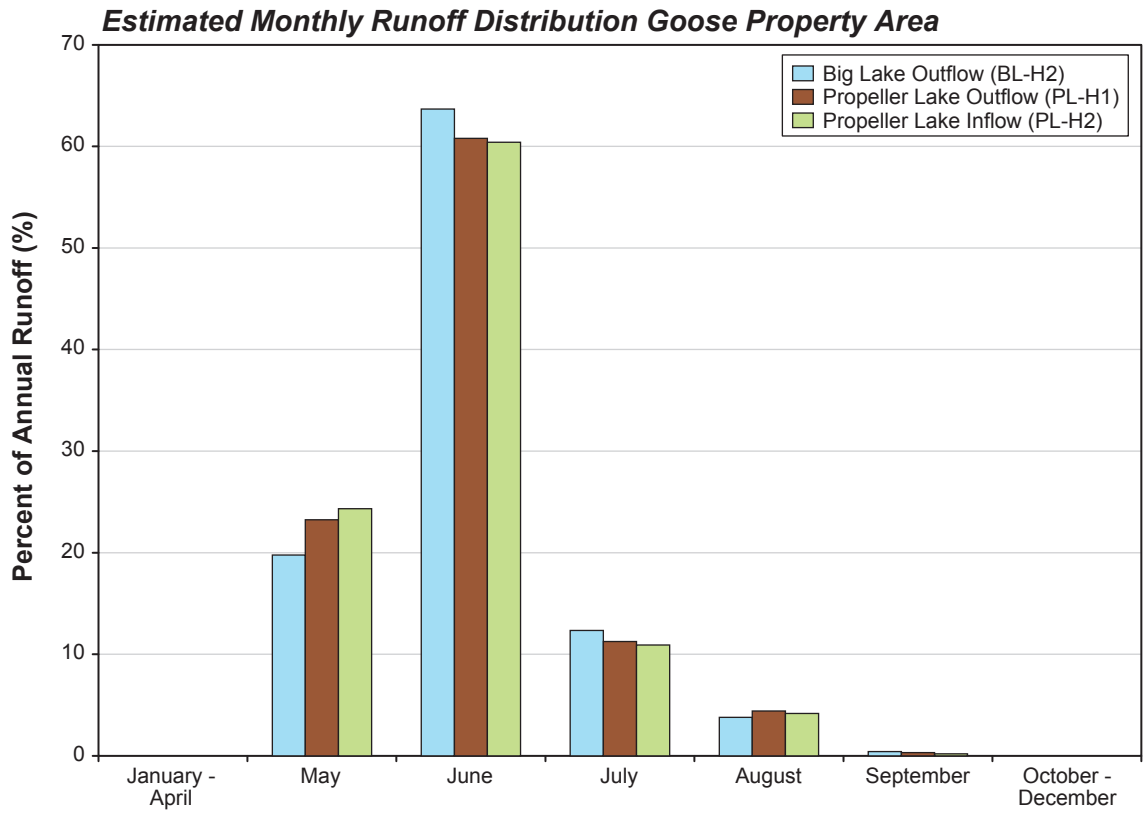
The mean annual discharge and the average discharge during the open-water period from the beginning of June through September were calculated and are provided in Tables 4.5-1 and 4.5-2.

For gauged drainages in the Goose Property area, average discharge during the open-water season was lowest at PL-H2 (0.603 m^3/s) and highest at PL-H1 (1.528 m^3/s; Table 4.5-1). Similarily in the George Property area, average discharge during the open-water season ranged from 0.066 m^3/s at KL-H2 2.726 m^3/s at LG-H1 Table 4.5-2).

Mean annual discharge is less than the open-water season discharge because a large portion of the year has zero flow conditions, thereby resulting in a reduction in mean annual discharge. In the Goose Property area, MAD was lowest at PL-H2 (0.266 m^3/s) and highest at PL-H1 (0.665 m^3/s) (Table 4.5-1). Similarily, in the George Property area, MAD ranged from 0.026 m^3/s at KL-H2 to 1.036 m^3/s at LG-H1 (Table 4.5-2).

4.5.3 Monthly Runoff Distribution

The maximum monthly runoff occurred in June in all drainages monitored in 2014 (Tables 4.5-3 and 4.5-4; Figure 4.5-1).



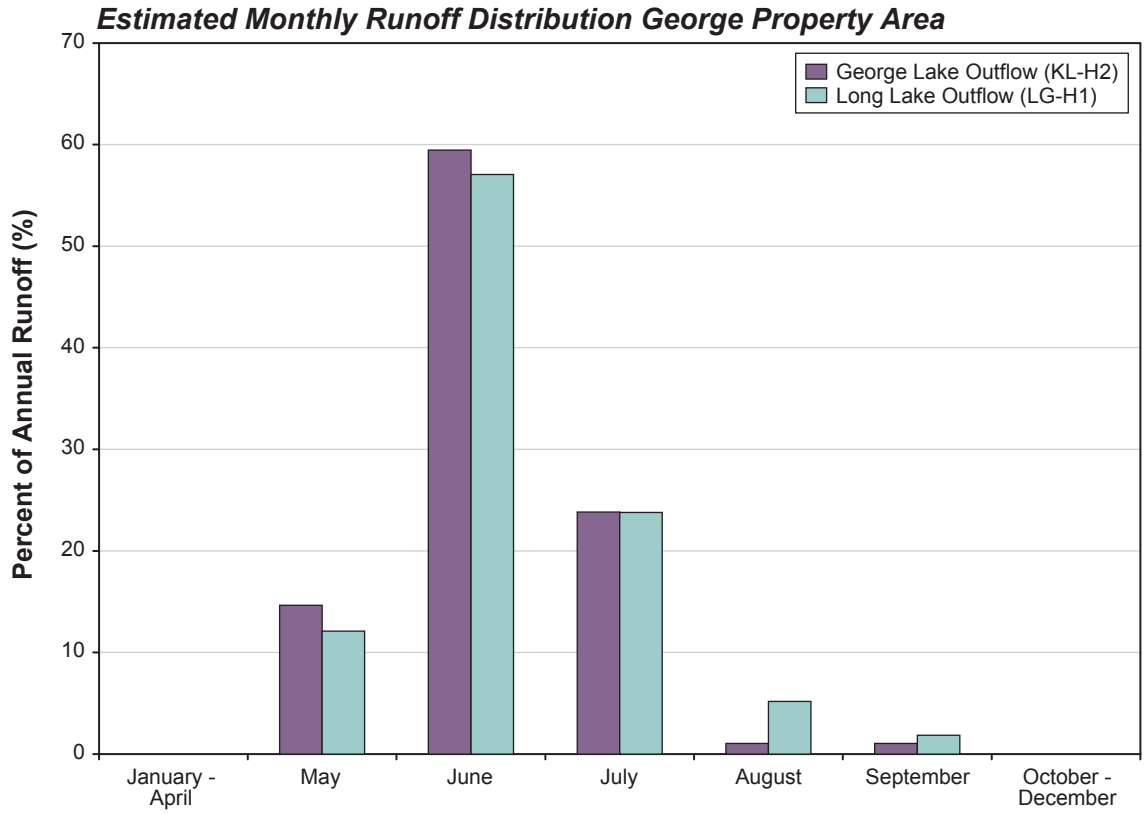


Figure 4.5-1

Estimated Monthly Runoff Distribution at Stations in the Goose and George Property Areas

Table 4.5-3. 2014 Runoff Distribution in the Goose Property Area

Hydrometric Station	January - April		May		June		July		August		September		October - December	
	(mm)	(%)*	(mm)	(%)*	(mm)	(%)*	(mm)	(%)*	(mm)	(%)*	(mm)	(%)*	(mm)	(%)*
BL-H2	0	0	18	20	58	64	11	12	3	4	0	0	0	0
PL-H1	0	0	24	23	62	61	12	11	5	4	0	0	0	0
PL-H2	0	0	20	24	50	60	9	11	3	4	0	0	0	0

** Monthly or a certain period runoff represented as a percentage of annual runoff.*

Table 4.5-4. 2014 Runoff Distribution in the George Property Area

Hydrometric Station	January - April		May		June		July		August		September		October - December	
	(mm)	(%)*	(mm)	(%)*	(mm)	(%)*	(mm)	(%)*	(mm)	(%)*	(mm)	(%)*	(mm)	(%)*
KL-H2	0	0	12	15	51	59	20	24	1	1	1	1	0	0
LG-H1	0	0	15	12	69	57	29	24	6	5	2	2	0	0

** Monthly or a certain period runoff represented as a percentage of annual runoff.*

Compared to previous years, the concentration of annual runoff in June was greater than 2011 but less than 2012 and 2013. Using PL-H1 as a representative station, runoff values in June accounted for 45, 84, 67 and 61% of the annual runoff in 2011, 2012, 2013, and 2014, respectively. This is consistent with WSC station Baillie River where June runoff was 40, 74, 65 and 60% in 2011, 2012, 2013 and 2014.

4.5.4 Annual Peak and Low Flow

The 2014 peak flow was the result of the spring freshet and was estimated, based on regression analysis, at all stations. Peak flows presented in this report are considered estimates only (Tables 4.5-5 and 4.5-6).

Table 4.5-5. Estimated and Observed 2014 Daily Peak Flows and Peak Unit Yields in the Goose Property Area

Hydrometric Station	Drainage Area (km^2)	Peak Daily Flow* (m^3/s)	Peak Daily Unit Yield* ($L/s/km^2$)	Maximum Observed Daily Flow (m^3/s)
BL-H2	158.5	5.35 (May 29)	33.76 (May 29)	3.970 (June 17)
PL-H1	204.6	9.00 (May 29)	43.98 (May 29)	5.854 (June 8)
PL-H2	101.6	3.78 (May 29)	37.18 (May 29)	2.079 (June 8)

** Based on regional regression analysis*

Table 4.5-6. Estimated and Observed 2014 Daily Peak Flows and Peak Unit Yields in the George Property Area

Hydrometric Station	Drainage Area (km^2)	Peak Daily Flow* (m^3/s)	Peak Daily Unit Yield* ($L/s/km^2$)	Maximum Observed Daily Flow (m^3/s)
KL-H2	9.6	0.42 (June 1)	43.27 (June 1)	0.202 (June 20)
LG-H1	271.1	14.88 (May 31)	54.89 (May 31)	9.621 (June 20)

** Based on regional regression analysis*

In the Goose Property area, estimated daily peak flows ranged from 3.78 m^3/s at PL-H2 to 9.00 m^3/s at PL-H1 (Table 4.5-5). In the George Property area, daily peak flows ranged from 0.42 m^3/s at KL-H2 to 14.88 m^3/s at LG-H1 (Table 4.5-6).

Annual low flows are expected to reach zero in all the basins once freeze-up occurs. Zero flow conditions will last throughout the winter months (approximately October to May). Due to the short monitoring period in 2014, the lowest flows observed were on the last days of monitoring which were still the receeding limb of the hydrograph. Low flows normally occur in August through October for the majority of the basins in the Project area when flows drop to baseflow levels.

5. Summary

5. Summary

The 2014 baseline network on the Goose Property included five hydrometric stations, consisting of three streamflow stations and two lake water level stations. The baseline network on the George Property consisted of four hydrometric stations, including two streamflow stations and two lake water level stations. The hydrometric networks were installed on June 6, 2014, after the onset of flow in the streams and when site access was available. Stations were operated until July 12, 2014, after which site access was restricted due to the closure of camp. During this time period, continuous time-series water level (stage) data were collected at each hydrometric station and more than 40 manual discharge measurements were completed at streamflow stations. Based on the stage and discharge data collected, stage-discharge relationships were developed and discharge hydrographs produced. Regressions with regional stations and the application of a logarithmic decay function were used to extend the discharge time-series to provide an estimated annual discharge hydrograph.

The hydrometric data collected in 2014 included 30 to 35 days of continuous sampling. Of the possible range of flows and lake water levels normally observed in a year, only a portion were documented. Consequently, regressions were performed with nearby Water Survey of Canada stations in order to provide estimates for the remainder of the 2014 period. The reduced set of measured data, and expanded period of estimated synthetic records, increases the uncertainty in parameters presented in this report.

The 2014 hydrograph was similar to previous years, characterized by snowmelt-driven high flows during the spring freshet. A snowmelt-driven high flow event occurred in each of the hydrographs during the freshet period in late May to early June.

Estimated daily peak flows varied substantially between gauged streams. Daily peak flows in the Goose Property area ranged from 3.78 m^3/s at streamflow monitoring station PL-H2 (Propeller Lake Inflow) to 9.00 m^3/s at station PL-H1 (Propeller Lake Outflow). Daily peak flows in the George Property area ranged from 0.42 m^3/s at streamflow monitoring station KL-H2 (George Lake Outflow) to 14.88 m^3/s at station LG-H1 (Long Lake Outflow).

Volumetric outflows from each of the monitored drainages were generally found to be a function of drainage area. In the Goose Property area, the minimum volumetric outflows were observed at PL-H2 (Propeller Lake Inflow; drainage area = 101.6 km^2) which had a total annual water output of 8.40 million m^3. The maximum annual volumetric output was 20.98 million m^3 at PL-H1 (Propeller Lake Outflow; drainage area = 204.6 km^2). In the George Property area, the minimum volumetric outflows were observed at KL-H2 (George Lake Outflow; drainage area = 9.6 km^2) which had a total annual water output of 0.82 million m^3. The maximum annual volumetric output was 32.69 million m^3 at LG-H1 (Long Lake Outflow; drainage area = 271.1 km^2).

Estimated annual runoff was similar to what was observed in 2013 and less than 2011 and 2012 at most stations. The highest annual runoff was 121 mm at LG-H1 (Long Lake Outflow in the George Property area) and the lowest was 83 mm at PL-H2 (Propeller Lake Inflow in the Goose Property area). In all drainages the maximum monthly runoff occurred in June (60 to 64% at Goose Property area stations and 57 to 59% at George Property area stations).

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Appendix 1
Station Information Sheets

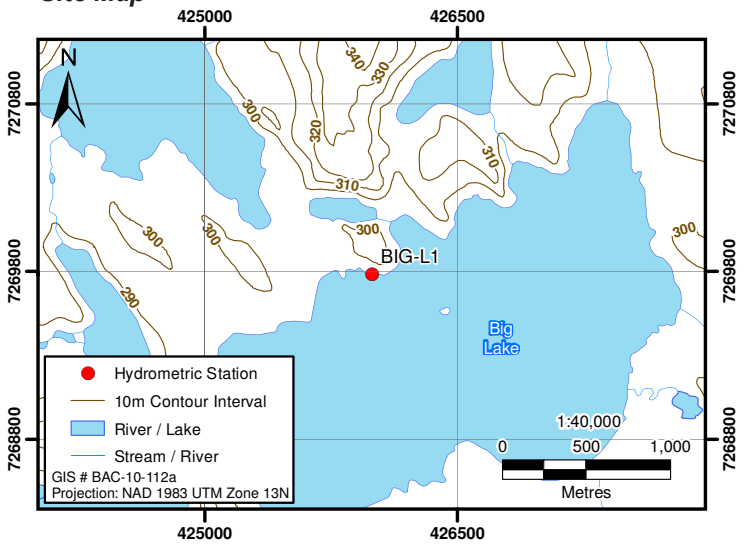
Rescan™
an ERM company

General Site Information

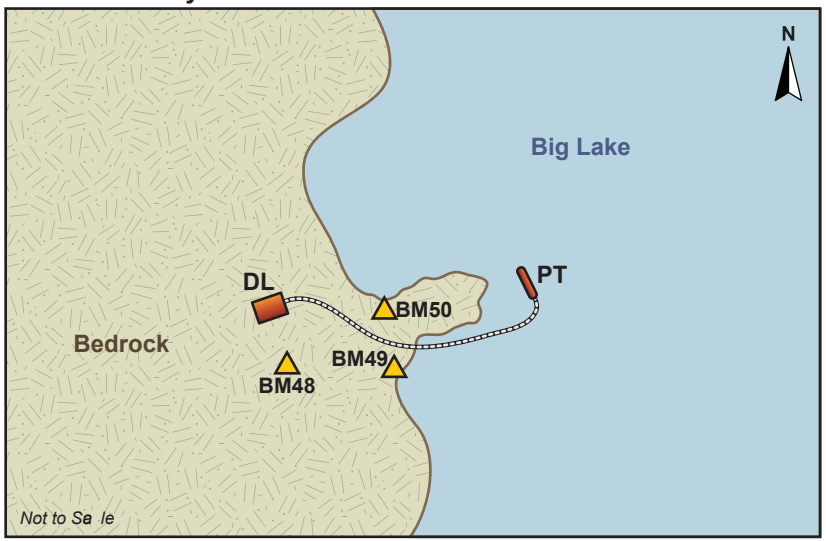
Site ID:	BIG-L1	**Drainage Area (km²):**	N/A
Site Location:	In Big Lake		
UTM:	NAD 83, Zone 13W	425,992 E	7,269,783N
Benchmarks	**Elevation (m)**	**Description**	
BM 50	100.000	In bedrock on shoreline near station	
BM 49	100.357	In bedrock on shoreline near station	
BM 48	101.321	In bedrock on ridge above station	
Transducer:	PT-2X	**Logger:**	Self-contained
Operating Period			
2014	Jun 9 to Jul 12	Established on June 9, 2014.	
General Comments:			

- Lake level monitoring station in Big Lake
- Bedrock lake bed at station location
- Access by helicopter

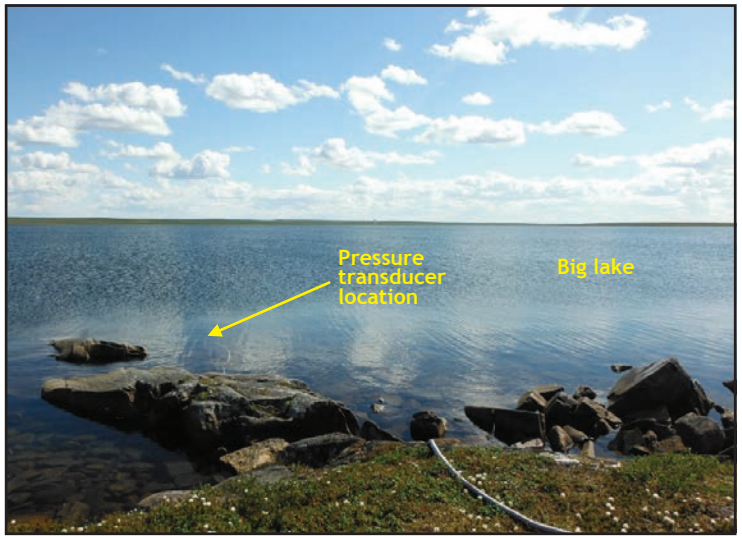
Site Map



Plan View of Hydrometric Station BIG-L1



Site Photo



View of the monitoring station looking towards the east. July 2, 2014.

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BIG-L1
Station Information Sheet

Rescan an ERM company

General Site Information

Site ID:	BL-H2	**Drainage Area (km²):**	158.5
Site Location:	Downstream of the outflows of Swan Lake and Big Lake		
UTM:	NAD 83, Zone 13W	424,412 E	7,265,460 N

Benchmarks	**Elevation (m)**	**Description**
BM 11	100.000	Bolt on right bank in bedrock
BM 12	99.572	Bolt on right bank in bedrock
BM 13	99.528	Bolt on right bank in bedrock

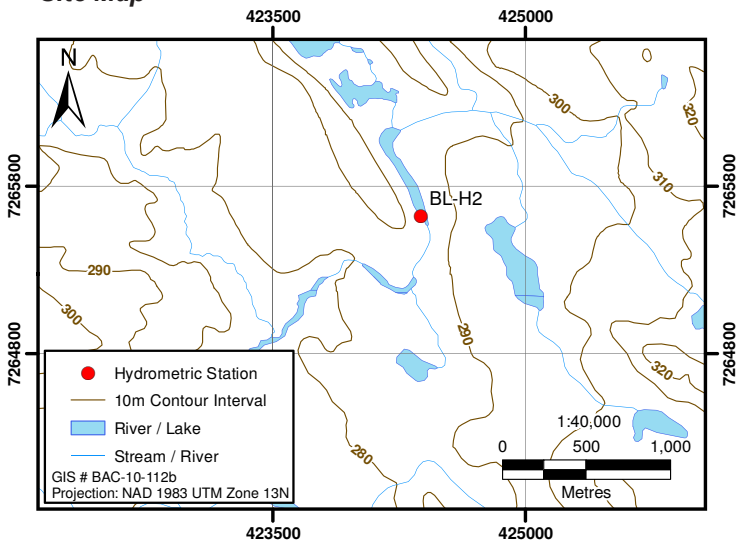
Transducer:	PT-2X	**Logger:**	Self-contained

Operating Period:		
2012	Jun 8 to Sep 9	Established on June 8, 2012
2014	Jun 9 to Jul 12	Re-established 800 m upstream of 2012 location

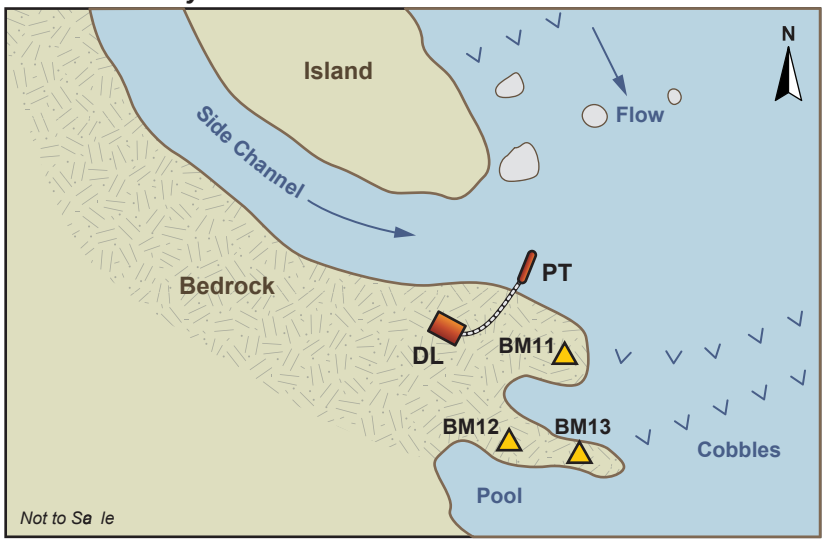
General Comments:

- Large, wide (30 m) channel with high flow
- Wadeable under all conditions
- Pool-riffle morphology with silt/boulder bed (gradient = 1%)
- Access by helicopter

Site Map



Plan View of Hydrometric Station BL-H2



Site Photo

View looking upstream from the station. July 12, 2014.

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BL-H2
Station Information Sheet

Rescan an ERM company

General Site Information

Site ID:	PL-H1	**Drainage Area (km²):**	204.4
Site Location:	Downstream from Propeller Lake outflow		
UTM:	NAD 83, Zone 13W	436,094 E	7,279,939 N

Benchmarks	**Elevation (m)**	**Description**
BM8	100.000	Bolt upstream from station
BM7	99.538	Bolt downstream from station
BM6	99.601	Bolt near station

Transducer:	PT-2X	**Logger:**	Self-Contained

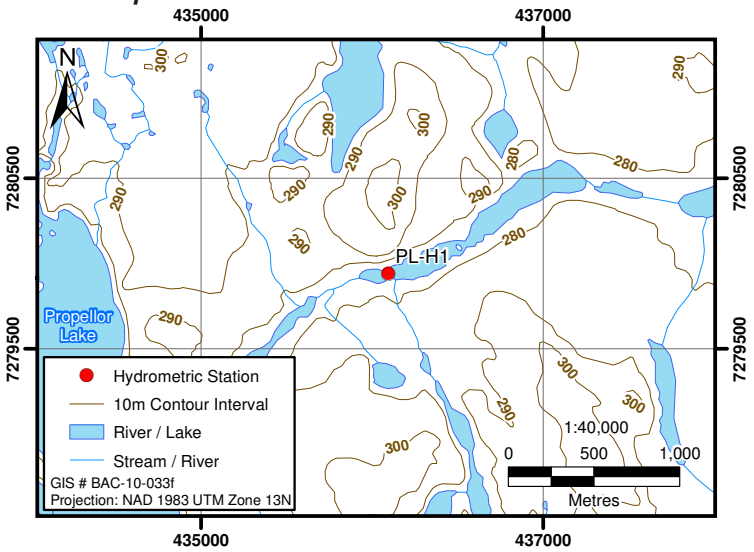
Operating Periods:

2011	Jun 14 to Sep 17	Established June 14, 2011
2012	Jun 6 to Sep 8	
2013	Jun 8 to Oct 4	
2014	Jun 8 to Jul 12	

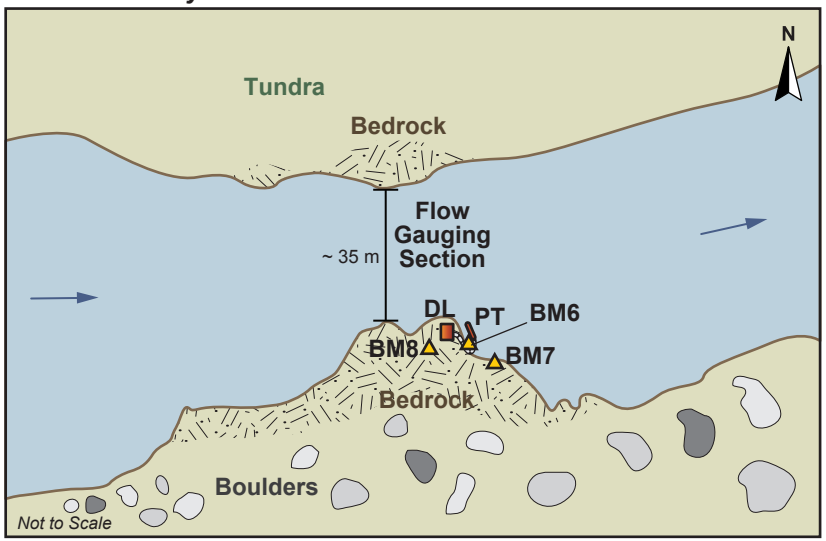
General Comments:

- Deep reach, low velocity
- Not wadeable, must walk 200 m upstream to cross
- Access by helicopter
- Under low flow conditions, manual flow measurement 400 m upstream of station
- Under high flow conditions, ADCP used for flow measurement

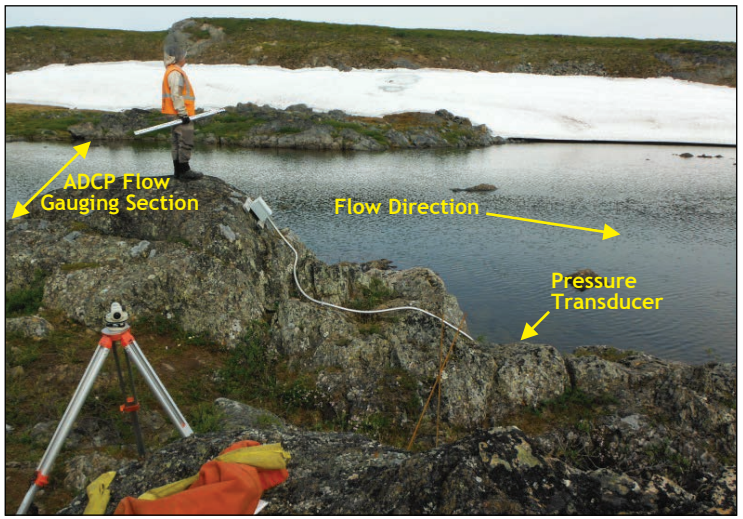
Site Map



Plan View of Hydrometric Station PL-H1



Site Photo



View looking across the stream at monitoring station PL-H1.
Manual measurements were taken 400 m further upstream. July 5, 2014.

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PL-H1
Station Information Sheet

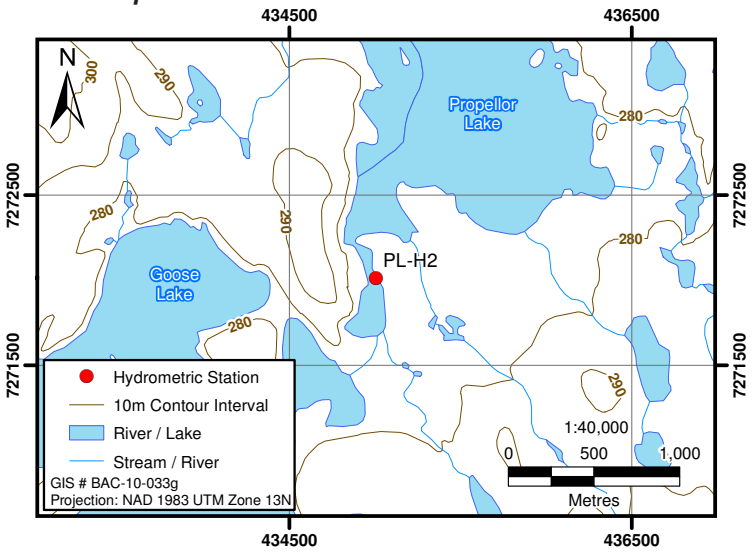
Rescan an ERM company

General Site Information

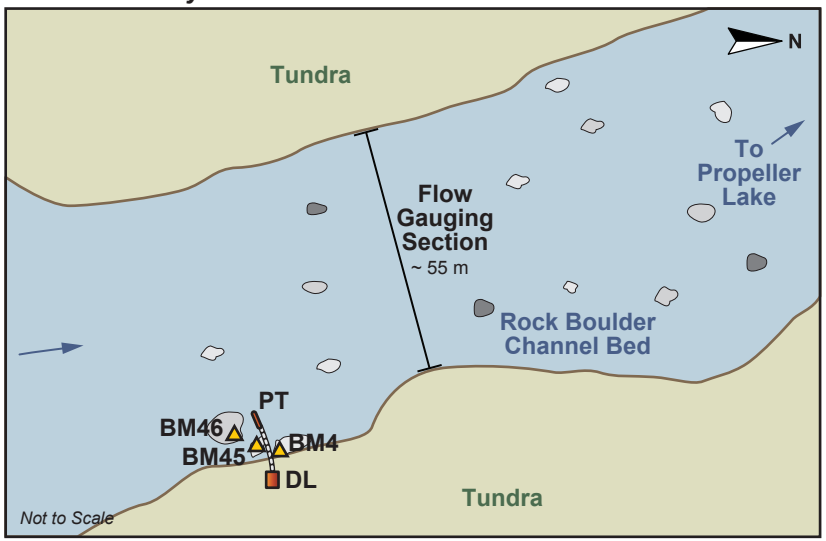
Site ID:	PL-H2	**Drainage Area (km²):**	101.6
Site Location:	Between the outflow of Goose Lake and the inflow of Propeller Lake		
UTM:	NAD 83, Zone 13 W	435,007 E	7,272,014 N
Benchmarks	**Elevation (m)**	**Description**	
BM 4	100.000	Bolt on in-stream boulder near the station	
BM 45	99.852	Bolt on in-stream boulder near the station	
BM 46	100.166	Bolt on in-stream boulder near the station	
Transducer:	PT-2X	**Logger:**	Self-Contained
Operating Periods:			
2011	Jun 11 to Sep 17	Established June 11, 2011	
2012	Jun 12 to Sep 13		
2013	Jun 2 to Oct 4		
2014	Jun 8 to Jul 12		
General Comments:			

- Wide boulder strewn channel
- Low flow through boulders where flow covers the majority of boulders
- Wadeable under all conditions
- Access by helicopter

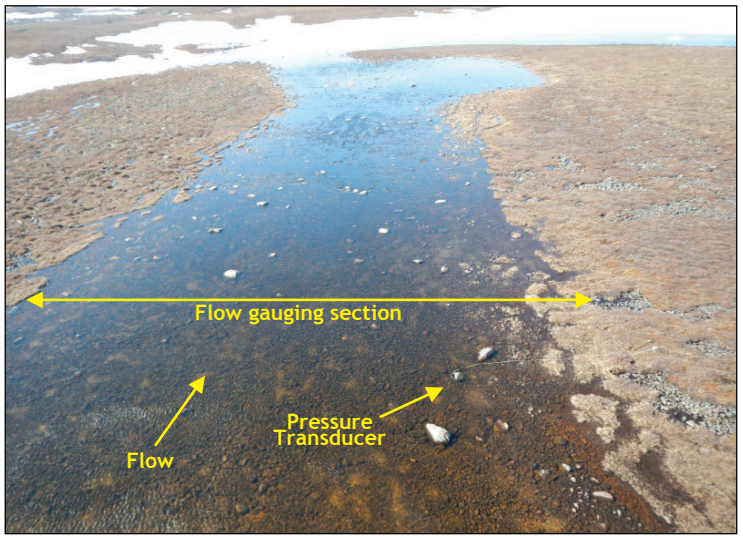
Site Map



Plan View of Hydrometric Station PL-H2



Site Photo



High angle view looking downstream at the monitoring station. June 8, 2014.

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PL-H2
Station Information Sheet

Rescan an ERM company

General Site Information

Site ID:	PROP-L1	Drainage Area (km²):	N/A
Site Location:	In Propeller Lake near the outflow		
UTM:	NAD 83, Zone 13W	434, 782 E	7,279,265 N

Benchmarks	**Elevation (m)**	**Description**
BM 4	100.000	Bolt on in-stream rock at lake outlet
BM 5	100.077	Bolt on in-stream rock at lake outlet
BM 12	100.082	Painted rock at lake outlet
BM 13	100.200	Painted rock at lake outlet
BM 14	100.596	Station rebar

Transducer:	PT-2X	**Logger:**	Self- contained

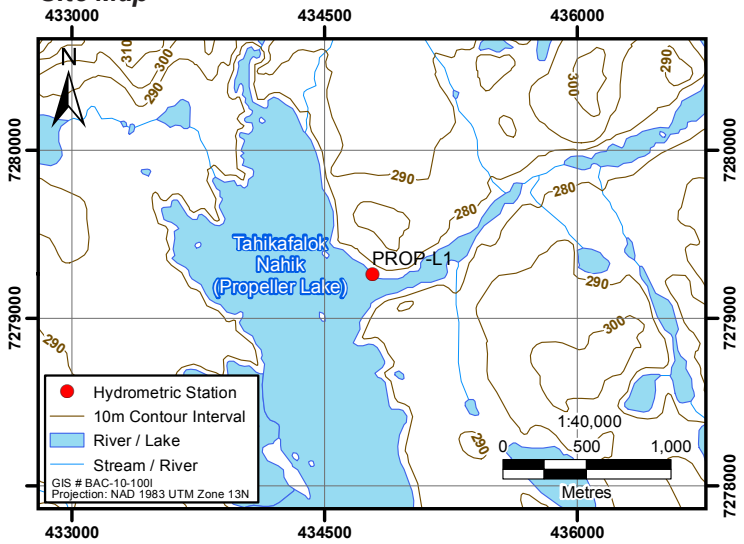
Operating Period:

2013	Sep 9 to Oct 4	Established on Sep 9, 2013
2014	Jun 8 to Jul 12	

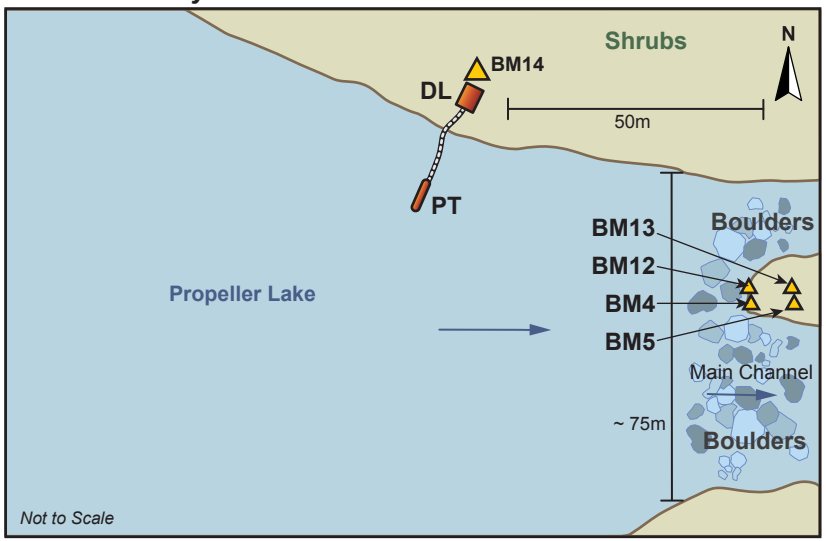
General Comments:

- Lake level monitoring station in Propeller Lake
- Propeller Lake is very shallow near the outlet
- Cobble lake bed at station location
- Access by helicopter

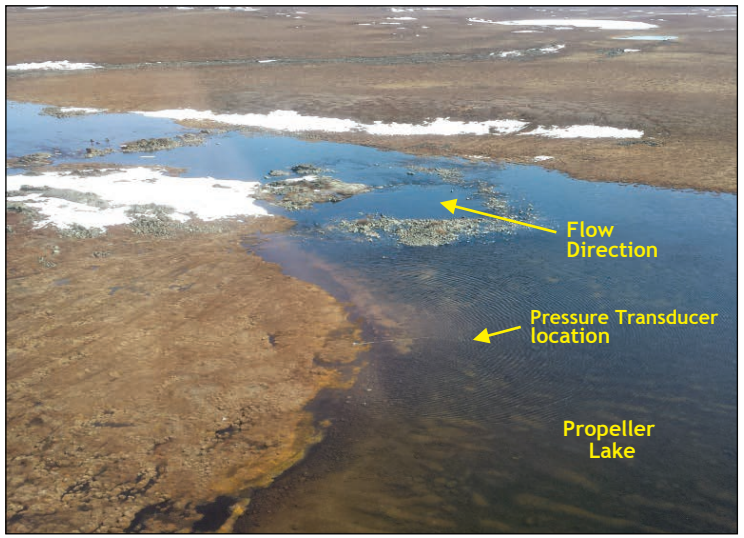
Site Map



Plan View of Hydrometric Station PROP-L1



Site Photo



High angle oblique view of the monitoring station looking towards the lake outlet. June 8, 2014.

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PROP-L1
Station Information Sheet

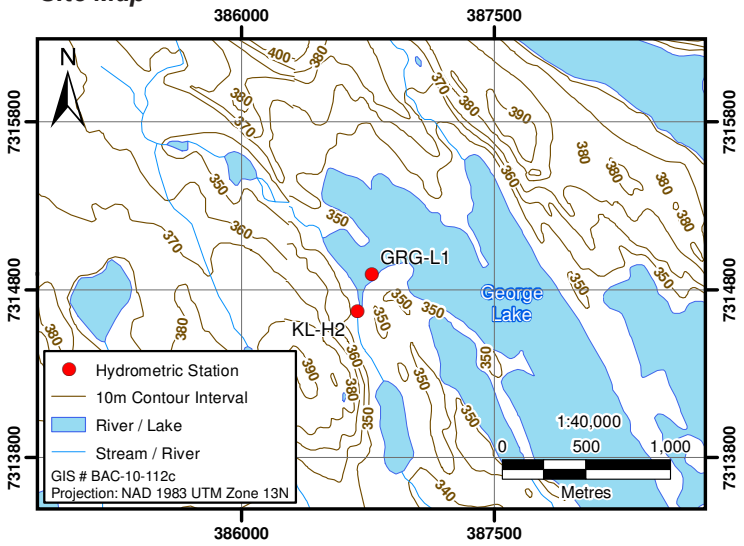
Rescan an ERM company

General Site Information

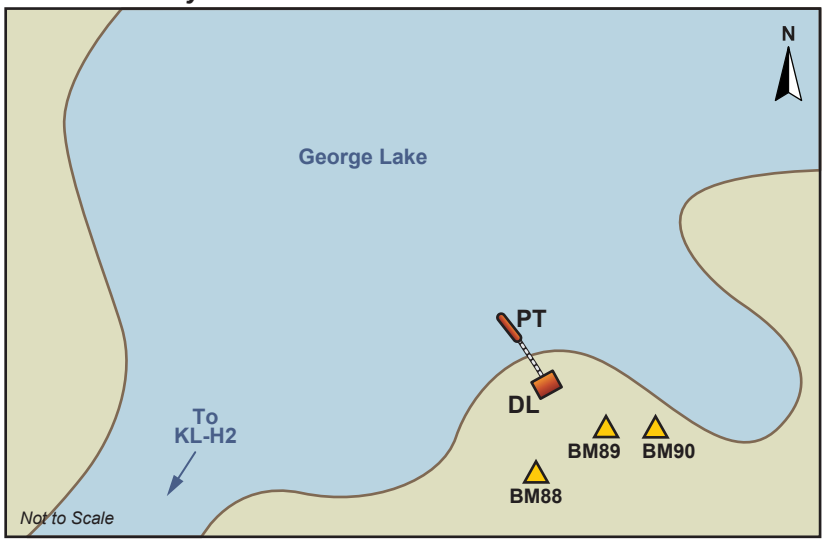
Site ID:	GRG-L1	Drainage Area (km²):	N/A
Site Location:	In George Lake near the outflow		
UTM:	NAD 83, Zone 13W	386,771E	7,314,895 N
Benchmarks	**Elevation (m)**	**Description**	
BM 88	100.000	On prominent boulder	
BM 89	98.903	On bedrock at ground level	
BM 90	98.746	On bedrock at ground level	
Transducer:	PT-2X	**Logger:**	Self-contained
Operating Period:			
2014	Jun 12 to Jul 12	Established on June 12, 2014	
General Comments:			

- Lake level monitoring station in George Lake
- Bedrock lake bed at station location
- Access by helicopter

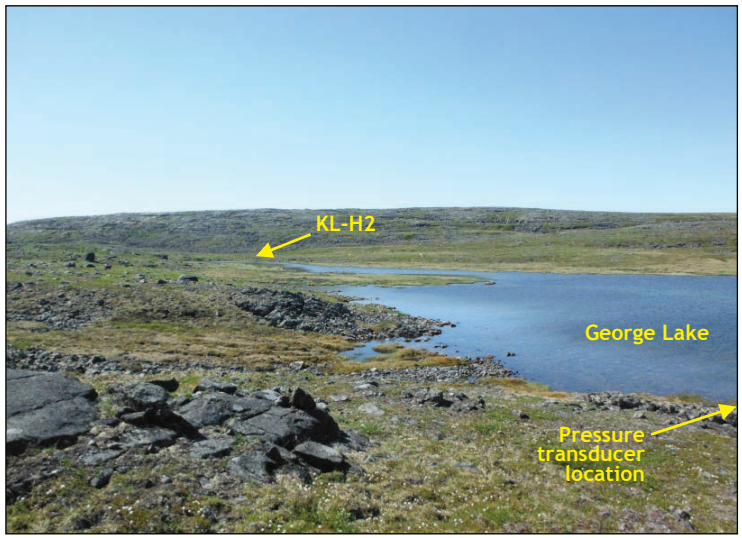
Site Map



Plan View of Hydrometric Station GRG-L1



Site Photo



View of the monitoring station looking towards the lake outlet and KL-H2. July 4, 2014.

Sabina GOLD & SILVER CORP.

GRG-L1
Station Information Sheet

Rescan an ERM company

General Site Information

Site ID:	KL-H2	Drainage Area (km²):	9.8
Site Location:	George Lake outflow		
UTM:	NAD 83, Zone 13W	386,687E	7,314,673N

Benchmarks	**Elevation (m)**	**Description**
BM 73	100.000	Bolt in rock 15m downstream of station
BM 74	99.848	Bolt in rock on right bank
BM 76	100.729	Bolt in rock on right bank
BM 42	100.617	Bolt in bedrock on left bank
BM 43	100.460	Bolt in bedrock on left bank

Transducer:	PT-2X	**Logger:**	Self-Contained

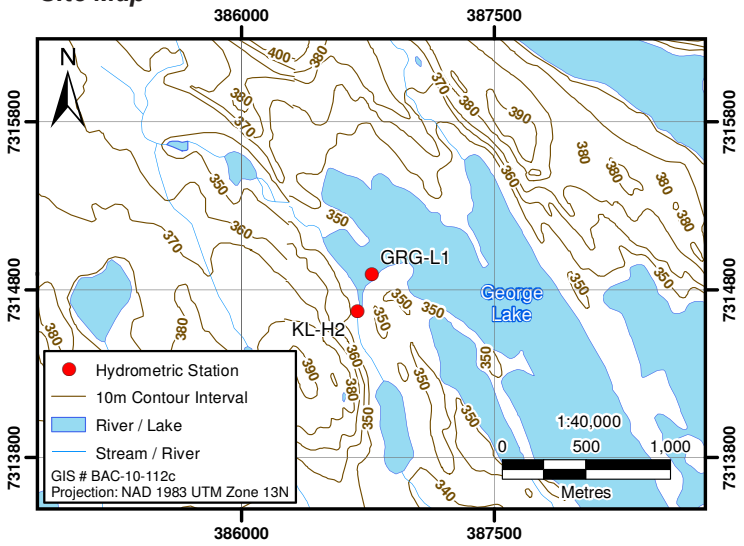
Operating Period:

2012	Jun 10 to Sep 12	Established on June 10, 2012
2013	Jun 11 to Sep 14	Installed BMs 42 and 43
2014	Jun 6 to Jul 12	BM 76 is no longer tagged

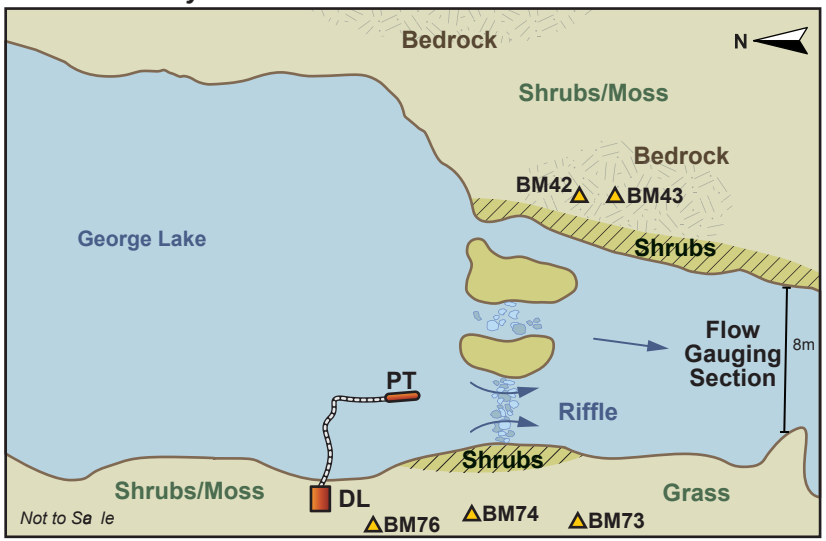
General Comments:

- Transducer installed in lake with flow gauging section immediately downstream of outlet
- Can be waded under all conditions
- Access by helicopter

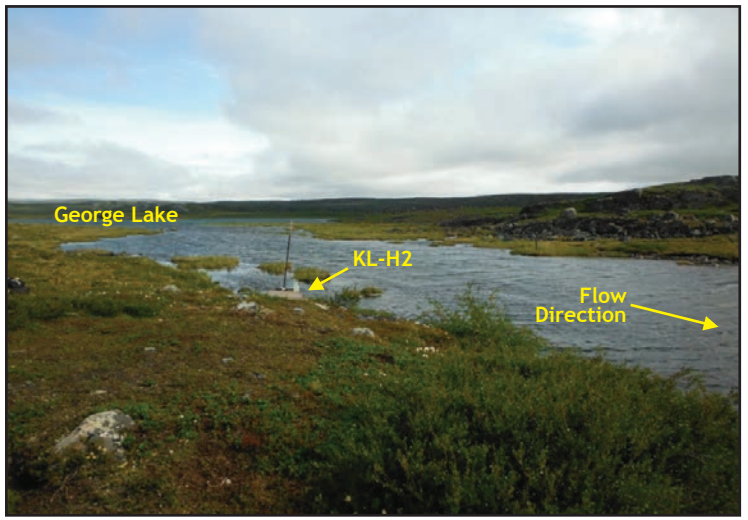
Site Map



Plan View of Hydrometric Station KL-H2



Site Photo



View looking upstream to the outlet of George Lake and KL-H2. The station is indicated on the right bank. July 6, 2014.

Sabina GOLD & SILVER CORP.

KL-H2
Station Information Sheet

Rescan an ERM company

General Site Information

Site ID:	LG-H1	Drainage Area (km²):	271.3
Site Location:	Long Lake outflow		
UTM:	NAD 83, Zone 13W	394,281E	7,305,112 N

Benchmarks	**Elevation (m)**	**Description**
BM 95	100.000	Bolt in bedrock near the station
BM 96	99.677	Bolt in bedrock on left bank
BM 97	99.758	Bolt in bedrock on left bank

Transducer:	PT-2X	**Logger:**	Self-Contained

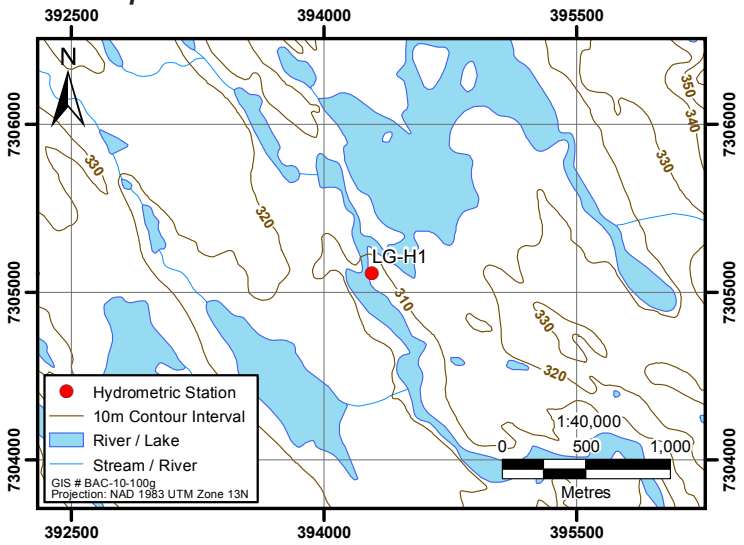
Operating Period:

2013	Jun 11 to Sep 9	Station installed June 11, 2013
2014	Jun 7 to Jul 12	

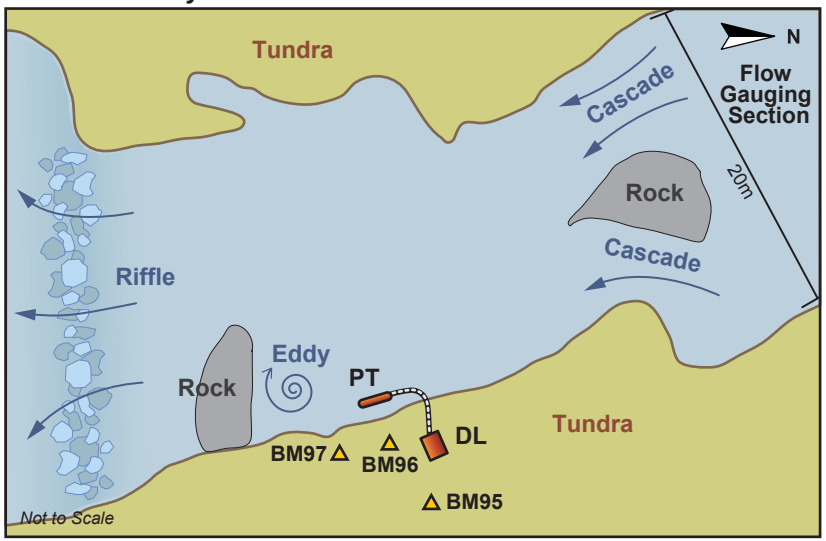
General Comments:

- Wide, high energy stream with cascade upstream
- Can be waded upstream of cascade
- Cobble bed with bedrock banks and wide boulder fan downstream of station
- Access by helicopter

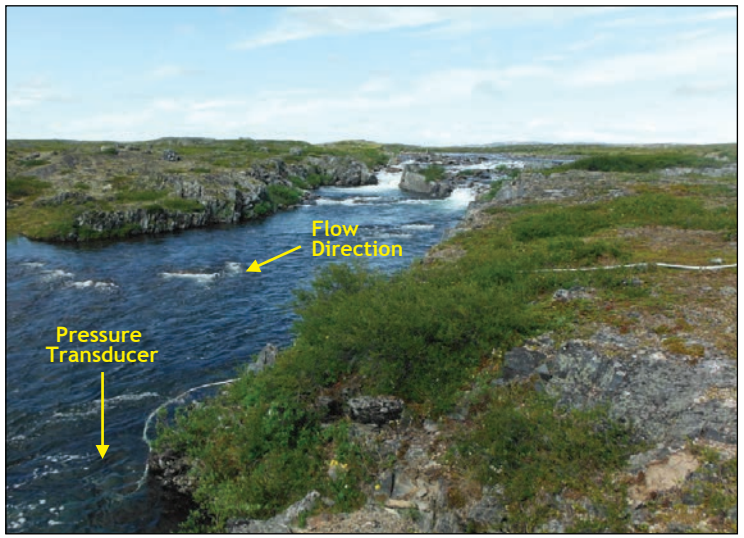
Site Map



Plan View of Hydrometric Station LG-H1



Site Photo



High angle oblique view looking upstream at the station under high flow conditions. July 6, 2014.

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LG-H1
Station Information Sheet

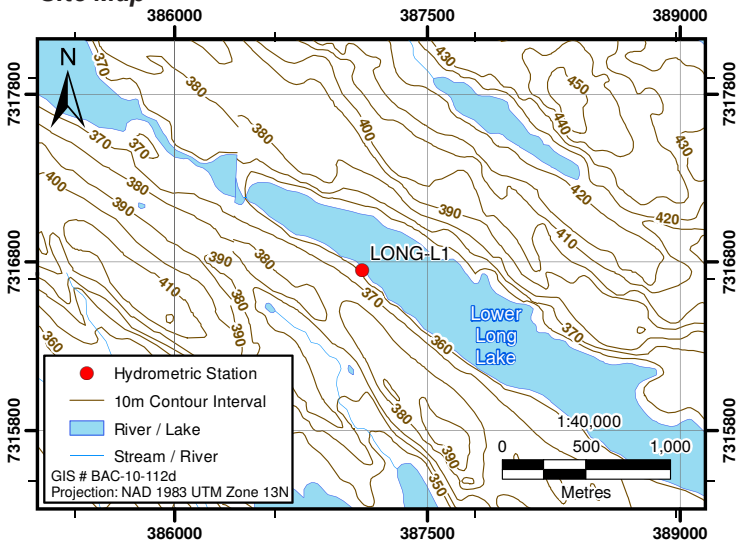
Rescan an ERM company

General Site Information

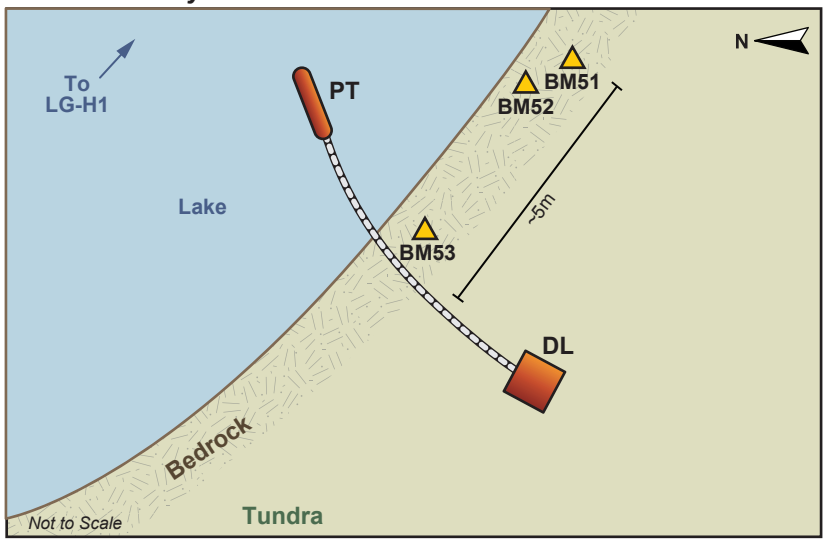
Site ID:	LONG-L1	Drainage Area (km²):	N/A
Site Location:	In Lower Long Lake near the outflow of Upper Long Lake		
UTM:	NAD 83, Zone 13W	387,112 E	7,316,752 N
Benchmarks	**Elevation (m)**	**Description**	
BM 53	100.000	In bedrock on southwest shore of lake	
BM 52	99.846	In bedrock on southwest shore of lake	
BM 51	100.069	In bedrock on southwest shore of lake	
Transducer:	PT-2X	**Logger:**	Self-contained
Operating Period:			
2014	Jun 7 to Jul 12	Established on June 7, 2014	
General Comments:			

- Lake level monitoring station in Lower Long Lake
- Bedrock lake bed at station location
- Access by helicopter

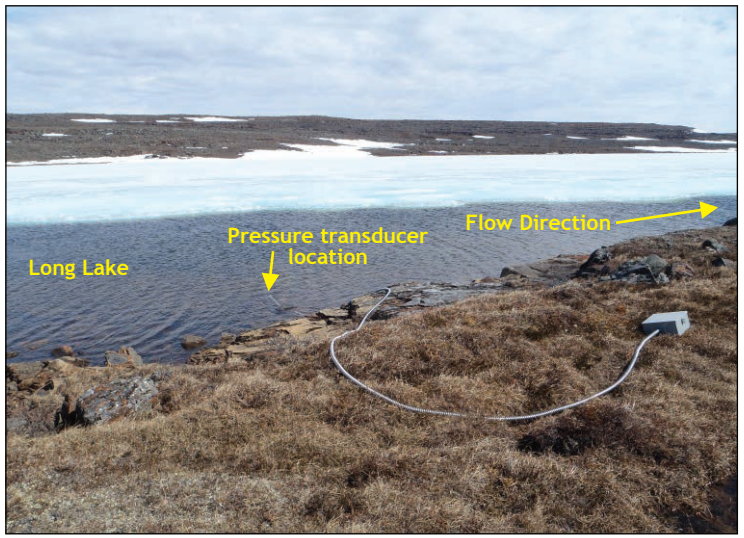
Site Map



Plan View of Hydrometric Station LONG-L1



Site Photo



View of the monitoring station looking northeast across the width of the lake. June 13, 2014.

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LONG-L1
Station Information Sheet

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Appendix 2
Drainage Area Maps

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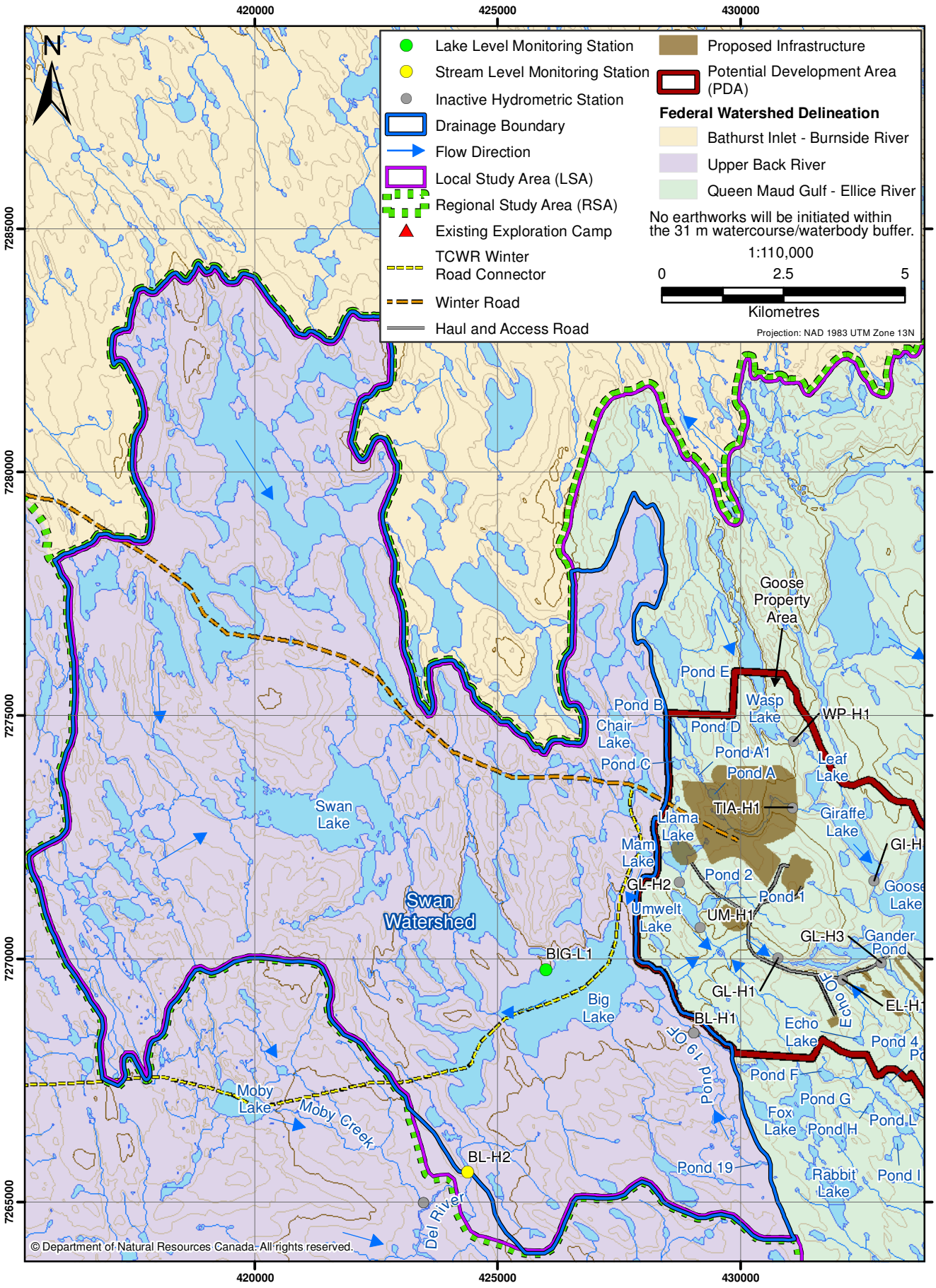
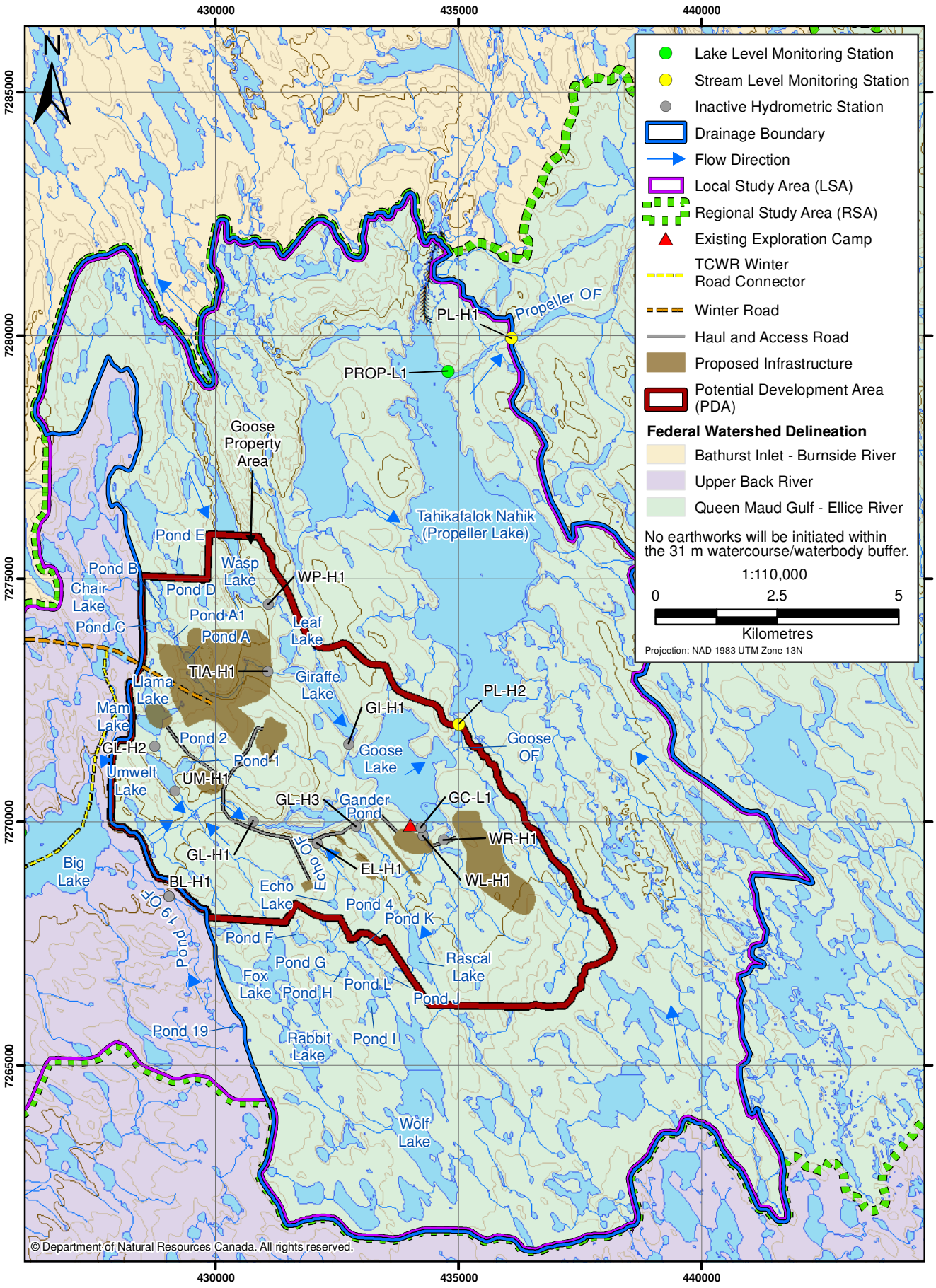


Sabina GOLD & SILVER CORP

Drainage Boundary for BL-H2 Hydrometric Monitoring Station

Figure A2-1

Rescan an ERM company

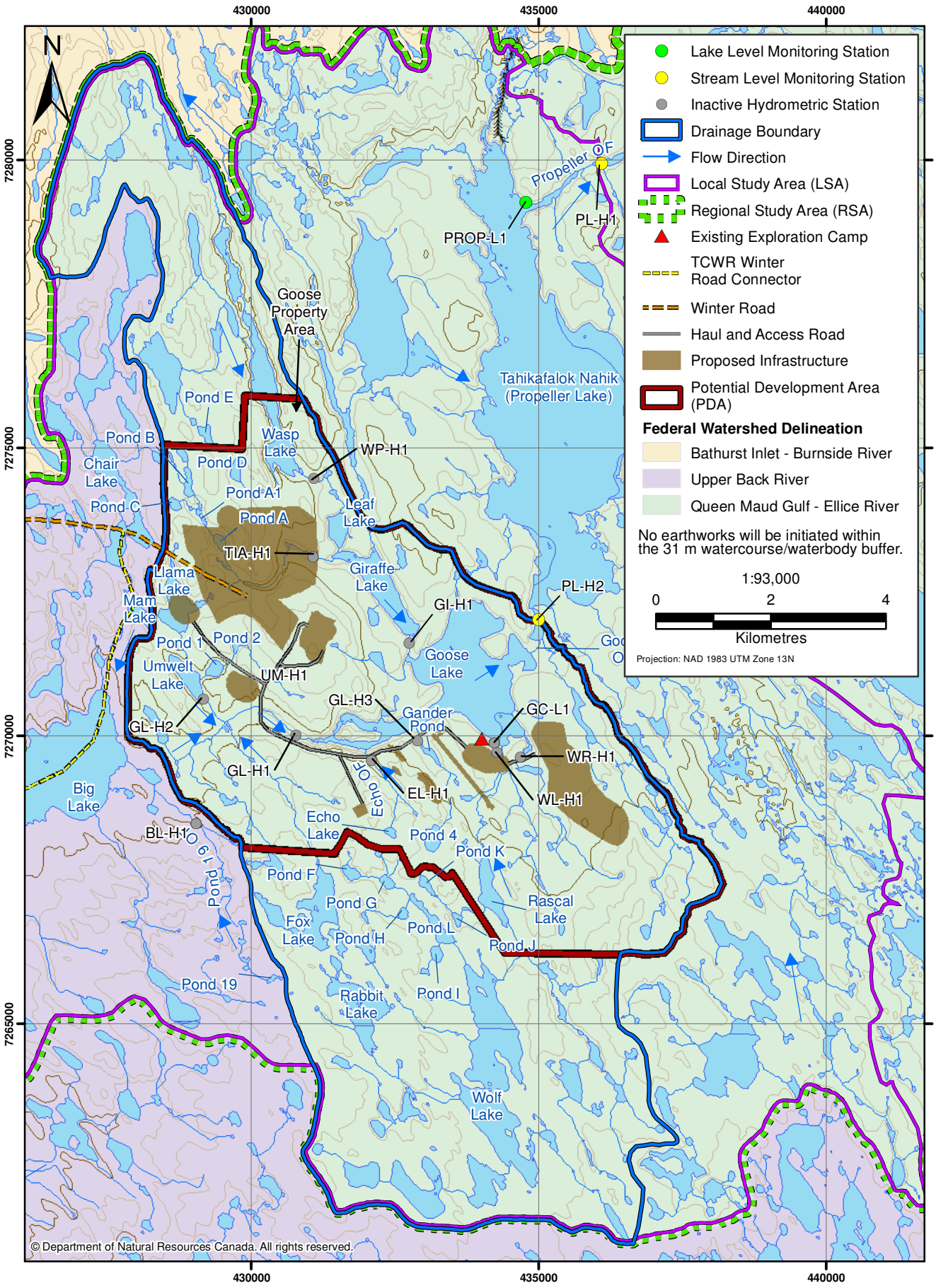


Sabina GOLD & SILVER CORP

Drainage Boundary for PL-H1 Hydrometric Monitoring Station

Figure A2-2

Rescan an ERM company



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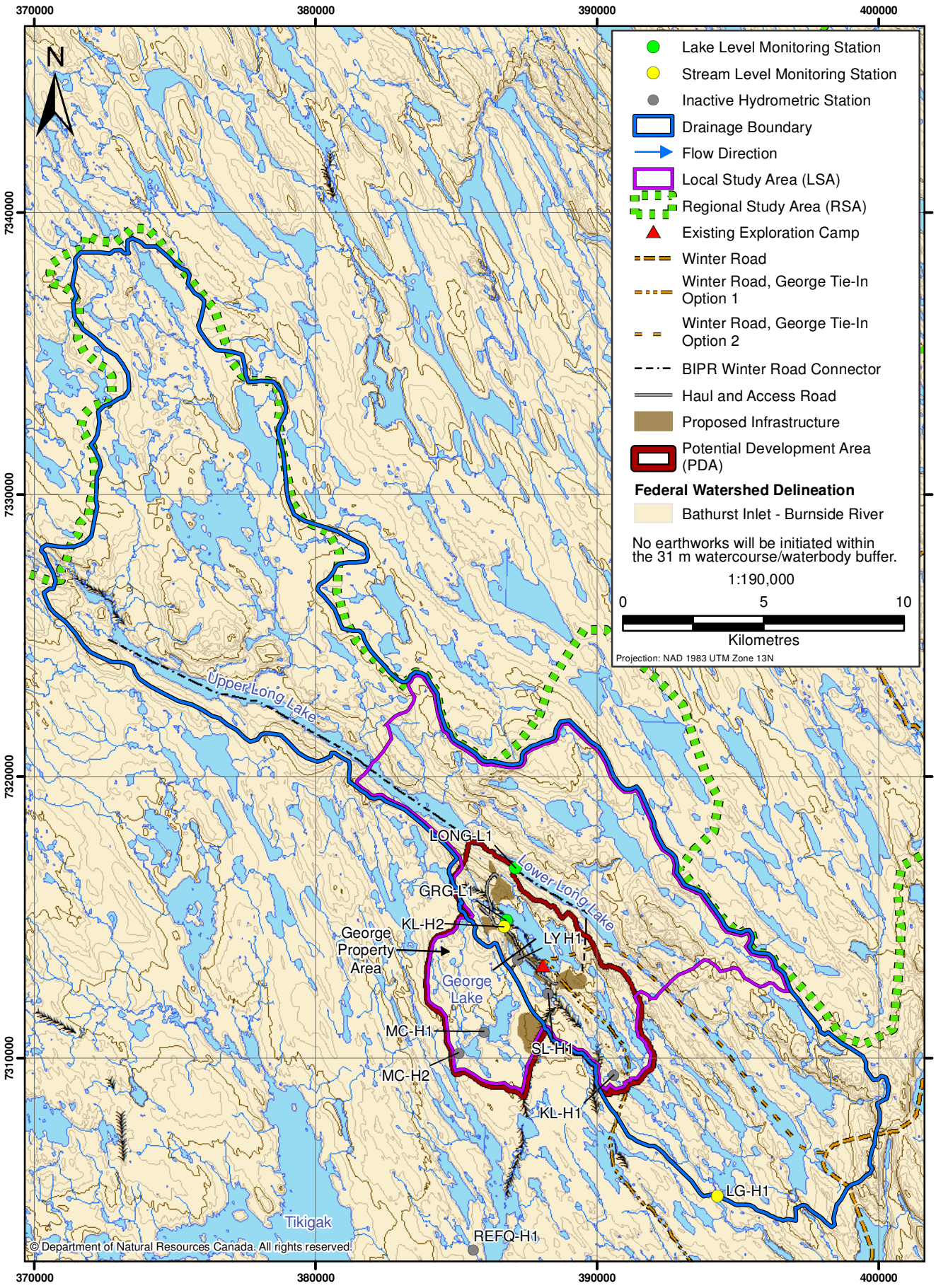
Drainage Boundary for PL-H2 Hydrometric Monitoring Station

Figure A2-3

Rescan an ERM company

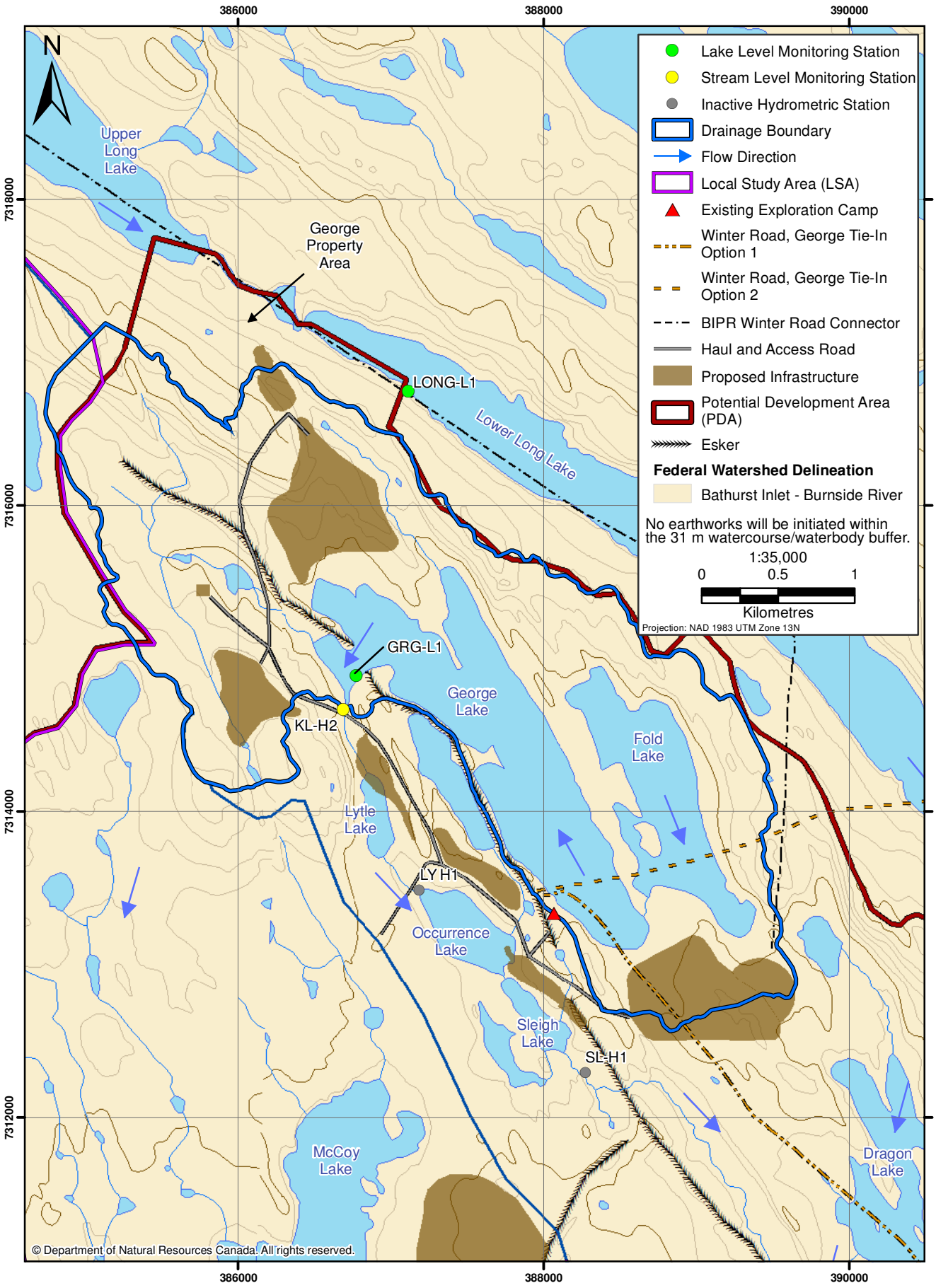


Sabina GOLD & SILVER CORP

Drainage Boundary for LG-H1 Hydrometric Monitoring Station

Figure A2-4

Rescan an ERM company



Sabina GOLD & SILVER CORP.

Drainage Boundary for KL-H2 Hydrometric Monitoring Station

Figure A2-5

Rescan an ERM company

Appendix 3

Manual Stage and Discharge Measurements

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Appendix 3. Manual Stage and Discharge Measurements, Site BIG-L1

Site Information				
Project Name	Back River			
Station Identification	BIG-L1			
Lake Name	Big Lake			
Date Monitored	9-Jun-14			
Time at Site (24 hr)	Start Time:	3:10:00 PM	End Time:	
Personnel	Emerson Belland, Jem Morrison			
Station Cordinates	Easting	Northing	Elevation	
	425992	7269783		
Weather Conditions	rain, overcast			

Transducer Information			
PT Model	PT2X	PT Serial #	21242043
Gain	0.006	Offset	1.007795
Status	Active	Battery	2.8 V
# of Records	0	Memory Free	524139
Date Serviced	5/14/2013	Crest Gauges	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 50	2.626	102.626		**100.000**	
BM 49			2.083	100.357	shot after TBM2
BM 48			-	-	bad shot
WL			2.881	99.745	
PT			3.475	99.151	on conduit
TBM			1.379	101.247	
TBM	1.249	102.496		101.247	
BM 50			2.496	100.000	
BM 49			2.138	100.358	
BM 48			1.173	101.323	
WL			2.752	99.744	
PT			3.344	99.152	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 50	100.000	100.000	0.000	
BM 49	100.357	100.358	0.000	
BM 48	101.321	101.323	0.002	

Summary	
Staff Gauge Reading (m)	-
Stage from WL Survey (m)	99.745
Pressure Transducer Reading (m)	0.622
Pressure Transducer Elevation (m)	99.122
Discharge (m^3/s)	-
Cross Sectional Area	-
Average Velocity	-

Discharge Measurement - Mid-Section Method

Measurement Time	Start		End		Location						
Method	Velocity-area (Mid-section)			Instrument Model							
Flow Meter Type				Instrument Serial #							
Real Time Reading (m)	Start	Reading		Time		Staff Gauge (m)					
	End	Reading		Time		Time of SG Reading					

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
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33										
Total Q										

General Notes

Lake level monitoring station installed.

Appendix 3. Manual Stage and Discharge Measurements, Site BIG-L1

Site Information				
Project Name	Back River			
Station Identification	BIG-L1			
Lake Name	Big Lake			
Date Monitored	14-Jun-14			
Time at Site (24 hr)	Start Time:	11:20:00 AM	End Time:	
Personnel	Jem Morrison, Kokiak Peetooloot			
Station Cordinates	Easting	Northing	Elevation	
	425992	7269783		
Weather Conditions				

Transducer Information			
PT Model	PT2X	PT Serial #	21242043
Gain	0.006	Offset	1.007795
Status	Active	Battery	2.7 V
# of Records	698	Memory Free	523441
Date Serviced	5/14/2013	Crest Gauges	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 50	2.587	102.587		**100.000**	
BM 49			2.229	100.358	
BM 48			1.266	101.321	
WL			2.859	99.728	
PT			3.437	99.150	
TBM			2.791	99.796	
TBM	2.709	102.505		99.796	
BM 50			2.505	100.000	
BM 49			2.148	100.357	
BM 48			1.184	101.321	
WL			2.778	99.727	
PT			3.355	99.150	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 50	100.000	100.000	0.000	
BM 49	100.357	100.358	0.001	
BM 48	101.321	101.321	0.000	

Summary	
Staff Gauge Reading (m)	-
Stage from WL Survey (m)	99.728
Pressure Transducer Reading (m)	0.606
Pressure Transducer Elevation (m)	99.121
Discharge (m^3/s)	-
Cross Sectional Area	-
Average Velocity	-

Discharge Measurement - Mid-Section Method

Measurement Time	Start		End		Location						
Method	Velocity-area (Mid-section)			Instrument Model							
Flow Meter Type				Instrument Serial #							
Real Time Reading (m)	Start	Reading		Time		Staff Gauge (m)					
	End	Reading		Time		Time of SG Reading					

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
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33										
Total Q										

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site BIG-L1

Site Information				
Project Name	Back River			
Station Identification	BIG-L1			
Lake Name	Big Lake			
Date Monitored	12-Jul-14			
Time at Site (24 hr)	Start Time:	4:07:00 PM	End Time:	4:24:00 PM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	Easting	Northing	Elevation	
	425992	7269783		
Weather Conditions				

Transducer Information			
PT Model	PT2X	PT Serial #	21242043
Gain	0.006	Offset	1.007795
Status	Active	Battery	2.7 V
# of Records	4761	Memory Free	519378
Date Serviced	5/14/2013	Crest Gauges	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 50	2.052	102.052		**100.000**	
BM 49			1.695	100.357	
BM 48			0.730	101.322	
WL			2.457	99.595	
PT			2.887	99.165	
TBM			2.202	99.850	
TBM	2.178	102.028		99.850	
BM 50			2.028	100.000	
BM 49			1.670	100.358	
BM 48			0.707	101.321	
WL			2.432	99.596	
PT			2.862	99.166	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 50	100.000	100.000	0.000	
BM 49	100.357	100.358	0.001	
BM 48	101.321	101.322	0.001	

Summary	
Staff Gauge Reading (m)	-
Stage from WL Survey (m)	99.596
Pressure Transducer Reading (m)	0.476
Pressure Transducer Elevation (m)	99.120
Discharge (m^3/s)	-
Cross Sectional Area	-
Average Velocity	-

Discharge Measurement - Mid-Section Method

Measurement Time	Start		End		Location						
Method	Velocity-area (Mid-section)			Instrument Model							
Flow Meter Type				Instrument Serial #							
Real Time Reading (m)	Start	Reading		Time		Staff Gauge (m)					
	End	Reading		Time		Time of SG Reading					

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
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33										
Total Q										

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site BIG-L1

Site Information				
Project Name	Back River			
Station Identification	BIG-L1			
Lake Name	Big Lake			
Date Monitored	2-Jul-14			
Time at Site (24 hr)	Start Time:	3:00:00 PM	End Time:	4:00:00 PM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	Easting	Northing	Elevation	
	425992	7269783		
Weather Conditions				

Transducer Information			
PT Model	PT2X	PT Serial #	21242043
Gain	0.006	Offset	1.007795
Status	Active	Battery	2.7 V
# of Records	3314	Memory Free	520826
Date Serviced	5/14/2013	Crest Gauges	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 50	2.024	102.024		**100.000**	
BM 49			1.667	100.357	
BM 48			0.703	101.321	
WL			2.378	99.646	
PT			2.861	99.163	
TBM			1.934	100.090	
TBM	2.118	102.208		100.090	
BM 50			2.208	100.000	
BM 49			1.851	100.357	
BM 48			0.887	101.321	
WL			2.562	99.646	
PT			3.043	99.165	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 50	100.000	100.000	0.000	
BM 49	100.357	100.357	0.000	
BM 48	101.321	101.321	0.000	

Summary	
Staff Gauge Reading (m)	-
Stage from WL Survey (m)	99.646
Pressure Transducer Reading (m)	0.528
Pressure Transducer Elevation (m)	99.118
Discharge (m^3/s)	-
Cross Sectional Area	-
Average Velocity	-

Discharge Measurement - Mid-Section Method

Measurement Time	Start		End		Location						
Method	Velocity-area (Mid-section)			Instrument Model							
Flow Meter Type				Instrument Serial #							
Real Time Reading (m)	Start	Reading		Time		Staff Gauge (m)					
	End	Reading		Time		Time of SG Reading					

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
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29										
30										
31										
32										
33										
Total Q										

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site BL-H2

Site Information				
Project Name	Back River			
Station Identification	BL-H2			
Stream Name	Big Lake Outflow			
Date Monitored	9-Jun-14			
Time at Site (24 hr)	**Start Time:**	11:30:00 AM	**End Time:**	
Personnel	Emerson Belland, Jem Morrison			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	424412	7265460		
Weather Conditions				

Transducer Information			
DL Model	PT2X	**PT Serial #**	21221020
Gain	-	**Offset**	-
Status	Active	**Battery**	2.9 V
# of Records	0	**Memory Free**	524139
Date Serviced	12/10/2013	**Crest Gauges**	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 11	1.455	101.455		**100.000**	
BM 12			1.889	99.566	
BM 13			1.928	99.527	
WL			1.980	99.475	
PT			2.798	98.657	on ground next to PT
TBM			1.693	99.762	
TBM	1.624	101.386		99.762	
BM 11			1.388	99.998	
BM 12			1.815	99.571	
BM 13			1.860	99.526	
WL			1.909	99.477	
PT			2.719	98.667	bad shot

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 11	100.000	99.999	-0.001	
BM 12	99.573	99.569	-0.004	
BM 13	99.527	99.527	-0.001	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.476
Pressure Transducer Reading (m)	0.799
Pressure Transducer Elevation (m)	98.677
Discharge (m^3/s)	**3.4**
Cross Sectional Area	11.888
Average Velocity	0.286

Discharge Measurement - Mid-Section Method

Measurement Time	**Start**	13:17	**End**		**Location**	~100 m upstream of pressure transducer		
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950		
Flow Meter Type	Current Meter			**Instrument Serial #**		130861001498		
Real Time Reading (m)	**Start**	**Reading**	0.801	**Time**	13:13	**Staff Gauge (m)**	n/a	
	End	**Reading**	0.799	**Time**	13:53	**Time of SG Reading**	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	**Notes**	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
1	RB	4.00	0.00	0.0	0.04	0			0.000	0.0
2		4.80	0.09	0.8	0.09	0.02			0.002	0.1
3		6.00	0.11	1.2	0.13	0.07			0.009	0.3
4		7.10	0.24	1.1	0.28	0.14			0.039	1.1
5		8.30	0.26	1.2	0.31	0.14			0.044	1.3
6		9.50	0.29	1.2	0.35	0.13			0.045	1.3
7		10.70	0.14	1.2	0.17	0.14			0.024	0.7
8		11.90	0.19	1.2	0.23	0.09			0.021	0.6
9		13.10	0.24	1.2	0.29	0.16			0.046	1.4
10		14.30	0.22	1.2	0.22	0.25			0.055	1.6
11		15.10	0.32	0.8	0.26	0.3			0.077	2.3
12		15.90	0.41	0.8	0.33	0.35			0.115	3.4
13		16.70	0.40	0.8	0.36	0.36			0.130	3.8
14		17.70	0.47	1.0	0.56	0.34			0.192	5.6
15		19.10	0.47	1.4	0.52	0.28			0.145	4.3
16		19.90	0.45	0.8	0.36	0.33			0.119	3.5
17		20.70	0.46	0.8	0.37	0.39			0.144	4.2
18		21.50	0.49	0.8	0.39	0.34			0.133	3.9
19		22.30	0.49	0.8	0.39	0.41			0.161	4.7
20		23.10	0.59	0.8	0.50	0.38			0.191	5.6
21		24.00	0.59	0.9	0.56	0.39			0.219	6.4
22		25.00	0.61	1.0	0.61	0.33			0.201	5.9
23		26.00	0.58	1.0	0.58	0.3			0.174	5.1
24		27.00	0.72	1.0	0.79	0.35			0.277	8.2
25		28.20	0.68	1.2	0.82	0.35			0.286	8.4
26		29.40	0.52	1.2	0.62	0.33			0.206	6.1
27		30.60	0.51	1.2	0.61	0.27			0.165	4.9
28		31.80	0.50	1.2	0.60	0.19			0.114	3.4
29		33.00	0.32	1.2	0.35	0.14			0.049	1.5
30		34.00	0.14	1.0	0.14	0.11			0.015	0.5
31	LB	35.00	0.00	1.0	0.07	0			0.000	0.0
32										
33										
Total Q									**3.394**	**100.0**

General Notes

New site. Station installed this visit.

Appendix 3. Manual Stage and Discharge Measurements, Site BL-H2

Site Information				
Project Name	Back River			
Station Identification	BL-H2			
Stream Name	Big Lake Outflow			
Date Monitored	11-Jun-14			
Time at Site (24 hr)	Start Time:	9:39:00 AM	End Time:	
Personnel	Emerson Belland, Jem Morrison			
Station Cordinates	Easting	Northing	Elevation	
	424412	7265460		
Weather Conditions				

Transducer Information			
DL Model	PT2X	PT Serial #	21221020
Gain	-	Offset	-
Status	Active	Battery	2.9 V
# of Records	-	Memory Free	523861
Date Serviced	12/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 11	1.531	101.531		**100.000**	
BM 12			1.958	99.573	
BM 13			2.003	99.528	
WL			2.056	99.475	
PT			1.154	100.377	
TBM			1.643	99.888	
TBM	1.544	101.432		99.888	
BM 11			1.431	100.001	
BM 12			1.859	99.573	
BM 13			1.903	99.529	
WL			1.955	99.477	
PT			1.055	100.377	
BM#	Established Elevation (m)	Mean Elevation (this date) (m)		Difference (m)	Notes
BM 11	100.000	100.001		0.001	
BM 12	99.573	99.573		0.000	
BM 13	99.527	99.529		0.002	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.476
Pressure Transducer Reading (m)	0.804
Pressure Transducer Elevation (m)	98.672
Discharge (m^3/s)	**4.0**
Cross Sectional Area	12.721
Average Velocity	0.313

Discharge Measurement - Mid-Section Method

Measurement Time	Start	11:19	End		Location	~100 m upstream of pressure transducer		
Method	Velocity-area (Mid-section)			Instrument Model		FH950		
Flow Meter Type	Current Meter			Instrument Serial #		130861001498		
Real Time Reading (m)	Start	Reading	0.805	Time	11:13	Staff Gauge (m)	n/a	
	End	Reading	0.804	Time	11:43	Time of SG Reading	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1	RB	32.00	0.00	0.0	0.09	0			0.000	0.0
2		30.90	0.16	1.1	0.20	0.1			0.020	0.5
3		29.50	0.12	1.4	0.14	0.15			0.022	0.5
4		28.50	0.24	1.0	0.24	0.13			0.031	0.8
5		27.50	0.26	1.0	0.26	0.1			0.026	0.7
6		26.50	0.25	1.0	0.34	0.17			0.057	1.4
7		24.80	0.18	1.7	0.27	0.07			0.019	0.5
8		23.50	0.18	1.3	0.25	0.16			0.040	1.0
9		22.00	0.18	1.5	0.27	0.19			0.051	1.3
10		20.50	0.25	1.5	0.31	0.28			0.088	2.2
11		19.50	0.44	1.0	0.44	0.37			0.163	4.1
12		18.50	0.40	1.0	0.40	0.33			0.132	3.3
13		17.50	0.48	1.0	0.48	0.32			0.154	3.9
14		16.50	0.58	1.0	0.58	0.25			0.145	3.6
15		15.50	0.56	1.0	0.56	0.29			0.162	4.1
16		14.50	0.54	1.0	0.54	0.32			0.173	4.3
17		13.50	0.56	1.0	0.70	0.42			0.294	7.4
18		12.00	0.50	1.5	0.63	0.41			0.256	6.4
19		11.00	0.60	1.0	0.60	0.41			0.246	6.2
20		10.00	0.62	1.0	0.62	0.41			0.254	6.4
21		9.00	0.66	1.0	0.66	0.38			0.251	6.3
22		8.00	0.69	1.0	0.69	0.42			0.290	7.3
23		7.00	0.63	1.0	0.63	0.4			0.252	6.3
24		6.00	0.58	1.0	0.73	0.4			0.290	7.3
25		4.50	0.58	1.5	0.73	0.27			0.196	4.9
26		3.50	0.50	1.0	0.65	0.34			0.221	5.6
27		1.90	0.36	1.6	0.52	0.24			0.125	3.1
28		0.60	0.16	1.3	0.15	0.14			0.021	0.5
29	LB	0.00	0.00	0.6	0.05	0			0.000	0.0
30										
31										
32										
33										
Total Q									**3.979**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site BL-H2

Site Information				
Project Name	Back River			
Station Identification	BL-H2			
Stream Name	Big Lake Outflow			
Date Monitored	14-Jun-14			
Time at Site (24 hr)	Start Time:	10:30:00 AM	End Time:	
Personnel	Jem Morrison, Kokiak Peetoolott			
Station Cordinates	Easting	Northing	Elevation	
	424412	7265460		
Weather Conditions	mostly sunny			

Transducer Information			
DL Model	PT2X	PT Serial #	21221020
Gain	-	Offset	-
Status	Active	Battery	2.9 V
# of Records	715	Memory Free	523424
Date Serviced	12/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 11	1.474	101.474		**100.000**	
BM 12			1.901	99.573	
BM 13			1.947	99.527	
WL			2.020	99.454	
PT			1.099	100.375	
TBM			1.504	99.970	
TBM	1.381	101.351		99.970	
BM 11			1.351	100.000	
BM 12			1.779	99.572	
BM 13			1.824	99.527	
WL			1.899	99.452	
PT			0.976	100.375	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 11	100.000	100.000	0.000	
BM 12	99.573	99.573	0.000	
BM 13	99.527	99.527	0.000	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.453
Pressure Transducer Reading (m)	0.789
Pressure Transducer Elevation (m)	98.664
Discharge (m^3/s)	**3.6**
Cross Sectional Area	12.831
Average Velocity	0.277

Discharge Measurement - Mid-Section Method

Measurement Time	Start	9:54	End		Location	~100 m upstream of pressure transducer		
Method	Velocity-area (Mid-section)				Instrument Model	FH950		
Flow Meter Type	Current Meter				Instrument Serial #	130861001498		
Real Time Reading (m)	Start	Reading	0.791	Time	9:53	Staff Gauge (m)	n/a	
	End	Reading	0.788	Time	10:33	Time of SG Reading	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1	RB	2.70	0.00	0.0	0.00	0			0.000	0.0
2		2.80	0.10	0.1	0.06	0.01			0.001	0.0
3		3.80	0.42	1.0	0.61	0			0.000	0.0
4		5.70	0.10	1.9	0.16	0.03			0.005	0.1
5		6.90	0.10	1.2	0.13	0.1			0.013	0.4
6		8.20	0.10	1.3	0.15	0.15			0.022	0.6
7		9.80	0.29	1.6	0.45	0.1			0.045	1.3
8		11.30	0.23	1.5	0.32	0.13			0.042	1.2
9		12.60	0.19	1.3	0.25	0.22			0.054	1.5
10		13.90	0.13	1.3	0.16	0.2			0.033	0.9
11		15.10	0.14	1.2	0.15	0.13			0.020	0.6
12		16.10	0.22	1.0	0.22	0.23			0.051	1.4
13		17.10	0.29	1.0	0.29	0.26			0.075	2.1
14		18.10	0.39	1.0	0.37	0.36			0.133	3.8
15		19.00	0.39	0.9	0.37	0.35			0.130	3.6
16		20.00	0.44	1.0	0.40	0.28			0.111	3.1
17		20.80	0.50	0.8	0.50	0.22			0.110	3.1
18		22.00	0.49	1.2	0.54	0.31			0.167	4.7
19		23.00	0.48	1.0	0.48	0.4			0.192	5.4
20		24.00	0.49	1.0	0.49	0.37			0.181	5.1
21		25.00	0.50	1.0	0.50	0.39			0.195	5.5
22		26.00	0.55	1.0	0.55	0.31			0.171	4.8
23		27.00	0.64	1.0	0.64	0.4			0.256	7.2
24		28.00	0.66	1.0	0.66	0.34			0.224	6.3
25		29.00	0.75	1.0	0.71	0.32			0.228	6.4
26		29.90	0.76	0.9	0.76	0.34			0.258	7.3
27		31.00	0.67	1.1	0.70	0.33			0.232	6.5
28		32.00	0.60	1.0	0.60	0.33			0.198	5.6
29		33.00	0.54	1.0	0.54	0.28			0.151	4.3
30		34.00	0.46	1.0	0.46	0.29			0.133	3.8
31		35.00	0.38	1.0	0.38	0.23			0.087	2.5
32		36.00	0.18	1.0	0.20	0.18			0.036	1.0
33		37.20	0.06	1.2	0.04	0.01			0.000	0.0
34		37.30	0.00	0.1	0.00	0			0.000	0.0
Total Q									**3.554**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site BL-H2

Site Information				
Project Name	Back River			
Station Identification	BL-H2			
Stream Name	Big Lake Outflow			
Date Monitored	18-Jun-14			
Time at Site (24 hr)	Start Time:	8:08:00 AM	End Time:	
Personnel	Jem Morrison			
Station Cordinates	Easting	Northing	Elevation	
	424412	7265460		
Weather Conditions	sunny			

Transducer Information			
DL Model	PT2X	PT Serial #	21221020
Gain	-	Offset	-
Status	Active	Battery	2.9 V
# of Records	1284	Memory Free	522855
Date Serviced	12/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 11	1.454	101.454		**100.000**	
BM 12			1.881	99.573	
BM 13			1.927	99.527	
WL			1.969	99.485	
PT			1.079	100.375	
TBM			1.733	99.721	
TBM	1.594	101.315		99.721	
BM 11			1.314	100.001	
BM 12			1.741	99.574	
BM 13			1.788	99.527	
WL			1.830	99.485	
PT			0.939	100.376	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 11	100.000	100.001	0.000	
BM 12	99.573	99.574	0.001	
BM 13	99.527	99.527	0.000	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.485
Pressure Transducer Reading (m)	0.819
Pressure Transducer Elevation (m)	98.666
Discharge (m^3/s)	**4.1**
Cross Sectional Area	14.086
Average Velocity	0.291

Discharge Measurement - Mid-Section Method

Measurement Time	Start	8:54	End		Location	~100 m upstream of pressure transducer		
Method	Velocity-area (Mid-section)			Instrument Model		FH950		
Flow Meter Type	Current Meter			Instrument Serial #		130861001498		
Real Time Reading (m)	Start	Reading	0.820	Time	8:53	Staff Gauge (m)	n/a	
	End	Reading	0.818	Time	9:33	Time of SG Reading	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1		3.00	0.00	0.0	0.00	0			0.000	0.0
2		3.10	0.02	0.1	0.02	0.01			0.000	0.0
3		4.60	0.30	1.5	0.42	0			0.000	0.0
4		5.90	0.31	1.3	0.42	0.01			0.004	0.1
5		7.30	0.12	1.4	0.16	0			0.000	0.0
6		8.60	0.06	1.3	0.08	0.05			0.004	0.1
7		9.90	0.08	1.3	0.10	0.17			0.018	0.4
8		11.20	0.21	1.3	0.27	0.19			0.052	1.3
9		12.50	0.28	1.3	0.36	0.11			0.040	1.0
10		13.80	0.30	1.3	0.42	0.13			0.055	1.3
11		15.30	0.14	1.5	0.20	0.17			0.033	0.8
12		16.60	0.15	1.3	0.20	0.09			0.018	0.4
13		17.90	0.22	1.3	0.29	0.19			0.054	1.3
14		19.20	0.34	1.3	0.44	0.31			0.137	3.3
15		20.50	0.44	1.3	0.57	0.39			0.223	5.4
16		21.80	0.45	1.3	0.54	0.29			0.157	3.8
17		22.90	0.53	1.1	0.64	0.23			0.146	3.6
18		24.20	0.52	1.3	0.68	0.38			0.257	6.3
19		25.50	0.50	1.3	0.65	0.44			0.286	7.0
20		26.80	0.52	1.3	0.62	0.39			0.243	5.9
21		27.90	0.56	1.1	0.62	0.4			0.246	6.0
22		29.00	0.69	1.1	0.72	0.39			0.283	6.9
23		30.00	0.74	1.0	0.74	0.37			0.274	6.7
24		31.00	0.82	1.0	0.82	0.31			0.254	6.2
25		32.00	0.81	1.0	0.93	0.37			0.345	8.4
26		33.30	0.70	1.3	0.91	0.38			0.346	8.4
27		34.60	0.61	1.3	0.79	0.27			0.214	5.2
28		35.90	0.50	1.3	0.65	0.31			0.202	4.9
29		37.20	0.38	1.3	0.49	0.3			0.148	3.6
30		38.50	0.26	1.3	0.27	0.22			0.060	1.5
31		39.30	0.10	0.8	0.05	0			0.000	0.0
32		39.50	0.00	0.2	0.01	0			0.000	0.0
33										
Total Q									**4.098**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site BL-H2

Site Information				
Project Name	Back River			
Station Identification	BL-H2			
Stream Name	Big Lake Outflow			
Date Monitored	2-Jul-14			
Time at Site (24 hr)	Start Time:	1:00:00 PM	End Time:	2:40:00 PM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	Easting	Northing	Elevation	
	424412	7265460		
Weather Conditions	sunny			

Transducer Information			
DL Model	PT2X	PT Serial #	21221020
Gain	-	Offset	-
Status	Active	Battery	2.9 V
# of Records	3332	Memory Free	520808
Date Serviced	12/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 11	0.895	100.895		**100.000**	
BM 12			1.329	99.566	
BM 13			1.366	99.529	
WL			1.561	99.334	
PT			2.208	98.687	
TBM			0.856	100.039	
TBM	0.900	100.939		100.039	
BM 11			0.939	100.000	
BM 12			1.364	99.575	
BM 13			1.410	99.529	
WL			1.605	99.334	
PT			2.251	98.688	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 11	100.000	100.000	0.000	
BM 12	99.573	99.571	-0.002	
BM 13	99.527	99.529	0.002	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.334
Pressure Transducer Reading (m)	0.651
Pressure Transducer Elevation (m)	98.683
Discharge (m^3/s)	**1.5**
Cross Sectional Area	6.157
Average Velocity	0.242

Discharge Measurement - Mid-Section Method

Measurement Time	Start	13:12	End	13:51	Location	~5 m downstream of pressure transducer		
Method	Velocity-area (Mid-section)			Instrument Model		FH950		
Flow Meter Type	Current Meter			Instrument Serial #		130861001498		
Real Time Reading (m)	Start	Reading	0.650	Time	13:13	Staff Gauge (m)	n/a	
	End	Reading	0.650	Time	13:53	Time of SG Reading	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1	RB	30.72	0.00	0.0	0.27	0			0.000	0.0
2		29.50	0.44	1.2	0.38	0.12			0.045	3.0
3		29.00	0.28	0.5	0.14	0.71			0.099	6.7
4		28.50	0.22	0.5	0.11	0.67			0.074	4.9
5		28.00	0.26	0.5	0.13	0.44			0.057	3.8
6		27.50	0.28	0.5	0.18	0.56			0.102	6.8
7		26.70	0.22	0.8	0.17	0.3			0.050	3.3
8		26.00	0.21	0.7	0.15	0.07			0.010	0.7
9		25.30	0.22	0.7	0.19	0.01			0.002	0.1
10		24.30	0.15	1.0	0.15	0.27			0.041	2.7
11		23.30	0.22	1.0	0.22	0.08			0.018	1.2
12		22.30	0.23	1.0	0.20	1.02			0.199	13.4
13		21.60	0.34	0.7	0.29	0.09			0.026	1.7
14		20.60	0.10	1.0	0.09	0.37			0.033	2.2
15		19.80	0.42	0.8	0.27	0.65			0.177	11.9
16		19.30	0.28	0.5	0.14	0.53			0.074	5.0
17		18.80	0.16	0.5	0.07	0.98			0.071	4.7
18		18.40	0.00	0.4	0.00	0			0.000	0.0
19		17.70	0.18	0.7	0.14	0.66			0.089	6.0
20		16.90	0.18	0.8	0.17	0.4			0.068	4.6
21		15.80	0.39	1.1	0.41	0.022			0.009	0.6
22		14.80	0.06	1.0	0.06	0.21			0.013	0.8
23		13.80	0.17	1.0	0.14	0.06			0.009	0.6
24		13.10	0.00	0.7	0.00	0			0.000	0.0
25		12.40	0.26	0.7	0.22	0.2			0.044	3.0
26		11.40	0.25	1.0	0.25	0.01			0.003	0.2
27		10.40	0.28	1.0	0.28	0.06			0.017	1.1
28		9.40	0.24	1.0	0.41	0.14			0.057	3.8
29		7.00	0.25	2.4	0.46	0.06			0.028	1.9
30		5.70	0.29	1.3	0.33	0.23			0.077	5.1
31	LB	4.70	0.00	1.0	0.15	0			0.000	0.0
32										
33										
Total Q									**1.491**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site BL-H2

Site Information				
Project Name	Back River			
Station Identification	BL-H2			
Stream Name	Big Lake Outflow			
Date Monitored	6-Jul-14			
Time at Site (24 hr)	Start Time:	2:30:00 PM	End Time:	4:00:00 PM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	Easting	Northing	Elevation	
	424412	7265460		
Weather Conditions	sun & cloud, windy			

Transducer Information			
DL Model	PT2X	PT Serial #	21221020
Gain	-	Offset	-
Status	-	Battery	-
# of Records	-	Memory Free	-
Date Serviced	12/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 11	1.332	101.332		**100.000**	
BM 12			1.759	99.573	
BM 13			1.804	99.528	
WL			2.039	99.293	
PT			2.647	98.685	
TBM			1.370	99.962	
TBM	0.946	100.908		99.962	
BM 11			0.908	100.000	
BM 12			1.334	99.574	
BM 13			1.379	99.529	
WL			1.616	99.292	
PT			2.223	98.685	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 11	100.000	100.000	0.000	
BM 12	99.573	99.574	0.001	
BM 13	99.527	99.529	0.001	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.293
Pressure Transducer Reading (m)	0.609
Pressure Transducer Elevation (m)	98.683
Discharge (m^3/s)	**1.0**
Cross Sectional Area	4.261
Average Velocity	0.230

Discharge Measurement - Mid-Section Method

Measurement Time	Start	14:56	End	15:24	Location	~5 m downstream of pressure transducer		
Method	Velocity-area (Mid-section)			Instrument Model		FH950		
Flow Meter Type	Current Meter			Instrument Serial #		130861001498		
Real Time Reading (m)	Start	Reading	0.617	Time	14:53	Staff Gauge (m)	n/a	
	End	Reading	0.606	Time	15:23	Time of SG Reading	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1	RB	0.00	0.00	0.0	0.21	0			0.000	0.0
2		1.00	0.41	1.0	0.41	0.32			0.131	13.4
3		2.00	0.14	1.0	0.14	0.59			0.083	8.4
4		3.00	0.00	1.0	0.00	0			0.000	0.0
5		4.00	0.17	1.0	0.17	0.25			0.044	4.4
6		5.00	0.24	1.0	0.24	0.17			0.041	4.2
7		6.00	0.18	1.0	0.18	0.27			0.049	5.0
8		7.00	0.26	1.0	0.26	0.17			0.044	4.5
9		8.00	0.19	1.0	0.19	0.16			0.030	3.1
10		9.00	0.29	1.0	0.29	0.51			0.148	15.1
11		10.00	0.38	1.0	0.38	0.52			0.198	20.1
12		11.00	0.08	1.0	0.08	0.28			0.022	2.3
13		12.00	0.18	1.0	0.18	0.4			0.072	7.3
14		13.00	0.23	1.0	0.23	0.09			0.021	2.1
15		14.00	0.22	1.0	0.22	0.07			0.015	1.6
16		15.00	0.00	1.0	0.00	0			0.000	0.0
17		16.00	0.24	1.0	0.24	0.01			0.002	0.2
18		17.00	0.20	1.0	0.20	0.16			0.032	3.3
19		18.00	0.09	1.0	0.09	0.04			0.004	0.4
20		19.00	0.19	1.0	0.19	0.06			0.011	1.2
21		20.00	0.20	1.0	0.20	0.03			0.006	0.6
22		21.00	0.00	1.0	0.00	0			0.000	0.0
23		22.00	0.18	1.0	0.13	0.23			0.029	3.0
24		22.40	0.00	0.4	0.04	0			0.000	0.0
25										
26										
27										
28										
29										
30										
31										
32										
33										
Total Q									**0.982**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site BL-H2

Site Information				
Project Name	Back River			
Station Identification	BL-H2			
Stream Name	Big Lake Outflow			
Date Monitored	7-Jul-14			
Time at Site (24 hr)	**Start Time:**	1:00:00 PM	**End Time:**	2:40:00 PM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	424412	7265460		
Weather Conditions	overcast, windy			

Transducer Information			
DL Model	PT2X	**PT Serial #**	21221020
Gain	-	**Offset**	-
Status	Active	**Battery**	2.9 V
# of Records	4051	**Memory Free**	520089
Date Serviced	12/10/2013	**Crest Gauges**	n/a

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 11	1.543	101.543		**100.000**	
BM 12			1.969	99.574	
BM 13			2.016	99.527	
WL			2.279	99.264	
PT			2.858	98.685	
TBM			1.555	99.988	
TBM	1.426	101.414		99.988	
BM 11			1.413	100.001	
BM 12			1.840	99.574	
BM 13			1.885	99.529	
WL			2.150	99.264	
PT			2.727	98.687	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 11	100.000	100.001	0.001	
BM 12	99.573	99.574	0.001	
BM 13	99.527	99.528	0.001	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.264
Pressure Transducer Reading (m)	0.587
Pressure Transducer Elevation (m)	98.677
Discharge (m^3/s)	**0.9915**
Cross Sectional Area	2.965
Average Velocity	0.334

Discharge Measurement - Mid-Section Method

Measurement Time	**Start**	13:15	**End**	13:43	**Location**	~15 m downstream of pressure transducer		
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950		
Flow Meter Type	Current Meter			**Instrument Serial #**		130861001498		
Real Time Reading (m)	**Start**	**Reading**	0.587	**Time**	13:13	**Staff Gauge (m)**		n/a
	End	**Reading**	0.587	**Time**	13:43	**Time of SG Reading**		-

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	**Notes**	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
1	RB	23.95	0.00	0.0	0.03	0			0.000	0.0
2		23.80	0.43	0.1	0.14	1.13			0.158	15.9
3		23.30	0.22	0.5	0.11	1.21			0.133	13.4
4		22.80	0.24	0.5	0.13	1.2			0.158	16.0
5		22.20	0.19	0.6	0.15	0.46			0.070	7.1
6		21.20	0.11	1.0	0.11	0.39			0.043	4.3
7		20.20	0.11	1.0	0.11	0.46			0.051	5.1
8		19.20	0.12	1.0	0.12	0.55			0.066	6.7
9		18.20	0.08	1.0	0.08	0.11			0.009	0.9
10		17.20	0.00	1.0	0.00	0.00			0.000	0.0
11		16.70	0.28	0.5	0.18	0.26			0.047	4.8
12		15.90	0.00	0.8	0.00	0.00			0.000	0.0
13		15.10	0.06	0.8	0.05	0.28			0.013	1.4
14		14.30	0.18	0.8	0.15	0.19			0.029	2.9
15		13.40	0.08	0.9	0.08	0.40			0.030	3.1
16		12.40	0.25	1.0	0.25	-0.04			-0.010	-1.0
17		11.40	0.22	1.0	0.23	0.13			0.030	3.0
18		10.30	0.10	1.1	0.10	0.41			0.041	4.1
19		9.40	0.21	0.9	0.20	0.04			0.008	0.8
20		8.40	0.00	1.0	0.00	0.00			0.000	0.0
21		7.40	0.06	1.0	0.06	0.11			0.007	0.7
22		6.30	0.12	1.1	0.12	0.21			0.025	2.5
23		5.40	0.00	0.9	0.00	0.00			0.000	0.0
24		4.90	0.00	0.5	0.00	0.00			0.000	0.0
25		3.90	0.27	1.0	0.27	0.14			0.038	3.8
26		2.90	0.13	1.0	0.14	0.15			0.021	2.1
27		1.75	0.12	1.2	0.11	0.22			0.024	2.4
28		1.10	0.00	0.7	0.04	0			0.000	0.0
29										
30										
31										
32										
33										
Total Q									**0.992**	**100.0**

General Notes

Some seepage through boulders on the left bank at this measurement location not captured. Approximately 4 L/s.

Appendix 3. Manual Stage and Discharge Measurements, Site BL-H2

Site Information				
Project Name	Back River			
Station Identification	BL-H2			
Stream Name	Big Lake Outflow			
Date Monitored	8-Jul-14			
Time at Site (24 hr)	Start Time:	12:00:00 PM	End Time:	1:40:00 PM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	Easting	Northing	Elevation	
	424412	7265460		
Weather Conditions	rainy			

Transducer Information			
DL Model	PT2X	PT Serial #	21221020
Gain	-	Offset	-
Status	-	Battery	-
# of Records	-	Memory Free	-
Date Serviced	12/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 11	0.974	100.974		**100.000**	
BM 12			1.400	99.574	
BM 13			1.446	99.528	
WL			1.707	99.267	
PT			2.288	98.686	
TBM			0.986	99.988	Moved 3 m horizontally
TBM	0.987	100.975		99.988	
BM 11			0.975	100.000	
BM 12			1.401	99.574	
BM 13			1.446	99.529	
WL			1.708	99.267	
PT			2.288	98.687	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 11	100.000	100.000	0.000	
BM 12	99.573	99.574	0.001	
BM 13	99.527	99.529	0.002	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.267
Pressure Transducer Reading (m)	0.586
Pressure Transducer Elevation (m)	98.681
Discharge (m^3/s)	**0.9**
Cross Sectional Area	7.945
Average Velocity	0.119

Discharge Measurement - Mid-Section Method

Measurement Time	Start	12:21	End	12:50	Location	~100 m upstream of pressure transducer		
Method	Velocity-area (Mid-section)			Instrument Model		FH950		
Flow Meter Type	Current Meter			Instrument Serial #		130861001498		
Real Time Reading (m)	Start	Reading	0.583	Time	12:23	Staff Gauge (m)	n/a	
	End	Reading	0.589	Time	12:53	Time of SG Reading	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1	RB	3.60	0.00	0.0	0.03	0			0.000	0.0
2		4.50	0.07	0.9	0.07	0.01			0.001	0.1
3		5.50	0.07	1.0	0.07	0.01			0.001	0.1
4		6.50	0.09	1.0	0.09	0.03			0.003	0.3
5		7.50	0.12	1.0	0.12	0.06			0.007	0.8
6		8.50	0.08	1.0	0.08	0.08			0.006	0.7
7		9.50	0.11	1.0	0.11	0.05			0.006	0.6
8		10.50	0.17	1.0	0.17	0.05			0.009	0.9
9		11.50	0.10	1.0	0.10	0.15			0.015	1.6
10		12.50	0.23	1.0	0.23	0.14			0.032	3.4
11		13.50	0.32	1.0	0.32	0.11			0.035	3.7
12		14.50	0.27	1.0	0.27	0.13			0.035	3.7
13		15.50	0.23	1.0	0.23	0.12			0.028	2.9
14		16.50	0.18	1.0	0.18	0.14			0.025	2.7
15		17.50	0.35	1.0	0.35	0.11			0.039	4.1
16		18.50	0.34	1.0	0.34	0.15			0.051	5.4
17		19.50	0.38	1.0	0.38	0.14			0.053	5.6
18		20.50	0.39	1.0	0.39	0.15			0.059	6.2
19		21.50	0.41	1.0	0.41	0.15			0.062	6.5
20		22.50	0.43	1.0	0.43	0.15			0.065	6.8
21		23.50	0.49	1.0	0.49	0.13			0.064	6.7
22		24.50	0.51	1.0	0.51	0.10			0.051	5.4
23		25.50	0.62	1.0	0.62	0.16			0.099	10.5
24		26.50	0.52	1.0	0.52	0.14			0.073	7.7
25		27.50	0.48	1.0	0.48	0.14			0.067	7.1
26		28.50	0.23	1.0	0.23	0.08			0.018	1.9
27		29.50	0.32	1.0	0.32	0.09			0.029	3.0
28		30.50	0.20	1.0	0.20	0.08			0.016	1.7
29		31.50	0.18	1.0	0.15	0.02			0.003	0.3
30		32.15	0.00	0.6	0.06	0			0.000	0.0
31										
32										
33										
Total Q									**0.949**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site BL-H2

Site Information				
Project Name	Back River			
Station Identification	BL-H2			
Stream Name	Big Lake Outflow			
Date Monitored	11-Jul-14			
Time at Site (24 hr)	Start Time:	1:00:00 PM	End Time:	2:15:00 PM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	Easting	Northing	Elevation	
	424412	7265460		
Weather Conditions	very windy, rainy			

Transducer Information			
DL Model	PT2X	PT Serial #	21221020
Gain	-	Offset	-
Status	-	Battery	-
# of Records	-	Memory Free	-
Date Serviced	12/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	-
Pressure Transducer Reading (m)	0.606
Pressure Transducer Elevation (m)	-
Discharge (m^3/s)	**1.1**
Cross Sectional Area	8.108
Average Velocity	0.135

Discharge Measurement - Mid-Section Method

Measurement Time	Start	13:04	End	13:47	Location	~100 m upstream of pressure transducer		
Method	Velocity-area (Mid-section)			Instrument Model		FH950		
Flow Meter Type	Current Meter			Instrument Serial #		130861001498		
Real Time Reading (m)	Start	Reading	0.603	Time	13:03	Staff Gauge (m)	n/a	
	End	Reading	0.609	Time	13:47	Time of SG Reading	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1	RB	0.00	0.00	0.0	0.04	0			0.000	0.0
2		1.00	0.08	1.0	0.08	0.03			0.002	0.2
3		2.00	0.16	1.0	0.16	0.05			0.008	0.7
4		3.00	0.08	1.0	0.08	0.05			0.004	0.4
5		4.00	0.00	1.0	0.00	0.00			0.000	0.0
6		5.00	0.16	1.0	0.16	0.02			0.003	0.3
7		6.00	0.13	1.0	0.13	0.07			0.009	0.8
8		7.00	0.17	1.0	0.17	0.11			0.019	1.7
9		8.00	0.16	1.0	0.16	0.14			0.022	2.1
10		9.00	0.26	1.0	0.20	0.15			0.029	2.7
11		9.50	0.28	0.5	0.14	0.11			0.015	1.4
12		10.00	0.28	0.5	0.14	0.13			0.018	1.7
13		10.50	0.30	0.5	0.15	0.16			0.024	2.2
14		11.00	0.32	0.5	0.16	0.09			0.014	1.3
15		11.50	0.33	0.5	0.17	0.16			0.026	2.4
16		12.00	0.39	0.5	0.20	0.06			0.012	1.1
17		12.50	0.21	0.5	0.11	0.16			0.017	1.5
18		13.00	0.44	0.5	0.33	0.04			0.013	1.2
19		14.00	0.44	1.0	0.33	0.09			0.030	2.7
20		14.50	0.44	0.5	0.22	0.18			0.040	3.6
21		15.00	0.44	0.5	0.22	0.16			0.035	3.2
22		15.50	0.30	0.5	0.15	0.14			0.021	1.9
23		16.00	0.29	0.5	0.15	0.17			0.025	2.3
24		16.50	0.36	0.5	0.18	0.21			0.038	3.5
25		17.00	0.45	0.5	0.23	0.15			0.034	3.1
26		17.50	0.46	0.5	0.23	0.19			0.044	4.0
27		18.00	0.42	0.5	0.21	0.21			0.044	4.0
28		18.50	0.47	0.5	0.24	0.18			0.042	3.9
29		19.00	0.39	0.5	0.29	0.18			0.053	4.8
30		20.00	0.47	1.0	0.47	0.16			0.075	6.9
31		21.00	0.53	1.0	0.53	0.17			0.090	8.2
32		22.00	0.41	1.0	0.41	0.19			0.078	7.1
33		23.00	0.49	1.0	0.49	0.15			0.074	6.7
34		24.00	0.40	1.0	0.40	0.15			0.060	5.5
35		25.00	0.39	1.0	0.39	0.11			0.043	3.9
36		26.00	0.12	1.0	0.12	0.11			0.013	1.2
37		27.00	0.20	1.0	0.20	0.09			0.018	1.6
38	LB	28.00	0.00	1.0	0.10	0			0.000	0.0
Total Q									**1.092**	**100.0**

General Notes

No survey was compelted due to high winds. The water level was oscillating 2-4 cm. Whitecaps were being created on parts of the stream with few boulders. The wind was blowing strongly in the direction of flow.

Appendix 3. Manual Stage and Discharge Measurements, Site PL-H1

Site Information				
Project Name	Back River			
Station Identification	PL-H1			
Stream Name	Propellor Lake Outflow			
Date Monitored	8-Jun-14			
Time at Site (24 hr)	Start Time:	10:47:00 AM	End Time:	11:55:00 AM
Personnel	Emerson Belland, Jem Morrison			
Station Cordinates	Easting	Northing	Elevation	
	436094	7279939		
Weather Conditions				

Transducer Information			
PT Model	PT2X	PT Serial #	21221021
Gain	-	Offset	-
Status	-	Battery	-
# of Records	-	Memory Free	-
Date Serviced	12/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 8	1.011	101.011		**100.000**	
BM 7			1.474	99.537	
BM 6			1.410	99.601	
WL			1.904	99.107	
PT			2.418	98.593	
TBM			1.578	99.433	
TBM	1.535	100.968		99.433	
BM 8			0.968	100.000	
BM 7			1.433	99.535	
BM 6			1.369	99.599	
WL			1.858	99.110	
PT			2.376	98.592	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 8	100.000	100.000	0.000	
BM 7	99.538	99.536	-0.002	
BM 6	99.601	99.600	-0.001	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.109
Pressure Transducer Reading (m)	0.503
Pressure Transducer Elevation (m)	98.606
Discharge (m^3/s)	-
Cross Sectional Area	-
Average Velocity	-

Discharge Measurement - Mid-Section Method

Measurement Time	Start		End		Location				
Method				Instrument Model					
Flow Meter Type				Instrument Serial #					
Real Time Reading (m)	Start	Reading		Time		Staff Gauge (m)		n/a	
	End	Reading		Time		Time of SG Reading		-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										
26										
27										
28										
29										
30										
31										
32										
33										
Total Q										

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site PL-H1

Site Information				
Project Name	Back River			
Station Identification	PL-H1			
Stream Name	Propellor Lake Outflow			
Date Monitored	10-Jun-14			
Time at Site (24 hr)	Start Time:	3:20:00 PM	End Time:	
Personnel	Emerson Belland, Jem Morrison			
Station Cordinates	Easting	Northing	Elevation	
	436094	7279939		
Weather Conditions				

Transducer Information			
PT Model	PT2X	PT Serial #	21221021
Gain	-	Offset	-
Status	-	Battery	-
# of Records	-	Memory Free	-
Date Serviced	12/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 8	1.053	101.053		**100.000**	
BM 7			1.516	99.537	
BM 6			1.451	99.602	
WL			1.968	99.085	
PT			2.467	98.586	
TBM			2.182	98.871	
TBM	2.064	100.935		98.871	
BM 8			0.934	100.001	
BM 7			1.398	99.537	
BM 6			1.333	99.602	
WL			1.850	99.085	
PT	1.988	100.860	2.271	98.589	used 2nd shot

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 8	100.000	100.001	0.001	
BM 7	99.538	99.537	-0.001	
BM 6	99.601	99.602	0.001	

Discharge Measurement ADCP								
Time (24 hr)	Start	12:13	End	13:03	Location	at station		
Method	Veloctity-area (ADCP)				Water Temp (ADCP)(°C)	4.9		
Flow Meter Type	ADCP				Water Temp (Therm) (°C)	4		
Instrument Model	StreamPro				Mean Discharge Q (m^3/s)	5.3		
Instrument Serial#					Error (Std Dev in m^3/s)	0.20		
Stage (m) Start	Reading	0.489	Time	12:14	Mean % of Q Measured	62.0		
Stage (m) End	Reading	0.490	Time	13:04				
File Location								

Transect #	Discharge Q (m^3/s)						% Q Measured	% Bad	
	Top	Mid	Bottom	Left	Right	Total Q		Ensembles	Bins
1	0.67	3.20	1.19	0.05	0.09	5.20	61.6	5	0
3	0.73	3.44	1.27	0.06	0.07	5.56	61.8	10	0
6	0.67	3.29	1.14	0.06	0.10	5.26	62.5	14	0
Mean	**0.69**	**3.31**	**1.20**	**0.06**	**0.08**	**5.34**	**62.0**	**9.7**	**0.0**

General Notes

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.085
Pressure Transducer Reading (m)	0.489
Pressure Transducer Elevation (m)	98.596
Discharge (m^3/s)	**5.3**
Cross Sectional Area	53.1
Average Velocity	0.101

Appendix 3. Manual Stage and Discharge Measurements, Site PL-H1

Site Information				
Project Name	Back River			
Station Identification	PL-H1			
Stream Name	Propellor Lake Outflow			
Date Monitored	15-Jun-14			
Time at Site (24 hr)	Start Time:	11:12:00 AM	End Time:	1:08:00 PM
Personnel	Jem Morrison, Kokiak Peetooloot			
Station Cordinates	Easting	Northing	Elevation	
	436094	7279939		
Weather Conditions				

Transducer Information			
PT Model	PT2X	PT Serial #	21221021
Gain	-	Offset	-
Status	-	Battery	-
# of Records	-	Memory Free	-
Date Serviced	12/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 8	1.133	101.133		**100.000**	
BM 7			1.596	99.537	
BM 6			1.532	99.601	
WL			2.057	99.076	
PT			2.538	98.595	
TBM			1.383	99.750	
TBM	1.234	100.984		99.750	
BM 8			0.983	100.001	
BM 7			1.446	99.538	
BM 6			1.382	99.602	
WL			1.906	99.078	
PT			2.391	98.593	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 8	100.000	100.001	0.000	
BM 7	99.538	99.538	-0.001	
BM 6	99.601	99.602	0.000	

Discharge Measurement ADCP								
Time (24 hr)	Start	11:12	End	13:08	Location	at station		
Method	Velocity-area (ADCP)				Water Temp (ADCP)(°C)	4.5		
Flow Meter Type	ADCP				Water Temp (Therm) (°C)	4		
Instrument Model	StreamPro				Mean Discharge Q (m^3/s)	5.3		
Instrument Serial#					Error (Std Dev in m^3/s)	0.17		
Stage (m) Start	Reading	0.481	Time	11:14	Mean % of Q Measured	63.8		
Stage (m) End	Reading	0.482	Time	13:14				
File Location								

Transect #	Discharge Q (m^3/s)						% Q Measured	% Bad	
	Top	Mid	Bottom	Left	Right	Total Q		Ensembles	Bins
4	0.73	3.41	1.19	0.03	0.01	5.37	63.5	23	0
6	0.73	3.36	1.21	0.03	0.02	5.34	62.9	20	0
7	0.77	3.49	1.23	0.02	0.01	5.52	63.2	20	0
9	0.67	3.35	1.05	0.02	0.02	5.11	65.6	23	0
Mean	**0.73**	**3.40**	**1.17**	**0.03**	**0.01**	**5.34**	**63.8**	**21.5**	**0.0**

General Notes

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.077
Pressure Transducer Reading (m)	0.482
Pressure Transducer Elevation (m)	98.595
Discharge (m^3/s)	**5.3**
Cross Sectional Area	51.3
Average Velocity	0.104

Appendix 3. Manual Stage and Discharge Measurements, Site PL-H1

Site Information				
Project Name	Back River			
Station Identification	PL-H1			
Stream Name	Propellor Lake Outflow			
Date Monitored	17-Jun-14			
Time at Site (24 hr)	**Start Time:**	1:30:00 PM	**End Time:**	2:33:00 PM
Personnel	Jem & Kokiak			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	436094	7279939		
Weather Conditions				

Transducer Information			
DL Model	PT2X	**PT Serial #**	21221021
Gain	-	**Offset**	-
Status	-	**Battery**	-
# of Records	-	**Memory Free**	-
Date Serviced	12/10/2013	**Crest Gauges**	n/a

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 8	1.105	101.105		**100.000**	
BM 6			1.504	99.601	
BM 7			1.568	99.537	
WL			2.025	99.080	
PT			2.498	98.607	
TBM			1.436	99.669	
TBM	1.279	100.948		99.669	
BM 8			0.948	100.000	
BM 6			1.347	99.601	
BM 7			1.410	99.538	
WL			1.866	99.082	
PT			2.339	98.609	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 8	100	100.000	0.000	
BM 6	99.538	99.538	0.000	
BM 7	99.601	99.601	0.000	

Discharge Measurement ADCP								
Time (24 hr)		**Start**	13:30	**End**	14:33	**Location**	at station	
Method		Velocity-area (ADCP)				**Water Temp (ADCP)(°C)**	8.2	
Flow Meter Type		ADCP				**Water Temp (Therm) (°C)**	4	
Instrument Model		StreamPro				**Mean Discharge Q (m^3/s)**	4.9	
Instrument Serial#						**Error (Std Dev in m^3/s)**	0.07	
Stage (m)	**Start**	**Reading**	0.465	**Time**	13:34	**Mean % of Q Measured**	62.8	
	End	**Reading**	0.466	**Time**	14:34			
File Location		(Measurement File Location on the N: Drive)						

Transect #	**Discharge Q (m^3/s)**						**% Q Measured**	**% Bad**	
	Top	**Mid**	**Bottom**	**Left**	**Right**	**Total Q**		**Ensembles**	**Bins**
8	0.69	3.12	1.17	0.03	0.01	5.02	62.2	7	0
9	0.66	3.10	1.07	0.04	0.01	4.88	63.5	2	0
10	0.66	3.06	1.11	0.03	0.00	4.86	63.0	1	0
11	0.66	3.08	1.12	0.06	0.01	4.92	62.6	1	0
Mean	**0.67**	**3.09**	**1.12**	**0.04**	**0.01**	**4.92**	**62.8**	**2.8**	**0.0**

General Notes

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.081
Pressure Transducer Reading (m)	0.466
Pressure Transducer Elevation (m)	98.615
Discharge (m^3/s)	**4.9**
Cross Sectional Area	**51.9**
Average Velocity	**0.1**

Appendix 3. Manual Stage and Discharge Measurements, Site PL-H1

Site Information				
Project Name	Back River			
Station Identification	PL-H1			
Stream Name	Propellor Lake Outflow			
Date Monitored	3-Jul-14			
Time at Site (24 hr)	**Start Time:**	9:30:00 AM	**End Time:**	11:00:00 AM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	436094	7279939		
Weather Conditions	sunny			

Transducer Information			
PT Model	PT2X	**PT Serial #**	21221021
Gain	-	**Offset**	-
Status	Active	**Battery**	2.9 V
# of Records		**Memory Free**	520541
Date Serviced	12/10/2013	**Crest Gauges**	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 8	0.999	100.999		**100.000**	
BM 7			1.462	99.537	
BM 6			1.399	99.600	
WL			2.087	98.912	
PT			2.371	98.628	
TBM			1.049	99.950	
TBM	0.872	100.822		99.950	
BM 8			0.821	100.001	
BM 7			1.284	99.538	
BM 6			1.221	99.601	
WL			1.909	98.913	
PT			2.194	98.628	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 8	100.000	100.001	0.000	
BM 7	99.538	99.538	-0.001	
BM 6	99.601	99.601	-0.001	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	98.913
Pressure Transducer Reading (m)	0.316
Pressure Transducer Elevation (m)	98.596
Discharge (m^3/s)	**1.3**
Cross Sectional Area	15.670
Average Velocity	0.083

Discharge Measurement - Mid-Section Method

Measurement Time	**Start**	9:44	**End**	10:30	**Location**	~100 m upstream of station		
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950		
Flow Meter Type	Current Meter			**Instrument Serial #**		130861001498		
Real Time Reading (m)	**Start**	**Reading**	0.316	**Time**	9:44	**Staff Gauge (m)**	n/a	
	End	**Reading**	0.316	**Time**	10:34	**Time of SG Reading**	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	**Notes**	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1	LB main channel	0.00	0.00	0.0	0.34	0			0.000	0.0
2		4.00	0.17	4.0	0.43	0.04			0.017	1.3
3		5.00	0.22	1.0	0.22	0.05			0.011	0.8
4		6.00	0.33	1.0	0.33	0.03			0.010	0.8
5		7.00	0.00	1.0	0.00	0.00			0.000	0.0
6		8.00	0.15	1.0	0.15	0.01			0.002	0.1
7		9.00	0.40	1.0	0.40	0.02			0.008	0.6
8		10.00	0.22	1.0	0.22	0.01			0.002	0.2
9		11.00	0.54	1.0	0.54	0.02			0.011	0.8
10		12.00	0.51	1.0	0.51	0.05			0.026	1.9
11		13.00	0.35	1.0	0.35	0.06			0.021	1.6
12		14.00	0.43	1.0	0.43	0.10			0.043	3.3
13		15.00	0.66	1.0	0.66	0.14			0.092	7.1
14		16.00	0.59	1.0	0.59	0.13			0.077	5.9
15		17.00	0.68	1.0	0.68	0.29			0.197	15.1
16		18.00	0.56	1.0	0.56	0.31			0.174	13.3
17		19.00	0.57	1.0	0.57	0.18			0.103	7.8
18		20.00	0.58	1.0	0.58	0.12			0.070	5.3
19		21.00	0.64	1.0	0.64	0.07			0.045	3.4
20		22.00	0.70	1.0	0.70	0.05			0.035	2.7
21		23.00	0.26	1.0	0.26	0.05			0.013	1.0
22		24.00	0.29	1.0	0.29	0.03			0.009	0.7
23		25.00	0.14	1.0	0.14	0.02			0.003	0.2
24		26.00	0.43	1.0	0.43	0.02			0.009	0.7
25		27.00	0.55	1.0	0.55	0.01			0.006	0.4
26		28.00	0.53	1.0	0.53	0.02			0.011	0.8
27		29.00	0.37	1.0	0.37	0.05			0.019	1.4
28		30.00	0.45	1.0	0.45	0.03			0.014	1.0
29		31.00	0.24	1.0	0.24	0.24			0.058	4.4
30		32.00	0.25	1.0	0.25	0.19			0.048	3.6
31		33.00	0.26	1.0	0.26	0.11			0.029	2.2
32		34.00	0.10	1.0	0.10	0.05			0.005	0.4
33		35.00	0.53	1.0	0.53	0.07			0.037	2.8
34		36.00	0.40	1.0	0.40	0.07			0.028	2.1
35		37.00	0.40	1.0	0.40	0.03			0.012	0.9
36		38.00	0.32	1.0	0.32	0.05			0.016	1.2
37		39.00	0.18	1.0	0.18	0.03			0.005	0.4
38		40.00	0.00	1.0	0.00	0.00			0.000	0.0
39		41.00	0.10	1.0	0.10	0.06			0.006	0.5
40	Rb main channel	42.00	0.00	1.0	0.05	0.00			0.000	0.0
41	LB left channel	53.00	0.00	0.0	0.12	0.00			0.000	0.0
42		54.00	0.24	1.0	0.24	0.09			0.022	1.7
43		55.00	0.33	1.0	0.33	0.04			0.013	1.0
44		56.00	0.00	1.0	0.00	0.00			0.000	0.0
45		57.00	0.10	1.0	0.10	0.04			0.004	0.3
46		58.00	0.09	1.0	0.09	0.03			0.003	0.2
47	RB left channel	59.00	0.00	1.0	0.05	0			0.000	0.0
Total Q									**1.308**	**100.0**

General Notes

Side tributary measured on hill above station with flowrate of 0.00264 m^3/s. Unable to tell where the tributary enters the stream (up or downstream of station) due to buried boulder gardens.

Appendix 3. Manual Stage and Discharge Measurements, Site PL-H1

Site Information				
Project Name	Back River			
Station Identification	PL-H1			
Stream Name	Propellor Lake Outflow			
Date Monitored	5-Jul-14			
Time at Site (24 hr)	**Start Time:**	8:30:00 AM	**End Time:**	10:30:00 AM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	436094	7279939		
Weather Conditions	sunny, 22° C			

Transducer Information			
PT Model	PT2X	**PT Serial #**	21221021
Gain	-	**Offset**	-
Status	-	**Battery**	-
# of Records	-	**Memory Free**	-
Date Serviced	12/10/2013	**Crest Gauges**	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 8	0.989	100.989		**100.000**	
BM 7			1.452	99.537	
BM 6			1.388	99.601	
WL			2.100	98.889	
PT			2.364	98.625	
TBM			0.985	100.004	
TBM	0.827	100.831		100.004	
BM 8			0.832	99.999	
BM 7			1.295	99.536	
BM 6			1.230	99.601	
WL			1.941	98.890	
PT			2.206	98.625	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 8	100.000	100.000	0.000	
BM 7	99.538	99.537	-0.001	
BM 6	99.601	99.601	0.000	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	98.890
Pressure Transducer Reading (m)	0.290
Pressure Transducer Elevation (m)	98.599
Discharge (m^3/s)	**1.4**
Cross Sectional Area	16.913
Average Velocity	0.085

Discharge Measurement - Mid-Section Method

Measurement Time	**Start**	8:39	**End**	9:25	**Location**	~100 m upstream of station		
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950		
Flow Meter Type	Current Meter			**Instrument Serial #**		130861001498		
Real Time Reading (m)	**Start**	**Reading**	0.291	**Time**	8:34	**Staff Gauge (m)**	n/a	
	End	**Reading**	0.290	**Time**	9:24	**Time of SG Reading**	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	**Notes**	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
1	LB main channel	0.00	0.00	0.0	0.26	0			0.000	0.0
2		1.50	0.34	1.5	0.51	0.00			0.000	0.0
3		3.00	0.23	1.5	0.35	0.03			0.010	0.7
4		4.50	0.19	1.5	0.29	0.00			0.000	0.0
5		6.00	0.36	1.5	0.54	0.01			0.005	0.4
6		7.50	0.50	1.5	0.75	0.06			0.045	3.1
7		9.00	0.35	1.5	0.53	0.04			0.021	1.5
8		10.50	0.12	1.5	0.18	0.02			0.004	0.2
9		12.00	0.54	1.5	0.81	0.07			0.057	3.9
10		13.50	0.47	1.5	0.71	0.14			0.099	6.8
11		15.00	0.68	1.5	1.02	0.18			0.184	12.7
12		16.50	0.68	1.5	1.02	0.32			0.326	22.6
13		18.00	0.61	1.5	0.92	0.14			0.128	8.9
14		19.50	0.45	1.5	0.68	0.08			0.054	3.7
15		21.00	0.68	1.5	1.02	0.03			0.031	2.1
16		22.50	0.58	1.5	0.87	0.02			0.017	1.2
17		24.00	0.16	1.5	0.24	0.03			0.007	0.5
18		25.50	0.42	1.5	0.63	0.01			0.006	0.4
19		27.00	0.36	1.5	0.54	0.01			0.005	0.4
20		28.50	0.38	1.5	0.57	0.14			0.080	5.5
21		30.00	0.20	1.5	0.30	0.17			0.051	3.5
22		31.50	0.46	1.5	0.69	0.09			0.062	4.3
23		33.00	0.34	1.5	0.51	0.04			0.020	1.4
24		34.50	0.45	1.5	0.68	0.21			0.142	9.8
25		36.00	0.28	1.5	0.42	0.00			0.000	0.0
26		37.50	0.17	1.5	0.26	0.05			0.013	0.9
27		39.00	0.00	1.5	0.00	0.00			0.000	0.0
28		40.50	0.09	1.5	0.14	0.02			0.003	0.2
29	RB main channel	42.00	0.00	1.5	0.07	0.00			0.000	0.0
30	LB left channel	53.50	0.00	11.5	0.18	0.00			0.000	0.0
31		55.00	0.24	1.5	0.36	0.08			0.029	2.0
32		56.50	0.25	3.0	0.38	0.08			0.030	2.1
33		58.00	0.24	1.5	0.36	0.04			0.014	1.0
34	RB left channel	59.50	0.00	1.5	0.18	0			0.000	0.0
Total Q									**1.443**	**100.0**

General Notes

Side tributary measured on hill above station with flowrate of 0.00182 m^3/s. Unable to tell where the tributary enters the stream (up or downstream of station) due to buried boulder gardens.

Appendix 3. Manual Stage and Discharge Measurements, Site PL-H1

Site Information				
Project Name	Back River			
Station Identification	PL-H1			
Stream Name	Propellor Lake Outflow			
Date Monitored	7-Jul-14			
Time at Site (24 hr)	**Start Time:**	8:30:00 AM	**End Time:**	10:30:00 AM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	436094	7279939		
Weather Conditions	windy, overcast			

Transducer Information			
PT Model	PT2X	**PT Serial #**	21221021
Gain	-	**Offset**	-
Status	Active	**Battery**	2.9 V
# of Records		**Memory Free**	519973
Date Serviced	12/10/2013	**Crest Gauges**	n/a

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 8	0.990	100.990		**100.000**	
BM 7			1.453	99.537	
BM 6			1.390	99.600	
WL			2.139	98.851	
PT			2.370	98.620	
TBM			1.056	99.934	
TBM	1.024	100.958		99.934	
BM 8			0.958	100.000	
BM 7			1.421	99.537	
BM 6			1.358	99.600	
WL			2.109	98.849	
PT			2.339	98.619	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 8	100.000	100.000	0.000	
BM 7	99.538	99.537	-0.001	
BM 6	99.601	99.600	-0.001	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	98.850
Pressure Transducer Reading (m)	0.256
Pressure Transducer Elevation (m)	98.594
Discharge (m^3/s)	**1.2**
Cross Sectional Area	14.670
Average Velocity	0.080

Discharge Measurement - Mid-Section Method

Measurement Time	**Start**	8:45	**End**	9:32	**Location**	~100 m upstream of station		
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950		
Flow Meter Type	Current Meter			**Instrument Serial #**		130861001498		
Real Time Reading (m)	**Start**	**Reading**	0.256	**Time**	8:44	**Staff Gauge (m)**	n/a	
	End	**Reading**	0.255	**Time**	9:34	**Time of SG Reading**	-	

		Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
No.	**Notes**	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
1	LB main channel	0.00	0.00	0.0	0.15	0			0.000	0.0
2		1.50	0.20	1.5	0.30	0.03			0.009	0.8
3		3.00	0.35	1.5	0.53	0.02			0.011	0.9
4		4.50	0.20	1.5	0.30	0.00			0.000	0.0
5		6.00	0.22	1.5	0.33	0.02			0.007	0.6
6		7.50	0.64	1.5	0.96	0.01			0.010	0.8
7		9.00	0.18	1.5	0.27	0.04			0.011	0.9
8		10.50	0.20	1.5	0.30	0.07			0.021	1.8
9		12.00	0.40	1.5	0.60	0.13			0.078	6.6
10		13.50	0.66	1.5	0.99	0.13			0.129	10.9
11		15.00	0.62	1.5	0.93	0.24			0.223	18.9
12		16.50	0.55	1.5	0.83	0.18			0.149	12.6
13		18.00	0.53	1.5	0.80	0.09			0.072	6.1
14		19.50	0.53	1.5	0.80	0.05			0.040	3.4
15		21.00	0.29	1.5	0.44	0.03			0.013	1.1
16		22.50	0.29	1.5	0.44	0.04			0.017	1.5
17		24.00	0.38	1.5	0.57	0.03			0.017	1.4
18		25.50	0.42	1.5	0.63	0.08			0.050	4.3
19		27.00	0.33	1.5	0.50	0.04			0.020	1.7
20		28.50	0.25	1.5	0.38	0.17			0.064	5.4
21		30.00	0.17	1.5	0.26	0.15			0.038	3.2
22		31.50	0.35	1.5	0.53	0.10			0.053	4.4
23		33.00	0.14	1.5	0.21	0.17			0.036	3.0
24		34.50	0.40	1.5	0.60	0.06			0.036	3.0
25		36.00	0.40	1.5	0.60	0.02			0.012	1.0
26		37.50	0.14	1.5	0.21	0.05			0.011	0.9
27		39.00	0.10	1.5	0.15	0.02			0.003	0.3
28		40.50	0.00	1.5	0.00	0.00			0.000	0.0
29		42.00	0.05	1.5	0.08	0.03			0.002	0.2
30	RB main channel	43.50	0.00	1.5	0.04	0.00			0.000	0.0
31	LB left channel	55.00	0.00	11.5	0.11	0.00			0.000	0.0
32		56.50	0.15	1.5	0.23	0.07			0.016	1.3
33		58.00	0.20	1.5	0.30	0.08			0.024	2.0
34		59.50	0.16	1.5	0.24	0.05			0.012	1.0
35	RB left channel	61.00	0.00	1.5	0.12	0			0.000	0.0
Total Q									**1.181**	**100.0**

General Notes

Side tributary measured on hill above station with flowrate of 0.000588 m^3/s. Unable to tell where the tributary enters the stream (up or downstream of station) due to buried boulder gardens.

Appendix 3. Manual Stage and Discharge Measurements, Site PL-H1

Site Information				
Project Name	Back River			
Station Identification	PL-H1			
Stream Name	Propellor Lake Outflow			
Date Monitored	9-Jul-14			
Time at Site (24 hr)	**Start Time:**	9:30:00 AM	**End Time:**	11:00:00 AM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	436094	7279939		
Weather Conditions	sun & cloud			

Transducer Information			
PT Model	PT2X	**PT Serial #**	21221021
Gain	-	**Offset**	-
Status	-	**Battery**	-
# of Records	-	**Memory Free**	-
Date Serviced	12/10/2013	**Crest Gauges**	n/a

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 8	1.038	101.038		**100.000**	
BM 7			1.502	99.536	
BM 6			1.438	99.600	
WL			2.192	98.846	
PT			2.421	98.617	
TBM			1.106	99.932	
TBM	0.987	100.919		99.932	
BM 8			0.920	99.999	
BM 7			1.384	99.535	
BM 6			1.321	99.598	
WL			2.077	98.842	
PT			2.307	98.612	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 8	100.000	100.000	-0.001	
BM 7	99.538	99.536	-0.002	
BM 6	99.601	99.599	-0.002	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	98.844
Pressure Transducer Reading (m)	0.246
Pressure Transducer Elevation (m)	98.598
Discharge (m^3/s)	**1.0**
Cross Sectional Area	14.438
Average Velocity	0.071

Discharge Measurement - Mid-Section Method

Measurement Time	**Start**	9:32	**End**	10:17	**Location**	~100 m upstream of station		
Method	Velocity-area (Mid-section)				**Instrument Model**	FH950		
Flow Meter Type	Current Meter				**Instrument Serial #**	130861001498		
Real Time Reading (m)	**Start**	**Reading**	0.246	**Time**	9:34	**Staff Gauge (m)**	n/a	
	End	**Reading**	0.246	**Time**	10:24	**Time of SG Reading**	-	

		Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
No.	**Notes**	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
1	LB main channel	0.00	0.00	0.0	0.16	0			0.000	0.0
2		1.50	0.21	1.5	0.32	0.02			0.006	0.6
3		3.00	0.33	1.5	0.50	0.02			0.010	1.0
4		4.50	0.44	1.5	0.66	0.00			0.000	0.0
5		6.00	0.62	1.5	0.93	0.01			0.009	0.9
6		7.50	0.48	1.5	0.72	0.04			0.029	2.8
7		9.00	0.25	1.5	0.38	0.05			0.019	1.8
8		10.50	0.32	1.5	0.48	0.07			0.034	3.3
9		12.00	0.36	1.5	0.54	0.09			0.049	4.8
10		13.50	0.52	1.5	0.78	0.16			0.125	12.2
11		15.00	0.65	1.5	0.98	0.28			0.273	26.7
12		16.50	0.52	1.5	0.78	0.13			0.101	9.9
13		18.00	0.62	1.5	0.93	0.06			0.056	5.5
14		19.50	0.47	1.5	0.71	0.02			0.014	1.4
15		21.00	0.56	1.5	0.84	0.01			0.008	0.8
16		22.50	0.12	1.5	0.18	0.05			0.009	0.9
17		24.00	0.30	1.5	0.45	0.04			0.018	1.8
18		25.50	0.20	1.5	0.30	0.08			0.024	2.3
19		27.00	0.36	1.5	0.54	0.09			0.049	4.8
20		28.50	0.11	1.5	0.17	0.14			0.023	2.3
21		30.00	0.10	1.5	0.15	0.10			0.015	1.5
22		31.50	0.09	1.5	0.14	0.03			0.004	0.4
23		33.00	0.36	1.5	0.54	0.07			0.038	3.7
24		34.50	0.21	1.5	0.32	0.06			0.019	1.9
25		36.00	0.32	1.5	0.48	0.06			0.029	2.8
26		37.50	0.12	1.5	0.18	0.06			0.011	1.1
27		39.00	0.10	1.5	0.15	0.01			0.002	0.1
28	RB main channel	40.50	0.00	1.5	0.08	0.00			0.000	0.0
29	LB left channel	52.00	0.00	11.5	0.16	0.00			0.000	0.0
30		53.50	0.21	1.5	0.32	0.05			0.016	1.5
31		55.00	0.22	1.5	0.33	0.06			0.020	1.9
32		56.50	0.13	1.5	0.20	0.07			0.014	1.3
33	RB left channel	58.00	0.00	1.5	0.10	0			0.000	0.0
Total Q									**1.022**	**100.0**

General Notes

Side tributary measured on hill above station with flowrate of 0.00084 m^3/s. Unable to tell where the tributary enters the stream (up or downstream of station) due to buried boulder gardens.

Appendix 3. Manual Stage and Discharge Measurements, Site PL-H1

Site Information				
Project Name	Back River			
Station Identification	PL-H1			
Stream Name	Propellor Lake Outflow			
Date Monitored	11-Jul-14			
Time at Site (24 hr)	**Start Time:**	8:30:00 AM	**End Time:**	10:30:00 AM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	436094	7279939		
Weather Conditions	rainy, windy			

Transducer Information			
PT Model	PT2X	**PT Serial #**	21221021
Gain	-	**Offset**	-
Status	-	**Battery**	-
# of Records	-	**Memory Free**	-
Date Serviced	12/10/2013	**Crest Gauges**	n/a

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 8	1.024	101.024		**100.000**	
BM 7			1.487	99.537	
BM 6			1.423	99.601	
WL			2.207	98.817	
PT			2.409	98.615	
TBM			1.090	99.934	
TBM	1.012	100.946		99.934	
BM 8			0.946	100.000	
BM 7			1.409	99.537	
BM 6			1.346	99.600	
WL			2.131	98.815	
PT			2.330	98.616	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 8	100.000	100.000	0.000	
BM 7	99.538	99.537	-0.001	
BM 6	99.601	99.601	-0.001	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	98.816
Pressure Transducer Reading (m)	0.220
Pressure Transducer Elevation (m)	98.596
Discharge (m^3/s)	**0.8**
Cross Sectional Area	11.595
Average Velocity	0.072

Discharge Measurement - Mid-Section Method

Measurement Time	**Start**	8:48	**End**	9:35	**Location**	~100 m upstream of station		
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950		
Flow Meter Type	Current Meter			**Instrument Serial #**		130861001498		
Real Time Reading (m)	**Start**	**Reading**	0.2203	**Time**	8:44	**Staff Gauge (m)**	n/a	
	End	**Reading**	0.2201	**Time**	9:34	**Time of SG Reading**	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	**Notes**	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
1	LB main channel	0.00	0.00	0.0	0.12	0			0.000	0.0
2		1.50	0.16	1.5	0.24	0.03			0.007	0.9
3		3.00	0.27	1.5	0.41	0.02			0.008	1.0
4		4.50	0.00	1.5	0.00	0.00			0.000	0.0
5		6.00	0.21	1.5	0.32	0.02			0.006	0.8
6		7.50	0.35	1.5	0.53	0.03			0.016	1.9
7		9.00	0.16	1.5	0.24	0.04			0.010	1.1
8		10.50	0.13	1.5	0.20	0.06			0.012	1.4
9		12.00	0.30	1.5	0.45	0.08			0.036	4.3
10		13.50	0.67	1.5	1.01	0.08			0.080	9.6
11		15.00	0.59	1.5	0.89	0.19			0.168	20.0
12		16.50	0.50	1.5	0.75	0.17			0.128	15.2
13		18.00	0.59	1.5	0.89	0.06			0.053	6.3
14		19.50	0.46	1.5	0.69	0.01			0.007	0.8
15		21.00	0.24	1.5	0.36	0.02			0.007	0.9
16		22.50	0.16	1.5	0.24	-0.04			-0.010	-1.1
17		24.00	0.24	1.5	0.36	-0.01			-0.004	-0.4
18		25.50	0.16	1.5	0.24	0.09			0.022	2.6
19		27.00	0.28	1.5	0.42	0.10			0.042	5.0
20		28.50	0.17	1.5	0.26	0.16			0.041	4.9
21		30.00	0.16	1.5	0.24	0.10			0.024	2.9
22		31.50	0.28	1.5	0.42	0.05			0.021	2.5
23		33.00	0.24	1.5	0.36	0.04			0.014	1.7
24		34.50	0.33	1.5	0.50	0.17			0.084	10.0
25		36.00	0.26	1.5	0.39	0.06			0.023	2.8
26		37.50	0.00	1.5	0.00	0.00			0.000	0.0
27		39.00	0.06	1.5	0.09	0.00			0.000	0.0
28	RB main channel	40.50	0.00	1.5	0.05	0.00			0.000	0.0
29	LB left channel	52.00	0.00	11.5	0.11	0.00			0.000	0.0
30		53.50	0.14	1.5	0.21	0.06			0.013	1.5
31		55.00	0.20	1.5	0.30	0.07			0.021	2.5
32		56.50	0.16	1.5	0.24	0.04			0.010	1.1
33	RB left channel	58.00	0.00	1.5	0.12	0			0.000	0.0
Total Q									**0.839**	**100.0**

General Notes

Side tributary measured on hill above station with flowrate of 0.00067 m^3/s. Unable to tell where the tributary enters the stream (up or downstream of station) due to buried boulder gardens.

Appendix 3. Manual Stage and Discharge Measurements, Site PL-H2

Site Information				
Project Name	Back River			
Station Identification	PL-H2			
Stream Name	Propellor Lake Inflow			
Date Monitored	8-Jun-14			
Time at Site (24 hr)	Start Time:	3:15:00 PM	End Time:	
Personnel	Emerson Belland, Jem Morrison			
Station Cordinates	Easting	Northing	Elevation	
	435007	7272014		
Weather Conditions				

Transducer Information			
PT Model	PT2X	PT Serial #	21252008
Gain	-	Offset	-
Status	Active	Battery	2.8 V
# of Records	0	Memory Free	524139
Date Serviced		Crest Gauges	n/a

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 4	1.255	101.255		**100.000**	
BM 45			1.407	99.848	
BM 46			1.099	100.156	
WL			1.548	99.707	
PT			1.904	99.351	
TBM			1.134	100.121	
TBM	1.085	101.206		100.121	
BM 4			1.205	100.001	
BM 45			1.358	99.848	
BM 46			1.049	100.157	
WL			1.499	99.707	
PT			1.854	99.352	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 4	100.000	100.001	0.000	
BM 45	99.855	99.848	-0.007	
BM 46	100.166	100.157	-0.010	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.707
Pressure Transducer Reading (m)	0.409
Pressure Transducer Elevation (m)	99.298
Discharge (m^3/s)	**2.0**
Cross Sectional Area	13.182
Average Velocity	0.154

Discharge Measurement - Mid-Section Method

Measurement Time	Start	16:26	End		Location	~3 m downstream of station				
Method	Velocity-area (Mid-section)				Instrument Model	FH950				
Flow Meter Type	Current Meter				Instrument Serial #	130861001498				
Real Time Reading (m)	Start	Reading	0.4089	Time	16:22	Staff Gauge (m)	n/a			
	End	Reading	0.4086	Time	17:02	Time of SG Reading	-			

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1	RB	3.80	0.00	0.0	0.02	0			0.000	0.0
2		4.10	0.11	0.3	0.14	0.05			0.007	0.4
3		6.40	0.17	2.3	0.42	0.05			0.021	1.0
4		9.00	0.09	2.6	0.23	0.06			0.014	0.7
5		11.50	0.14	2.5	0.35	0.09			0.032	1.5
6		14.00	0.18	2.5	0.41	0.21			0.085	4.2
7		16.00	0.27	2.0	0.54	0.18			0.097	4.8
8		18.00	0.26	2.0	0.52	0.20			0.104	5.1
9		20.00	0.25	2.0	0.50	0.13			0.065	3.2
10		22.00	0.28	2.0	0.57	0.17			0.098	4.8
11		24.10	0.38	2.1	0.76	0.17			0.129	6.3
12		26.00	0.32	1.9	0.62	0.22			0.137	6.7
13		28.00	0.29	2.0	0.58	0.22			0.128	6.3
14		30.00	0.32	2.0	0.64	0.16			0.102	5.0
15		32.00	0.32	2.0	0.64	0.20			0.128	6.3
16		34.00	0.52	2.0	1.04	0.11			0.114	5.6
17		36.00	0.42	2.0	0.84	0.18			0.151	7.4
18		38.00	0.38	2.0	0.76	0.20			0.152	7.5
19		40.00	0.36	2.0	0.72	0.19			0.137	6.7
20		42.00	0.33	2.0	0.66	0.15			0.099	4.9
21		44.00	0.28	2.0	0.56	0.18			0.101	5.0
22		46.00	0.20	2.0	0.45	0.12			0.054	2.7
23		48.50	0.26	2.5	0.66	0.04			0.027	1.3
24		51.10	0.16	2.6	0.35	0.13			0.046	2.2
25		52.90	0.18	1.8	0.18	0.05			0.009	0.4
26	LB	53.10	0.00	0.2	0.02	0			0.000	0.0
27										
28										
29										
30										
31										
32										
33										
Total Q									**2.036**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site PL-H2

Site Information				
Project Name	Back River			
Station Identification	PL-H2			
Stream Name	Propellor Lake Inflow			
Date Monitored	11-Jun-14			
Time at Site (24 hr)	Start Time:	1:04:00 PM	End Time:	
Personnel	Emerson Belland, Jem Morrison			
Station Cordinates	Easting	Northing	Elevation	
	435007	7272014		
Weather Conditions				

Transducer Information			
PT Model	PT2X	PT Serial #	21252008
Gain	-	Offset	-
Status	Active	Battery	2.8 V
# of Records	418	Memory Free	523721
Date Serviced		Crest Gauges	n/a

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 4	1.301	101.301		**100.000**	
BM 45			1.449	99.852	
BM 46			1.139	100.162	
WL			1.585	99.716	
PT			1.904	99.362	shot with 2nd TBM
TBM			1.469	99.832	
TBM	1.321	101.153		99.832	
BM 4			1.155	99.998	
BM 45			1.300	99.853	
BM 46			0.992	100.161	
WL			1.439	99.714	
PT			1.789	99.364	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 4	100	99.999	-0.001	
BM 45	99.855	99.853	-0.002	
BM 46	100.166	100.162	-0.004	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.715
Pressure Transducer Reading (m)	0.403
Pressure Transducer Elevation (m)	99.312
Discharge (m^3/s)	**2.1**
Cross Sectional Area	14.041
Average Velocity	0.149

Discharge Measurement - Mid-Section Method

Measurement Time	Start	14:25	End		Location	~15 m downstream of station				
Method	Velocity-area (Mid-section)				Instrument Model	FH950				
Flow Meter Type	Current Meter				Instrument Serial #	130861001498				
Real Time Reading (m)	Start	Reading	0.402	Time	14:22	Staff Gauge (m)	n/a			
	End	Reading	0.403	Time	15:02	Time of SG Reading	-			

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1	RB	3.70	0.00	0.0	0.01	0			0.000	0.0
2		3.80	0.20	0.1	0.21	0.05			0.011	0.5
3		5.80	0.22	2.0	0.44	0.05			0.022	1.1
4		7.80	0.18	2.0	0.40	0.05			0.020	0.9
5		10.20	0.15	2.4	0.26	0.14			0.036	1.7
6		11.20	0.19	1.0	0.19	0.14			0.027	1.3
7		12.20	0.21	1.0	0.53	0.17			0.089	4.3
8		16.20	0.22	4.0	0.66	0.18			0.119	5.7
9		18.20	0.28	2.0	0.56	0.19			0.106	5.1
10		20.20	0.28	2.0	0.56	0.13			0.073	3.5
11		22.20	0.33	2.0	0.59	0.15			0.089	4.3
12		23.80	0.39	1.6	0.60	0.18			0.109	5.2
13		25.30	0.32	1.5	0.48	0.27			0.130	6.2
14		26.80	0.31	1.5	0.45	0.27			0.121	5.8
15		28.20	0.30	1.4	0.44	0.26			0.113	5.4
16		29.70	0.34	1.5	0.53	0.22			0.116	5.5
17		31.30	0.32	1.6	0.48	0.18			0.086	4.1
18		32.70	0.41	1.4	0.57	0.15			0.086	4.1
19		34.10	0.44	1.4	0.77	0.12			0.092	4.4
20		36.20	0.32	2.1	0.66	0.20			0.131	6.3
21		38.20	0.40	2.0	0.80	0.20			0.160	7.6
22		40.20	0.41	2.0	0.82	0.15			0.123	5.9
23		42.20	0.36	2.0	0.77	0.13			0.101	4.8
24		44.50	0.27	2.3	0.58	0.13			0.075	3.6
25		46.50	0.32	2.0	0.56	0.02			0.011	0.5
26		48.00	0.12	1.5	0.15	0.05			0.008	0.4
27		49.00	0.30	1.0	0.45	0.03			0.014	0.6
28		51.00	0.22	2.0	0.41	0.05			0.020	1.0
29		52.70	0.13	1.7	0.12	0.04			0.005	0.2
30	LB	52.80	0.00	0.1	0.01	0			0.000	0.0
31										
32										
33										
Total Q									**2.092**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site PL-H2

Site Information				
Project Name	Back River			
Station Identification	PL-H2			
Stream Name	Propellor Lake Inflow			
Date Monitored	14-Jun-14			
Time at Site (24 hr)	Start Time:	12:00:00 PM	End Time:	
Personnel	Jem Morrison			
Station Cordinates	Easting	Northing	Elevation	
	435007	7272014		
Weather Conditions				

Transducer Information			
PT Model	PT2X	PT Serial #	21252008
Gain	-	Offset	-
Status	Active	Battery	2.8 V
# of Records	854	Memory Free	523285
Date Serviced		Crest Gauges	n/a

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 4	1.295	101.295		**100.000**	
BM 45			1.439	99.856	
BM 46			1.131	100.164	
WL			1.572	99.723	
PT			1.945	99.350	
TBM			1.560	99.735	
TBM	1.450	101.185		99.735	
BM 4			1.185	100.000	
BM 45			1.329	99.856	
BM 46			1.020	100.165	
WL			1.461	99.724	
PT			1.836	99.349	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 4	100	100.000	0.000	
BM 45	99.855	99.856	0.001	
BM 46	100.166	100.165	-0.001	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.724
Pressure Transducer Reading (m)	0.400
Pressure Transducer Elevation (m)	99.324
Discharge (m^3/s)	**2.0**
Cross Sectional Area	13.551
Average Velocity	0.148

Discharge Measurement - Mid-Section Method

Measurement Time	Start	13:04	End		Location	~15 m downstream of station				
Method	Velocity-area (Mid-section)				Instrument Model	FH950				
Flow Meter Type	Current Meter				Instrument Serial #	130861001498				
Real Time Reading (m)	Start	Reading	0.400		Time	13:04	Staff Gauge (m)		n/a	
	End	Reading	0.400		Time	13:32	Time of SG Reading		-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1	RB	3.50	0.00	0.0	0.00	0			0.000	0.0
2		3.60	0.06	0.1	0.06	0.00			0.000	0.0
3		5.40	0.20	1.8	0.36	0.05			0.018	0.9
4		7.20	0.20	1.8	0.36	0.03			0.011	0.5
5		9.00	0.12	1.8	0.22	0.05			0.011	0.5
6		10.80	0.16	1.8	0.29	0.02			0.006	0.3
7		12.60	0.20	1.8	0.34	0.17			0.058	2.9
8		14.20	0.22	1.6	0.37	0.14			0.052	2.6
9		16.00	0.24	1.8	0.43	0.18			0.078	3.9
10		17.80	0.26	1.8	0.47	0.14			0.066	3.3
11		19.60	0.25	1.8	0.45	0.17			0.077	3.8
12		21.40	0.30	1.8	0.54	0.22			0.119	5.9
13		23.20	0.35	1.8	0.63	0.12			0.076	3.8
14		25.00	0.36	1.8	0.65	0.19			0.123	6.1
15		26.80	0.32	1.8	0.58	0.23			0.132	6.6
16		28.60	0.26	1.8	0.47	0.28			0.131	6.5
17		30.40	0.30	1.8	0.54	0.26			0.140	7.0
18		32.20	0.36	1.8	0.54	0.11			0.059	3.0
19		33.40	0.52	1.2	0.75	0.10			0.075	3.8
20		35.10	0.43	1.7	0.75	0.17			0.128	6.4
21		36.90	0.29	1.8	0.54	0.19			0.102	5.1
22		38.80	0.39	1.9	0.72	0.20			0.144	7.2
23		40.60	0.40	1.8	0.68	0.14			0.095	4.7
24		42.20	0.32	1.6	0.54	0.19			0.103	5.1
25		44.00	0.40	1.8	0.72	0.06			0.043	2.2
26		45.80	0.22	1.8	0.40	0.11			0.044	2.2
27		47.60	0.13	1.8	0.20	0.11			0.022	1.1
28		48.90	0.22	1.3	0.39	0.06			0.023	1.1
29		51.10	0.21	2.2	0.41	0.17			0.070	3.5
30		52.80	0.16	1.7	0.15	0.02			0.003	0.1
31	LB	52.95	0.00	0.2	0.01	0			0.000	0.0
32										
33										
Total Q									**2.009**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site PL-H2

Site Information				
Project Name	Back River			
Station Identification	PL-H2			
Stream Name	Propellor Lake Inflow			
Date Monitored	18-Jun-14			
Time at Site (24 hr)	Start Time:	12:15:00 PM	End Time:	
Personnel	Jem Morrison			
Station Cordinates	Easting	Northing	Elevation	
	435007	7272014		
Weather Conditions				

Transducer Information			
DL Model	PT2X	PT Serial #	21252008
Gain	-	Offset	-
Status	Active	Battery	2.8 V
# of Records	1421	Memory Free	522718
Date Serviced		Crest Gauges	n/a

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 4	1.240	101.240		**100.000**	
BM 45			1.386	99.854	
BM 46			1.075	100.165	
WL			1.528	99.712	
PT			1.880	99.360	
TBM			1.491	99.749	
TBM	1.558	101.307		99.749	
BM 4			1.306	100.001	
BM 45			1.451	99.856	
BM 46			1.141	100.166	
WL			1.596	99.711	
PT			1.949	99.358	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 4	100.000	100.001	0.001	
BM 45	99.855	99.855	0.000	
BM 46	100.166	100.166	-0.001	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.712
Pressure Transducer Reading (m)	0.393
Pressure Transducer Elevation (m)	99.319
Discharge (m^3/s)	**1.9**
Cross Sectional Area	13.615
Average Velocity	0.140

Discharge Measurement - Mid-Section Method

Measurement Time	Start	11:28	End		Location	~15 m downstream of station				
Method	Velocity-area (Mid-section)				Instrument Model	FH950				
Flow Meter Type	Current Meter				Instrument Serial #	130861001498				
Real Time Reading (m)	Start	Reading	0.393		Time	11:22	Staff Gauge (m)		n/a	
	End	Reading	0.393		Time	12:02	Time of SG Reading		-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1		0.80	0.00	0.0	0.00	0			0.000	0.0
2		0.90	0.06	0.1	0.07	0.03			0.002	0.1
3		3.00	0.23	2.1	0.47	0.03			0.014	0.7
4		5.00	0.15	2.0	0.30	0.06			0.018	0.9
5		7.00	0.11	2.0	0.22	0.11			0.024	1.3
6		9.00	0.15	2.0	0.30	0.12			0.036	1.9
7		11.00	0.22	2.0	0.44	0.19			0.084	4.4
8		13.00	0.30	2.0	0.62	0.10			0.062	3.2
9		15.10	0.26	2.1	0.52	0.14			0.073	3.8
10		17.00	0.23	1.9	0.45	0.2			0.090	4.7
11		19.00	0.28	2.0	0.52	0.14			0.073	3.8
12		20.70	0.32	1.7	0.56	0.24			0.134	7.1
13		22.50	0.34	1.8	0.66	0.24			0.159	8.4
14		24.60	0.32	2.1	0.66	0.13			0.085	4.5
15		26.60	0.33	2.0	0.66	0.15			0.099	5.2
16		28.60	0.32	2.0	0.64	0.16			0.102	5.4
17		30.60	0.43	2.0	0.75	0.14			0.105	5.5
18		32.10	0.40	1.5	0.70	0.15			0.105	5.5
19		34.10	0.32	2.0	0.53	0.18			0.095	5.0
20		35.40	0.47	1.3	0.66	0.14			0.092	4.8
21		36.90	0.38	1.5	0.51	0.19			0.097	5.1
22		38.10	0.40	1.2	0.62	0.13			0.081	4.2
23		40.00	0.43	1.9	0.84	0.11			0.092	4.8
24		42.00	0.22	2.0	0.41	0.11			0.045	2.3
25		43.70	0.22	1.7	0.39	0.12			0.046	2.4
26		45.50	0.12	1.8	0.23	0.08			0.018	1.0
27		47.50	0.30	2.0	0.48	0.11			0.053	2.8
28		48.70	0.32	1.2	0.35	0.06			0.021	1.1
29		49.70	0.12	1.0	0.07	0.00			0.000	0.0
30		49.80	0.00	0.1	0.01	0			0.000	0.0
31										
32										
33										
Total Q									**1.906**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site PL-H2

Site Information				
Project Name	Back River			
Station Identification	PL-H2			
Stream Name	Propellor Lake Inflow			
Date Monitored	3-Jul-14			
Time at Site (24 hr)	**Start Time:**	2:00:00 PM	**End Time:**	4:00:00 PM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	435007	7272014		
Weather Conditions				

Transducer Information			
PT Model	PT2X	**PT Serial #**	21252008
Gain	-	**Offset**	-
Status	Active	**Battery**	2.8 V
# of Records		**Memory Free**	520534
Date Serviced		**Crest Gauges**	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 4	1.532	101.532		**100.000**	
BM 45			1.680	99.852	
BM 46			1.359	100.173	
WL			1.922	99.610	
PT			2.170	99.362	
TBM			1.809	99.723	
TBM	1.622	101.345		99.723	
BM 4			1.348	99.997	
BM 45			1.495	99.850	
BM 46			1.175	100.170	
WL			1.737	99.608	
PT			1.985	99.360	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 4	100	99.999	-0.001	
BM 45	99.855	99.851	-0.004	
BM 46	100.166	100.172	0.006	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.609
Pressure Transducer Reading (m)	0.297
Pressure Transducer Elevation (m)	99.312
Discharge (m^3/s)	**0.6**
Cross Sectional Area	8.536
Average Velocity	0.075

Discharge Measurement - Mid-Section Method

Measurement Time	**Start**		**End**		**Location**	~15 m downstream of station		
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950		
Flow Meter Type	Current Meter			**Instrument Serial #**		130861001498		
Real Time Reading (m)	**Start**	**Reading**	0.297	**Time**	15:54	**Staff Gauge (m)**	n/a	
	End	**Reading**	0.297	**Time**	13:02	**Time of SG Reading**	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	**Notes**	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
1	RB	0.60	0.00	0.0	0.15	0			0.000	0.0
2		2.60	0.15	2.0	0.50	0.00			0.000	0.0
3		7.30	0.08	4.7	0.27	0.03			0.008	1.3
4		9.30	0.12	2.0	0.24	0.05			0.012	1.9
5		11.30	0.12	2.0	0.24	0.13			0.031	4.9
6		13.30	0.14	2.0	0.28	0.11			0.031	4.8
7		15.30	0.14	2.0	0.28	0.11			0.031	4.8
8		17.30	0.18	2.0	0.36	0.04			0.014	2.2
9		19.30	0.14	2.0	0.21	0.10			0.021	3.3
10		20.30	0.30	1.0	0.30	0.07			0.021	3.3
11		21.30	0.30	1.0	0.30	0.09			0.027	4.2
12		22.30	0.25	1.0	0.25	0.16			0.040	6.2
13		23.30	0.17	1.0	0.17	0.19			0.032	5.0
14		24.30	0.21	1.0	0.21	0.12			0.025	3.9
15		25.30	0.16	1.0	0.16	0.14			0.022	3.5
16		26.30	0.18	1.0	0.18	0.10			0.018	2.8
17		27.30	0.23	1.0	0.23	0.11			0.025	3.9
18		28.30	0.23	1.0	0.23	0.10			0.023	3.6
19		29.30	0.29	1.0	0.44	0.05			0.022	3.4
20		31.30	0.21	2.0	0.42	0.10			0.042	6.5
21		33.30	0.21	2.0	0.42	0.12			0.050	7.8
22		35.30	0.20	2.0	0.40	0.10			0.040	6.2
23		37.30	0.33	2.0	0.66	0.04			0.026	4.1
24		39.30	0.29	2.0	0.58	0.04			0.023	3.6
25		41.30	0.16	2.0	0.32	0.07			0.022	3.5
26		43.30	0.08	2.0	0.16	-0.01			-0.002	-0.2
27		45.30	0.00	2.0	0.00	0.0			0.000	0.0
28		47.30	0.20	2.0	0.39	0.09			0.035	5.5
29		49.20	0.00	1.9	0.19	0			0.000	0.0
30										
31										
32										
33										
Total Q									**0.642**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site PL-H2

Site Information				
Project Name	Back River			
Station Identification	PL-H2			
Stream Name	Propellor Lake Inflow			
Date Monitored	5-Jul-14			
Time at Site (24 hr)	Start Time:	2:06:00 PM	End Time:	2:39:00 PM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	Easting	Northing	Elevation	
	435007	7272014		
Weather Conditions				

Transducer Information			
PT Model	PT2X	PT Serial #	21252008
Gain	-	Offset	-
Status	Active	Battery	2.8 V
# of Records	3890	Memory Free	520250
Date Serviced		Crest Gauges	n/a

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 4	1.344	101.344		**100.000**	
BM 45			1.491	99.853	
BM 46			1.171	100.173	
WL			1.745	99.599	
PT			1.981	99.363	
TBM			1.627	99.717	
TBM	1.807	101.524		99.717	
BM 4			1.524	100.000	
BM 45			1.670	99.854	
BM 46			1.350	100.174	
WL			1.927	99.597	
PT			2.161	99.363	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 4	100	100.000	0.000	
BM 45	99.855	99.854	-0.002	
BM 46	100.166	100.174	0.007	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.598
Pressure Transducer Reading (m)	0.284
Pressure Transducer Elevation (m)	99.314
Discharge (m^3/s)	**0.5**
Cross Sectional Area	6.946
Average Velocity	0.067

Discharge Measurement - Mid-Section Method

Measurement Time	Start	14:06	End	14:39	Location	~15 m downstream of station				
Method	Velocity-area (Mid-section)			Instrument Model		FH950				
Flow Meter Type	Current Meter			Instrument Serial #		130861001498				
Real Time Reading (m)	Start	Reading	0.287	Time	14:02	Staff Gauge (m)		n/a		
	End	Reading	0.285	Time	14:32	Time of SG Reading		-		

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1	RB	49.10	0.00	0.0	0.10	0			0.000	0.0
2		47.50	0.12	1.6	0.16	0.07			0.011	2.3
3		46.50	0.08	1.0	0.08	0.01			0.001	0.2
4		45.50	0.00	1.0	0.00	0.00			0.000	0.0
5		44.50	0.14	1.0	0.14	0.07			0.010	2.1
6		43.50	0.06	1.0	0.06	0.05			0.003	0.6
7		42.50	0.10	1.0	0.10	0.01			0.001	0.2
8		41.50	0.16	1.0	0.16	0.05			0.008	1.7
9		40.50	0.23	1.0	0.23	0.06			0.014	3.0
10		39.50	0.25	1.0	0.25	0.06			0.015	3.2
11		38.50	0.10	1.0	0.10	0.06			0.006	1.3
12		37.50	0.30	1.0	0.30	0.06			0.018	3.9
13		36.50	0.29	1.0	0.44	0.07			0.030	6.5
14		34.50	0.26	2.0	0.52	0.03			0.016	3.3
15		32.50	0.28	2.0	0.56	0.09			0.050	10.8
16		30.50	0.22	2.0	0.44	0.11			0.048	10.4
17		28.50	0.22	2.0	0.44	0.10			0.044	9.4
18		26.50	0.11	2.0	0.22	0.09			0.020	4.2
19		24.50	0.18	2.0	0.36	0.10			0.036	7.7
20		22.50	0.22	2.0	0.44	0.09			0.040	8.5
21		20.50	0.07	2.0	0.14	0.08			0.011	2.4
22		18.50	0.18	2.0	0.36	0.09			0.032	7.0
23		16.50	0.15	2.0	0.30	0.12			0.036	7.7
24		14.50	0.08	2.0	0.16	0.02			0.003	0.7
25		12.50	0.11	2.0	0.22	0.04			0.009	1.9
26		10.50	0.10	2.0	0.17	0.00			0.000	0.0
27		9.05	0.08	1.5	0.16	0.01			0.002	0.3
28		6.60	0.00	2.5	0.00	0.00			0.000	0.0
29		3.35	0.08	3.3	0.24	0.01			0.002	0.5
30		0.60	0.00	2.8	0.11	0			0.000	0.0
31										
32										
33										
Total Q									**0.466**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site PL-H2

Site Information				
Project Name	Back River			
Station Identification	PL-H2			
Stream Name	Propellor Lake Inflow			
Date Monitored	7-Jul-14			
Time at Site (24 hr)	**Start Time:**	11:00:00 AM	**End Time:**	12:45:00 PM
Personnel	Jaclyn Bowman			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	435007	7272014		
Weather Conditions				

Transducer Information			
PT Model	PT2X	**PT Serial #**	21252008
Gain	-	**Offset**	-
Status	-	**Battery**	-
# of Records	-	**Memory Free**	-
Date Serviced		**Crest Gauges**	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 4	1.272	101.272		**100.000**	
BM 45			1.420	99.852	
BM 46			1.099	100.173	
WL			1.690	99.582	
PT			1.911	99.361	
TBM			1.551	99.721	
TBM	1.549	101.270		99.721	
BM 4			1.268	100.002	
BM 45			1.416	99.854	
BM 46			1.093	100.177	
WL			1.688	99.582	
PT			1.906	99.364	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 4	100.000	100.001	0.001	
BM 45	99.855	99.853	-0.002	
BM 46	100.166	100.175	0.009	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.582
Pressure Transducer Reading (m)	0.270
Pressure Transducer Elevation (m)	99.312
Discharge (m^3/s)	**0.4**
Cross Sectional Area	6.206
Average Velocity	0.064

Discharge Measurement - Mid-Section Method

Measurement Time	**Start**	11:17	**End**	11:42	**Location**	~15 m downstream of station		
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950		
Flow Meter Type	Current Meter			**Instrument Serial #**		130861001498		
Real Time Reading (m)	**Start**	**Reading**	0.270	**Time**	11:12	**Staff Gauge (m)**	n/a	
	End	**Reading**	0.271	**Time**	11:42	**Time of SG Reading**	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	**Notes**	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
1	LB	49.20	0.00	0.0	0.07	0			0.000	0.0
2		47.80	0.10	1.4	0.16	0.05			0.008	1.9
3		46.10	0.00	1.7	0.00	0.00			0.000	0.0
4		44.10	0.07	2.0	0.14	0.03			0.004	1.1
5		42.10	0.11	2.0	0.22	0.04			0.009	2.2
6		40.10	0.25	2.0	0.50	0.06			0.030	7.5
7		38.10	0.22	2.0	0.44	0.05			0.022	5.5
8		36.10	0.18	2.0	0.36	0.05			0.018	4.5
9		34.10	0.12	2.0	0.24	0.06			0.014	3.6
10		32.10	0.23	2.0	0.46	0.08			0.037	9.2
11		30.10	0.30	2.0	0.60	0.04			0.024	6.0
12		28.10	0.19	2.0	0.38	0.10			0.038	9.5
13		26.10	0.11	2.0	0.22	0.17			0.037	9.4
14	behind rock	24.10	0.15	2.0	0.30	0.01			0.003	0.8
15		22.10	0.18	2.0	0.36	0.10			0.036	9.0
16	on rock	20.10	0.08	2.0	0.16	0.11			0.018	4.4
17		18.10	0.13	2.0	0.26	0.11			0.029	7.2
18		16.10	0.10	2.0	0.20	0.05			0.010	2.5
19		14.10	0.08	2.0	0.16	0.13			0.021	5.2
20		12.10	0.15	2.0	0.30	0.09			0.027	6.8
21		10.10	0.12	2.0	0.24	0.05			0.012	3.0
22		8.10	0.00	2.0	0.00	0.00			0.000	0.0
23		6.00	0.07	2.1	0.26	0.01			0.003	0.6
24	RB	0.75	0.00	5.3	0.18	0			0.000	0.0
25										
26										
27										
28										
29										
30										
31										
32										
33										
Total Q									**0.399**	**100.0**

General Notes

Wind is blowing in the opposite direction of flow.

Appendix 3. Manual Stage and Discharge Measurements, Site PL-H2

Site Information				
Project Name	Back River			
Station Identification	PL-H2			
Stream Name	Propellor Lake Inflow			
Date Monitored	9-Jul-14			
Time at Site (24 hr)	Start Time:	12:45:00 PM	End Time:	2:30:00 PM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	Easting	Northing	Elevation	
	435007	7272014		
Weather Conditions				

Transducer Information			
PT Model	PT2X	PT Serial #	21252008
Gain	-	Offset	-
Status	-	Battery	-
# of Records	-	Memory Free	-
Date Serviced		Crest Gauges	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 4	1.319	101.319		**100.000**	
BM 45			1.467	99.852	
BM 46			1.144	100.175	
WL			1.741	99.578	
PT			1.958	99.361	
TBM			1.600	99.719	
TBM	1.651	101.370		99.719	
BM 4			1.370	100.000	
BM 45			1.519	99.851	
BM 46			1.197	100.173	
WL			1.792	99.578	
PT			2.009	99.361	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 4	100	100.000	0.000	
BM 45	99.855	99.852	-0.004	
BM 46	100.166	100.174	0.008	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.578
Pressure Transducer Reading (m)	0.264
Pressure Transducer Elevation (m)	99.314
Discharge (m^3/s)	**0.4**
Cross Sectional Area	7.657
Average Velocity	0.053

Discharge Measurement - Mid-Section Method

Measurement Time	Start	12:58	End	13:29	Location	~15 m downstream of station		
Method	Velocity-area (Mid-section)			Instrument Model		FH950		
Flow Meter Type	Current Meter			Instrument Serial #		130861001498		
Real Time Reading (m)	Start	Reading	0.264	Time	12:52	Staff Gauge (m)	n/a	
	End	Reading	0.264	Time	13:32	Time of SG Reading	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1	RB	0.75	0.00	0.0	0.14	0			0.000	0.0
2		2.75	0.14	2.0	0.42	0.00			0.000	0.0
3		6.70	0.00	4.0	0.00	0.00			0.000	0.0
4		9.30	0.06	2.6	0.07	0.04			0.003	0.7
5		9.00	0.07	0.3	0.09	0.05			0.005	1.2
6		12.00	0.15	3.0	0.38	0.06			0.023	5.5
7		14.00	0.13	2.0	0.26	0.02			0.005	1.3
8		16.00	0.13	2.0	0.20	0.07			0.014	3.4
9		17.00	0.22	1.0	0.22	0.08			0.018	4.3
10		18.00	0.14	1.0	0.14	0.10			0.014	3.4
11		19.00	0.07	1.0	0.07	0.08			0.006	1.4
12		20.00	0.23	1.0	0.23	0.03			0.007	1.7
13		21.00	0.17	1.0	0.17	0.05			0.009	2.1
14		22.00	0.22	1.0	0.22	0.09			0.020	4.9
15		23.00	0.19	1.0	0.19	0.12			0.023	5.6
16		24.00	0.16	1.0	0.16	0.02			0.003	0.8
17		25.00	0.11	1.0	0.11	0.06			0.007	1.6
18		26.00	0.14	1.0	0.14	0.13			0.018	4.5
19		27.00	0.20	1.0	0.20	0.00			0.000	0.0
20		28.00	0.20	1.0	0.20	0.09			0.018	4.4
21		29.00	0.23	1.0	0.23	0.05			0.012	2.8
22		30.00	0.28	1.0	0.28	0.02			0.006	1.4
23		31.00	0.30	1.0	0.45	0.05			0.023	5.5
24		33.00	0.20	2.0	0.40	0.08			0.032	7.9
25		35.00	0.33	2.0	0.66	0.07			0.046	11.4
26		37.00	0.31	2.0	0.62	0.07			0.043	10.7
27		39.00	0.22	2.0	0.44	0.04			0.018	4.3
28		41.00	0.18	2.0	0.36	0.06			0.022	5.3
29		43.00	0.12	2.0	0.24	0.01			0.002	0.6
30		45.00	0.00	2.0	0.00	0.00			0.000	0.0
31		47.30	0.13	2.3	0.26	0.05			0.013	3.2
32	LB	49.05	0.00	1.8	0.11	0			0.000	0.0
33										
Total Q									**0.406**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site PL-H2

Site Information				
Project Name	Back River			
Station Identification	PL-H2			
Stream Name	Propellor Lake Inflow			
Date Monitored	11-Jul-14			
Time at Site (24 hr)	Start Time:	10:30:00 AM	End Time:	12:30:00 PM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	Easting	Northing	Elevation	
	435007	7272014		
Weather Conditions				

Transducer Information			
PT Model	PT2X	PT Serial #	21252008
Gain	-	Offset	-
Status	-	Battery	-
# of Records	-	Memory Free	-
Date Serviced		Crest Gauges	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 4	1.323	101.323		**100.000**	
BM 45			1.472	99.851	
BM 46			1.149	100.174	
WL			1.755	99.568	
PT			1.962	99.361	
TBM			1.649	99.674	
TBM	1.511	101.185		99.674	
BM 4			1.187	99.998	
BM 45			1.336	99.849	
BM 46			1.012	100.173	
WL			1.619	99.566	
PT			1.827	99.358	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 4	100.000	99.999	-0.001	
BM 45	99.855	99.850	-0.005	
BM 46	100.166	100.174	0.007	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.567
Pressure Transducer Reading (m)	0.254
Pressure Transducer Elevation (m)	99.313
Discharge (m^3/s)	**0.4**
Cross Sectional Area	6.464
Average Velocity	0.062

Discharge Measurement - Mid-Section Method

Measurement Time	Start	11:02	End	11:30	Location	~15 m downstream of station		
Method	Velocity-area (Mid-section)			Instrument Model		FH950		
Flow Meter Type	Current Meter			Instrument Serial #		130861001498		
Real Time Reading (m)	Start	Reading	0.254	Time	11:02	Staff Gauge (m)	n/a	
	End	Reading	0.255	Time	11:32	Time of SG Reading	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1	RB	49.05	0.00	0.0	0.18	0			0.000	0.0
2		47.00	0.18	2.1	0.36	0.02			0.007	1.8
3		45.00	0.00	2.0	0.00	0.00			0.000	0.0
4		43.00	0.16	2.0	0.32	0.02			0.006	1.6
5		41.00	0.18	2.0	0.36	0.08			0.029	7.2
6		39.00	0.19	2.0	0.38	0.06			0.023	5.7
7		37.00	0.28	2.0	0.56	0.09			0.050	12.7
8		35.00	0.27	2.0	0.54	0.07			0.038	9.5
9		33.00	0.18	2.0	0.27	0.08			0.022	5.4
10		32.00	0.22	1.0	0.22	0.10			0.022	5.5
11		31.00	0.22	1.0	0.22	0.09			0.020	5.0
12		30.00	0.30	1.0	0.30	0.05			0.015	3.8
13		29.00	0.20	1.0	0.20	0.07			0.014	3.5
14		28.00	0.16	1.0	0.16	0.08			0.013	3.2
15		27.00	0.16	1.0	0.16	0.08			0.013	3.2
16		26.00	0.14	1.0	0.14	0.11			0.015	3.9
17		25.00	0.14	1.0	0.14	0.10			0.014	3.5
18		24.00	0.16	1.0	0.16	0.01			0.002	0.4
19		23.00	0.15	1.0	0.15	0.12			0.018	4.5
20		22.00	0.15	1.0	0.15	0.11			0.017	4.1
21		21.00	0.09	1.0	0.09	0.11			0.010	2.5
22		20.00	0.12	1.0	0.18	0.08			0.014	3.6
23		18.00	0.10	2.0	0.20	0.03			0.006	1.5
24		16.00	0.10	2.0	0.20	0.02			0.004	1.0
25		14.00	0.08	2.0	0.16	0.07			0.011	2.8
26		12.00	0.10	2.0	0.20	0.04			0.008	2.0
27		10.00	0.06	2.0	0.12	0.04			0.005	1.2
28		8.00	0.00	2.0	0.00	0.00			0.000	0.0
29		5.30	0.00	2.7	0.00	0.00			0.000	0.0
30		2.70	0.10	2.6	0.23	0.01			0.002	0.6
31		0.65	0.00	2.1	0.10	0			0.000	0.0
32										
33										
Total Q									**0.398**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site PROP-L1

Site Information				
Project Name	Back River			
Station Identification	PROPL-L1			
Stream Name	Propellor Lake			
Date Monitored	8-Jun-14			
Time at Site (24 hr)	Start Time:	3:05:00 PM	End Time:	
Personnel	Emerson Belland, Jem Morrison			
Station Cordinates	Easting	Northing	Elevation	
	434782	7279265		
Weather Conditions				

Transducer Information			
PT Model	PT2X	PT Serial #	21221025
Gain	-	Offset	-
Status	Active	Battery	2.9 V
# of Records	0	Memory Free	524139
Date Serviced	12/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 4	1.249	101.249		**100.000**	
BM 13			1.051	100.198	
BM 14			0.655	100.594	
BM 12			1.167	100.082	
BM 5			1.181	100.068	
WL			1.358	99.891	
PT			1.983	99.266	
TBM			1.708	99.541	
TBM	1.622	101.163		99.541	
BM 4			1.167	99.996	
BM 13			0.970	100.193	
BM 14			0.569	100.594	
BM 12			1.085	100.078	
BM 5			1.098	100.065	
WL			1.275	99.888	
PT			1.910	99.253	bad shot

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 4	100.000	99.998	-0.002	
BM 13	100.200	100.196	-0.005	
BM 14	100.541	100.594	0.053	

Summary	
Staff Gauge Reading (m)	-
Stage from WL Survey (m)	99.890
Pressure Transducer Reading (m)	0.635
Pressure Transducer Elevation (m)	99.254
Discharge (m^3/s)	-
Cross Sectional Area	-
Average Velocity	-

Discharge Measurement - Mid-Section Method

Measurement Time	Start		End		Location			
Method				Instrument Model				
Flow Meter Type				Instrument Serial #				
Real Time Reading (m)	Start	Reading		Time		Staff Gauge (m)	n/a	
	End	Reading		Time		Time of SG Reading	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
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Total Q										

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site PROP-L1

Site Information				
Project Name	Back River			
Station Identification	PROPL-L1			
Stream Name	Propellor Lake			
Date Monitored	14-Jun-14			
Time at Site (24 hr)	Start Time:	2:31:00 PM	End Time:	
Personnel	Jem Morrison, Kokiak Peetooloot			
Station Cordinates	Easting	Northing	Elevation	
	434782	7279265		
Weather Conditions				

Transducer Information			
PT Model	PT2X	PT Serial #	21221025
Gain	-	Offset	-
Status	Active	Battery	2.9 V
# of Records	873	Memory Free	523266
Date Serviced	12/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 4	1.351	101.351		**100.000**	
BM 13			1.158	100.193	
BM 14			0.752	100.599	
BM 12			1.269	100.082	
BM 5			1.281	100.070	
WL			1.492	99.859	
PT			2.080	99.271	
TBM			1.459	99.892	
TBM	1.421	101.313		99.892	
BM 4			1.315	99.998	
BM 13			1.119	100.194	
BM 14			0.715	100.598	
BM 12			1.231	100.082	
BM 5			1.243	100.070	
WL			1.458	99.855	
PT			2.041	99.272	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 4	100.000	99.999	-0.001	
BM 13	100.200	100.194	-0.007	
BM 14	100.541	100.599	0.058	

Summary	
Staff Gauge Reading (m)	-
Stage from WL Survey (m)	99.857
Pressure Transducer Reading (m)	0.612
Pressure Transducer Elevation (m)	99.245
Discharge (m^3/s)	-
Cross Sectional Area	-
Average Velocity	-

Discharge Measurement - Mid-Section Method

Measurement Time	Start		End		Location			
Method				Instrument Model				
Flow Meter Type				Instrument Serial #				
Real Time Reading (m)	Start	Reading		Time		Staff Gauge (m)	n/a	
	End	Reading		Time		Time of SG Reading	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
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32										
33										
Total Q										

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site PROP-L1

Site Information				
Project Name	Back River			
Station Identification	PROPL-L1			
Stream Name	Propellor Lake			
Date Monitored	3-Jul-14			
Time at Site (24 hr)	Start Time:	12:30:00 PM	End Time:	1:30:00 PM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	Easting	Northing	Elevation	
	434782	7279265		
Weather Conditions				

Transducer Information			
PT Model	PT2X	PT Serial #	21221025
Gain	-	Offset	-
Status	Active	Battery	2.9 V
# of Records	3602	Memory Free	520589
Date Serviced	12/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 4	1.503	101.503		**100.000**	
BM 5			1.422	100.081	
BM 13			1.301	100.202	
WL			1.721	99.782	
PT			2.221	99.282	
TBM			1.587	99.916	
TBM	1.817	101.733		99.916	
BM 4			1.731	100.002	
BM 5			1.651	100.082	
BM 13			1.530	100.203	
WL			1.951	99.782	
PT			2.455	99.278	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 4	100.000	100.001	0.001	
BM 5	100.077	100.082	0.004	
BM 13	100.200	100.203	0.002	

Summary	
Staff Gauge Reading (m)	-
Stage from WL Survey (m)	99.782
Pressure Transducer Reading (m)	0.539
Pressure Transducer Elevation (m)	99.243
Discharge (m^3/s)	-
Cross Sectional Area	-
Average Velocity	-

Discharge Measurement - Mid-Section Method

Measurement Time	Start		End		Location			
Method				Instrument Model				
Flow Meter Type				Instrument Serial #				
Real Time Reading (m)	Start	Reading		Time		Staff Gauge (m)	n/a	
	End	Reading		Time		Time of SG Reading	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
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33										
Total Q										

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site PROP-L1

Site Information				
Project Name	Back River			
Station Identification	PROPL-L1			
Stream Name	Propellor Lake			
Date Monitored	5-Jul-14			
Time at Site (24 hr)	Start Time:	12:48:00 PM	End Time:	
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	Easting	Northing	Elevation	
	434782	7279265		
Weather Conditions	windy			

Transducer Information			
PT Model	PT2X	PT Serial #	21221025
Gain	-	Offset	-
Status	-	Battery	-
# of Records	-	Memory Free	-
Date Serviced	12/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 4	1.492	101.492		**100.000**	
BM 5			1.411	100.081	
BM 13			1.287	100.205	
WL			1.727	99.765	
PT			2.212	99.280	
TBM			1.621	99.871	
TBM	1.502	101.373		99.871	
BM 4			1.370	100.003	
BM 5			1.288	100.085	
BM 13			1.166	100.207	
WL			1.604	99.769	
PT			2.090	99.283	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 4	100.000	100.002	0.001	
BM 5	100.077	100.083	0.006	
BM 13	100.200	100.206	0.006	

Summary	
Staff Gauge Reading (m)	-
Stage from WL Survey (m)	99.767
Pressure Transducer Reading (m)	0.524
Pressure Transducer Elevation (m)	99.243
Discharge (m^3/s)	-
Cross Sectional Area	-
Average Velocity	-

Discharge Measurement - Mid-Section Method

Measurement Time	Start		End		Location			
Method				Instrument Model				
Flow Meter Type				Instrument Serial #				
Real Time Reading (m)	Start	Reading		Time		Staff Gauge (m)	n/a	
	End	Reading		Time		Time of SG Reading	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1										
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33										
Total Q										

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site PROP-L1

Site Information				
Project Name	Back River			
Station Identification	PROPL-L1			
Stream Name	Propellor Lake			
Date Monitored	12-Jul-14			
Time at Site (24 hr)	Start Time:	2:10:00 PM	End Time:	3:00:00 PM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	Easting	Northing	Elevation	
	434782	7279265		
Weather Conditions	sunny			

Transducer Information			
PT Model	PT2X	PT Serial #	21221025
Gain	-	Offset	-
Status	Inactive	Battery	-
# of Records	4907	Memory Free	-
Date Serviced	12/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 4	1.602	101.602		**100.000**	
BM 5			1.519	100.083	
BM 13			1.400	100.202	
WL			1.869	99.733	
PT			2.321	99.281	
TBM			1.742	99.860	
TBM	1.442	101.302		99.860	
BM 4			1.297	100.005	
BM 5			1.213	100.089	
BM 13			1.096	100.206	
WL			1.569	99.733	
PT			2.019	99.283	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 4	100.000	100.003	0.002	
BM 5	100.077	100.086	0.009	
BM 13	100.200	100.204	0.004	

Summary	
Staff Gauge Reading (m)	-
Stage from WL Survey (m)	99.733
Pressure Transducer Reading (m)	0.486
Pressure Transducer Elevation (m)	99.247
Discharge (m^3/s)	-
Cross Sectional Area	-
Average Velocity	-

Discharge Measurement - Mid-Section Method

Measurement Time	Start		End		Location			
Method				Instrument Model				
Flow Meter Type				Instrument Serial #				
Real Time Reading (m)	Start	Reading		Time		Staff Gauge (m)	n/a	
	End	Reading		Time		Time of SG Reading	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1										
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32										
33										
Total Q										

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site GRG-L1

Site Information				
Project Name	Back River			
Station Identification	GRG-L1			
Lake Name	George Lake			
Date Monitored	6-Jun-14			
Time at Site (24 hr)	Start Time:	2:00:00 PM	End Time:	
Personnel	Emerson Belland, Jem Morrison			
Station Cordinates	Easting	Northing	Elevation	
	386771	7314895		
Weather Conditions	sunny, cool			

Transducer Information			
DL Model	PT2X	PT Serial #	21251010
Gain	-	Offset	-
Status	-	Battery	-
# of Records	-	Memory Free	-
Date Serviced	5/14/2013	Crest Gauges	n/a

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 88	0.580	100.580		**100.000**	P
BM 89			1.677	98.903	
BM 90			1.834	98.746	
WL			3.254	97.326	
PT			-	-	
TBM			3.062	97.518	
TBM	2.935	100.453		97.518	
BM 88			0.453	100.000	
BM 89			1.550	98.903	
BM 90			1.707	98.746	
WL			3.128	97.325	
PT			-	-	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 88	-	100.000	-	
BM 89	-	98.903	-	
BM 90	-	98.746	-	

Summary	
Staff Gauge Reading (m)	-
Stage from WL Survey (m)	97.326
Pressure Transducer Reading (m)	-
Pressure Transducer Elevation (m)	-
Discharge (m^3/s)	-
Cross Sectional Area	-
Average Velocity	-

Discharge Measurement - Mid-Section Method

Measurement Time	Start		End		Location						
Method	Velocity-area (Mid-section)				Instrument Model						
Flow Meter Type					Instrument Serial #						
Real Time Reading (m)	Start	Reading			Time		Staff Gauge (m)				
	End	Reading			Time		Time of SG Reading				
		Station	Depth	Distance	Area	Velocity (m/s)				Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%		(m^3/s)	%
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33											
Total Q											

General Notes

Site established. Too much ice present to install the pressure transducer.

Appendix 3. Manual Stage and Discharge Measurements, Site GRG-L1

Site Information				
Project Name	Back River			
Station Identification	GRG-L1			
Lake Name	George Lake			
Date Monitored	12-Jun-14			
Time at Site (24 hr)	Start Time:	11:20:00 AM	End Time:	
Personnel	Jem Morrison, Kokiak Peetooloot			
Station Cordinates	Easting	Northing	Elevation	
	386771	7314895		
Weather Conditions				

Transducer Information			
PT Model	PT2X	PT Serial #	21251010
Gain	-	Offset	-
Status	Active	Battery	2.7 V
# of Records	0	Memory Free	524139
Date Serviced	5/14/2013	Crest Gauges	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 88	0.381	100.381		**100.000**	
BM 89			1.479	98.902	
BM 90			1.635	98.746	
WL			3.050	97.331	bad shot
PT			3.784	96.597	
TBM			2.872	97.509	
TBM	2.890	100.399		97.509	
BM 88			0.400	99.999	
BM 89			1.498	98.901	
BM 90			1.654	98.745	
WL			3.078	97.321	
PT			3.801	96.598	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 88	100.000	100.000	-0.001	
BM 89	98.903	98.902	-0.002	
BM 90	98.746	98.746	-0.001	

Summary	
Staff Gauge Reading (m)	-
Stage from WL Survey (m)	97.321
Pressure Transducer Reading (m)	0.774
Pressure Transducer Elevation (m)	96.547
Discharge (m^3/s)	-
Cross Sectional Area	-
Average Velocity	-

Discharge Measurement - Mid-Section Method

Measurement Time	Start		End		Location						
Method	Velocity-area (Mid-section)				Instrument Model						
Flow Meter Type					Instrument Serial #						
Real Time Reading (m)	Start	Reading		Time		Staff Gauge (m)					
	End	Reading		Time		Time of SG Reading					

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
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32										
33										
Total Q										

General Notes

Pressure transducer installed this visit.

Appendix 3. Manual Stage and Discharge Measurements, Site GRG-L1

Site Information				
Project Name	Back River			
Station Identification	GRG-L1			
Lake Name	George Lake			
Date Monitored	13-Jun-14			
Time at Site (24 hr)	Start Time:	2:10:00 PM	End Time:	
Personnel	Jem Morrison, Kokiak Peetoolott			
Station Cordinates	Easting	Northing	Elevation	
	386771	7314895		
Weather Conditions				

Transducer Information			
PT Model	PT2X	PT Serial #	21251010
Gain	-	Offset	-
Status	Active	Battery	2.7 V
# of Records	161	Memory Free	523978
Date Serviced	5/14/2013	Crest Gauges	n/a

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 88	0.422	100.422		**100.000**	
BM 89			1.519	98.903	
BM 90			1.676	98.746	
WL			3.098	97.324	
PT			3.828	96.594	
TBM			3.041	97.381	
TBM	2.978	100.359		97.381	
BM 88			0.359	100.000	
BM 89			1.458	98.901	
BM 90			1.614	98.745	
WL			3.033	97.326	
PT			3.762	96.597	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 88	100.000	100.000	0.000	
BM 89	98.903	98.902	-0.001	
BM 90	98.746	98.746	-0.001	

Summary	
Staff Gauge Reading (m)	-
Stage from WL Survey (m)	97.325
Pressure Transducer Reading (m)	0.778
Pressure Transducer Elevation (m)	96.547
Discharge (m^3/s)	-
Cross Sectional Area	-
Average Velocity	-

Discharge Measurement - Mid-Section Method

Measurement Time	Start		End		Location						
Method	Velocity-area (Mid-section)				Instrument Model						
Flow Meter Type					Instrument Serial #						
Real Time Reading (m)	Start	Reading			Time		Staff Gauge (m)				
	End	Reading			Time		Time of SG Reading				
		Station	Depth	Distance	Area	Velocity (m/s)				Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%		(m^3/s)	%
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33											
Total Q											

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site GRG-L1

Site Information				
Project Name	Back River			
Station Identification	GRG-L1			
Lake Name	George Lake			
Date Monitored	16-Jun-14			
Time at Site (24 hr)	Start Time:	2:08:00 PM	End Time:	
Personnel	Jem Morrison, Kokiak Peetooloot			
Station Cordinates	Easting	Northing	Elevation	
	386771	7314895		
Weather Conditions				

Transducer Information			
PT Model	PT2X	PT Serial #	21251010
Gain	-	Offset	-
Status	Active	Battery	2.7 V
# of Records	593	Memory Free	523546
Date Serviced	5/14/2013	Crest Gauges	n/a

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 88	0.553	100.553		**100.000**	
BM 89			1.651	98.902	
BM 90			1.808	98.745	
WL			3.222	97.331	
PT			3.966	96.587	
TBM			2.479	98.074	
TBM	2.392	100.466		98.074	
BM 88			0.469	99.997	
BM 89			1.567	98.899	
BM 90			1.723	98.743	
WL			3.135	97.331	
PT			3.881	96.585	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 88	100.000	99.999	-0.001	
BM 89	98.903	98.901	-0.003	
BM 90	98.746	98.744	-0.002	

Summary	
Staff Gauge Reading (m)	-
Stage from WL Survey (m)	97.331
Pressure Transducer Reading (m)	0.794
Pressure Transducer Elevation (m)	96.537
Discharge (m^3/s)	-
Cross Sectional Area	-
Average Velocity	-

Discharge Measurement - Mid-Section Method

Measurement Time	Start		End		Location						
Method	Velocity-area (Mid-section)			Instrument Model							
Flow Meter Type				Instrument Serial #							
Real Time Reading (m)	Start	Reading		Time		Staff Gauge (m)					
	End	Reading		Time		Time of SG Reading					

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1										
2										
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33										
Total Q										

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site GRG-L1

Site Information				
Project Name	Back River			
Station Identification	GRG-L1			
Lake Name	George Lake			
Date Monitored	1-Jul-14			
Time at Site (24 hr)	Start Time:	3:52:00 PM	End Time:	5:00:00 PM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	Easting	Northing	Elevation	
	386771	7314895		
Weather Conditions				

Transducer Information			
PT Model	PT2X	PT Serial #	21251010
Gain	-	Offset	-
Status	Active	Battery	2.7 V
# of Records	2763	Memory Free	521376
Date Serviced	5/14/2013	Crest Gauges	n/a

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 88	0.291	100.291		100.000	
BM 89			1.389	98.902	
BM 90			1.546	98.745	
WL			2.966	97.325	
PT			3.738	96.553	
TBM			1.973	98.318	
TBM	1.908	100.226		98.318	
BM 88			0.228	99.998	
BM 89			1.324	98.902	
BM 90			1.481	98.745	
WL			2.901	97.325	
PT			3.673	96.553	
BM#	Established Elevation (m)	Mean Elevation (this date) (m)		Difference (m)	Notes
BM 88	100.00	99.999		-0.001	
BM 89	98.903	98.902		-0.001	
BM 90	98.746	98.745		-0.001	

Summary	
Staff Gauge Reading (m)	-
Stage from WL Survey (m)	97.325
Pressure Transducer Reading (m)	0.826
Pressure Transducer Elevation (m)	96.499
Discharge (m^3/s)	-
Cross Sectional Area	-
Average Velocity	-

Discharge Measurement - Mid-Section Method

Measurement Time	Start		End		Location						
Method	Velocity-area (Mid-section)			Instrument Model							
Flow Meter Type				Instrument Serial #							
Real Time Reading (m)	Start	Reading		Time		Staff Gauge (m)					
	End	Reading		Time		Time of SG Reading					

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										
26										
27										
28										
29										
30										
31										
32										
33										
Total Q										

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site GRG-L1

Site Information				
Project Name	Back River			
Station Identification	GRG-L1			
Lake Name	George Lake			
Date Monitored	3-Jul-14			
Time at Site (24 hr)	Start Time:	11:00:00 AM	End Time:	11:34:00 AM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	Easting	Northing	Elevation	
	386771	7314895		
Weather Conditions				

Transducer Information			
PT Model	PT2X	PT Serial #	21251010
Gain	-	Offset	-
Status	Active	Battery	2.7 V
# of Records	3170	Memory Free	520969
Date Serviced	5/14/2013	Crest Gauges	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 88		99.754		**100.000**	Too high to shoot
BM 89			0.852	98.902	
BM 90			1.009	98.745	
WL			2.446	97.308	
PT			3.204	96.550	
TBM			0.870	98.884	
TBM	1.465	100.349		98.884	
BM 88			0.349	100.000	
BM 89			1.446	98.903	
BM 90			1.603	98.746	
WL			3.042	97.307	
PT			3.795	96.554	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 88	100.000	100.000	0.000	
BM 89	98.903	98.903	-0.001	
BM 90	98.746	98.746	0.000	

Summary	
Staff Gauge Reading (m)	-
Stage from WL Survey (m)	97.308
Pressure Transducer Reading (m)	0.813
Pressure Transducer Elevation (m)	96.495
Discharge (m^3/s)	-
Cross Sectional Area	-
Average Velocity	-

Discharge Measurement - Mid-Section Method

Measurement Time	Start		End		Location						
Method	Velocity-area (Mid-section)			Instrument Model							
Flow Meter Type				Instrument Serial #							
Real Time Reading (m)	Start	Reading		Time		Staff Gauge (m)					
	End	Reading		Time		Time of SG Reading					

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										
26										
27										
28										
29										
30										
31										
32										
33										
Total Q										

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site GRG-L1

Site Information				
Project Name	Back River			
Station Identification	GRG-L1			
Lake Name	George Lake			
Date Monitored	12-Jul-14			
Time at Site (24 hr)	Start Time:	10:16:00 AM	End Time:	
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	Easting	Northing	Elevation	
	386771	7314895		
Weather Conditions				

Transducer Information			
PT Model	PT2X	PT Serial #	21251010
Gain	-	Offset	-
Status	Active	Battery	2.7 V
# of Records	4316	Memory Free	519823
Date Serviced	5/14/2013	Crest Gauges	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 88	0.241	100.241		**100.000**	
BM 89			1.338	98.903	
BM 90			1.495	98.746	
WL			2.973	97.268	
PT			3.690	96.551	
TBM			1.906	98.335	
TBM	2.061	100.396		98.335	
BM 88			0.397	99.999	
BM 89			1.493	98.903	
BM 90			1.650	98.746	
WL			3.129	97.267	
PT			3.843	96.553	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 88	100.000	100.000	-0.001	
BM 89	98.903	98.903	0.000	
BM 90	98.746	98.746	0.000	

Summary	
Staff Gauge Reading (m)	-
Stage from WL Survey (m)	97.268
Pressure Transducer Reading (m)	0.778
Pressure Transducer Elevation (m)	96.490
Discharge (m^3/s)	-
Cross Sectional Area	-
Average Velocity	-

Discharge Measurement - Mid-Section Method

Measurement Time	Start		End		Location			
Method	Velocity-area (Mid-section)			Instrument Model				
Flow Meter Type				Instrument Serial #				
Real Time Reading (m)	Start	Reading		Time		Staff Gauge (m)		
	End	Reading		Time		Time of SG Reading		

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										
26										
27										
28										
29										
30										
31										
32										
33										
Total Q										

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site KL-H2

Site Information				
Project Name	Back River			
Station Identification	KL-H2			
Stream Name	George Lake Outflow			
Date Monitored	6-Jun-14			
Time at Site (24 hr)	**Start Time:**	10:53:00 AM	**End Time:**	
Personnel	Emerson Belland, Jem Morrison			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	386687	7314673		
Weather Conditions				

Transducer Information			
PT Model	PT2X	**PT Serial #**	21251009
Gain	-	**Offset**	-
Status	Active	**Battery**	2.7 V
# of Records	0	**Memory Free**	524139
Date Serviced	9/10/2013	**Crest Gauges**	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 76	1.327	102.056		**100.729**	
BM 42			1.449	100.607	
BM 43			1.606	100.450	
WL			2.560	99.496	
PT			~~3.004~~	~~99.052~~	
PZF			2.779	99.277	
TBM			1.353	100.703	
TBM	1.269	101.972		100.703	
BM 76			1.244	100.728	
BM 42			1.366	100.606	
BM 43			1.523	100.449	
WL			2.475	99.497	
PT			2.973	98.999	shot twice with TBM

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 76	100.728	100.729	0.001	
BM 42	100.617	100.607	-0.010	
BM 43	100.460	100.450	-0.010	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.497
Pressure Transducer Reading (m)	0.662
Pressure Transducer Elevation (m)	98.835
Discharge (m^3/s)	**0.1**
Cross Sectional Area	0.365
Average Velocity	0.313

Discharge Measurement - Mid-Section Method

Measurement Time	**Start**	12:53	**End**		**Location**			
Method	Velocity-area (Mid-section)			**Instrument Model**	FH950			
Flow Meter Type	Current Meter			**Instrument Serial #**	130861001498			
Real Time Reading (m)	**Start**	**Reading**	0.663	**Time**	12:58	**Staff Gauge (m)**	n/a	
	End	**Reading**	0.663	**Time**	13:38	**Time of SG Reading**	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	**Notes**	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
1	RB	6.64	0.00	0.0	0.01	0			0.000	0.0
2		6.50	0.21	0.1	0.03	0.34			0.010	9.1
3		6.35	0.16	0.2	0.02	0.27			0.005	4.7
4		6.25	0.14	0.1	0.01	0.35			0.005	4.3
5		6.15	0.13	0.1	0.01	0.37			0.005	4.2
6		6.05	0.18	0.1	0.02	0.33			0.006	5.2
7		5.95	0.16	0.1	0.02	0.35			0.006	4.9
8		5.85	0.13	0.1	0.01	0.36			0.005	4.1
9		5.75	0.16	0.1	0.02	0.27			0.004	3.8
10		5.65	0.14	0.1	0.01	0.31			0.004	3.8
11		5.55	0.12	0.1	0.01	0.26			0.003	2.7
12		5.45	0.13	0.1	0.01	0.31			0.004	3.5
13		5.35	0.15	0.1	0.02	0.27			0.004	3.5
14		5.25	0.12	0.1	0.01	0.36			0.004	3.8
15		5.15	0.12	0.1	0.01	0.36			0.004	3.8
16		5.05	0.11	0.1	0.01	0.31			0.003	3.0
17		4.95	0.10	0.1	0.01	0.38			0.004	3.3
18		4.85	0.10	0.1	0.01	0.41			0.004	3.6
19		4.75	0.09	0.1	0.01	0.39			0.004	3.1
20		4.65	0.10	0.1	0.01	0.42			0.004	3.7
21		4.55	0.08	0.1	0.01	0.44			0.004	3.1
22		4.45	0.08	0.1	0.01	0.37			0.003	2.6
23		4.35	0.10	0.1	0.01	0.39			0.004	3.4
24		4.25	0.12	0.1	0.01	0.42			0.005	4.4
25		4.15	0.12	0.1	0.01	0.27			0.003	2.8
26		4.05	0.10	0.1	0.01	0.32			0.003	2.8
27		3.95	0.08	0.1	0.01	0.21			0.002	1.5
28		3.85	0.07	0.1	0.01	0.12			0.001	0.7
29		3.75	0.04	0.1	0.00	0.12			0.000	0.4
30		3.65	0.02	0.1	0.00	0.15			0.000	0.3
31	LB	3.55	0.00	0.1	0.00	0			0.000	0.0
32										
33										
Total Q									**0.114**	**100.0**

General Notes

Under snow flow may not have been captured in this measurement.

Appendix 3. Manual Stage and Discharge Measurements, Site KL-H2

Site Information				
Project Name	Back River			
Station Identification	KL-H2			
Stream Name	George Lake Outflow			
Date Monitored	12-Jun-14			
Time at Site (24 hr)	Start Time:	8:45:00 AM	End Time:	
Personnel	Jem Morrison, Kokiak Peetooloot			
Station Cordinates	Easting	Northing	Elevation	
	386687	7314673		
Weather Conditions	overcast			

Transducer Information			
DL Model	PT2X	PT Serial #	21251009
Gain	-	Offset	-
Status	Active	Battery	2.7 V
# of Records	854	Memory Free	523285
Date Serviced	9/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 76	1.337	102.066		**100.729**	
BM 74			-	-	
BM 42			1.454	100.612	
BM 43			1.611	100.455	
WL			2.559	99.507	
PT			3.068	98.998	
TBM			2.483	99.583	
TBM	2.410	101.993		99.583	
BM 76			1.264	100.729	
BM 74			-	-	
BM 42			1.381	100.612	
BM 43			1.540	100.453	
WL			2.488	99.505	
PT			2.996	98.997	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 76	100.728	100.729	0.001	
BM 42	100.617	100.612	-0.005	
BM 43	100.460	100.454	-0.006	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.506
Pressure Transducer Reading (m)	0.668
Pressure Transducer Elevation (m)	98.838
Discharge (m^3/s)	**0.1**
Cross Sectional Area	2.196
Average Velocity	0.059

Discharge Measurement - Mid-Section Method

Measurement Time	Start	10:15	End		Location			
Method	Velocity-area (Mid-section)			Instrument Model		FH950		
Flow Meter Type	Current Meter			Instrument Serial #		130861001498		
Real Time Reading (m)	Start	Reading	0.669	Time	8:48	Staff Gauge (m)	n/a	
	End	Reading	0.671	Time	10:18	Time of SG Reading	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1	RB	4.50	0.00	0.0	0.01	0			0.000	0.0
2		4.60	0.22	0.1	0.04	-0.01			0.000	-0.3
3		4.90	0.21	0.3	0.06	-0.03			-0.002	-1.3
4		5.15	0.29	0.3	0.07	0.07			0.005	3.9
5		5.40	0.30	0.3	0.08	0.22			0.017	12.8
6		5.65	0.37	0.3	0.09	0.15			0.014	10.8
7		5.90	0.37	0.3	0.09	0.05			0.005	3.6
8		6.15	0.32	0.3	0.10	-0.03			-0.003	-2.2
9		6.50	0.30	0.4	0.10	-0.01			-0.001	-0.8
10		6.80	0.30	0.3	0.10	0.00			0.000	0.0
11		7.15	0.34	0.4	0.10	0.06			0.006	4.7
12		7.40	0.30	0.3	0.08	0.04			0.003	2.6
13		7.70	0.34	0.3	0.10	0.01			0.001	0.8
14		8.00	0.35	0.3	0.11	0.03			0.003	2.4
15		8.30	0.35	0.3	0.11	0.02			0.002	1.6
16		8.60	0.30	0.3	0.09	0.04			0.004	2.8
17		8.90	0.32	0.3	0.10	0.04			0.004	3.0
18		9.20	0.36	0.3	0.10	0.06			0.006	4.6
19		9.45	0.44	0.3	0.11	0.07			0.008	6.0
20		9.70	0.41	0.3	0.10	0.09			0.009	7.2
21		9.95	0.42	0.3	0.11	0.11			0.012	9.0
22		10.20	0.43	0.3	0.11	0.10			0.011	8.3
23		10.45	0.42	0.3	0.12	0.11			0.013	9.9
24		10.75	0.36	0.3	0.10	0.12			0.012	9.2
25		11.00	0.09	0.3	0.02	0.08			0.002	1.5
26	LB	11.30	0.00	0.3	0.01	0			0.000	0.0
27										
28										
29										
30										
31										
32										
33										
Total Q									**0.129**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site KL-H2

Site Information				
Project Name	Back River			
Station Identification	KL-H2			
Stream Name	George Lake Outflow			
Date Monitored	13-Jun-14			
Time at Site (24 hr)	Start Time:	12:59:00 PM	End Time:	
Personnel	Jem Morrison, Kokiak Peetooloot			
Station Cordinates	Easting	Northing	Elevation	
	386687	7314673		
Weather Conditions				

Transducer Information			
DL Model	PT2X	PT Serial #	21251009
Gain	-	Offset	-
Status	Active	Battery	2.8 V
# of Records	1024	Memory Free	523115
Date Serviced	9/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 76	1.359	102.088		**100.729**	
BM 74			-	-	
BM 42			1.478	100.610	
BM 43			1.635	100.453	
WL			2.581	99.507	
PT			2.954	98.993	shot with 2nd TBM
TBM			2.541	99.547	
TBM	2.466	102.013		99.547	
BM 76			1.283	100.730	
BM 74			-	-	
BM 42			1.401	100.612	
BM 43			1.559	100.454	
WL			2.505	99.508	
PT			3.018	98.995	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 76	100.728	100.730	0.002	
BM 42	100.617	100.611	-0.006	
BM 43	100.460	100.454	-0.007	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.508
Pressure Transducer Reading (m)	0.677
Pressure Transducer Elevation (m)	98.831
Discharge (m^3/s)	**0.1**
Cross Sectional Area	2.196
Average Velocity	0.062

Discharge Measurement - Mid-Section Method

Measurement Time	Start	12:59	End		Location			
Method	Velocity-area (Mid-section)			Instrument Model		FH950		
Flow Meter Type	Current Meter			Instrument Serial #		130861001498		
Real Time Reading (m)	Start	Reading	0.676	Time	12:58	Staff Gauge (m)	n/a	
	End	Reading	0.678	Time	13:58	Time of SG Reading	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1	RB	3.90	0.00	0.0	0.02	0			0.000	0.0
2		4.05	0.22	0.2	0.04	-0.02			-0.001	-0.7
3		4.30	0.20	0.3	0.05	-0.01			-0.001	-0.4
4		4.55	0.29	0.3	0.07	0.05			0.004	2.7
5		4.80	0.30	0.3	0.08	0.27			0.020	15.0
6		5.05	0.29	0.3	0.07	0.17			0.012	9.1
7		5.30	0.34	0.3	0.09	0.04			0.004	2.8
8		5.60	0.32	0.3	0.09	-0.04			-0.004	-2.6
9		5.85	0.30	0.3	0.08	-0.02			-0.002	-1.2
10		6.15	0.31	0.3	0.09	0.02			0.002	1.3
11		6.40	0.34	0.3	0.09	0.07			0.007	4.8
12		6.70	0.30	0.3	0.09	0.05			0.005	3.3
13		7.00	0.31	0.3	0.09	0.01			0.001	0.6
14		7.25	0.33	0.3	0.08	0.02			0.002	1.2
15		7.50	0.34	0.3	0.09	0.02			0.002	1.4
16		7.80	0.33	0.3	0.10	0.03			0.003	2.2
17		8.10	0.32	0.3	0.10	0.05			0.005	3.6
18		8.40	0.35	0.3	0.11	0.06			0.006	4.7
19		8.70	0.45	0.3	0.14	0.07			0.009	7.0
20		9.00	0.45	0.3	0.14	0.09			0.012	9.0
21		9.30	0.46	0.3	0.14	0.09			0.012	9.2
22		9.60	0.42	0.3	0.13	0.11			0.014	10.3
23		9.90	0.34	0.3	0.10	0.09			0.009	6.8
24		10.20	0.38	0.3	0.11	0.11			0.013	9.3
25		10.50	0.06	0.3	0.02	0.06			0.001	0.7
26	LB	10.70	0.00	0.2	0.01	0			0.000	0.0
27										
28										
29										
30										
31										
32										
33										
Total Q									**0.135**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site KL-H2

Site Information				
Project Name	Back River			
Station Identification	KL-H2			
Stream Name	George Lake Outflow			
Date Monitored	16-Jun-14			
Time at Site (24 hr)	Start Time:	1:04:00 PM	End Time:	
Personnel	Jem Morrison, Kokiak Peetooloot			
Station Cordinates	Easting	Northing	Elevation	
	386687	7314673		
Weather Conditions				

Transducer Information			
DL Model	PT2X	PT Serial #	21251009
Gain	-	Offset	-
Status	Active	Battery	2.7 V
# of Records	1456	Memory Free	522683
Date Serviced	9/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 76	1.368	102.097		**100.729**	
BM 74			2.251	99.846	
BM 42			1.486	100.611	
BM 43			1.643	100.454	
WL			2.584	99.513	
PT			3.114	98.983	
TBM			2.516	99.581	
TBM	2.408	101.989		99.581	
BM 76			1.261	100.728	
BM 74			2.144	99.845	
BM 42			1.379	100.610	
BM 43			1.537	100.452	
WL			2.475	99.514	
PT			3.005	98.984	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 76	100.728	100.729	0.001	
BM 42	100.617	100.611	-0.007	
BM 43	100.460	100.453	-0.007	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.514
Pressure Transducer Reading (m)	0.686
Pressure Transducer Elevation (m)	98.828
Discharge (m^3/s)	**0.2**
Cross Sectional Area	2.373
Average Velocity	0.070

Discharge Measurement - Mid-Section Method

Measurement Time	Start	13:04	End		Location			
Method	Velocity-area (Mid-section)			Instrument Model		FH950		
Flow Meter Type	Current Meter			Instrument Serial #		130861001498		
Real Time Reading (m)	Start	Reading	0.689	Time	13:08	Staff Gauge (m)	n/a	
	End	Reading	0.689	Time	14:08	Time of SG Reading	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1	RB	3.90	0.00	0.0	0.03	0			0.000	0.0
2		4.10	0.25	0.2	0.05	-0.02			-0.001	-0.6
3		4.30	0.20	0.2	0.04	-0.01			0.000	-0.2
4		4.50	0.21	0.2	0.04	0.08			0.003	2.0
5		4.70	0.49	0.2	0.10	0.21			0.021	12.4
6		4.90	0.34	0.2	0.07	0.17			0.012	7.0
7		5.10	0.38	0.2	0.09	0.22			0.019	11.4
8		5.35	0.37	0.3	0.09	0.08			0.007	4.5
9		5.60	0.34	0.3	0.09	0.05			0.005	2.8
10		5.90	0.32	0.3	0.10	0.06			0.006	3.5
11		6.20	0.33	0.3	0.10	0.04			0.004	2.4
12		6.50	0.34	0.3	0.10	0.02			0.002	1.2
13		6.80	0.34	0.3	0.10	0.03			0.003	1.8
14		7.10	0.36	0.3	0.11	0.00			0.000	0.0
15		7.40	0.36	0.3	0.11	0.00			0.000	0.0
16		7.70	0.38	0.3	0.11	0.02			0.002	1.4
17		8.00	0.34	0.3	0.10	0.04			0.004	2.5
18		8.30	0.34	0.3	0.10	0.06			0.006	3.7
19		8.60	0.38	0.3	0.13	0.07			0.009	5.6
20		9.00	0.48	0.4	0.17	0.07			0.012	7.1
21		9.30	0.47	0.3	0.14	0.06			0.008	5.1
22		9.60	0.45	0.3	0.12	0.1			0.012	7.5
23		9.85	0.44	0.3	0.12	0.11			0.013	8.0
24		10.15	0.42	0.3	0.12	0.12			0.014	8.4
25		10.40	0.14	0.3	0.04	0.1			0.004	2.3
26		10.70	0.02	0.3	0.00	0.06			0.000	0.1
27	LB	10.80	0.00	0.1	0.00	0			0.000	0.0
28										
29										
30										
31										
32										
33										
Total Q									**0.165**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site KL-H2

Site Information				
Project Name	Back River			
Station Identification	KL-H2			
Stream Name	George Lake Outflow			
Date Monitored	1-Jul-14			
Time at Site (24 hr)	Start Time:	1:15:00 PM	End Time:	3:00:00 PM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	Easting	Northing	Elevation	
	386687	7314673		
Weather Conditions				

Transducer Information			
PT Model	PT2X	PT Serial #	21251009
Gain	-	Offset	-
Status	-	Battery	2.7
# of Records	-	Memory Free	520512
Date Serviced	9/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 73	1.377	101.377		**100.000**	
BM 74			1.529	99.848	
BM 76			0.649	100.728	destroyed later in July
WL			1.865	99.512	
PT			2.414	98.963	
TBM			1.889	99.488	
TBM	1.925	101.413		99.488	
BM 73			1.414	99.999	
BM 74			1.566	99.847	
BM 76			0.684	100.729	
WL			1.903	99.510	
PT			2.462	98.951	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 73	100.000	100.000	-0.001	
BM 74	99.848	99.848	0.000	
BM 76	100.728	100.729	0.001	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.511
Pressure Transducer Reading (m)	0.732
Pressure Transducer Elevation (m)	98.779
Discharge (m^3/s)	**0.1**
Cross Sectional Area	2.077
Average Velocity	0.071

Discharge Measurement - Mid-Section Method

Measurement Time	Start	13:43	End	14:19	Location	~20 m downstream of pressure transducer		
Method	Velocity-area (Mid-section)			Instrument Model		FH950		
Flow Meter Type	Current Meter			Instrument Serial #		130861001498		
Real Time Reading (m)	Start	Reading	0.730	Time	13:38	Staff Gauge (m)	n/a	
	End	Reading	0.735	Time	14:18	Time of SG Reading	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1	RB	7.60	0.00	0.0	0.01	0			0.000	0.0
2		7.32	0.08	0.3	0.02	0.00			0.000	0.0
3		7.15	0.13	0.2	0.02	0.22			0.005	3.1
4		7.00	0.22	0.2	0.03	0.35			0.010	6.5
5		6.90	0.25	0.1	0.04	0.37			0.014	9.4
6		6.70	0.25	0.2	0.04	0.18			0.007	4.6
7		6.60	0.26	0.1	0.03	0.18			0.005	3.2
8		6.50	0.27	0.1	0.03	0.26			0.007	4.7
9		6.40	0.26	0.1	0.04	0.19			0.007	5.0
10		6.20	0.37	0.2	0.08	-0.03			-0.002	-1.7
11		5.95	0.20	0.3	0.04	0.19			0.008	5.1
12		5.80	0.29	0.2	0.05	0.04			0.002	1.4
13		5.60	0.26	0.2	0.05	0.08			0.004	2.8
14		5.40	0.28	0.2	0.06	0.03			0.002	1.1
15		5.20	0.28	0.2	0.06	0.04			0.002	1.5
16		5.00	0.30	0.2	0.07	0.01			0.001	0.5
17		4.75	0.31	0.3	0.08	-0.01			-0.001	-0.5
18		4.50	0.16	0.3	0.04	0.00			0.000	0.0
19		4.25	0.20	0.3	0.05	0.00			0.000	0.0
20		4.00	0.30	0.3	0.08	0.02			0.002	1.0
21		3.75	0.38	0.3	0.10	0.05			0.005	3.2
22		3.50	0.33	0.3	0.08	0.05			0.004	2.8
23		3.25	0.32	0.3	0.08	0.04			0.003	2.2
24		3.00	0.40	0.3	0.15	0.06			0.009	6.1
25		2.50	0.45	0.5	0.23	0.07			0.016	10.6
26		2.00	0.47	0.5	0.24	0.09			0.021	14.3
27		1.50	0.46	0.5	0.21	0.08			0.017	11.2
28		1.10	0.22	0.4	0.08	0.04			0.003	2.1
29	LB	0.80	0.00	0.3	0.03	0			0.000	0.0
30										
31										
32										
33										
Total Q									**0.148**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site KL-H2

Site Information				
Project Name	Back River			
Station Identification	KL-H2			
Stream Name	George Lake Outflow			
Date Monitored	4-Jul-14			
Time at Site (24 hr)	Start Time:	9:00:00 AM	End Time:	10:30:00 AM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	Easting	Northing	Elevation	
	386687	7314673		
Weather Conditions	sunny			

Transducer Information			
DL Model	PT2X	PT Serial #	21251009
Gain	-	Offset	-
Status	-	Battery	-
# of Records	-	Memory Free	-
Date Serviced	9/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 73	2.021	102.021		**100.000**	
BM 74			2.173	99.848	
BM 42			1.401	100.620	
BM 43			1.559	100.462	
WL			2.521	99.500	
PT			3.061	98.960	
TBM			1.362	100.659	
TBM	0.746	101.405		100.659	
BM 73			1.406	99.999	
BM 74			1.558	99.847	
BM 42			0.787	100.618	
BM 43			0.944	100.461	
WL			1.905	99.500	
PT			2.444	98.961	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 73	100.000	100.000	-0.001	
BM 42	100.617	100.619	0.002	
BM 43	100.46	100.462	0.002	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.500
Pressure Transducer Reading (m)	0.716
Pressure Transducer Elevation (m)	98.784
Discharge (m^3/s)	**0.1**
Cross Sectional Area	2.170
Average Velocity	0.069

Discharge Measurement - Mid-Section Method

Measurement Time	Start	9:10	End	9:43	Location	~20 m downstream of pressure transducer		
Method	Velocity-area (Mid-section)			Instrument Model		FH950		
Flow Meter Type	Current Meter			Instrument Serial #		130861001498		
Real Time Reading (m)	Start	Reading	0.716	Time	9:08	Staff Gauge (m)	n/a	
	End	Reading	0.717	Time	9:48	Time of SG Reading	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1	LB	0.80	0.00	0.0	0.02	0			0.000	0.0
2		1.00	0.20	0.2	0.05	0.08			0.004	2.4
3		1.25	0.34	0.3	0.09	0.13			0.011	7.4
4		1.50	0.41	0.3	0.10	0.09			0.009	6.2
5		1.75	0.43	0.3	0.11	0.07			0.008	5.0
6		2.00	0.46	0.3	0.12	0.08			0.009	6.2
7		2.25	0.43	0.3	0.11	0.09			0.010	6.5
8		2.50	0.46	0.3	0.12	0.09			0.010	6.9
9		2.75	0.42	0.3	0.11	0.06			0.006	4.2
10		3.00	0.37	0.3	0.09	0.05			0.005	3.1
11		3.25	0.31	0.3	0.08	0.03			0.002	1.6
12		3.50	0.31	0.3	0.08	0.03			0.002	1.6
13		3.75	0.32	0.3	0.08	0.03			0.002	1.6
14		4.00	0.34	0.3	0.09	0.01			0.001	0.6
15		4.25	0.18	0.3	0.05	0.00			0.000	0.0
16		4.50	0.33	0.3	0.08	0.02			0.002	1.1
17		4.75	0.24	0.3	0.06	0.04			0.002	1.6
18		5.00	0.26	0.3	0.07	0.07			0.005	3.0
19		5.25	0.27	0.3	0.07	0.04			0.003	1.8
20		5.50	0.31	0.3	0.08	-0.01			-0.001	-0.5
21		5.75	0.30	0.3	0.08	-0.03			-0.002	-1.5
22		6.00	0.30	0.3	0.08	-0.02			-0.002	-1.0
23		6.25	0.34	0.3	0.07	0.00			0.000	0.0
24		6.40	0.33	0.2	0.04	0.19			0.008	5.2
25		6.50	0.33	0.1	0.03	0.21			0.007	4.6
26		6.60	0.31	0.1	0.05	0.13			0.006	4.0
27		6.20	0.24	0.4	0.02	0.18			0.004	2.9
28		6.80	0.29	0.6	0.10	0.32			0.032	21.7
29		6.90	0.29	0.1	0.05	0.11			0.005	3.4
30		7.12	0.12	0.2	0.03	0.02			0.001	0.4
31	RB	7.40	0.00	0.3	0.02	0			0.000	0.0
32										
33										
Total Q									**0.150**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site KL-H2

Site Information				
Project Name	Back River			
Station Identification	KL-H2			
Stream Name	George Lake Outflow			
Date Monitored	6-Jul-14			
Time at Site (24 hr)	Start Time:	9:00:00 AM	End Time:	10:30:00 AM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	Easting	Northing	Elevation	
	386687	7314673		
Weather Conditions	windy, sun			

Transducer Information			
DL Model	PT2X	PT Serial #	21251009
Gain	-	Offset	-
Status	-	Battery	-
# of Records	-	Memory Free	-
Date Serviced	9/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 73	1.516	101.516		**100.000**	
BM 74			1.667	99.849	
BM 42			0.902	100.614	
BM 43			1.059	100.457	
WL			2.029	99.487	
PT			2.569	98.947	
TBM			0.857	100.659	
TBM	0.691	101.350		100.659	
BM 73			1.349	100.001	
BM 74			1.500	99.850	
BM 42			0.734	100.616	
BM 43			0.890	100.460	
WL			1.862	99.488	
PT			2.406	98.944	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 73	100.000	100.001	0.001	
BM 42	100.617	100.615	-0.002	
BM 43	100.46	100.459	-0.001	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.488
Pressure Transducer Reading (m)	0.700
Pressure Transducer Elevation (m)	98.788
Discharge (m^3/s)	**0.1**
Cross Sectional Area	1.872
Average Velocity	0.056

Discharge Measurement - Mid-Section Method

Measurement Time	Start	9:28	End	9:54	Location	~15 m downstream of pressure transducer		
Method	Velocity-area (Mid-section)			Instrument Model		FH950		
Flow Meter Type	Current Meter			Instrument Serial #		130861001498		
Real Time Reading (m)	Start	Reading	0.707	Time	9:28	Staff Gauge (m)	n/a	
	End	Reading	0.700	Time	9:58	Time of SG Reading	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1	LB	8.20	0.00	0.0	0.01	0			0.000	0.0
2		7.90	0.06	0.3	0.02	0.04			0.001	0.7
3		7.60	0.44	0.3	0.12	0.12			0.015	13.8
4		7.35	0.43	0.3	0.11	0.08			0.009	8.2
5		7.10	0.42	0.3	0.11	0.07			0.007	7.0
6		6.85	0.35	0.3	0.09	0.09			0.008	7.5
7		6.60	0.40	0.3	0.10	0.09			0.009	8.6
8		6.35	0.43	0.3	0.11	0.07			0.008	7.2
9		6.10	0.34	0.3	0.09	0.07			0.006	5.7
10		5.85	0.34	0.3	0.09	0.05			0.004	4.0
11		5.60	0.28	0.3	0.07	0.04			0.003	2.7
12		5.35	0.32	0.3	0.08	0.03			0.002	2.3
13		5.10	0.34	0.3	0.09	0.01			0.001	0.8
14		4.85	0.32	0.3	0.08	0.01			0.001	0.8
15		4.60	0.27	0.3	0.07	0.01			0.001	0.6
16		4.35	0.28	0.3	0.12	0.04			0.005	4.5
17		3.75	0.24	0.6	0.10	0.05			0.005	4.9
18		3.50	0.26	0.3	0.07	0.00			0.000	0.0
19		3.25	0.26	0.3	0.07	-0.02			-0.001	-1.2
20		3.00	0.28	0.3	0.07	-0.01			-0.001	-0.7
21		2.75	0.34	0.3	0.07	0.00			0.000	0.0
22		2.60	0.32	0.2	0.04	0.02			0.001	0.8
23		2.50	0.32	0.1	0.03	0.08			0.003	2.4
24		2.40	0.23	0.1	0.02	0.11			0.003	2.4
25		2.30	0.17	0.1	0.02	0.18			0.003	2.9
26		2.20	0.14	0.1	0.01	0.32			0.004	4.3
27		2.10	0.13	0.1	0.01	0.36			0.005	4.5
28		2.00	0.10	0.1	0.02	0.33			0.006	5.5
29		1.75	0.05	0.3	0.01	0.00			0.000	0.0
30	RB	1.50	0.00	0.3	0.01	0			0.000	0.0
31										
32										
33										
Total Q									**0.105**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site KL-H2

Site Information				
Project Name	Back River			
Station Identification	KL-H2			
Stream Name	George Lake Outflow			
Date Monitored	8-Jul-14			
Time at Site (24 hr)	Start Time:	8:30:00 AM	End Time:	10:00:00 AM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	Easting	Northing	Elevation	
	386687	7314673		
Weather Conditions	overcast, light rain			

Transducer Information			
DL Model	PT2X	PT Serial #	21251009
Gain	-	Offset	-
Status	-	Battery	-
# of Records	-	Memory Free	-
Date Serviced	9/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 73	1.992	101.992		**100.000**	
BM 74			2.143	99.849	
BM 42			1.378	100.614	
BM 43			1.534	100.458	
WL			2.518	99.474	
PT			3.053	98.939	
TBM			1.332	100.660	
TBM	0.809	101.469		100.660	
BM 73			1.469	100.000	
BM 74			1.619	99.850	
BM 42			0.853	100.616	
BM 43			1.010	100.459	
WL			1.998	99.471	
PT			2.531	98.938	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 73	100.000	100.000	0.000	
BM 42	100.617	100.615	-0.002	
BM 43	100.46	100.459	-0.001	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.473
Pressure Transducer Reading (m)	0.683
Pressure Transducer Elevation (m)	98.789
Discharge (m^3/s)	**0.1**
Cross Sectional Area	1.606
Average Velocity	0.048

Discharge Measurement - Mid-Section Method

Measurement Time	Start	8:39	End	9:09	Location	~20 m downstream of pressure transducer		
Method	Velocity-area (Mid-section)			Instrument Model		FH950		
Flow Meter Type	Current Meter			Instrument Serial #		130861001498		
Real Time Reading (m)	Start	Reading	0.683	Time	8:38	Staff Gauge (m)	n/a	
	End	Reading	0.683	Time	9:08	Time of SG Reading	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1	RB	7.40	0.00	0.0	0.03	0			0.000	0.0
2		7.00	0.16	0.4	0.04	0.07			0.003	3.6
3		6.90	0.15	0.1	0.02	0.20			0.003	3.9
4		6.80	0.24	0.1	0.02	0.27			0.006	8.4
5		6.70	0.15	0.1	0.02	0.23			0.003	4.5
6		6.60	0.16	0.1	0.02	0.07			0.001	1.5
7		6.50	0.17	0.1	0.02	0.04			0.001	0.9
8		6.40	0.20	0.1	0.02	0.06			0.001	1.6
9		6.30	0.15	0.1	0.03	0.04			0.001	1.6
10		6.00	0.22	0.3	0.06	-0.01			-0.001	-0.8
11		5.75	0.22	0.3	0.06	-0.03			-0.002	-2.1
12		5.50	0.10	0.3	0.03	0.21			0.005	6.8
13		5.25	0.24	0.3	0.06	0.07			0.004	5.4
14		5.00	0.22	0.3	0.06	0.04			0.002	2.9
15		4.75	0.26	0.3	0.07	0.00			0.000	0.0
16		4.50	0.10	0.3	0.03	-0.01			0.000	-0.3
17		4.25	0.14	0.3	0.04	-0.01			0.000	-0.5
18		4.00	0.32	0.3	0.08	0.01			0.001	1.0
19		3.75	0.31	0.3	0.08	0.03			0.002	3.0
20		3.50	0.24	0.3	0.06	0.03			0.002	2.3
21		3.25	0.30	0.3	0.08	0.04			0.003	3.9
22		3.00	0.29	0.3	0.07	0.04			0.003	3.8
23		2.75	0.33	0.3	0.08	0.05			0.004	5.3
24		2.50	0.34	0.3	0.09	0.06			0.005	6.6
25		2.25	0.32	0.3	0.08	0.06			0.005	6.2
26		2.00	0.36	0.3	0.09	0.06			0.005	7.0
27		1.75	0.40	0.3	0.10	0.06			0.006	7.8
28		1.50	0.41	0.3	0.12	0.05			0.006	8.0
29		1.15	0.20	0.4	0.05	0.10			0.005	6.5
30		1.00	0.15	0.2	0.03	0.04			0.001	1.4
31		0.80	0.00	0.2	0.02	0			0.000	0.0
32										
33										
Total Q									**0.077**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site KL-H2

Site Information				
Project Name	Back River			
Station Identification	KL-H2			
Stream Name	George Lake Outflow			
Date Monitored	10-Jul-14			
Time at Site (24 hr)	Start Time:	8:30:00 AM	End Time:	9:45:00 AM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	Easting	Northing	Elevation	
	386687	7314673		
Weather Conditions	sun & cloud			

Transducer Information			
DL Model	PT2X	PT Serial #	21251009
Gain	-	Offset	-
Status	-	Battery	-
# of Records	-	Memory Free	-
Date Serviced	9/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 73	1.483	101.483		**100.000**	
BM 74			1.634	99.849	
BM 42			0.868	100.615	
BM 43			1.025	100.458	
WL			2.021	99.462	
PT			2.548	98.935	
TBM			0.753	100.730	
TBM	1.036	101.766		100.730	
BM 73			1.768	99.998	
BM 74			1.919	99.847	
BM 42			1.152	100.614	
BM 43			1.309	100.457	
WL			2.305	99.461	
PT			2.831	98.935	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 73	100.000	99.999	-0.001	
BM 42	100.617	100.615	-0.002	
BM 43	100.46	100.458	-0.002	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	99.462
Pressure Transducer Reading (m)	0.680
Pressure Transducer Elevation (m)	98.781
Discharge (m^3/s)	**0.1**
Cross Sectional Area	1.637
Average Velocity	0.045

Discharge Measurement - Mid-Section Method

Measurement Time	Start	8:42	End	9:09	Location	~20 m downstream of pressure transducer		
Method	Velocity-area (Mid-section)			Instrument Model		FH950		
Flow Meter Type	Current Meter			Instrument Serial #		130861001498		
Real Time Reading (m)	Start	Reading	0.680	Time	8:38	Staff Gauge (m)	n/a	
	End	Reading	0.680	Time	9:08	Time of SG Reading	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1	RB	7.28	0.00	0.0	0.01	0			0.000	0.0
2		7.00	0.06	0.3	0.01	0.05			0.001	0.8
3		6.90	0.14	0.1	0.01	0.04			0.001	0.8
4		6.80	0.22	0.1	0.02	0.06			0.001	1.8
5		6.70	0.23	0.1	0.02	0.20			0.005	6.2
6		6.60	0.19	0.1	0.02	0.10			0.002	2.6
7		6.50	0.20	0.1	0.04	0.03			0.001	1.4
8		6.25	0.25	0.3	0.06	0.02			0.001	1.7
9	behind rock	6.00	0.11	0.3	0.03	0.01			0.000	0.4
10		5.75	0.10	0.3	0.03	0.01			0.000	0.3
11		5.50	0.21	0.3	0.05	0.01			0.001	0.7
12		5.25	0.22	0.3	0.06	0.08			0.004	6.0
13		5.00	0.19	0.3	0.05	0.09			0.004	5.8
14		4.75	0.22	0.3	0.06	0.00			0.000	0.0
15		4.50	0.14	0.3	0.04	-0.01			0.000	-0.5
16		4.25	0.14	0.3	0.04	0.00			0.000	0.0
17		4.00	0.23	0.3	0.06	0.03			0.002	2.3
18		3.75	0.30	0.3	0.08	0.03			0.002	3.0
19		3.50	0.26	0.3	0.07	0.02			0.001	1.8
20		3.25	0.28	0.3	0.07	0.03			0.002	2.8
21		3.00	0.27	0.3	0.07	0.04			0.003	3.7
22		2.75	0.30	0.3	0.08	0.04			0.003	4.1
23		2.50	0.38	0.3	0.09	0.05			0.004	5.8
24		2.30	0.38	0.2	0.08	0.06			0.005	6.2
25		2.10	0.38	0.2	0.08	0.07			0.005	7.2
26		1.90	0.35	0.2	0.07	0.07			0.005	6.6
27		1.70	0.40	0.2	0.08	0.07			0.006	7.6
28		1.50	0.36	0.2	0.07	0.08			0.006	7.8
29		1.30	0.40	0.2	0.14	0.07			0.010	13.3
30	LB	0.80	0.00	0.5	0.10	0			0.000	0.0
31										
32										
33										
Total Q									**0.074**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site LG-H1

Site Information				
Project Name	Back River			
Station Identification	LG-H1			
Stream Name	Long Lake Outflow			
Date Monitored	7-Jun-14			
Time at Site (24 hr)	**Start Time:**	8:45:00 AM	**End Time:**	
Personnel	Emerson Belland, Jem Morrison			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	0394281	7305113		
Weather Conditions	Sunny and 8°C			

Transducer Information			
PT Model	PT2X	**PT Serial #**	21221024
Gain	-	**Offset**	-
Status	Active	**Battery**	2.9 V
# of Records	0	**Memory Free**	524139
Date Serviced	12/10/2013	**Crest Gauges**	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 95	1.118	101.118		**100.000**	
BM 96			1.441	99.677	
BM 97			1.358	99.760	
WL			3.583	97.535	
PT			4.394	96.724	
TBM			3.556	97.562	
TBM	3.421	100.983		97.562	
BM 95			0.983	100.000	
BM 96			1.306	99.677	
BM 97			1.225	99.758	
WL			3.445	97.538	
PT			4.262	96.721	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 95	100.000	100.000	0.000	
BM 96	99.677	99.677	0.000	
BM 97	99.758	99.759	0.001	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	97.537
Pressure Transducer Reading (m)	0.810
Pressure Transducer Elevation (m)	96.726
Discharge (m^3/s)	**3.3**
Cross Sectional Area	13.246
Average Velocity	0.246

Discharge Measurement - Mid-Section Method

Measurement Time	**Start**	12:11	**End**		**Location**	upstream of falls, ~100 m upstream of station	
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950	
Flow Meter Type	Current Meter			**Instrument Serial #**		130861001498	
Real Time Reading (m)	**Start**	**Reading**	0.809	**Time**	12:12	**Staff Gauge (m)**	n/a
	End	**Reading**	0.812	**Time**	13:12	**Time of SG Reading**	-

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	**Notes**	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
1	LB	43.90	0.00	0.0	0.06	0			0.000	0.0
2		42.20	0.07	1.7	0.10	0.04			0.004	0.1
3		41.00	0.24	1.2	0.32	0.09			0.029	0.9
4		39.50	0.26	1.5	0.39	0.10			0.039	1.2
5		38.00	0.25	1.5	0.38	0.17			0.064	2.0
6		36.50	0.32	1.5	0.48	0.19			0.091	2.8
7		35.00	0.36	1.5	0.49	0.20			0.097	3.0
8		33.80	0.42	1.2	0.53	0.20			0.105	3.2
9		32.50	0.53	1.3	0.66	0.21			0.139	4.3
10		31.30	0.63	1.2	0.76	0.20			0.151	4.6
11		30.10	0.65	1.2	0.91	0.20			0.182	5.6
12		28.50	0.49	1.6	0.76	0.33			0.251	7.7
13		27.00	0.50	1.5	0.68	0.28			0.189	5.8
14		25.80	0.50	1.2	0.60	0.30			0.180	5.5
15		24.60	0.55	1.2	0.74	0.29			0.215	6.6
16		23.10	0.52	1.5	0.81	0.24			0.193	5.9
17		21.50	0.53	1.6	0.82	0.32			0.263	8.1
18		20.00	0.48	1.5	0.72	0.33			0.238	7.3
19		18.50	0.44	1.5	0.66	0.36			0.238	7.3
20		17.00	0.36	1.5	0.54	0.34			0.184	5.6
21		15.50	0.29	1.5	0.44	0.25			0.109	3.3
22		14.00	0.32	1.5	0.64	0.25			0.160	4.9
23		11.50	0.25	2.5	0.38	0.24			0.090	2.8
24		11.00	0.20	0.5	0.25	0.12			0.030	0.9
25		9.00	0.08	2.0	0.12	0.10			0.012	0.4
26	RB	8.10	0.00	0.9	0.04	0			0.000	0.0
27										
28										
29										
30										
31										
32										
33										
Total Q									**3.252**	**100.0**

General Notes

Stage is ice affected. Ice and snow were present on the banks during this measurement.

Appendix 3. Manual Stage and Discharge Measurements, Site LG-H1

Site Information				
Project Name	Back River			
Station Identification	LG-H1			
Stream Name	Long Lake Outflow			
Date Monitored	13-Jun-14			
Time at Site (24 hr)	Start Time:	9:00:00 AM	End Time:	
Personnel	Jem Morrison, Kokiak Peetoolott			
Station Cordinates	Easting	Northing	Elevation	
	0394281	7305113		
Weather Conditions	overast, 12°C			

Transducer Information			
PT Model	PT2X	PT Serial #	21221024
Gain	-	Offset	-
Status	Active	Battery	2.9 V
# of Records	857	Memory Free	523282
Date Serviced	12/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 95	1.223	101.223		**100.000**	
BM 96			1.547	99.676	
BM 97			1.465	99.758	
WL			3.710	97.513	
PT			4.495	96.728	end of angle iron
TBM			3.618	97.605	
TBM	3.489	101.094		97.605	
BM 95			1.095	99.999	
BM 96			1.419	99.675	
BM 97			1.338	99.756	
WL			3.578	97.516	
PT			4.368	96.726	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 95	100.000	100.000	0.000	
BM 96	99.677	99.676	-0.002	
BM 97	99.758	99.757	-0.001	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	97.515
Pressure Transducer Reading (m)	0.855
Pressure Transducer Elevation (m)	96.660
Discharge (m^3/s)	**4.8**
Cross Sectional Area	14.560
Average Velocity	0.329

Discharge Measurement - Mid-Section Method

Measurement Time	Start	10:42	End		Location	upstream of falls, ~100 m upstream of station		
Method	Velocity-area (Mid-section)			Instrument Model		FH950		
Flow Meter Type	Current Meter			Instrument Serial #		130861001498		
Real Time Reading (m)	Start	Reading	0.852	Time	10:42	Staff Gauge (m)	n/a	
	End	Reading	0.861	Time	11:42	Time of SG Reading	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1	LB	44.70	0.00	0.0	0.01	0			0.000	0.0
2		44.50	0.06	0.2	0.07	0.01			0.001	0.0
3		42.50	0.10	2.0	0.20	0.07			0.014	0.3
4		40.50	0.24	2.0	0.46	0.21			0.096	2.0
5		38.70	0.30	1.8	0.57	0.24			0.137	2.9
6		36.70	0.38	2.0	0.78	0.25			0.195	4.1
7		34.60	0.48	2.1	0.89	0.27			0.240	5.0
8		33.00	0.56	1.6	0.92	0.29			0.268	5.6
9		31.30	0.64	1.7	1.12	0.35			0.392	8.2
10		29.50	0.62	1.8	1.02	0.28			0.286	6.0
11		28.00	0.67	1.5	1.04	0.46			0.478	10.0
12		26.40	0.49	1.6	0.76	0.39			0.296	6.2
13		24.90	0.57	1.5	0.86	0.41			0.351	7.3
14		23.40	0.51	1.5	0.77	0.37			0.283	5.9
15		21.90	0.56	1.5	0.95	0.44			0.419	8.8
16		20.00	0.57	1.9	0.97	0.36			0.349	7.3
17		18.50	0.46	1.5	0.71	0.51			0.364	7.6
18		16.90	0.36	1.6	0.58	0.28			0.161	3.4
19		15.30	0.32	1.6	0.58	0.37			0.213	4.5
20		13.30	0.21	2.0	0.42	0.22			0.092	1.9
21		11.30	0.15	2.0	0.27	0.22			0.059	1.2
22		9.70	0.20	1.6	0.31	0.18			0.056	1.2
23		8.20	0.06	1.5	0.08	0.02			0.002	0.0
24		7.10	0.12	1.1	0.19	0.19			0.035	0.7
25		5.10	0.05	2.0	0.06	0.01			0.001	0.0
26	RB	4.90	0.00	0.2	0.00	0			0.000	0.0
27										
28										
34										
35										
36										
37										
38										
Total Q									**4.786**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site LG-H1

Site Information				
Project Name	Back River			
Station Identification	LG-H1			
Stream Name	Long Lake Outflow			
Date Monitored	16-Jun-14			
Time at Site (24 hr)	Start Time:	10:00:00 AM	End Time:	
Personnel	Jem Morrison, Emerson Belland			
Station Cordinates	Easting	Northing	Elevation	
	0394281	7305113		
Weather Conditions	overcast and cool			

Transducer Information			
PT Model	PT2X	PT Serial #	21221024
Gain	-	Offset	-
Status	Active	Battery	2.9 V
# of Records	1305	Memory Free	522834
Date Serviced	12/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 95	1.172	101.172		**100.000**	
BM 96			1.497	99.675	
BM 97			1.415	99.757	
WL			3.537	97.635	
PT			4.449	96.723	
TBM			3.510	97.662	
TBM	3.428	101.090		97.662	
BM 95			1.090	100.000	
BM 96			1.413	99.677	
BM 97			1.332	99.758	
WL			3.453	97.637	
PT			4.364	96.726	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 95	100	100.000	0.000	
BM 96	99.677	99.676	-0.001	
BM 97	99.758	99.758	-0.001	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	97.636
Pressure Transducer Reading (m)	0.933
Pressure Transducer Elevation (m)	96.703
Discharge (m^3/s)	**6.1**
Cross Sectional Area	16.818
Average Velocity	0.363

Discharge Measurement - Mid-Section Method

Measurement Time	Start	11:13	End		Location	upstream of falls, ~100 m upstream of station	
Method	Velocity-area (Mid-section)			Instrument Model		FH950	
Flow Meter Type	Current Meter			Instrument Serial #		130861001498	
Real Time Reading (m)	Start	Reading	0.935	Time	11:12	Staff Gauge (m)	n/a
	End	Reading	0.927	Time	12:12	Time of SG Reading	-

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1		5.60	0.00	0.0	0.02	0			0.000	0.0
2		5.90	0.11	0.3	0.09	0.02			0.002	0.0
3		7.30	0.16	1.4	0.21	0.10			0.021	0.3
4		8.50	0.18	1.2	0.23	0.17			0.038	0.6
5		9.80	0.30	1.3	0.47	0.21			0.098	1.6
6		11.60	0.34	1.8	0.53	0.11			0.058	0.9
7		12.90	0.39	1.3	0.51	0.26			0.132	2.2
8		14.20	0.49	1.3	0.56	0.07			0.039	0.6
9		15.20	0.54	1.0	0.54	0.30			0.162	2.7
10		16.20	0.56	1.0	0.50	0.29			0.146	2.4
11		17.00	0.61	0.8	0.55	0.33			0.181	3.0
12		18.00	0.73	1.0	0.73	0.37			0.270	4.4
13		19.00	0.71	1.0	0.71	0.31			0.220	3.6
14		20.00	0.59	1.0	0.59	0.33			0.195	3.2
15		21.00	0.62	1.0	0.59	0.47			0.277	4.5
16		21.90	0.61	0.9	0.58	0.48			0.278	4.6
17		22.90	0.65	1.0	0.65	0.45			0.293	4.8
18		23.90	0.53	1.0	0.53	0.47			0.249	4.1
19		24.90	0.65	1.0	0.65	0.47			0.306	5.0
20		25.90	0.61	1.0	0.61	0.48			0.293	4.8
21		26.90	0.58	1.0	0.58	0.35			0.203	3.3
22		27.90	0.62	1.0	0.62	0.52			0.322	5.3
23		28.90	0.61	1.0	0.58	0.58			0.336	5.5
24		29.80	0.67	0.9	0.60	0.64			0.386	6.3
25		30.70	0.57	0.9	0.51	0.00			0.000	0.0
26		31.60	0.48	0.9	0.46	0.60			0.274	4.5
27		32.60	0.48	1.0	0.48	0.50			0.240	3.9
28		33.60	0.42	1.0	0.46	0.47			0.217	3.6
29		34.80	0.43	1.2	0.54	0.37			0.199	3.3
30		36.10	0.31	1.3	0.40	0.54			0.218	3.6
31		37.40	0.31	1.3	0.36	0.42			0.150	2.5
32		38.40	0.29	1.0	0.33	0.32			0.107	1.7
33		39.70	0.24	1.3	0.31	0.24			0.075	1.2
34		41.00	0.13	1.3	0.19	0.21			0.040	0.6
35		42.60	0.18	1.6	0.29	0.16			0.046	0.8
36		44.20	0.14	1.6	0.20	0.16			0.031	0.5
37		45.40	0.08	1.2	0.06	0.04			0.002	0.0
38		45.70	0.00	0.3	0.01	0			0.000	0.0
Total Q									**6.102**	**100.0**

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site LG-H1

Site Information				
Project Name	Back River			
Station Identification	LG-H1			
Stream Name	Long Lake Outflow			
Date Monitored	2-Jul-14			
Time at Site (24 hr)	Start Time:	10:00:00 AM	End Time:	12:30:00 PM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	Easting	Northing	Elevation	
	0394281	7305113		
Weather Conditions	sunny			

Transducer Information			
PT Model	PT2X	PT Serial #	21221024
Gain	-	Offset	-
Status	-	Battery	-
# of Records	-	Memory Free	-
Date Serviced	12/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 95	0.844	100.844		**100.000**	
BM 96			1.168	99.676	
BM 97			1.087	99.757	
WL			3.242	97.602	
PT			-	-	water too fast to survey
TBM			1.329	99.515	
TBM	1.449	100.964		99.515	
BM 95			0.965	99.999	
BM 96			1.288	99.676	
BM 97			1.207	99.757	
WL			3.360	97.604	
PT			-	-	
BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes	
BM 95	100	100.000	-0.001		
BM 96	99.677	99.676	-0.001		
BM 97	99.758	99.757	-0.001		

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	97.603
Pressure Transducer Reading (m)	0.923
Pressure Transducer Elevation (m)	-
Discharge (m^3/s)	**5.8**
Cross Sectional Area	15.535
Average Velocity	0.376

Discharge Measurement - Mid-Section Method

Measurement Time	Start	10:36	End	11:31	Location	upstream of falls, ~100 m upstream of station	
Method	Velocity-area (Mid-section)			Instrument Model		FH950	
Flow Meter Type	Current Meter			Instrument Serial #		130861001498	
Real Time Reading (m)	Start	Reading	0.9255	Time	10:32	Staff Gauge (m)	n/a
	End	Reading	0.9203	Time	11:32	Time of SG Reading	-

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1	LB	0.00	0.00	0.0	0.08	0			0.000	0.0
2		1.00	0.15	1.0	0.15	0.01			0.002	0.0
3		2.00	0.14	1.0	0.14	0.18			0.025	0.4
4		3.00	0.22	1.0	0.22	0.2			0.044	0.8
5		4.00	0.38	1.0	0.38	0.18			0.068	1.2
6		5.00	0.26	1.0	0.26	0.26			0.068	1.2
7		6.00	0.42	1.0	0.42	0.26			0.109	1.9
8		7.00	0.40	1.0	0.40	0.25			0.100	1.7
9		8.00	0.49	1.0	0.49	0.26			0.127	2.2
10		9.00	0.45	1.0	0.45	0.27			0.122	2.1
11		10.00	0.55	1.0	0.55	0.25			0.138	2.4
12		11.00	0.47	1.0	0.47	0.34			0.160	2.7
13		12.00	0.55	1.0	0.55	0.38			0.209	3.6
14		13.00	0.70	1.0	0.70	0.22			0.154	2.6
15		14.00	0.66	1.0	0.66	0.25			0.165	2.8
16		15.00	0.61	1.0	0.61	0.46			0.281	4.8
17		16.00	0.70	1.0	0.70	0.46			0.322	5.5
18		17.00	0.53	1.0	0.53	0.53			0.281	4.8
19		18.00	0.58	1.0	0.58	0.46			0.267	4.6
20		19.00	0.64	1.0	0.64	0.46			0.294	5.0
21		20.00	0.62	1.0	0.62	0.42			0.260	4.5
22		21.00	0.55	1.0	0.55	0.39			0.215	3.7
23		22.00	0.66	1.0	0.66	0.44			0.290	5.0
24		23.00	0.59	1.0	0.59	0.55			0.325	5.6
25		24.00	0.53	1.0	0.53	0.44			0.233	4.0
26		25.00	0.53	1.0	0.53	0.66			0.350	6.0
27		26.00	0.54	1.0	0.54	0.55			0.297	5.1
28		27.00	0.49	1.0	0.49	0.44			0.216	3.7
29		28.00	0.42	1.0	0.42	0.44			0.185	3.2
30		29.00	0.45	1.0	0.45	0.22			0.099	1.7
31		30.00	0.38	1.0	0.38	0.38			0.144	2.5
32		31.00	0.42	1.0	0.42	0.41			0.172	2.9
33		32.00	0.38	1.0	0.38	0.31			0.118	2.0
34		33.00	0.35	1.0	0.35	0.29			0.102	1.7
35		34.00	0.30	1.0	0.30	0.19			0.057	1.0
36		35.00	0.11	1.0	0.11	0.23			0.025	0.4
37		36.00	0.05	1.0	0.05	0.21			0.011	0.2
38		37.00	0.09	1.0	0.09	0.06			0.005	0.1
39		38.00	0.27	1.0	0.19	0.05			0.009	0.2
40	RB	38.40	0.00	0.4	0.05	0			0.000	0.0
Total Q									**5.838**	**100.0**

General Notes

Water around the area of the pressure transducer was too swift to survey safely.

Appendix 3. Manual Stage and Discharge Measurements, Site LG-H1

Site Information				
Project Name	Back River			
Station Identification	LG-H1			
Stream Name	Long Lake Outflow			
Date Monitored	4-Jul-14			
Time at Site (24 hr)	Start Time:	1:00:00 PM	End Time:	3:00:00 PM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	Easting	Northing	Elevation	
	0394281	7305113		
Weather Conditions	sunny			

Transducer Information			
PT Model	PT2X	PT Serial #	21221024
Gain	-	Offset	-
Status	Active	Battery	2.9 V
# of Records	3910	Memory Free	520229
Date Serviced	12/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 95	0.967	100.967		**100.000**	
BM 96			1.290	99.677	
BM 97			1.210	99.757	
WL			3.389	97.578	
PT			-	-	water too fast to survey
TBM			1.127	99.840	
TBM	1.294	101.134		99.840	
BM 95			1.133	100.001	
BM 96			1.457	99.677	
BM 97			1.376	99.758	
WL			3.555	97.579	
PT			-	-	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 95	100.000	100.001	0.001	
BM 96	99.677	99.677	0.000	
BM 97	99.758	99.758	-0.001	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	97.579
Pressure Transducer Reading (m)	0.880
Pressure Transducer Elevation (m)	96.699
Discharge (m^3/s)	**5.4**
Cross Sectional Area	14.543
Average Velocity	0.369

Discharge Measurement - Mid-Section Method

Measurement Time	Start	13:00	End	13:31	Location	upstream of falls, ~100 m upstream of station		
Method	Velocity-area (Mid-section)			Instrument Model		FH950		
Flow Meter Type	Current Meter			Instrument Serial #		130861001498		
Real Time Reading (m)	Start	Reading	0.884	Time	13:02	Staff Gauge (m)	n/a	
	End	Reading	0.886	Time	13:42	Time of SG Reading	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1	LB	0.00	0.00	0.0	0.11	0			0.000	0.0
2		1.50	0.15	1.5	0.23	0.13			0.029	0.5
3		3.00	0.21	1.5	0.32	0.19			0.060	1.1
4		4.50	0.22	1.5	0.33	0.19			0.063	1.2
5		6.00	0.22	1.5	0.33	0.28			0.092	1.7
6		7.50	0.28	1.5	0.42	0.27			0.113	2.1
7		9.00	0.37	1.5	0.56	0.26			0.144	2.7
8		10.50	0.52	1.5	0.78	0.34			0.265	4.9
9		12.00	0.41	1.5	0.62	0.32			0.197	3.7
10		13.50	0.58	1.5	0.87	0.29			0.252	4.7
11		15.00	0.62	1.5	0.93	0.31			0.288	5.4
12		16.50	0.66	1.5	0.99	0.4			0.396	7.4
13		18.00	0.50	1.5	0.75	0.45			0.338	6.3
14		19.50	0.60	1.5	0.90	0.43			0.387	7.2
15		21.00	0.54	1.5	0.81	0.39			0.316	5.9
16		22.50	0.59	1.5	0.89	0.49			0.434	8.1
17		24.00	0.54	1.5	0.81	0.56			0.454	8.4
18		25.50	0.50	1.5	0.75	0.59			0.443	8.2
19		27.00	0.40	1.5	0.60	0.51			0.306	5.7
20		28.50	0.38	1.5	0.57	0.46			0.262	4.9
21		30.00	0.34	1.5	0.51	0.38			0.194	3.6
22		31.50	0.30	1.5	0.45	0.29			0.131	2.4
23		33.00	0.22	1.5	0.33	0.32			0.106	2.0
24		34.50	0.23	1.5	0.35	0.2			0.069	1.3
25		36.00	0.09	1.5	0.14	0.13			0.018	0.3
26		37.50	0.10	1.5	0.15	0.09			0.014	0.3
27	RB	39.00	0.00	1.5	0.08	0			0.000	0.0
28										
29										
30										
31										
32										
33										
Total Q									**5.369**	**100.0**

General Notes

Water around the area of the pressure transducer was too swift to survey safely.

Appendix 3. Manual Stage and Discharge Measurements, Site LG-H1

Site Information				
Project Name	Back River			
Station Identification	LG-H1			
Stream Name	Long Lake Outflow			
Date Monitored	6-Jul-14			
Time at Site (24 hr)	Start Time:	12:00:00 PM	End Time:	2:00:00 PM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	Easting	Northing	Elevation	
	0394281	7305113		
Weather Conditions	sun & cloud			

Transducer Information			
PT Model	PT2X	PT Serial #	21221024
Gain	-	Offset	-
Status	-	Battery	-
# of Records	-	Memory Free	-
Date Serviced	12/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 95	1.116	101.116		**100.000**	
BM 96			1.439	99.677	
BM 97			1.358	99.758	
WL			3.571	97.545	
PT			-	-	water too fast to survey
TBM			1.163	99.953	
TBM	1.286	101.239		99.953	
BM 95			1.239	100.000	
BM 96			1.562	99.677	
BM 97			1.481	99.758	
WL			3.694	97.545	
PT			-	-	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 95	100.000	100.000	0.000	
BM 96	99.677	99.677	0.000	
BM 97	99.758	99.758	0.000	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	97.545
Pressure Transducer Reading (m)	0.848
Pressure Transducer Elevation (m)	96.697
Discharge (m^3/s)	**4.9**
Cross Sectional Area	14.828
Average Velocity	0.331

Discharge Measurement - Mid-Section Method

Measurement Time	Start	12:49	End	13:14	Location	upstream of falls, ~100 m upstream of station		
Method	Velocity-area (Mid-section)			Instrument Model		FH950		
Flow Meter Type	Current Meter			Instrument Serial #		130861001498		
Real Time Reading (m)	Start	Reading	0.853	Time	12:52	Staff Gauge (m)	n/a	
	End	Reading	0.845	Time	13:22	Time of SG Reading	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1	LB	0.00	0.00	0.0	0.09	0			0.000	0.0
2		1.50	0.12	1.5	0.18	0.06			0.011	0.2
3		3.00	0.14	1.5	0.21	0.14			0.029	0.6
4		4.50	0.30	1.5	0.45	0.23			0.104	2.1
5		6.00	0.35	1.5	0.53	0.24			0.126	2.6
6		7.50	0.37	1.5	0.56	0.25			0.139	2.8
7		9.00	0.35	1.5	0.53	0.21			0.110	2.2
8		10.50	0.51	1.5	0.77	0.26			0.199	4.0
9		12.00	0.49	1.5	0.74	0.30			0.221	4.5
10		13.50	0.57	1.5	0.86	0.28			0.239	4.9
11		15.00	0.62	1.5	0.93	0.39			0.363	7.4
12		16.50	0.66	1.5	0.99	0.37			0.366	7.5
13		18.00	0.55	1.5	0.83	0.41			0.338	6.9
14		19.50	0.57	1.5	0.86	0.42			0.359	7.3
15		21.00	0.53	1.5	0.80	0.34			0.270	5.5
16		22.50	0.56	1.5	0.84	0.44			0.370	7.5
17		24.00	0.52	1.5	0.78	0.46			0.359	7.3
18		25.50	0.47	1.5	0.71	0.53			0.374	7.6
19		27.00	0.37	1.5	0.56	0.46			0.255	5.2
20		28.50	0.41	1.5	0.62	0.42			0.258	5.3
21		30.00	0.31	1.5	0.47	0.42			0.195	4.0
22		31.50	0.27	1.5	0.41	0.26			0.105	2.1
23		33.00	0.21	1.5	0.32	0.27			0.085	1.7
24		34.50	0.19	1.5	0.29	0.07			0.020	0.4
25		36.00	0.07	1.5	0.11	0.17			0.018	0.4
26		37.50	0.00	1.5	0.00	0.00			0.000	0.0
27		39.00	0.21	1.5	0.32	0.00			0.000	0.0
28		40.50	0.00	1.5	0.16	0			0.000	0.0
29										
30										
31										
32										
33										
Total Q									**4.913**	**100.0**

General Notes

Water around the area of the pressure transducer was too swift to survey safely.

Appendix 3. Manual Stage and Discharge Measurements, Site LG-H1

Site Information				
Project Name	Back River			
Station Identification	LG-H1			
Stream Name	Long Lake Outflow			
Date Monitored	8-Jul-14			
Time at Site (24 hr)	**Start Time:**	10:00:00 AM	**End Time:**	11:30:00 AM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	394281	7305112		
Weather Conditions	rainy			

Transducer Information			
PT Model	PT2X	**PT Serial #**	21221024
Gain	-	**Offset**	-
Status	-	**Battery**	-
# of Records	-	**Memory Free**	-
Date Serviced	12/10/2013	**Crest Gauges**	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 95	1.120	101.120		**100.000**	
BM 96			1.443	99.677	
BM 97			1.362	99.758	
WL			3.624	97.496	
PT			-	-	water too fast to survey
TBM			0.852	100.268	
TBM	0.678	100.946		100.268	
BM 95			0.946	100.000	
BM 96			1.269	99.677	
BM 97			1.188	99.758	
WL			3.450	97.496	
PT			-	-	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 95	100.000	100.000	0.000	
BM 96	99.677	99.677	0.000	
BM 97	99.758	99.758	0.000	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	97.496
Pressure Transducer Reading (m)	0.806
Pressure Transducer Elevation (m)	-
Discharge (m^3/s)	**4.1**
Cross Sectional Area	13.065
Average Velocity	0.314

Discharge Measurement - Mid-Section Method

Measurement Time	**Start**	10:18	**End**	10:48	**Location**	upstream of falls, ~100 m upstream of station		
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950		
Flow Meter Type	Current Meter			**Instrument Serial #**		130861001498		
Real Time Reading (m)	**Start**	**Reading**	0.807	**Time**	10:22	**Staff Gauge (m)**	n/a	
	End	**Reading**	0.806	**Time**	10:52	**Time of SG Reading**	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	**Notes**	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
1		0.00	0.00	0.0	0.05	0			0.000	0.0
2		1.50	0.06	1.5	0.09	0.07			0.006	0.2
3		3.00	0.20	1.5	0.30	0.15			0.045	1.1
4		4.50	0.23	1.5	0.35	0.14			0.048	1.2
5		6.00	0.24	1.5	0.36	0.22			0.079	1.9
6		7.50	0.42	1.5	0.63	0.20			0.126	3.1
7		9.00	0.48	1.5	0.72	0.25			0.180	4.4
8		10.50	0.52	1.5	0.78	0.25			0.195	4.7
9		12.00	0.53	1.5	0.80	0.32			0.254	6.2
10		13.50	0.50	1.5	0.75	0.29			0.218	5.3
11		15.00	0.50	1.5	0.75	0.40			0.300	7.3
12		16.50	0.54	1.5	0.81	0.38			0.308	7.5
13		18.00	0.46	1.5	0.69	0.37			0.255	6.2
14		19.50	0.49	1.5	0.74	0.39			0.287	7.0
15		21.00	0.51	1.5	0.77	0.10			0.077	1.9
16		22.50	0.51	1.5	0.77	0.48			0.367	8.9
17		24.00	0.50	1.5	0.75	0.49			0.368	8.9
18		25.50	0.43	1.5	0.65	0.48			0.310	7.5
19		27.00	0.31	1.5	0.47	0.43			0.200	4.9
20		28.50	0.32	1.5	0.48	0.42			0.202	4.9
21		30.00	0.34	1.5	0.51	0.32			0.163	4.0
22		31.50	0.26	1.5	0.39	0.24			0.094	2.3
23		33.00	0.00	1.5	0.00	0.00			0.000	0.0
24		34.50	0.14	1.5	0.21	0.12			0.025	0.6
25		36.00	0.07	1.5	0.11	0.00			0.000	0.0
26		37.50	0.08	1.5	0.12	0.01			0.001	0.0
27		39.00	0.00	1.5	0.06	0			0.000	0.0
28										
29										
30										
31										
32										
33										
Total Q									**4.107**	**100.0**

General Notes

Water around the area of the pressure transducer was too swift to survey safely.

Appendix 3. Manual Stage and Discharge Measurements, Site LG-H1

Site Information				
Project Name	Back River			
Station Identification	LG-H1			
Stream Name	Long Lake Outflow			
Date Monitored	10-Jul-14			
Time at Site (24 hr)	**Start Time:**	10:00:00 AM	**End Time:**	11:30:00 AM
Personnel	Jaclyn Bowman			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	394281	7305112		
Weather Conditions	overcast			

Transducer Information			
PT Model	PT2X	**PT Serial #**	21221024
Gain	-	**Offset**	-
Status	-	**Battery**	-
# of Records	-	**Memory Free**	-
Date Serviced	12/10/2013	**Crest Gauges**	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 95	1.256	101.256		**100.000**	
BM 96			1.579	99.677	
BM 97			1.498	99.758	
WL			3.795	97.461	
PT			-	-	water too fast to survey
TBM			1.076	100.180	
TBM	0.848	101.028		100.180	
BM 95			1.026	100.002	
BM 96			1.350	99.678	
BM 97			1.268	99.760	
WL			3.565	97.463	
PT			-	-	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 95	100.000	100.001	0.001	
BM 96	99.677	99.678	0.001	
BM 97	99.758	99.759	0.001	

Summary

Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	97.462
Pressure Transducer Reading (m)	0.772
Pressure Transducer Elevation (m)	-
Discharge (m^3/s)	**3.4**
Cross Sectional Area	12.593
Average Velocity	0.274

Discharge Measurement - Mid-Section Method

Measurement Time	**Start**	10:00	**End**	10:27	**Location**	upstream of falls, ~100 m upstream of station		
Method	Velocity-area (Mid-section)			**Instrument Model**		FH950		
Flow Meter Type	Current Meter			**Instrument Serial #**		130861001498		
Real Time Reading (m)	**Start**	**Reading**	0.772	**Time**	10:02	**Staff Gauge (m)**	n/a	
	End	**Reading**	0.773	**Time**	10:32	**Time of SG Reading**	-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	**Notes**	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
1	LB	0.00	0.00	0.0	0.06	0			0.000	0.0
2		1.50	0.08	1.5	0.12	0.12			0.014	0.4
3		3.00	0.12	1.5	0.18	0.18			0.032	0.9
4		4.50	0.33	1.5	0.50	0.19			0.094	2.7
5		6.00	0.28	1.5	0.42	0.20			0.084	2.4
6		7.50	0.32	1.5	0.48	0.22			0.106	3.1
7		9.00	0.40	1.5	0.60	0.18			0.108	3.1
8		10.50	0.49	1.5	0.74	0.22			0.162	4.7
9		12.00	0.30	1.5	0.45	0.22			0.099	2.9
10		13.50	0.55	1.5	0.83	0.18			0.149	4.3
11		15.00	0.54	1.5	0.81	0.30			0.243	7.0
12		16.50	0.54	1.5	0.81	0.33			0.267	7.7
13		18.00	0.46	1.5	0.69	0.33			0.228	6.6
14		19.50	0.57	1.5	0.86	0.30			0.257	7.4
15		21.00	0.24	1.5	0.36	0.36			0.130	3.8
16		22.50	0.50	1.5	0.75	0.38			0.285	8.3
17		24.00	0.46	1.5	0.69	0.47			0.324	9.4
18		25.50	0.40	1.5	0.60	0.42			0.252	7.3
19		27.00	0.32	1.5	0.48	0.43			0.206	6.0
20		28.50	0.28	1.5	0.42	0.40			0.168	4.9
21		30.00	0.32	1.5	0.48	0.26			0.125	3.6
22		31.50	0.27	1.5	0.41	0.15			0.061	1.8
23		33.00	0.19	1.5	0.29	0.15			0.043	1.2
24		34.50	0.14	1.5	0.21	0.04			0.008	0.2
25		36.00	0.00	1.5	0.00	0.00			0.000	0.0
26		37.50	0.17	1.5	0.26	0.02			0.005	0.1
27		39.00	0.00	1.5	0.13	0			0.000	0.0
28										
29										
30										
31										
32										
33										
Total Q									**3.449**	**100.0**

General Notes

Water around the area of the pressure transducer was too swift to survey safely.

Appendix 3. Manual Stage and Discharge Measurements, Site LG-H1

Site Information				
Project Name	Back River			
Station Identification	LG-H1			
Stream Name	Long Lake Outflow			
Date Monitored	12-Jul-14			
Time at Site (24 hr)	Start Time:	11:25:00 AM	End Time:	12:30:00 PM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	Easting	Northing	Elevation	
	394281	7305112		
Weather Conditions	sun & cloud			

Transducer Information			
PT Model	PT2X	PT Serial #	21221024
Gain	-	Offset	-
Status	Active	Battery	2.9 V
# of Records	-	Memory Free	519088
Date Serviced	12/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 95	1.127	101.127		**100.000**	
BM 96			1.450	99.677	
BM 97			1.369	99.758	
WL			3.779	97.348	
PT			4.402	96.725	
TBM			0.947	100.180	
TBM	0.945	101.125		100.180	
BM 95			1.125	100.000	
BM 96			1.448	99.677	
BM 97			1.367	99.758	
WL			3.777	97.348	
PT			4.397	96.728	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 95	100.000	100.000	0.000	
BM 96	99.677	99.677	0.000	
BM 97	99.758	99.758	0.000	

Summary	
Staff Gauge Reading (m)	n/a
Stage from WL Survey (m)	97.348
Pressure Transducer Reading (m)	0.759
Pressure Transducer Elevation (m)	96.589
Discharge (m^3/s)	-
Cross Sectional Area	-
Average Velocity	-

Discharge Measurement - Mid-Section Method

Measurement Time	Start		End		Location				
Method				Instrument Model					
Flow Meter Type				Instrument Serial #					
Real Time Reading (m)	Start	Reading		Time		Staff Gauge (m)		n/a	
	End	Reading		Time		Time of SG Reading		-	

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1										
2										
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28										
29										
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31										
32										
33										
Total Q										

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site LONG-L1

Site Information				
Project Name	Back River			
Station Identification	LONG-L1			
Stream Name	Long Lake			
Date Monitored	7-Jun-14			
Time at Site (24 hr)	Start Time:	1:00:00 PM	End Time:	2:46:00 PM
Personnel	Emerson Belland, Jem Morrison			
Station Cordinates	Easting	Northing	Elevation	
	387112	7316752		
Weather Conditions	Sunny, 12°C			

Transducer Information			
DL Model	PT2X	PT Serial #	21221025
Gain	-	Offset	-
Status	Active	Battery	2.9 V
# of Records	0	Memory Free	524139
Date Serviced	12/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 53	2.001	102.001		**100.000**	
BM 52			2.154	99.847	
BM 51			1.928	100.073	
WL			2.708	99.293	
PT			3.228	98.773	
TBM			2.487	99.514	
TBM	2.409	101.923		99.514	
BM 53			1.922	100.001	
BM 52			2.075	99.848	
BM 51			1.851	100.072	
WL			2.628	99.295	
PT			3.148	98.775	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 53	100.000	100.001	0.001	
BM 52	99.846	99.848	0.002	
BM 51	100.069	100.073	0.004	

Summary	
Staff Gauge Reading (m)	-
Stage from WL Survey (m)	99.294
Pressure Transducer Reading (m)	0.558
Pressure Transducer Elevation (m)	98.736
Discharge (m^3/s)	-
Cross Sectional Area	-
Average Velocity	-

Discharge Measurement - Mid-Section Method

Measurement Time	Start		End		Location						
Method	Velocity-area (Mid-section)				Instrument Model						
Flow Meter Type					Instrument Serial #						
Real Time Reading (m)	Start	Reading			Time		Staff Gauge (m)				
	End	Reading			Time		Time of SG Reading				

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1										
2										
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4										
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6										
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8										
9										
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33										
Total Q										

General Notes

Lake level monitoring station installed. Distance from the centre of the pressure transducer to the top of the pipe is 40 mm.

Appendix 3. Manual Stage and Discharge Measurements, Site LONG-L1

Site Information				
Project Name	Back River			
Station Identification	LONG-L1			
Stream Name	Long Lake			
Date Monitored	13-Jun-14			
Time at Site (24 hr)	Start Time:	11:38:00 AM	End Time:	
Personnel	Jem Morrison, Kokiak Peetooloot			
Station Cordinates	Easting	Northing	Elevation	
	387112	7316752		
Weather Conditions	Sunny, 17°C			

Transducer Information			
DL Model	PT2X	PT Serial #	21221025
Gain	-	Offset	-
Status	Active	Battery	2.8 V
# of Records	845	Memory Free	523294
Date Serviced	12/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 53	1.029	101.029		**100.000**	
BM 52			1.181	99.848	
BM 51			0.959	100.070	
WL			1.671	99.358	
PT			2.256	98.773	
TBM			1.670	99.359	
TBM	1.490	100.849		99.359	
BM 53			0.849	100.000	
BM 52			1.001	99.848	
BM 51			0.779	100.070	
WL			1.488	99.361	
PT			2.079	98.770	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 53	100.000	100.000	0.000	
BM 52	99.846	99.848	0.002	
BM 51	100.069	100.070	0.001	

Summary	
Staff Gauge Reading (m)	-
Stage from WL Survey (m)	99.360
Pressure Transducer Reading (m)	0.627
Pressure Transducer Elevation (m)	98.733
Discharge (m^3/s)	-
Cross Sectional Area	-
Average Velocity	-

Discharge Measurement - Mid-Section Method

Measurement Time	Start		End		Location						
Method	Velocity-area (Mid-section)			Instrument Model							
Flow Meter Type				Instrument Serial #							
Real Time Reading (m)	Start	Reading		Time		Staff Gauge (m)					
	End	Reading		Time		Time of SG Reading					

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1										
2										
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31										
32										
33										
Total Q										

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site LONG-L1

Site Information				
Project Name	Back River			
Station Identification	LONG-L1			
Stream Name	Long Lake			
Date Monitored	16-Jun-14			
Time at Site (24 hr)	Start Time:	2:50:00 PM	End Time:	
Personnel	Jem Morrison			
Station Cordinates	Easting	Northing	Elevation	
	387112	7316752		
Weather Conditions				

Transducer Information			
DL Model	PT2X	PT Serial #	21221025
Gain	-	Offset	-
Status	Active	Battery	2.8 V
# of Records	1296	Memory Free	522843
Date Serviced	12/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 53	1.099	101.099		**100.000**	
BM 52			1.253	99.846	
BM 51			1.030	100.069	
WL			1.692	99.407	
PT			2.334	98.765	
TBM			1.365	99.734	
TBM	1.261	100.995		99.734	
BM 53			0.996	99.999	
BM 52			1.150	99.845	
BM 51			0.927	100.068	
WL			1.589	99.406	
PT			2.229	98.766	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 53	100.000	100.000	0.000	
BM 52	99.846	99.846	-0.001	
BM 51	100.069	100.069	-0.001	

Summary	
Staff Gauge Reading (m)	-
Stage from WL Survey (m)	99.407
Pressure Transducer Reading (m)	0.681
Pressure Transducer Elevation (m)	98.725
Discharge (m^3/s)	-
Cross Sectional Area	-
Average Velocity	-

Discharge Measurement - Mid-Section Method

Measurement Time	Start		End		Location						
Method	Velocity-area (Mid-section)			Instrument Model							
Flow Meter Type				Instrument Serial #							
Real Time Reading (m)	Start	Reading		Time		Staff Gauge (m)					
	End	Reading		Time		Time of SG Reading					

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1										
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31										
32										
33										
Total Q										

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site LONG-L1

Site Information				
Project Name	Back River			
Station Identification	LONG-L1			
Stream Name	Long Lake			
Date Monitored	12-Jul-14			
Time at Site (24 hr)	Start Time:	9:01:00 AM	End Time:	9:20:00 AM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	Easting	Northing	Elevation	
	387112	7316752		
Weather Conditions	Overcast, windy			

Transducer Information			
PT Model	PT2X	PT Serial #	21221025
Gain	-	Offset	-
Status	Active	Battery	2.8 V
# of Records	5008	Memory Free	519131
Date Serviced	12/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 53	1.698	101.698		**100.000**	
BM 52			1.850	99.848	
BM 51			1.627	100.071	
WL			2.439	99.259	
PT			2.928	98.770	
TBM			1.992	99.706	
TBM	1.843	101.549		99.706	
BM 53			1.548	100.001	
BM 52			1.702	99.847	
BM 51			1.479	100.070	
WL			2.289	99.260	
PT			2.778	98.771	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 53	100.000	100.001	0.000	
BM 52	99.846	99.848	0.001	
BM 51	100.069	100.071	0.001	

Summary	
Staff Gauge Reading (m)	-
Stage from WL Survey (m)	99.260
Pressure Transducer Reading (m)	0.528
Pressure Transducer Elevation (m)	98.732
Discharge (m^3/s)	-
Cross Sectional Area	-
Average Velocity	-

Discharge Measurement - Mid-Section Method

Measurement Time	Start		End		Location						
Method	Velocity-area (Mid-section)			Instrument Model							
Flow Meter Type				Instrument Serial #							
Real Time Reading (m)	Start	Reading		Time		Staff Gauge (m)					
	End	Reading		Time		Time of SG Reading					

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1										
2										
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26										
27										
28										
29										
30										
31										
32										
33										
Total Q										

General Notes

Appendix 3. Manual Stage and Discharge Measurements, Site LONG-L1

Site Information				
Project Name	Back River			
Station Identification	LONG-L1			
Stream Name	Long Lake			
Date Monitored	2-Jul-14			
Time at Site (24 hr)	Start Time:	8:45:00 AM	End Time:	9:45:00 AM
Personnel	Jaclyn Bowman, Justin Porter			
Station Cordinates	Easting	Northing	Elevation	
	387112	7316752		
Weather Conditions				

Transducer Information			
PT Model	PT2X	PT Serial #	21221025
Gain	-	Offset	-
Status	Active	Battery	2.8 V
# of Records	3565	Memory Free	520574
Date Serviced	12/10/2013	Crest Gauges	n/a

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 53	1.614	101.614		**100.000**	
BM 52			1.767	99.847	
BM 51			1.543	100.071	
WL			2.203	99.411	
PT			2.848	98.766	
TBM			1.509	100.105	
TBM	1.516	101.621		100.105	
BM 53			1.621	100.000	
BM 52			1.773	99.848	
BM 51			1.549	100.072	
WL			2.211	99.410	
PT			2.854	98.767	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 53	100.000	100.000	0.000	
BM 52	99.846	99.847	0.001	
BM 51	100.069	100.071	0.002	

Summary	
Staff Gauge Reading (m)	-
Stage from WL Survey (m)	99.410
Pressure Transducer Reading (m)	0.683
Pressure Transducer Elevation (m)	98.727
Discharge (m^3/s)	-
Cross Sectional Area	-
Average Velocity	-

Discharge Measurement - Mid-Section Method

Measurement Time	Start		End		Location						
Method	Velocity-area (Mid-section)			Instrument Model							
Flow Meter Type				Instrument Serial #							
Real Time Reading (m)	Start	Reading		Time		Staff Gauge (m)					
	End	Reading		Time		Time of SG Reading					

		Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
No.	Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
1										
2										
3										
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6										
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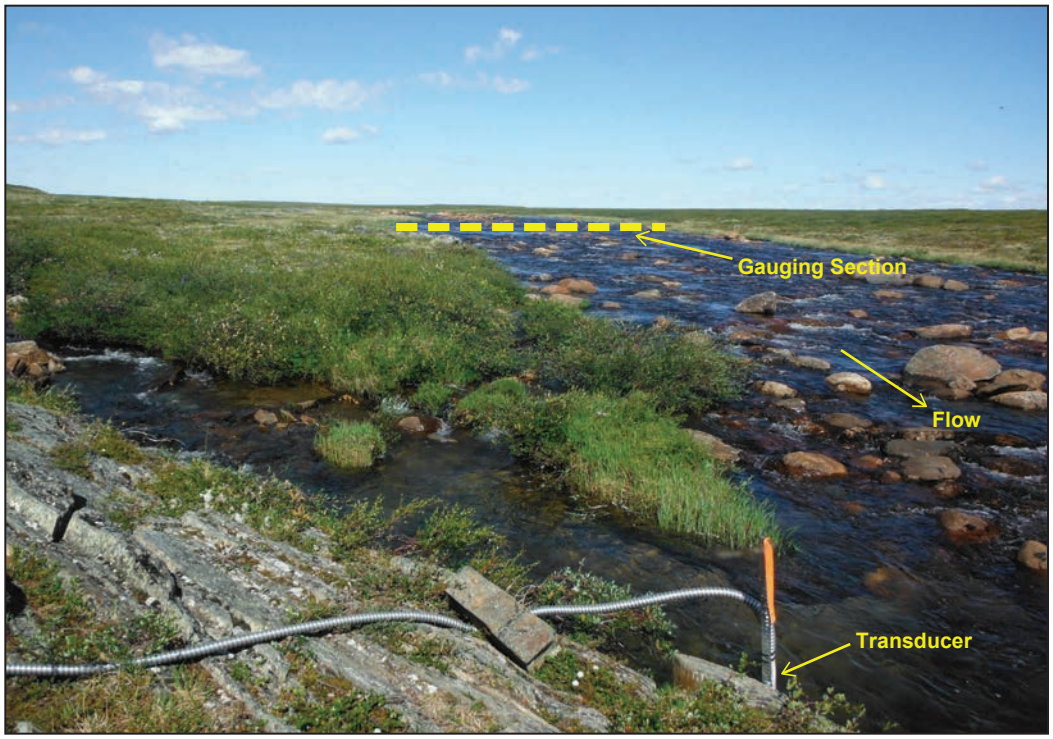
31										
32										
33										
Total Q										

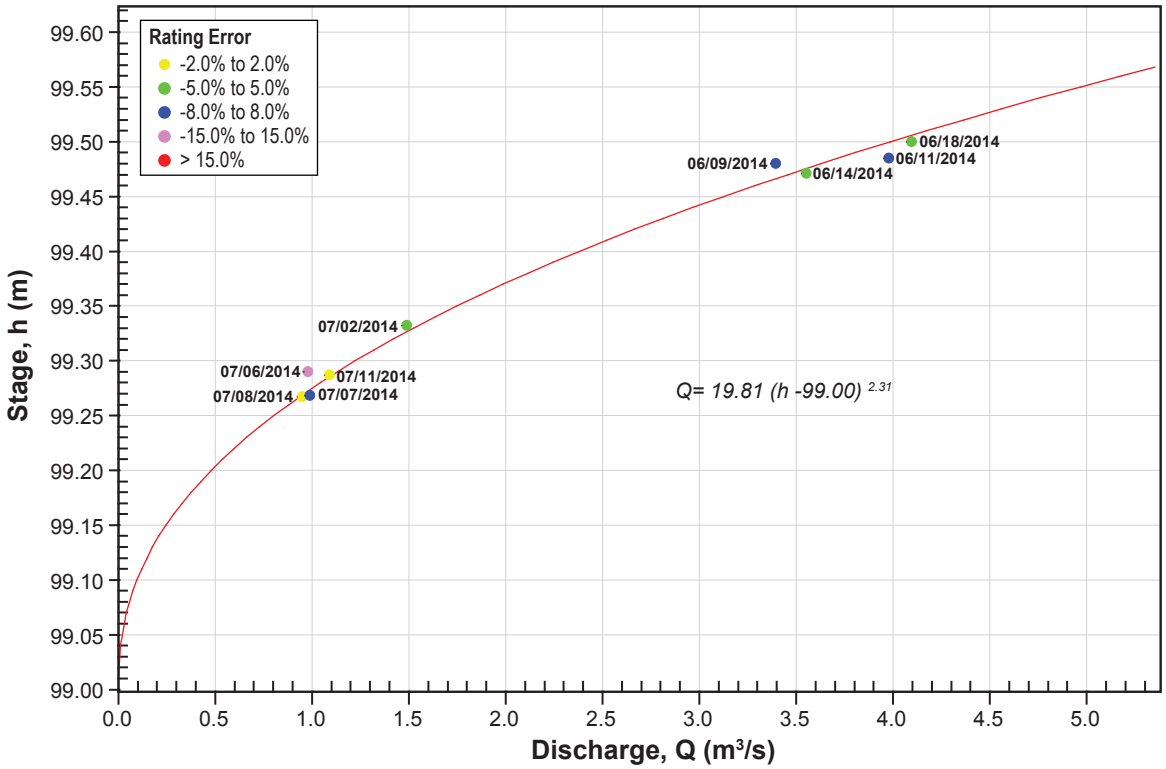
General Notes

Appendix 4
Rating Curves

Rescan™
an ERM company



BL-H2 (Big Lake Outflow), looking upstream towards the gauging section from the station location. July 2, 2014.



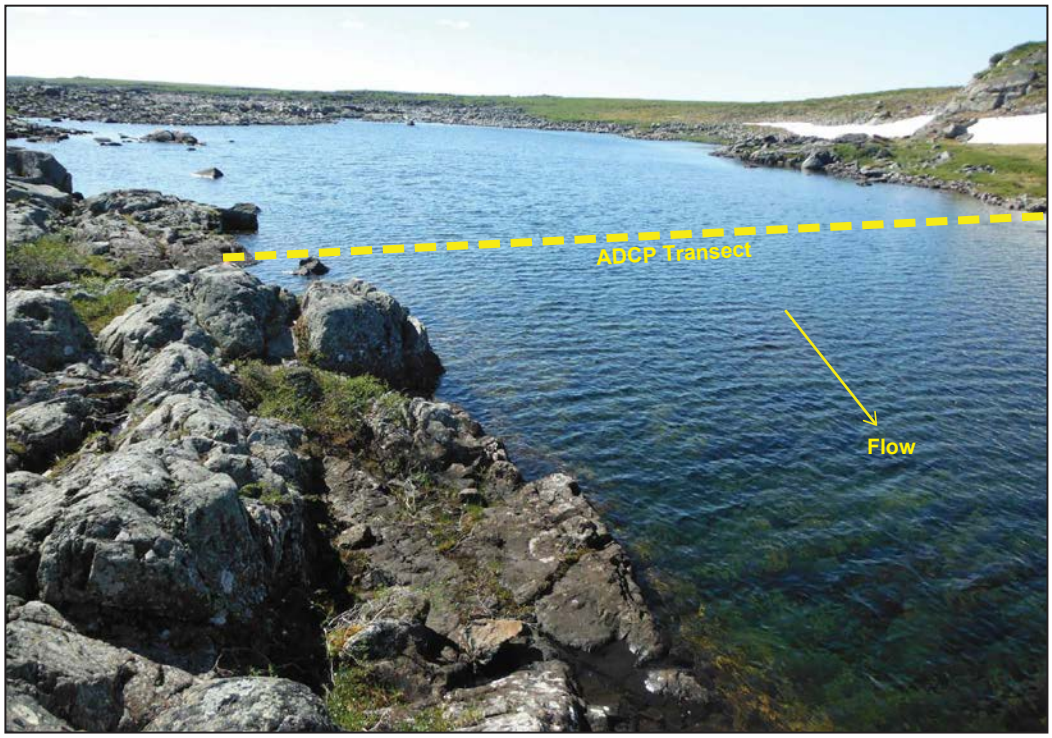
Notes: Rating period from June 9, 2014 to July 11, 2014.
Pressure transducer stage readings are referenced to local (non geodetic) datum.
Rating equation applied to stage values between 99.244 and 99.506 m in 2014.

Figure A4-1

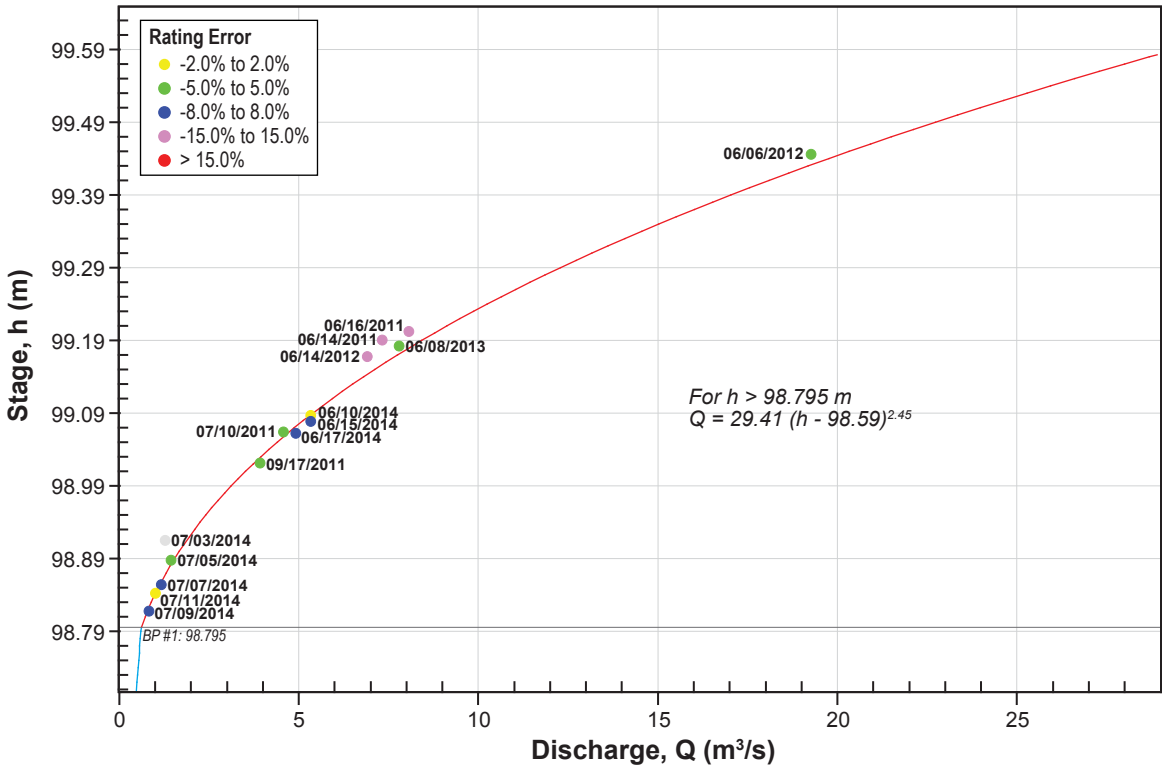
BL-H2 (Big Lake Outflow) Rating Curve

Sabina GOLD & SILVER CORP.

Rescan an ERM company



PL-H1 (Propeller Lake Outflow), looking upstream from the station towards the lake inlet. July 12, 2014.



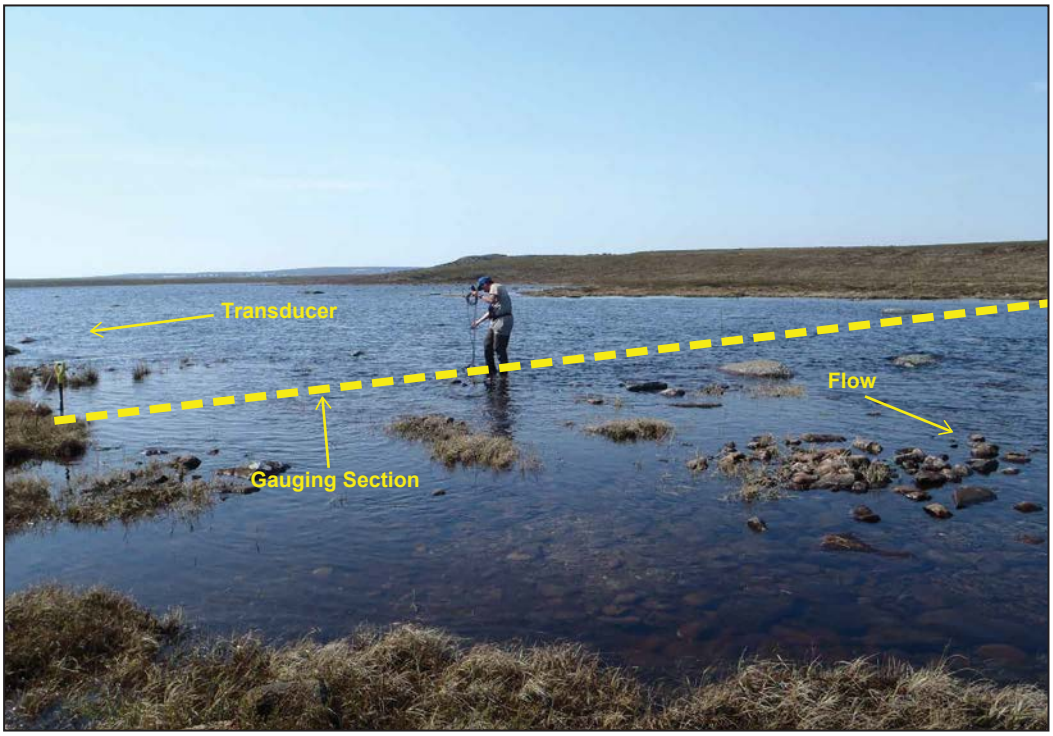
Notes: Rating period from June 14, 2011 to July 11, 2014.
Pressure transducer stage readings are referenced to local (non geodetic) datum.
The measurement taken on July 3, 2014 was not used in development of the 2014 rating curve.
Rating equation applied to stage values between 98.810 and 99.112 m in 2014.

Figure A4-2

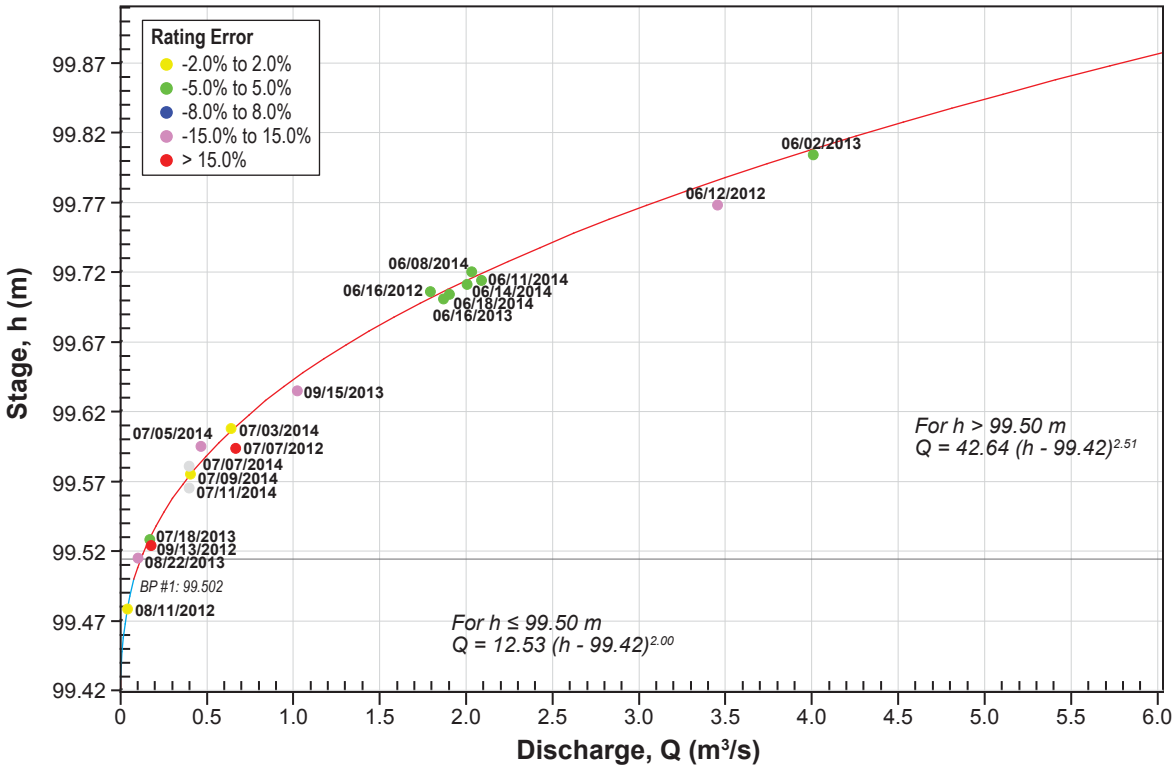
PL-H1 (Propeller Lake Outflow) Rating Curve

Sabina GOLD & SILVER CORP.

Rescan an ERM company



PL-H2 (Propeller Lake Inflow), looking across the stream toward the station and gauging section. June 18, 2014.



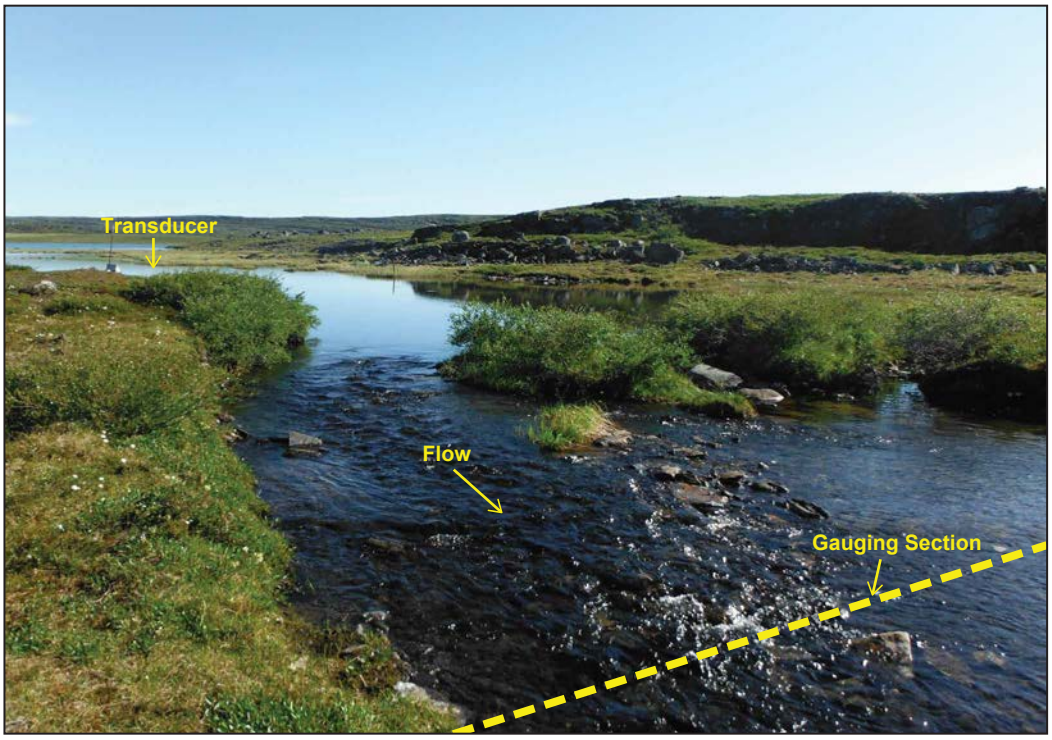
Notes: Rating period from June 12, 2012 to July 9, 2014.
Pressure transducer stage readings are referenced to local (non geodetic) datum.
Measurements taken on July 7 and July 11, 2014 were not used in development of the 2014 rating curve.
Rating equation applied to stage values between 99.562 and 99.726 m in 2014.

Figure A4-3

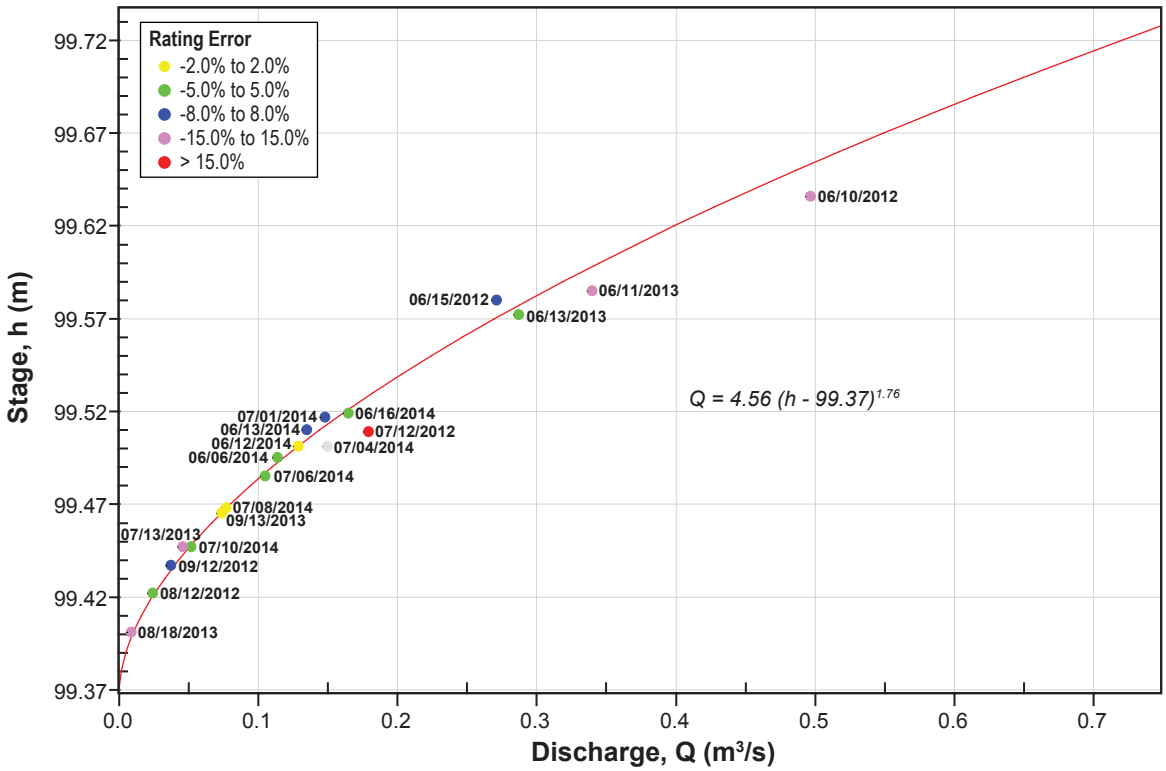
PL-H2 (Propeller Lake Inflow) Rating Curve

Sabina GOLD & SILVER CORP.

Rescan an ERM company



KL-H2 (George Lake Outflow), looking upstream toward the station and lake outlet. July 4, 2014.



Notes: Rating period from June 10, 2012 to July 10, 2014.
Pressure transducer stage readings are referenced to local (non geodetic) datum.
The measurement taken on July 4, 2014 was not used in development of the 2014 rating curve.
Rating equation applied to stage values between 99.574 and 99.454 m in 2014.

Figure A4-4

KL-H2 (George Lake Outflow) Rating Curve

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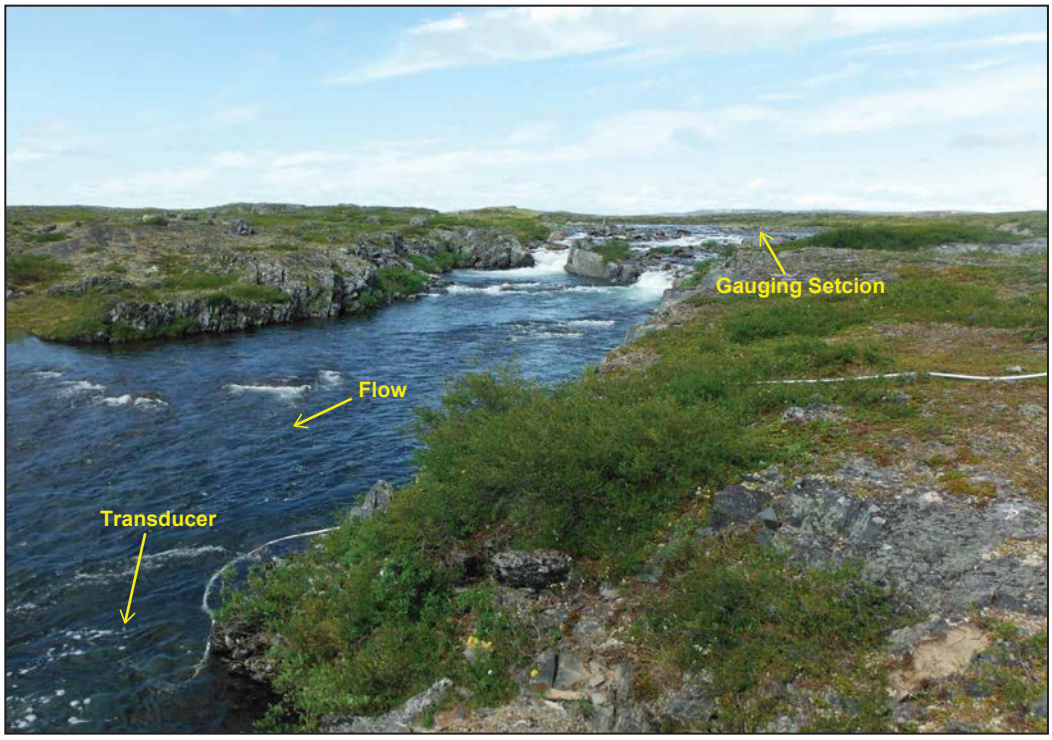
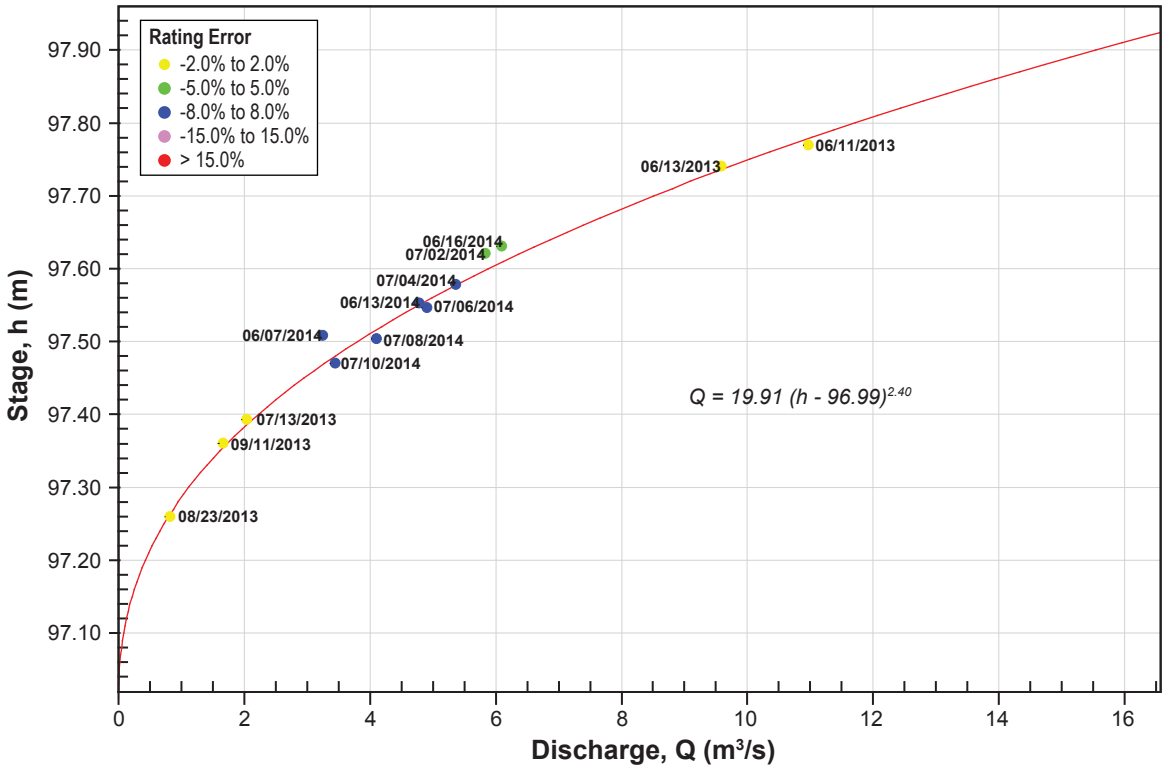


LG-H1 (Long Lake Outflow), looking upstream toward the gauging section. July 6, 2014.



Notes: Rating period from June 11, 2013 to July 10, 2014.
Pressure transducer stage readings are referenced to local (non geodetic) datum.
Rating equation applied to stage values between 99.445 and 99.745 m in 2014.

Figure A4-5

LG-H1 (Long Lake Outflow) Rating Curve

Sabina GOLD & SILVER CORP.

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Appendix 5

Annual Hydrographs and Lake Level Fluctuation

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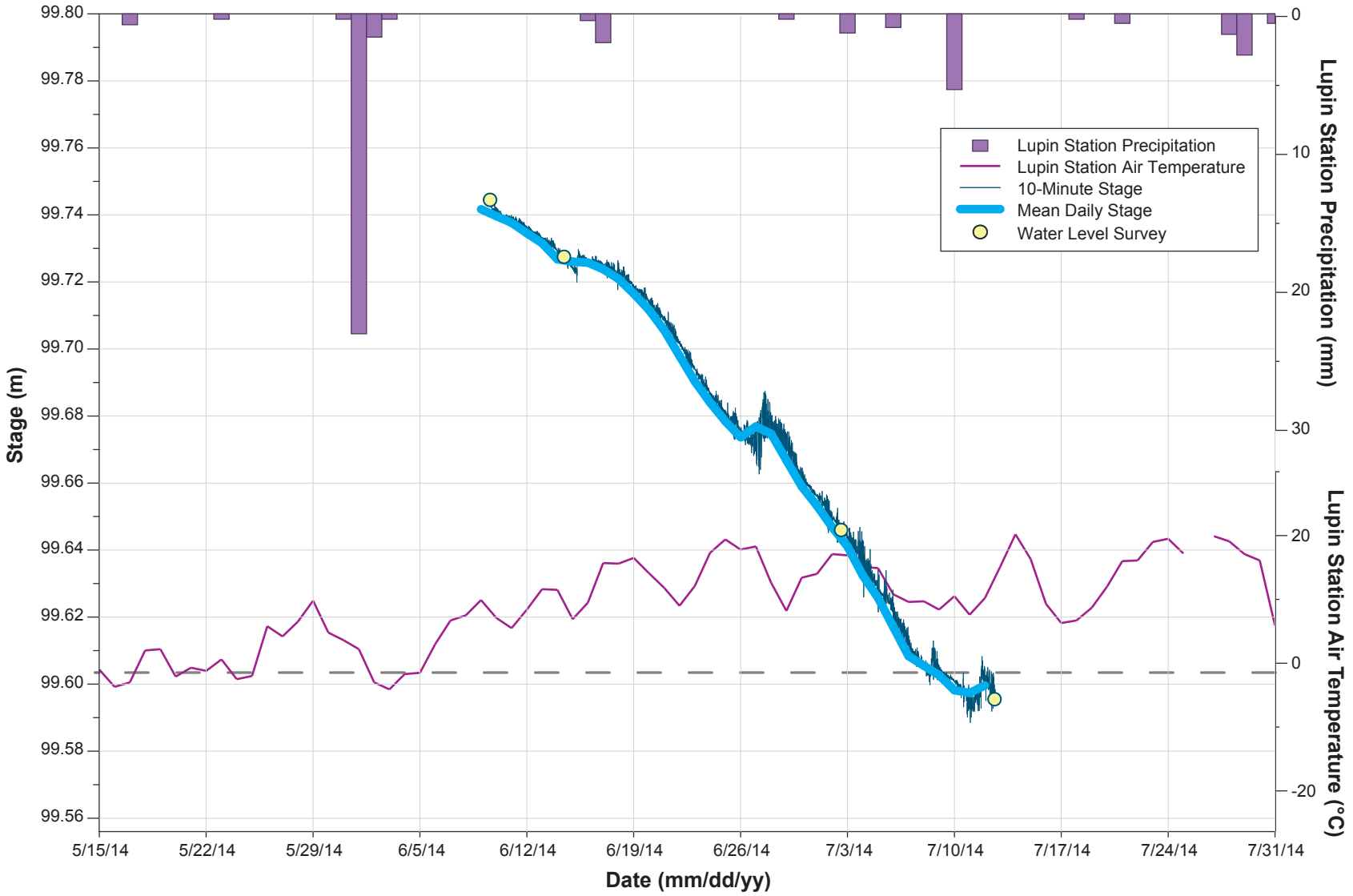


Notes: Precipitation and temperature data are based on Environment Canada Lupin CS station which is located 215 km west of BIG-L1.

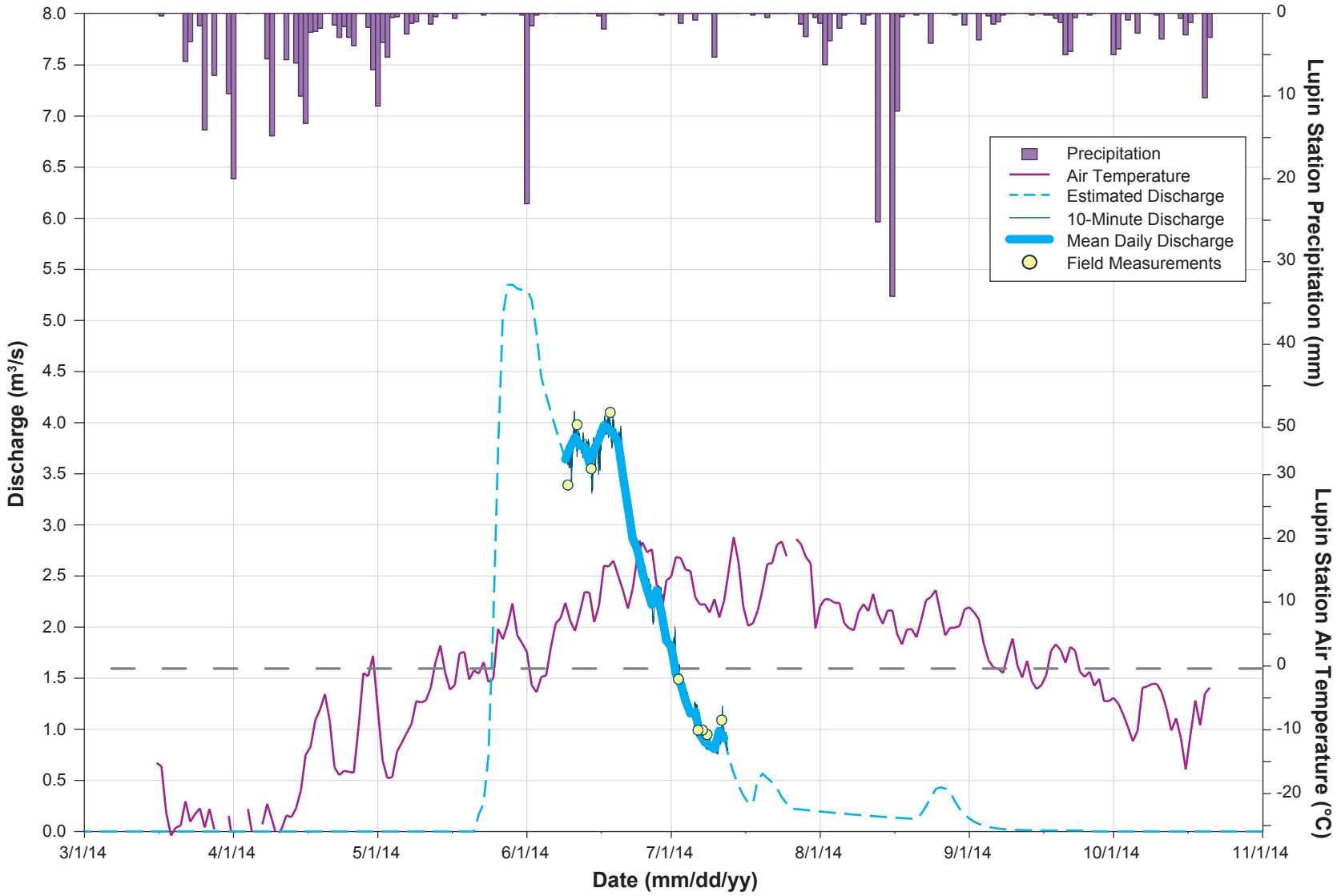
Figure A5-1

Sabina GOLD & SILVER CORP.

Observed Lake Level Fluctuation at BIG-L1 (Big Lake), 2014

Figure A5-1

Rescan an ERM company



Notes: Precipitation and temperature data are based on Environment Canada Lupin CS station which is located 214 km west of BL-H2.
Portions of daily discharge estimated based on a regression with the PL-H2 2014 synthetic series include May 22-June 4 and July 17-August 26, 2014.

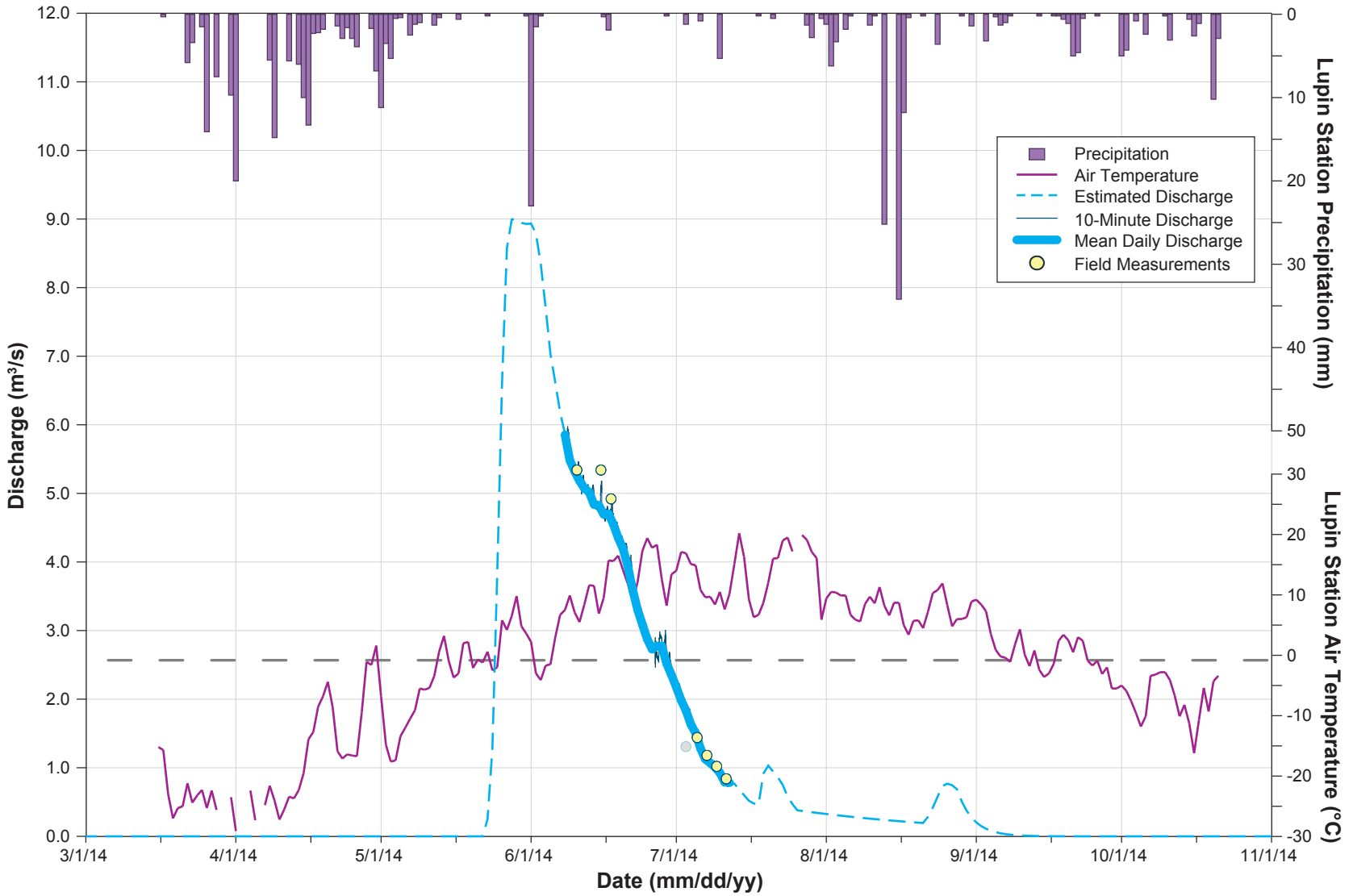
Figure A5-2

Sabina GOLD & SILVER CORP.

Annual Hydrograph for BL-H2 (Big Lake Outflow), 2014

Figure A5-2

Rescan an ERM company



Notes: Precipitation and temperature data are based on Environment Canada Lupin CS station which is located 224 km west of PL-H1.
The stage-discharge measurement taken on July 3, 2014 (denoted in grey) was inconsistent with measured discharge at a similar stage and was not used in 2014 rating curve development. This variation may be due to the presence of boulder gardens at this station.
Portions of daily discharge estimated based on a regression with Baillie River include May 24-June 7, 2014.
Portions of daily discharge estimated based on a regression with Ellice River include July 13-25 and August 23-28, 2014.

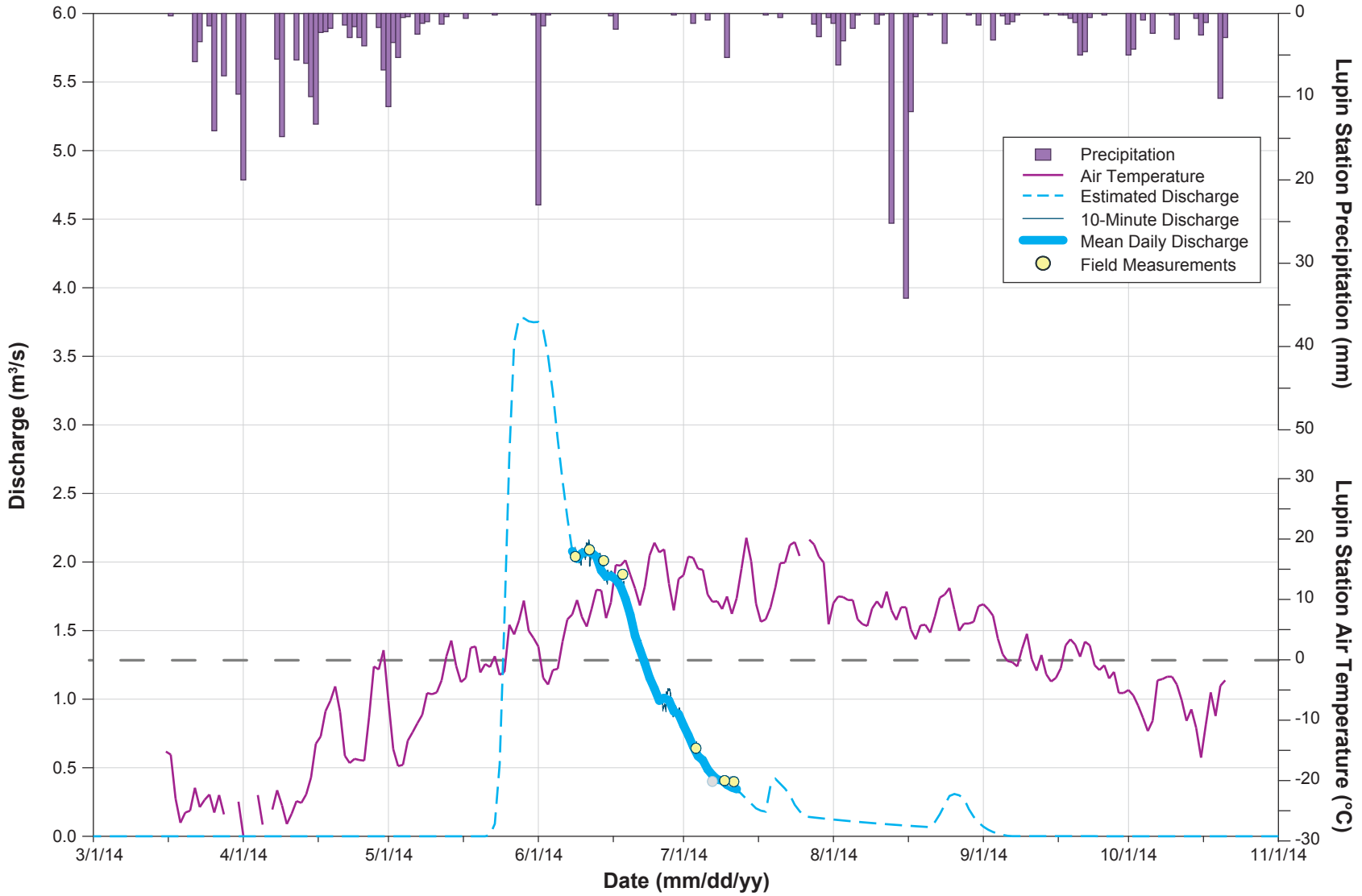
Figure A5-3

Sabina GOLD & SILVER CORP.

Annual Hydrograph for PL-H1 (Propeller Lake Outflow), 2014

Figure A5-3

Rescan an ERM company



Notes: Precipitation and temperature data are based on Environment Canada Lupin CS station which is located 223 km west of PL-H2.
The stage-discharge measurements taken on July 7 and 11, 2014 (denoted in grey) were inconsistent with measured discharge at a similar stage and were not used in 2014 rating curve development.
This variation may be due to the presence of boulder gardens at this station.
Portions of daily discharge estimated based on a regression with the 2014 PL-H1 synthetic time-series include May 23-June 7, July 15-25 and August 23-28, 2014.

Figure A5-4

Sabina GOLD & SILVER CORP.

Annual Hydrograph for PL-H2 (Propeller Lake Inflow), 2014

Figure A5-4

Rescan an ERM company

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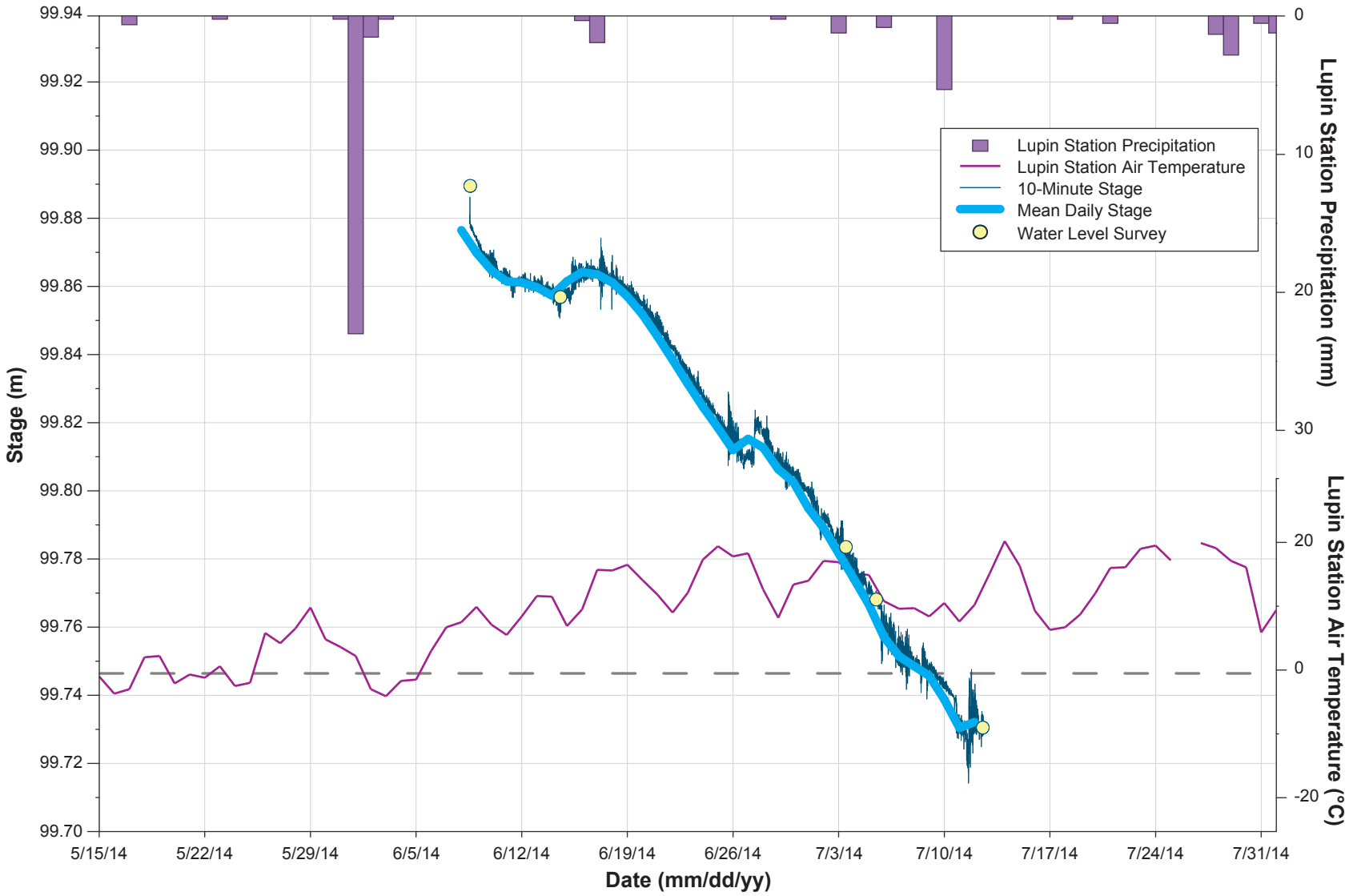


Notes: An estimate of the point of zero flow (PZF) was surveyed at 99.320 m on July 5, 2014.
Precipitation and temperature data are based on Environment Canada Lupin CS station which is located 222 km west of PROP-L1.

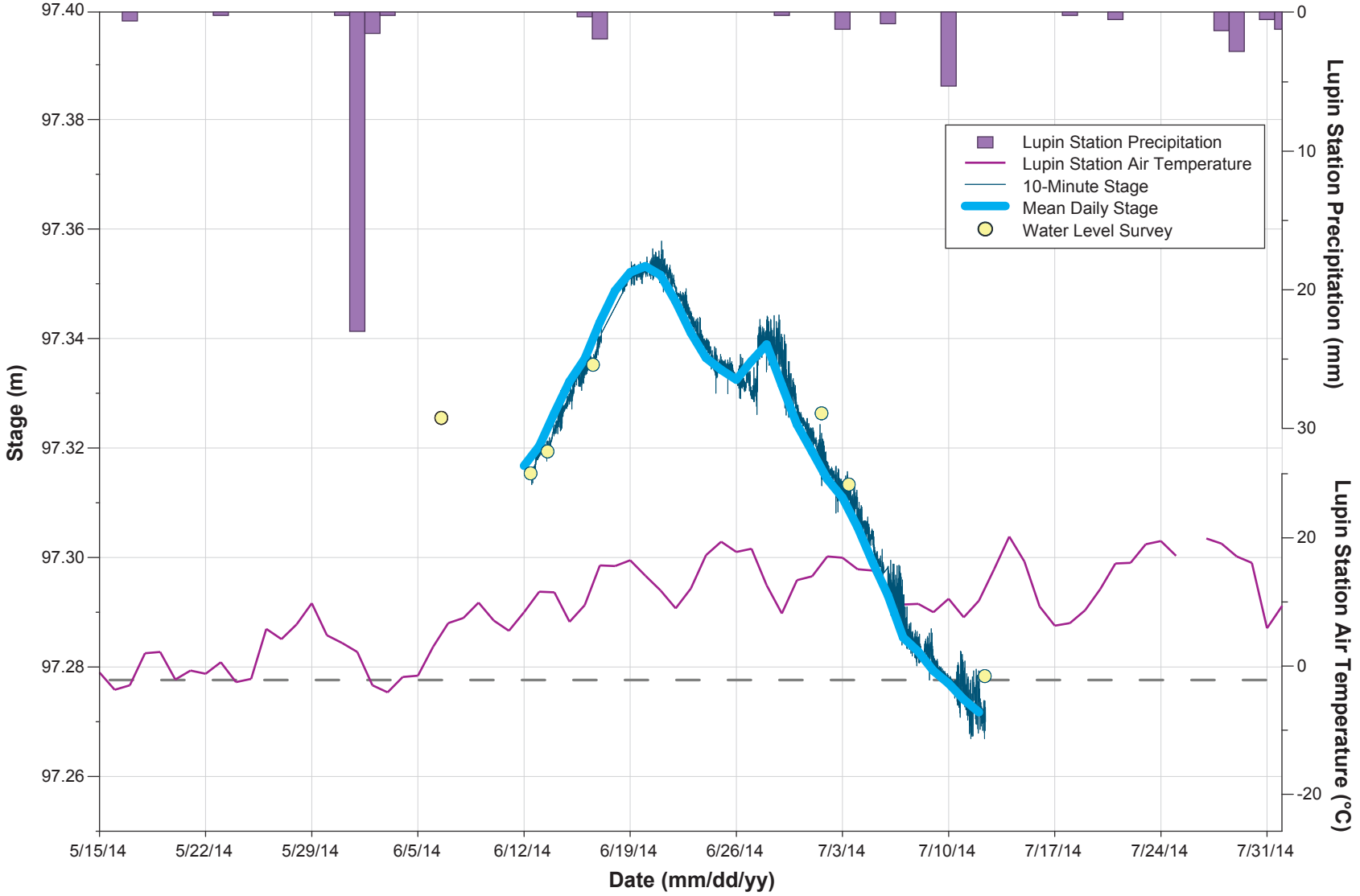
Figure A5-5

Sabina GOLD & SILVER CORP.

Observed Lake Level Fluctuation at PROP-L1 (Propeller Lake), 2014

Figure A5-5

Rescan an ERM company



Notes: The point of zero flow (PZF) was surveyed at 97.123 m on July 6, 2014.
Precipitation and temperature data are based on Environment Canada Lupin CS station which is located 173 km west of GRG-L1.

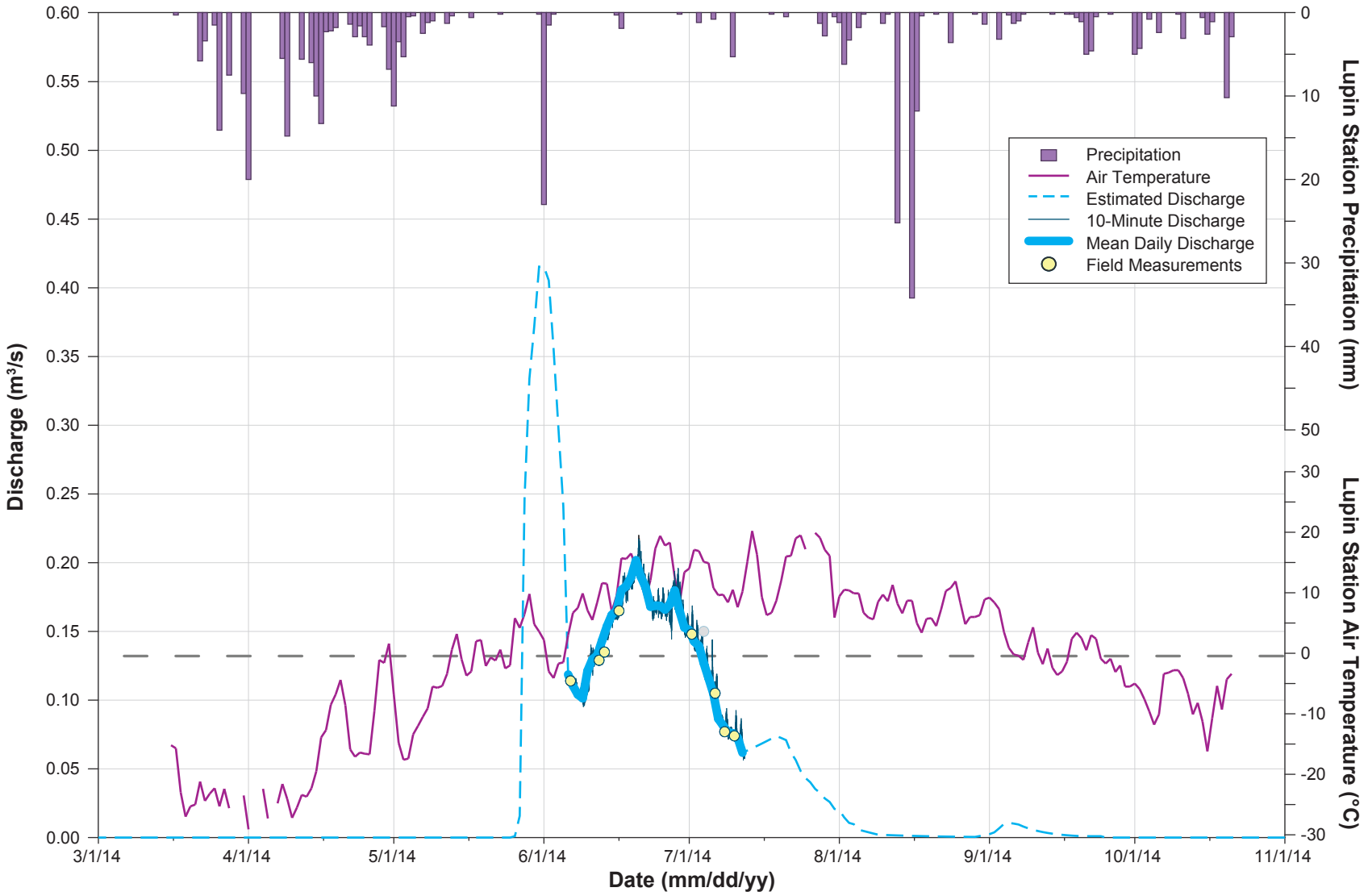
Figure A5-6

Sabina GOLD & SILVER CORP.

Observed Lake Level Fluctuation at GRG-L1 (George Lake), 2014

Figure A5-6

Rescan an ERM company



Notes: Precipitation and temperature data are based on Environment Canada Lupin CS station which is located 173 km west of KL-H2.
Portions of daily discharge estimated based on a regression with the LG-H1 2014 synthetic series include May 28-June 5 and July 19-August 9, 2014.
The stage-discharge measurement taken on July 4, 2014 (denoted in grey) was inconsistent with measured discharge at a similar stage and was not used in 2014 rating curve development.

Figure A5-7

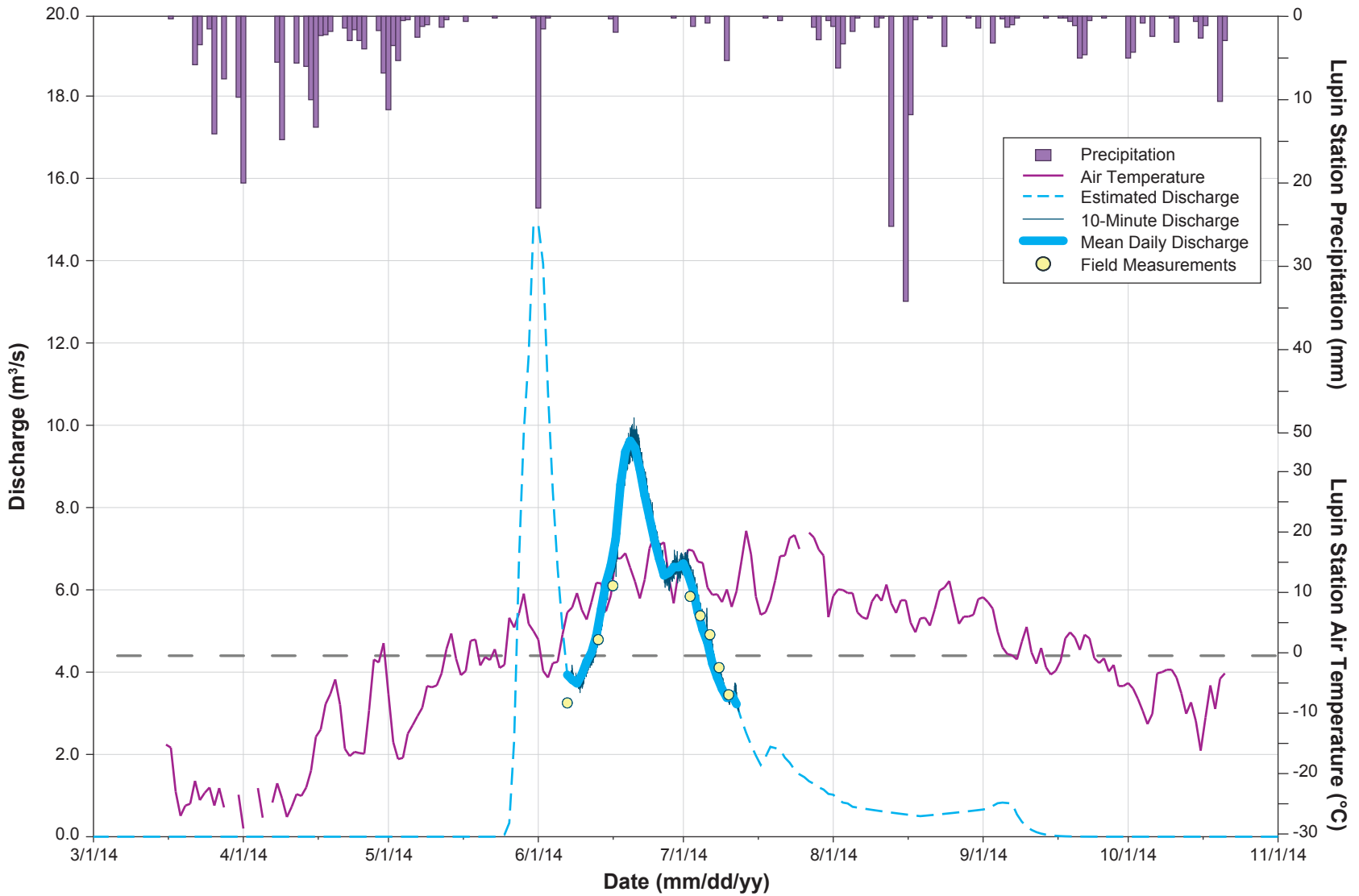
Sabina GOLD & SILVER CORP.

Annual Hydrograph for KL-H2 (George Lake Outflow), 2014

Figure A5-7

Rescan an ERM company

N:\0234411 Sabina\0234411-0022 Hydrology\Working Folder\Graphics\Hydrographs\2014 10 31 KL-H2.emf



Notes: Precipitation and temperature data are based on Environment Canada Lupin CS station which is located 180 km west of LG-H1.
Portions of daily discharge estimated based on a regression with Baillie River include May 28-31 and June 17-August 5, 2014.
Portions of daily discharge estimated based on a regression with Ellice River include September 1-7, 2014.

Figure A5-8

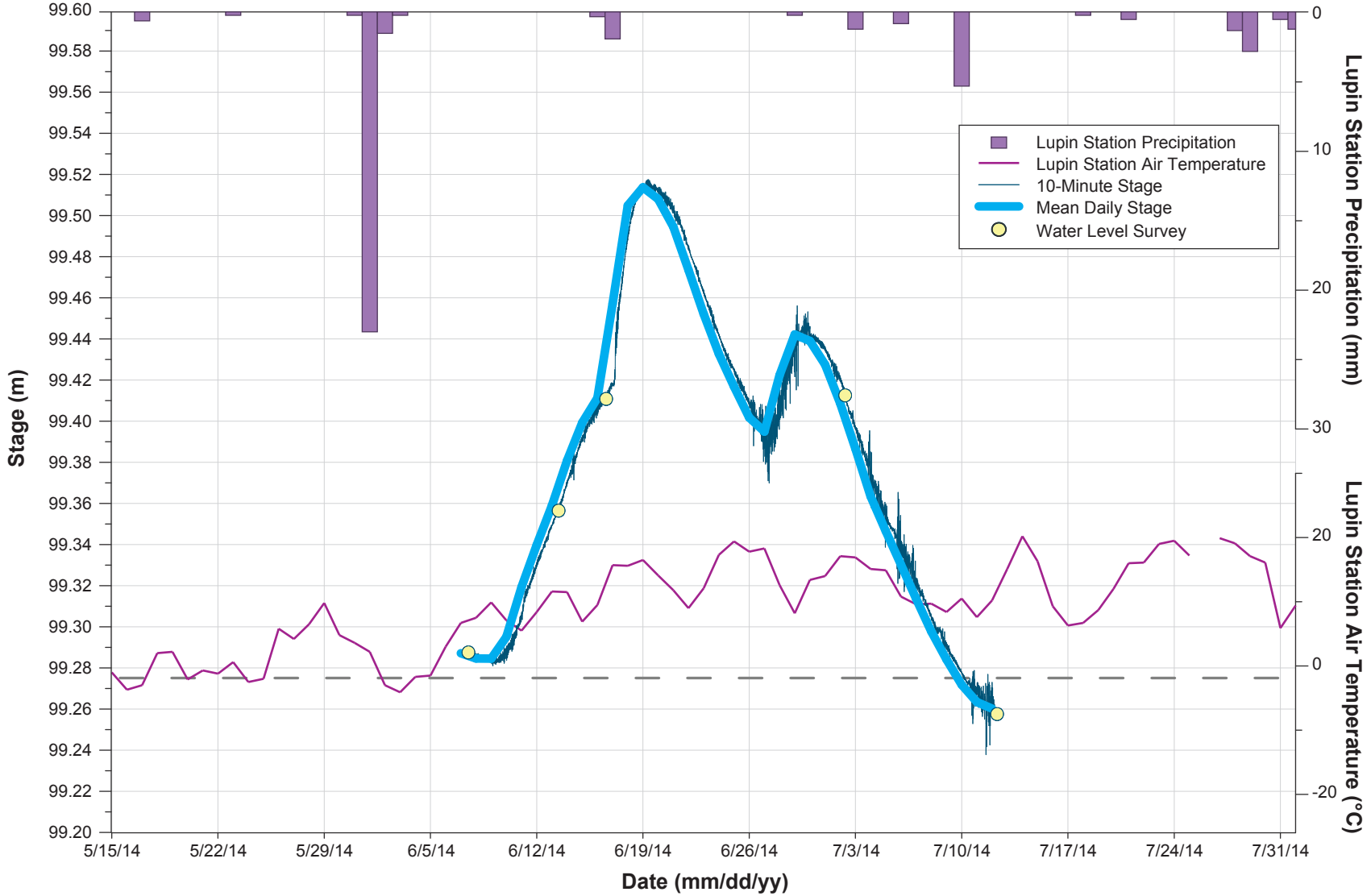
Sabina GOLD & SILVER CORP.

Annual Hydrograph for LG-H1 (Long Lake Outflow), 2014

Figure A5-8

Rescan an ERM company

N:\0234411 Sabina\0234411-0022 Hydrology\Working Folder\Graphics\Hydrographs\2014 10 29 LG-H1.emf



Notes: Precipitation and temperature data are based on Environment Canada Lupin CS station which is located 174 km west of LONG-L1.

Figure A5-9

Sabina GOLD & SILVER CORP.

Observed Lake Level Fluctuation at LONG-L1 (Long Lake), 2014

Figure A5-9

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Appendix 6

Daily Discharge and Stage Tables

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Appendix 6. Summary of Daily Stage [h, m] at Hydrometric Station BIG-L1

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	-	-	-	-	99.653	-	-	-	-	-
2	-	-	-	-	-	-	99.647	-	-	-	-	-
3	-	-	-	-	-	-	99.641	-	-	-	-	-
4	-	-	-	-	-	-	99.632	-	-	-	-	-
5	-	-	-	-	-	-	99.626	-	-	-	-	-
6	-	-	-	-	-	-	99.617	-	-	-	-	-
7	-	-	-	-	-	-	99.608	-	-	-	-	-
8	-	-	-	-	-	-	99.605	-	-	-	-	-
9	-	-	-	-	-	99.742	99.603	-	-	-	-	-
10	-	-	-	-	-	99.740	99.598	-	-	-	-	-
11	-	-	-	-	-	99.738	99.597	-	-	-	-	-
12	-	-	-	-	-	99.735	99.600	-	-	-	-	-
13	-	-	-	-	-	99.732	-	-	-	-	-	-
14	-	-	-	-	-	99.727	-	-	-	-	-	-
15	-	-	-	-	-	99.726	-	-	-	-	-	-
16	-	-	-	-	-	99.726	-	-	-	-	-	-
17	-	-	-	-	-	99.724	-	-	-	-	-	-
18	-	-	-	-	-	99.721	-	-	-	-	-	-
19	-	-	-	-	-	99.717	-	-	-	-	-	-
20	-	-	-	-	-	99.712	-	-	-	-	-	-
21	-	-	-	-	-	99.706	-	-	-	-	-	-
22	-	-	-	-	-	99.698	-	-	-	-	-	-
23	-	-	-	-	-	99.690	-	-	-	-	-	-
24	-	-	-	-	-	99.684	-	-	-	-	-	-
25	-	-	-	-	-	99.678	-	-	-	-	-	-
26	-	-	-	-	-	99.674	-	-	-	-	-	-
27	-	-	-	-	-	99.677	-	-	-	-	-	-
28	-	-	-	-	-	99.675	-	-	-	-	-	-
29	-		-	-	-	99.667	-	-	-	-	-	-
30	-		-	-	-	99.659	-	-	-	-	-	-
31	-		-		-		-	-		-		-
Mean	n/a	n/a	n/a	n/a	n/a	99.707	99.619	n/a	n/a	n/a	n/a	n/a
Max	n/a	n/a	n/a	n/a	n/a	99.742	99.653	n/a	n/a	n/a	n/a	n/a
Min	n/a	n/a	n/a	n/a	n/a	99.659	99.597	n/a	n/a	n/a	n/a	n/a

Appendix 6. Summary of Daily Discharge [Q, m^3/s] at Hydrometric Station BL-H2

Drainage Area =	158.5 km^2											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1	-	-	-	-	-	*5.304*	1.811	*0.196*	*0.127*	-	-	-
2	-	-	-	-	-	*5.198*	1.542	*0.191*	*0.097*	-	-	-
3	-	-	-	-	-	*4.883*	1.444	*0.187*	*0.074*	-	-	-
4	-	-	-	-	-	*4.443*	1.280	*0.182*	*0.057*	-	-	-
5	-	-	-	-	-	*4.270*	1.157	*0.178*	*0.045*	-	-	-
6	-	-	-	-	-	*4.103*	1.171	*0.174*	*0.036*	-	-	-
7	-	-	-	-	-	*3.943*	0.950	*0.170*	*0.029*	-	-	-
8	-	-	-	-	-	*3.789*	0.876	*0.166*	*0.024*	-	-	-
9	-	-	-	-	-	3.641	0.839	*0.162*	*0.020*	-	-	-
10	-	-	-	-	-	3.758	0.809	*0.158*	*0.018*	-	-	-
11	-	-	-	-	-	3.856	0.983	*0.155*	*0.016*	-	-	-
12	-	-	-	-	-	3.777	0.915	*0.151*	*0.014*	-	-	-
13	-	-	-	-	-	3.762	*0.722*	*0.147*	*0.013*	-	-	-
14	-	-	-	-	-	3.609	*0.570*	*0.144*	*0.012*	-	-	-
15	-	-	-	-	-	3.738	*0.450*	*0.141*	*0.012*	-	-	-
16	-	-	-	-	-	3.842	*0.355*	*0.137*	*0.011*	-	-	-
17	-	-	-	-	-	3.970	*0.280*	*0.134*	*0.011*	-	-	-
18	-	-	-	-	-	3.942	*0.271*	*0.131*	*0.011*	-	-	-
19	-	-	-	-	-	3.887	*0.508*	*0.128*	*0.010*	-	-	-
20	-	-	-	-	-	3.804	*0.565*	*0.125*	*0.010*	-	-	-
21	-	-	-	-	-	3.471	*0.523*	*0.122*	*0.010*	-	-	-
22	-	-	-	-	*0.168*	3.175	*0.479*	*0.173*	*0.010*	-	-	-
23	-	-	-	-	*0.276*	2.865	*0.423*	*0.247*	*0.010*	-	-	-
24	-	-	-	-	*0.742*	2.756	*0.335*	*0.334*	*0.010*	-	-	-
25	-	-	-	-	*2.045*	2.533	*0.276*	*0.415*	*0.010*	-	-	-
26	-	-	-	-	*3.720*	2.368	*0.226*	*0.433*	*0.010*	-	-	-
27	-	-	-	-	*5.048*	2.220	*0.221*	*0.421*	-	-	-	-
28	-	-	-	-	*5.348*	2.355	*0.215*	*0.390*	-	-	-	-
29	-		-	-	*5.351*	2.136	*0.210*	*0.295*	-	-	-	-
30	-		-	-	*5.312*	1.870	*0.205*	*0.222*	-	-	-	-
31	-		-		*5.300*		*0.201*	*0.168*		-		-
Mean	n/a	n/a	n/a	n/a	3.331	3.576	0.671	0.206	0.027	n/a	n/a	n/a
Max	n/a	n/a	n/a	n/a	5.351	5.304	1.811	0.433	0.127	n/a	n/a	n/a
Min	n/a	n/a	n/a	n/a	0.168	1.870	0.201	0.122	0.010	n/a	n/a	n/a
Total	n/a	n/a	n/a	n/a	33.310	107.270	20.812	6.376	0.709	n/a	n/a	n/a

Note: Estimated and modelled values are italicized

Values in red denote high uncertainty based on extrapolation of the rating curve beyond 2 times the greatest measured discharge.

Appendix 6. Summary of Daily Discharge [Q, m^3/s] at Hydrometric Station PL-H1

Drainage Area =	204.6 km^2											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1	-	-	-	-	-	*8.933*	2.176	*0.326*	*0.203*	-	-	-
2	-	-	-	-	-	*8.787*	1.985	*0.317*	*0.150*	-	-	-
3	-	-	-	-	-	*8.344*	1.835	*0.309*	*0.110*	-	-	-
4	-	-	-	-	-	*7.708*	1.634	*0.301*	*0.081*	-	-	-
5	-	-	-	-	-	*7.030*	1.504	*0.294*	*0.060*	-	-	-
6	-	-	-	-	-	*6.614*	1.281	*0.286*	*0.044*	-	-	-
7	-	-	-	-	-	*6.181*	1.125	*0.279*	*0.033*	-	-	-
8	-	-	-	-	-	5.854	1.070	*0.272*	*0.024*	-	-	-
9	-	-	-	-	-	5.483	1.008	*0.265*	*0.018*	-	-	-
10	-	-	-	-	-	5.323	0.928	*0.258*	*0.013*	-	-	-
11	-	-	-	-	-	5.183	0.791	*0.252*	*0.010*	-	-	-
12	-	-	-	-	-	5.075	0.782	*0.245*	*0.007*	-	-	-
13	-	-	-	-	-	5.017	*0.768*	*0.239*	*0.005*	-	-	-
14	-	-	-	-	-	4.838	*0.682*	*0.233*	*0.004*	-	-	-
15	-	-	-	-	-	4.824	*0.602*	*0.227*	*0.003*	-	-	-
16	-	-	-	-	-	4.694	*0.519*	*0.221*	*0.002*	-	-	-
17	-	-	-	-	-	4.701	*0.479*	*0.216*	*0.002*	-	-	-
18	-	-	-	-	-	4.548	*0.462*	*0.210*	*0.001*	-	-	-
19	-	-	-	-	-	4.352	*0.915*	*0.205*	*0.001*	-	-	-
20	-	-	-	-	-	4.191	*1.031*	*0.199*	*0.001*	-	-	-
21	-	-	-	-	-	3.932	*0.945*	*0.194*	*0.000*	-	-	-
22	-	-	-	-	*0.000*	3.589	*0.859*	*0.285*	*0.000*	-	-	-
23	-	-	-	-	*0.251*	3.306	*0.749*	*0.418*	*0.000*	-	-	-
24	-	-	-	-	*1.282*	3.087	*0.581*	*0.579*	*0.000*	-	-	-
25	-	-	-	-	*3.829*	2.876	*0.471*	*0.733*	*0.000*	-	-	-
26	-	-	-	-	*6.620*	2.729	*0.380*	*0.768*	*0.000*	-	-	-
27	-	-	-	-	*8.577*	2.773	*0.370*	*0.745*	-	-	-	-
28	-	-	-	-	*8.994*	2.774	*0.361*	*0.686*	-	-	-	-
29	-		-	-	*8.998*	2.521	*0.352*	*0.506*	-	-	-	-
30	-		-	-	*8.945*	2.353	*0.343*	*0.373*	-	-	-	-
31	-		-		*8.928*		*0.334*	*0.275*		-		-
Mean	n/a	n/a	n/a	n/a	5.642	4.921	0.881	0.346	0.030	n/a	n/a	n/a
Max	n/a	n/a	n/a	n/a	8.998	8.933	2.176	0.768	0.203	n/a	n/a	n/a
Min	n/a	n/a	n/a	n/a	0.000	2.353	0.334	0.194	0.000	n/a	n/a	n/a
Total	n/a	n/a	n/a	n/a	56.425	147.622	27.323	10.715	0.772	n/a	n/a	n/a

Note: Estimated and modelled values are italicized

Values in red denote high uncertainty based on extrapolation of the rating curve beyond 2 times the greatest measured discharge.

Appendix 6. Summary of Daily Discharge [Q, m^3/s] at Hydrometric Station PL-H2

Drainage Area =	101.6 km^2											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1	-	-	-	-	-	*3.751*	0.809	*0.122*	*0.070*	-	-	-
2	-	-	-	-	-	*3.689*	0.737	*0.119*	*0.048*	-	-	-
3	-	-	-	-	-	*3.502*	0.655	*0.115*	*0.031*	-	-	-
4	-	-	-	-	-	*3.234*	0.585	*0.112*	*0.019*	-	-	-
5	-	-	-	-	-	*2.948*	0.555	*0.109*	*0.010*	-	-	-
6	-	-	-	-	-	*2.773*	0.488	*0.106*	*0.004*	-	-	-
7	-	-	-	-	-	*2.590*	0.446	*0.102*	*0.001*	-	-	-
8	-	-	-	-	-	2.079	0.414	*0.099*	*0.001*	-	-	-
9	-	-	-	-	-	2.025	0.406	*0.097*	*0.001*	-	-	-
10	-	-	-	-	-	2.064	0.376	*0.094*	*0.001*	-	-	-
11	-	-	-	-	-	2.075	0.357	*0.091*	*0.001*	-	-	-
12	-	-	-	-	-	2.068	0.344	*0.088*	*0.001*	-	-	-
13	-	-	-	-	-	2.038	*0.308*	*0.086*	*0.001*	-	-	-
14	-	-	-	-	-	1.938	*0.272*	*0.083*	*0.001*	-	-	-
15	-	-	-	-	-	1.895	*0.238*	*0.081*	*0.001*	-	-	-
16	-	-	-	-	-	1.898	*0.204*	*0.078*	*0.001*	-	-	-
17	-	-	-	-	-	1.874	*0.187*	*0.076*	*0.001*	-	-	-
18	-	-	-	-	-	1.823	*0.180*	*0.073*	*0.001*	-	-	-
19	-	-	-	-	-	1.732	*0.371*	*0.071*	*0.001*	-	-	-
20	-	-	-	-	-	1.615	*0.419*	*0.069*	*0.001*	-	-	-
21	-	-	-	-	-	1.461	*0.383*	*0.067*	*0.001*	-	-	-
22	-	-	-	-	*0.010*	1.360	*0.347*	*0.105*	*0.001*	-	-	-
23	-	-	-	-	*0.091*	1.262	*0.301*	*0.161*	*0.001*	-	-	-
24	-	-	-	-	*0.525*	1.155	*0.230*	*0.229*	*0.001*	-	-	-
25	-	-	-	-	*1.599*	1.077	*0.183*	*0.294*	-	-	-	-
26	-	-	-	-	*2.776*	0.990	*0.145*	*0.308*	-	-	-	-
27	-	-	-	-	*3.600*	1.009	*0.141*	*0.299*	-	-	-	-
28	-	-	-	-	*3.776*	0.991	*0.137*	*0.274*	-	-	-	-
29	-		-	-	*3.778*	0.911	*0.133*	*0.198*	-	-	-	-
30	-		-	-	*3.756*	0.890	*0.129*	*0.142*	-	-	-	-
31	-		-		*3.748*		*0.126*	*0.101*	-	-		-
Mean	n/a	n/a	n/a	n/a	2.366	1.957	0.342	0.131	0.008	n/a	n/a	n/a
Max	n/a	n/a	n/a	n/a	3.778	3.751	0.809	0.308	0.070	n/a	n/a	n/a
Min	n/a	n/a	n/a	n/a	0.010	0.890	0.126	0.067	0.001	n/a	n/a	n/a
Total	n/a	n/a	n/a	n/a	23.660	58.719	10.606	4.049	0.201	n/a	n/a	n/a

Note: Estimated and modelled values are italicized

Values in red denote high uncertainty based on extrapolation of the rating curve beyond 2 times the greatest measured discharge.

Appendix 6. Summary of Daily Stage [h, m] at Hydrometric Station PROP-L1

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	-	-	-	-	99.795	-	-	-	-	-
2	-	-	-	-	-	-	99.789	-	-	-	-	-
3	-	-	-	-	-	-	99.782	-	-	-	-	-
4	-	-	-	-	-	-	99.774	-	-	-	-	-
5	-	-	-	-	-	-	99.767	-	-	-	-	-
6	-	-	-	-	-	-	99.757	-	-	-	-	-
7	-	-	-	-	-	-	99.751	-	-	-	-	-
8	-	-	-	-	-	99.876	99.749	-	-	-	-	-
9	-	-	-	-	-	99.870	99.746	-	-	-	-	-
10	-	-	-	-	-	99.865	99.739	-	-	-	-	-
11	-	-	-	-	-	99.861	99.730	-	-	-	-	-
12	-	-	-	-	-	99.861	99.732	-	-	-	-	-
13	-	-	-	-	-	99.860	-	-	-	-	-	-
14	-	-	-	-	-	99.857	-	-	-	-	-	-
15	-	-	-	-	-	99.862	-	-	-	-	-	-
16	-	-	-	-	-	99.864	-	-	-	-	-	-
17	-	-	-	-	-	99.864	-	-	-	-	-	-
18	-	-	-	-	-	99.861	-	-	-	-	-	-
19	-	-	-	-	-	99.857	-	-	-	-	-	-
20	-	-	-	-	-	99.852	-	-	-	-	-	-
21	-	-	-	-	-	99.845	-	-	-	-	-	-
22	-	-	-	-	-	99.838	-	-	-	-	-	-
23	-	-	-	-	-	99.831	-	-	-	-	-	-
24	-	-	-	-	-	99.825	-	-	-	-	-	-
25	-	-	-	-	-	99.818	-	-	-	-	-	-
26	-	-	-	-	-	99.812	-	-	-	-	-	-
27	-	-	-	-	-	99.815	-	-	-	-	-	-
28	-	-	-	-	-	99.813	-	-	-	-	-	-
29	-		-	-	-	99.806	-	-	-	-	-	-
30	-		-	-	-	99.803	-	-	-	-	-	-
31	-		-		-		-	-		-		-
Mean	n/a	n/a	n/a	n/a	n/a	99.844	99.759	n/a	n/a	n/a	n/a	n/a
Max	n/a	n/a	n/a	n/a	n/a	99.876	99.795	n/a	n/a	n/a	n/a	n/a
Min	n/a	n/a	n/a	n/a	n/a	99.803	99.730	n/a	n/a	n/a	n/a	n/a

Appendix 6. Summary of Daily Stage [h, m] at Hydrometric Station GRG-L1

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	-	-	-	-	97.319	-	-	-	-	-
2	-	-	-	-	-	-	97.314	-	-	-	-	-
3	-	-	-	-	-	-	97.311	-	-	-	-	-
4	-	-	-	-	-	-	97.306	-	-	-	-	-
5	-	-	-	-	-	-	97.299	-	-	-	-	-
6	-	-	-	-	-	-	97.293	-	-	-	-	-
7	-	-	-	-	-	-	97.285	-	-	-	-	-
8	-	-	-	-	-	-	97.283	-	-	-	-	-
9	-	-	-	-	-	-	97.279	-	-	-	-	-
10	-	-	-	-	-	-	97.277	-	-	-	-	-
11	-	-	-	-	-	-	97.274	-	-	-	-	-
12	-	-	-	-	-	97.317	97.272	-	-	-	-	-
13	-	-	-	-	-	97.320	-	-	-	-	-	-
14	-	-	-	-	-	97.326	-	-	-	-	-	-
15	-	-	-	-	-	97.332	-	-	-	-	-	-
16	-	-	-	-	-	97.336	-	-	-	-	-	-
17	-	-	-	-	-	97.343	-	-	-	-	-	-
18	-	-	-	-	-	97.349	-	-	-	-	-	-
19	-	-	-	-	-	97.352	-	-	-	-	-	-
20	-	-	-	-	-	97.353	-	-	-	-	-	-
21	-	-	-	-	-	97.352	-	-	-	-	-	-
22	-	-	-	-	-	97.347	-	-	-	-	-	-
23	-	-	-	-	-	97.341	-	-	-	-	-	-
24	-	-	-	-	-	97.336	-	-	-	-	-	-
25	-	-	-	-	-	97.334	-	-	-	-	-	-
26	-	-	-	-	-	97.332	-	-	-	-	-	-
27	-	-	-	-	-	97.336	-	-	-	-	-	-
28	-	-	-	-	-	97.339	-	-	-	-	-	-
29	-		-	-	-	97.331	-	-	-	-	-	-
30	-		-	-	-	97.324	-	-	-	-	-	-
31	-		-		-		-	-		-		-
Mean	n/a	n/a	n/a	n/a	n/a	97.337	97.293	n/a	n/a	n/a	n/a	n/a
Max	n/a	n/a	n/a	n/a	n/a	97.353	97.319	n/a	n/a	n/a	n/a	n/a
Min	n/a	n/a	n/a	n/a	n/a	97.317	97.272	n/a	n/a	n/a	n/a	n/a

Appendix 6. Summary of Daily Discharge [Q, m^3/s] at Hydrometric Station KL-H2

Drainage Area =	9.6 km^2											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1	-	-	-	-	-	*0.415*	0.151	*0.020*	*0.002*	-	-	-
2	-	-	-	-	-	*0.405*	0.143	*0.015*	*0.004*	-	-	-
3	-	-	-	-	-	*0.355*	0.139	*0.011*	*0.007*	-	-	-
4	-	-	-	-	-	*0.297*	0.127	*0.010*	*0.010*	-	-	-
5	-	-	-	-	-	*0.241*	0.116	*0.006*	*0.011*	-	-	-
6	-	-	-	-	-	0.119	0.105	*0.005*	*0.010*	-	-	-
7	-	-	-	-	-	0.110	0.086	*0.004*	*0.010*	-	-	-
8	-	-	-	-	-	0.104	0.081	*0.003*	*0.008*	-	-	-
9	-	-	-	-	-	0.101	0.077	*0.002*	*0.007*	-	-	-
10	-	-	-	-	-	0.121	0.076	*0.002*	*0.006*	-	-	-
11	-	-	-	-	-	0.130	0.073	*0.002*	*0.005*	-	-	-
12	-	-	-	-	-	0.133	0.062	*0.002*	*0.004*	-	-	-
13	-	-	-	-	-	0.143	*0.063*	*0.002*	*0.003*	-	-	-
14	-	-	-	-	-	0.154	*0.065*	*0.001*	*0.003*	-	-	-
15	-	-	-	-	-	0.162	*0.067*	*0.001*	*0.002*	-	-	-
16	-	-	-	-	-	0.165	*0.068*	*0.001*	*0.002*	-	-	-
17	-	-	-	-	-	0.180	*0.070*	*0.001*	*0.002*	-	-	-
18	-	-	-	-	-	0.183	*0.072*	*0.001*	*0.001*	-	-	-
19	-	-	-	-	-	0.189	*0.074*	*0.001*	*0.001*	-	-	-
20	-	-	-	-	-	0.202	*0.072*	*0.001*	*0.001*	-	-	-
21	-	-	-	-	-	0.190	*0.071*	*0.001*	*0.001*	-	-	-
22	-	-	-	-	-	0.182	*0.062*	*0.001*	*0.001*	-	-	-
23	-	-	-	-	-	0.168	*0.056*	*0.001*	*0.001*	-	-	-
24	-	-	-	-	-	0.169	*0.048*	*0.001*	*0.001*	-	-	-
25	-	-	-	-	-	0.169	*0.043*	*0.001*	-	-	-	-
26	-	-	-	-	*0.001*	0.166	*0.040*	*0.001*	-	-	-	-
27	-	-	-	-	*0.016*	0.170	*0.035*	*0.001*	-	-	-	-
28	-	-	-	-	*0.247*	0.180	*0.033*	*0.000*	-	-	-	-
29	-		-	-	*0.334*	0.165	*0.028*	*0.000*	-	-	-	-
30	-		-	-	*0.372*	0.153	*0.026*	*0.001*	-	-	-	-
31	-		-		*0.415*		*0.021*	*0.002*		-		-
Mean	n/a	n/a	n/a	n/a	0.231	0.187	0.073	0.003	0.004	n/a	n/a	n/a
Max	n/a	n/a	n/a	n/a	0.415	0.415	0.151	0.020	0.011	n/a	n/a	n/a
Min	n/a	n/a	n/a	n/a	0.001	0.101	0.021	0.000	0.001	n/a	n/a	n/a
Total	n/a	n/a	n/a	n/a	1.385	5.621	2.252	0.098	0.102	n/a	n/a	n/a

Note: Estimated and modelled values are italicized

Values in red denote high uncertainty based on extrapolation of the rating curve beyond 2 times the greatest measured discharge.

Appendix 6. Summary of Daily Discharge [Q, m^3/s] at Hydrometric Station LG-H1

Drainage Area =	271.1 km^2											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1	-	-	-	-	-	*14.880*	6.636	*1.021*	*0.661*	-	-	-
2	-	-	-	-	-	*13.917*	6.366	*0.913*	*0.688*	-	-	-
3	-	-	-	-	-	*10.809*	6.007	*0.830*	*0.748*	-	-	-
4	-	-	-	-	-	*8.396*	5.450	*0.809*	*0.814*	-	-	-
5	-	-	-	-	-	*6.522*	5.033	*0.728*	*0.830*	-	-	-
6	-	-	-	-	-	*5.066*	4.717	*0.708*	*0.819*	-	-	-
7	-	-	-	-	-	3.935	4.209	*0.690*	*0.806*	-	-	-
8	-	-	-	-	-	3.816	3.874	*0.671*	*0.543*	-	-	-
9	-	-	-	-	-	3.729	3.592	*0.654*	*0.367*	-	-	-
10	-	-	-	-	-	3.942	3.378	*0.636*	*0.247*	-	-	-
11	-	-	-	-	-	4.259	3.451	*0.620*	*0.167*	-	-	-
12	-	-	-	-	-	4.477	3.223	*0.603*	*0.113*	-	-	-
13	-	-	-	-	-	4.883	*2.851*	*0.587*	*0.076*	-	-	-
14	-	-	-	-	-	5.534	*2.522*	*0.572*	*0.051*	-	-	-
15	-	-	-	-	-	6.177	*2.231*	*0.557*	*0.035*	-	-	-
16	-	-	-	-	-	6.596	*1.973*	*0.542*	*0.023*	-	-	-
17	-	-	-	-	-	7.229	*1.745*	*0.528*	*0.016*	-	-	-
18	-	-	-	-	-	8.551	*1.939*	*0.514*	*0.011*	-	-	-
19	-	-	-	-	-	9.353	*2.186*	*0.500*	*0.007*	-	-	-
20	-	-	-	-	-	9.621	*2.155*	*0.511*	*0.005*	-	-	-
21	-	-	-	-	-	9.449	*2.120*	*0.522*	*0.003*	-	-	-
22	-	-	-	-	-	8.929	*1.922*	*0.533*	*0.002*	-	-	-
23	-	-	-	-	*0.001*	8.291	*1.799*	*0.545*	*0.001*	-	-	-
24	-	-	-	-	*0.007*	7.752	*1.627*	*0.557*	*0.001*	-	-	-
25	-	-	-	-	*0.048*	7.210	*1.518*	*0.569*	-	-	-	-
26	-	-	-	-	*0.336*	6.757	*1.450*	*0.581*	-	-	-	-
27	-	-	-	-	*2.334*	6.352	*1.348*	*0.594*	-	-	-	-
28	-	-	-	-	*6.697*	6.415	*1.286*	*0.607*	-	-	-	-
29	-		-	-	*9.842*	6.552	*1.201*	*0.620*	-	-	-	-
30	-		-	-	*11.685*	6.552	*1.147*	*0.634*	-	-	-	-
31	-		-		*14.878*		*1.040*	*0.647*		-		-
Mean	n/a	n/a	n/a	n/a	5.092	7.198	2.903	0.632	0.293	n/a	n/a	n/a
Max	n/a	n/a	n/a	n/a	14.878	14.880	6.636	1.021	0.830	n/a	n/a	n/a
Min	n/a	n/a	n/a	n/a	0.001	3.729	1.040	0.500	0.001	n/a	n/a	n/a
Total	n/a	n/a	n/a	n/a	45.827	215.949	89.995	19.600	7.034	n/a	n/a	n/a

Note: Estimated and modelled values are italicized

Values in red denote high uncertainty based on extrapolation of the rating curve beyond 2 times the greatest measured discharge.

Appendix 6. Summary of Daily Stage [h, m] at Hydrometric Station LONG-L1

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	-	-	-	-	99.428	-	-	-	-	-
2	-	-	-	-	-	-	99.409	-	-	-	-	-
3	-	-	-	-	-	-	99.387	-	-	-	-	-
4	-	-	-	-	-	-	99.363	-	-	-	-	-
5	-	-	-	-	-	-	99.347	-	-	-	-	-
6	-	-	-	-	-	-	99.330	-	-	-	-	-
7	-	-	-	-	-	99.287	99.314	-	-	-	-	-
8	-	-	-	-	-	99.285	99.298	-	-	-	-	-
9	-	-	-	-	-	99.285	99.284	-	-	-	-	-
10	-	-	-	-	-	99.295	99.272	-	-	-	-	-
11	-	-	-	-	-	99.319	99.263	-	-	-	-	-
12	-	-	-	-	-	99.340	99.260	-	-	-	-	-
13	-	-	-	-	-	99.359	-	-	-	-	-	-
14	-	-	-	-	-	99.381	-	-	-	-	-	-
15	-	-	-	-	-	99.399	-	-	-	-	-	-
16	-	-	-	-	-	99.411	-	-	-	-	-	-
17	-	-	-	-	-	99.457	-	-	-	-	-	-
18	-	-	-	-	-	99.505	-	-	-	-	-	-
19	-	-	-	-	-	99.514	-	-	-	-	-	-
20	-	-	-	-	-	99.508	-	-	-	-	-	-
21	-	-	-	-	-	99.495	-	-	-	-	-	-
22	-	-	-	-	-	99.474	-	-	-	-	-	-
23	-	-	-	-	-	99.452	-	-	-	-	-	-
24	-	-	-	-	-	99.433	-	-	-	-	-	-
25	-	-	-	-	-	99.417	-	-	-	-	-	-
26	-	-	-	-	-	99.402	-	-	-	-	-	-
27	-	-	-	-	-	99.395	-	-	-	-	-	-
28	-	-	-	-	-	99.422	-	-	-	-	-	-
29	-		-	-	-	99.442	-	-	-	-	-	-
30	-		-	-	-	99.439	-	-	-	-	-	-
31	-		-		-	-	-	-		-		-
Mean	n/a	n/a	n/a	n/a	n/a	99.405	99.329	n/a	n/a	n/a	n/a	n/a
Max	n/a	n/a	n/a	n/a	n/a	99.514	99.428	n/a	n/a	n/a	n/a	n/a
Min	n/a	n/a	n/a	n/a	n/a	99.285	99.260	n/a	n/a	n/a	n/a	n/a

Appendix V6-1E

Effects of Proposed Development and Water Withdrawal on Hydrologic Indices of Goose and Propeller Lakes

Sabina
GOLD & SILVER CORP.

Memorandum

DATE:	November 12, 2015
TO:	Max Brownhill, R.P.Bio (Sabina)
FROM:	Ali Naghibi, Ph.D., P.Eng. (ERM); Cameron Evans, B.A.Sc., EIT (ERM)
CC:	Deborah Muggli, Ph.D., M.Sc., R.P.Bio. (ERM); Cameron McCarthy, M.A.Sc, P.Eng., P.Geo. (ERM)
SUBJECT:	**Back River Project – Effects of Proposed Development and Water Withdrawal on Hydrologic Indices of Goose and Propeller Lakes**

1. Background

Site water management activities (i.e., water withdrawal from lakes, water diversions and storage, and modification of natural drainage) within the Goose Property Potential Development Area (PDA) of the Back River Project (the Project) have the potential to interact with surface water hydrology. A water balance model (SRK 2015a, Appendix V2-7H) with monthly input data was used to predict the effects of the Project on streamflows during different phases of the Project.

Winter water withdrawal from Goose Lake can delay the onset of lake outflow at Goose and Propeller lakes. This delay is a fraction of a month and cannot be captured by a model with monthly input data and time-step. Likewise, baseline flows during the month of May occur only during a few days. Therefore, effects of the aforementioned delay on lake outflows in May cannot be addressed by a model with monthly input data.

This memorandum presents the findings of a spreadsheet model that was developed with daily input data and time-step to refine the effects assessment, i.e., flow and volume reduction, for Goose and Propeller lakes.

2. Summary

Contact and non-contact water diversions reduce the natural watershed area, and therefore the natural runoff, in the Goose Lake Watershed (Prediction Node PN3 in Figure A-1) by up to 11% during life of the Project (SRK 2015a). In addition, up to 900 m^3/day of year-round withdrawal from Goose Lake will occur for mill operation and other industrial uses. During June to October, an additional 400 m^3/day will be used for dust suppression.

Impacts of the proposed diversions and withdrawal on Goose Outflow (PN3 in Figure A-1), Propeller Outflow (PN2 in Figure A-1), and Ellice River (PN1 in Figure A-2) are summarized in Table 2-1. PN1 and PN2 represent the outflow of the Freshwater Regional Study Area (RSA) and the Goose Property Local Study Area (LSA), respectively. Results are provided for both average and 1-in-20-year dry hydrologic conditions (SRK 2015a).

Table 2-1. Hydrologic Effects of Water Diversion and Withdrawal on Goose Lake, Propeller Lake, and Ellice River

Hydrologic Alteration Parameter	Estimated Value	
	Average Condition	1-in-20-Year Dry Condition
Goose Lake (PN3)		
Decrease of annual lake outflow	0.06 m^3/s ; 13.3% of baseline flow	0.04 m^3/s ; 17.4% of baseline flow
Delay in onset of lake outflow[1]	5 days	6 days
Decrease of minimum water surface elevation in the lake	0.06 m	0.06 m
Propeller Lake (LSA Outflow; PN2)		
Decrease of annual lake outflow	0.06 m^3/s ; 6.2% of baseline flow	0.04 m^3/s ; 8.2% of baseline flow
Delay in onset of lake outflow[1]	1 days	3 days
Decrease of minimum water surface elevation in the lake	0 m	0 m
Ellice River (RSA Outflow; PN1)		
Decrease of annual flow	0.06 m^3/s ; 0.2% of baseline flow	0.04 m^3/s ; 0.3% of baseline flow
Delay in onset of flow[1]	0 days	0 days

[1] *Above the useful flow threshold (30% of mean annual discharge)*

Goose Lake annual outflow (PN3) will be reduced by 13.3% during average and 17.4% during dry conditions, in response to the 11% reduction in catchment area and water withdrawal from Goose Lake. Onset of flow above the useful flow threshold (i.e., 30% of mean annual discharge; Volume 6, Chapter 6) will be delayed by 5 to 6 days during average and dry conditions, respectively. The winter withdrawal volume (0.2 Mm^3) was less than the maximum allowable withdrawal based on the DFO (2010) protocol for over-wintering habitat (0.5 Mm^3). Maximum water level drawdown during the winter, compared to the baseline condition, was 6 cm. (Table 2-1).

Propeller Lake annual outflow (PN2) will be reduced by 6.2% during average and 8.2% during dry conditions. Onset of flow above the useful flow threshold (i.e., 30% of mean annual discharge) will be delayed by 1 to 3 days during average and dry conditions (Table 2-1). There is no water withdrawal, and therefore no water level drawdown during the winter.

Effects of the Project on Ellice River (PN1) flow are negligible (i.e., flows will be changed by less than 1% of baseline flows).

3. Assumptions and Data Sources

The annual runoff estimate for the Goose Property watersheds is 149 mm during average conditions and 75 mm during 1-in-20-year dry conditions (SRK 2015b). Daily distribution of annual runoff is shown in Figure A-3 (SRK 2015a).

Contact water is contained in event ponds and tailings facilities, and is transferred via channel and pipe diversions. Non-contact water is diverted off-site through event ponds, pipelines and culverts (SRK 2015b). These diversions reduce the natural watershed area of, and therefore the natural runoff in, the Goose Watershed (Prediction Node PN3 in Figure A-1) by up to 11% during life of the Project (SRK 2015a).

The proposed water withdrawal from Goose Lake is 900 m^3/day (year-round) for mill operation and other industrial uses, and 400 m^3/day (June to October) for dust suppression.

Goose Lake volume data were based on the 2011 bathymetry survey (Rescan 2012). The depth-volume relationship based on the bathymetry survey is shown in Figure A-4. The full lake volume during the bathymetry survey (August 2011) was 10.7 Mm^3; the volume of the lake under 2 m ice cover would be approximately 5.4 Mm^3. It is seen that the depth-volume relationship in the top 3 m layer of the lake can be sufficiently represented by a linear equation (Figure A-4). That is, 1.0 Mm^3 change in the lake volume will result in a 42 cm change in the water elevation.

4. Analysis and Results

Impacts of water withdrawal on Goose Outflow and water surface elevation were estimated using a flow continuity scheme with daily time-steps (Equation 1).

Winter water withdrawal from Goose Lake will lower the water level below the invert elevation because the flows cease during winter (Rescan 2014). This lowered water level is represented as lake volume deficit (Def_i) at the end of each time-step (i). That is, volume of water that should be added to the lake before it starts overflowing. The simulation starts on January 1st, with a presumed Def_1, which is identified through a recursive trial-and-error exercise to reach equilibrium (i.e., $Def_1 = Def_{365}$). At each time-step, lake deficit (Def_i) will be updated based on the balance of baseline lake outflow ($Q_{b,i}$), upstream flow reductions (D_i), water withdrawal from the lake (W_i), and lake deficit at the end of previous time-step (Def_{i-1} ; Equation 1).

When the lake was overflowing (i.e., $Def_i = 0$), it was assumed that baseline lake outflow ($Q_{b,i}$) would be reduced by the sum of upstream flow reductions (D_i), water withdrawal from the lake (W_i), and lake deficit at the end of previous time-step (Def_{i-1}), i.e., no attenuation was considered (Equation 1).

$$\begin{cases} if\ Q_{b,i} - D_i - W_i - Def_{i-1} \leq 0 \rightarrow \begin{cases} Def_i = Def_{i-1} + W_i + D_i - Q_{b,i} \\ Q_{w,i} = 0 \end{cases} \\ if\ Q_{b,i} - D_i - W_i - Def_{i-1} > 0 \rightarrow \begin{cases} Def_i = 0 \\ Q_{w,i} = Q_{b,i} - D_i - W_i - Def_{i-1} \end{cases} \end{cases} \quad \text{Equation (1)}$$

Where

- i : daily time-steps (day)
- Def_i : lake volume deficit at the end of time-step i (Mm^3). That is, volume of water that should be added to the lake before it starts overflowing.
- D_i : reduction in lake inflow and outflow at time-step i due to upstream water diversions (Mm^3)
- W_i : water withdrawal from lake at time-step i (Mm^3)
- $Q_{b,i}$: baseline lake outflow during time-step i (Mm^3)
- $Q_{w,i}$: lake outflow, after water withdrawal and upstream diversions, during time-step i (Mm^3)

Baseline daily runoff estimates during average and 1-in-20-year dry conditions (Figure A-3) were used as the lake baseline outflow time-series ($Q_{b,i}$) in Equation 1. The volume-depth curve, based on bathymetry (Figure A-4) was used to estimate the water surface elevation corresponding to lake volume deficit conditions.

Baseline and simulated project-affected daily outflows at PN3, PN2, and PN1 during average and 1-in-20-year dry conditions are shown in Figures A-5 to A-7. Effects of water diversion and withdrawal

on hydrologic indices, i.e., difference between baseline and project-affected conditions, at Goose Outflow (PN3), Propeller Outflow (PN2), and Ellice River (PN1), are summarized in Tables 4-1 to 4-3 and briefly described in the following sections. Implications to fish and fish habitat are explained in Volume 6, Chapter 6.

Reduction of volumetric flow at Propeller Outflow (PN2) and Ellice River (PN1) in response to the Project activities would be the same as volumetric flow reduction at Goose Outflow (PN3) because there are no watershed disturbances downstream of Goose Outflow (PN3). However, baseline flows at PN1 and PN2 are higher than those of PN3; therefore, relative flow reductions, i.e., percent of baseline flow, at PN1 and PN2 are less than those of PN3 (Tables 4-1 to 4-3).

4.1 Goose Lake

Hydrological analysis results (Table 4-1) show that average annual outflows are expected to be reduced by 13.3% (during average years) to 17.4% (during dry years) compared to baseline flows.

Table 4-1. Predicted Hydrologic Indices at Goose Lake (PN3) during Baseline and Project Conditions

Parameter		Average Condition	1-in-20-Year Dry Condition
Mean annual lake outflow	Baseline (m^3/s)	0.45	0.23
	Project Affected (m^3/s)	0.39	0.19
	Flow Reduction (m^3/s)	0.06	0.04
	Flow Reduction (% of Baseline)	13.3%	17.4%
Date at onset of lake outflow[1]	Baseline	24-May	25-May
	Project Affected	29-May	31-May
	Delayed Onset (days)	5	6
Date at flow ceasing[1]	Baseline	27-Oct	19-Oct
	Project Affected	25-Oct	15-Oct
	Accelerated Ceasing (days)	2	4
Total number of flow days[1]	Baseline	156	147
	Project Affected	149	137
	Reduction of Flow Days (days)	7	10
Maximum Decrease of lake level in winter	(m)	0.06	0.06
Maximum winter withdrawal	(% of under ice volume)	3.7%	3.7%

[1] *Flows less than a minimum useful flow threshold (i.e., 30% of mean annual discharge) were considered zero.*

Winter withdrawal volume (i.e., up to 0.2 Mm^3) is less than the maximum allowable withdrawal (10% of lake volume under a 2 m ice depth) based on the DFO (2010) protocol for over-wintering habitat (i.e., 10% of 5.4 Mm^3). Maximum water level drawdown during the winter, compared to baseline conditions is 6 cm.

The active withdrawal occurring over winter months will result in a water level that is below the elevation required for lake outflow. The delay in onset of flow (defined when a minimum flow of 30% of mean annual discharge is attained) is 5 days during average conditions, and 6 days during 1-in-20-year dry conditions. Furthermore, predictions also indicate that flow will cease more rapidly (2 days during average years and 4 days during dry years) in autumn. Therefore, the duration of the open-water season will be reduced by 7 and 10 days during average and dry years, respectively (Table 4-1).

4.2 Propeller Lake

The catchment area of Propeller Outflow (PN2; 205 km^2) is approximately twice that of the Goose Outflow (PN3; 95 km^2). Therefore, effects of the Project on Propeller Outflow are less notable than the effects on Goose Outflow. Average annual Propeller outflows are reduced by 6.2% (during average years) to 8.2% (during dry years) compared to baseline flows (Table 4-2).

Table 4-2. Predicted Hydrologic Indices at Propeller Lake (PN2) during Baseline and Project Conditions

Parameter		Average Condition	1-in-20-Year Dry Condition
Mean annual lake outflow	Baseline (m^3/s)	0.97	0.49
	Project Affected (m^3/s)	0.91	0.45
	Flow Reduction (m^3/s)	0.06	0.04
	Flow Reduction (% of Baseline)	6.2%	8.2%
Date at onset of lake outflow[1]	Baseline	24-May	25-May
	Project Affected	25-May	28-May
	Delayed Onset (days)	1	3
Date at flow ceasing[1]	Baseline	27-Oct	19-Oct
	Project Affected	26-Oct	18-Oct
	Accelerated Ceasing (days)	1	1
Total number of flow days[1]	Baseline	156	147
	Project Affected	154	143
	Reduction of Flow Days (days)	2	4
Maximum Decrease of lake level in winter	(m)	0.00	0.00
Maximum winter withdrawal	(% of under ice volume)	0.0%	0.0%

[1] *Flows less than a minimum useful flow threshold (i.e., 30% of mean annual discharge) were considered zero.*

There is no direct water withdrawal from Propeller Lake. However, the water withdrawal from Goose Lake during winter months will result in a delay in onset of flow, above the 30% of mean annual discharge threshold, at Propeller Outflow. This delay is 1 day during average conditions, and 3 days during 1-in-20-year dry conditions. Similarly, flow will cease 1 day sooner than baseline conditions during both average and dry years. Therefore, the duration of the open-water season will be reduced by 2 and 4 days during average and dry years, respectively (Table 4-2).

4.3 Ellice River

The catchment area of Ellice River (PN1; 6655 km^2) is approximately 70 times of the Goose Outflow catchment area (PN3; 95 km^2). Therefore, the effect of the Project on Ellice River streamflow is negligible (less than 1%; Table 4-3). The onset of flow is not anticipated to be delayed due to the Project, nor will the flow cease earlier compared to baseline conditions. Therefore, the number of flow days will be similar to baseline conditions.

Table 4-3. Predicted Hydrologic Indices at Ellice River (PN1) during Baseline and Project Conditions

Parameter		Average Condition	1-in-20-Year Dry Condition
Mean annual lake outflow	Baseline (m^3/s)	31.44	15.83
	Project Affected (m^3/s)	31.38	15.79
	Flow Reduction (m^3/s)	0.06	0.04
	Flow Reduction (% of Baseline)	0.2%	0.3%
Date at onset of lake outflow[1]	Baseline	24-May	25-May
	Project Affected	24-May	25-May
	Delayed Onset (days)	0	0
Date at flow ceasing[1]	Baseline	27-Oct	19-Oct
	Project Affected	27-Oct	19-Oct
	Accelerated Ceasing (days)	0	0
Total number of flow days[1]	Baseline	156	147
	Project Affected	156	147
	Reduction of Flow Days (days)	0	0

[1] *Flows less than a minimum useful flow threshold (i.e., 30% of mean annual discharge) were considered zero.*

5. Conclusions

This study assumes that runoff from up to 11% of catchments upstream of the Goose Watershed (PN3) could be disturbed by the Project. Likewise, it considers 900 m^3/day (year-round) water withdrawal from Goose Lake for mill operation, as well as 400 m^3/day water withdrawal (June to October) for dust suppression.

Effects of these disturbances and withdrawal on hydrologic indices of Goose Lake are estimated to be moderate. Annual lake outflow during 1-in-20-year conditions will be reduced by 17.4%. Lake elevation during winter months will be decreased by up to 6 cm, and onset of lake outflow will be delayed by up to 6 days compared to baseline conditions.

Effects on hydrologic indices of Propeller Lake are estimated to be low. Annual lake outflow during 1-in-20-year conditions will be reduced by 8.2%. Lake elevation during winter months will not be affected, but onset of lake outflow will be delayed by up to 3 days compared to baseline conditions.

Effects on Ellice River streamflow are estimated to be negligible (i.e., less than 1% change compared to baseline conditions). The number of flow days will be similar to baseline conditions.

6. Disclaimer

This memorandum was prepared by ERM-Rescan for Sabina Gold & Silver (Sabina). The content reflects ERM's best judgment in light of the information available to it at the time of preparation and the uncertainty associated with such information. Any third party use of this study, or any reliance on it, is the responsibility of such third parties.

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DFO. 2010. DFO Protocol for Winter Water Withdrawal from Ice-covered Waterbodies in the Northwest Territories and Nunavut, Fisheries and Oceans Canada, 21 June 2010.

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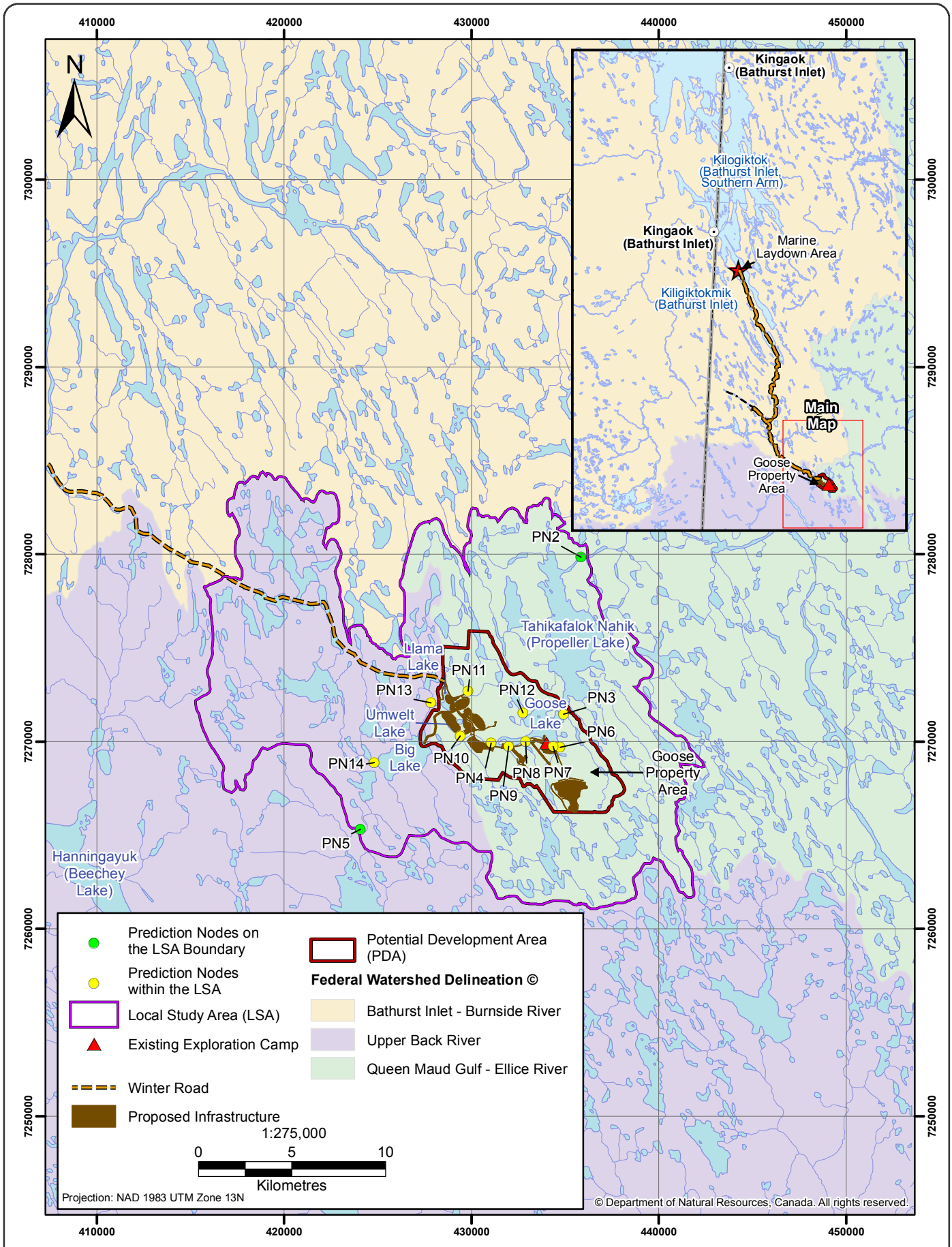
SRK. 2015a. Back River Project Water and Load Balance Report. Prepared for Sabina Gold & Silver Corp. by SRK Consulting (Canada) Inc.

SRK. 2015b. Back River Project Site-Wide Water Management Report. Prepared for Sabina Gold & Silver Corp. by SRK Consulting (Canada) Inc.

- Appendix A -

Figures and Graphs



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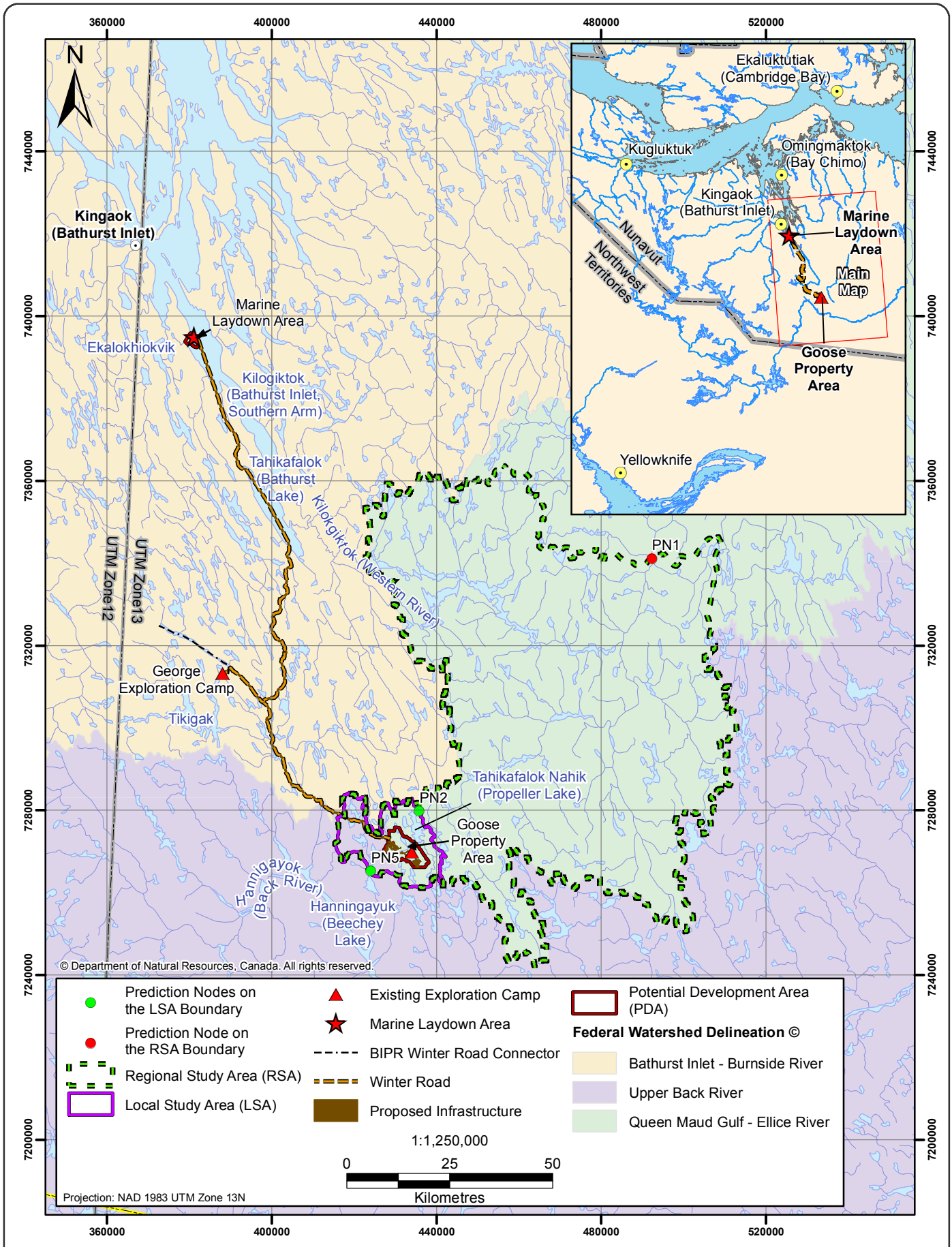
Surface Water Hydrology Prediction Nodes within the Local Study Area

Figure A-1

Rescan an ERM company



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Spatial Boundaries of the Surface Water Hydrology Effects Assessment and Prediction Nodes on the Local Study Area and Regional Study Area Boundaries

Figure A-2

Rescan an ERM company

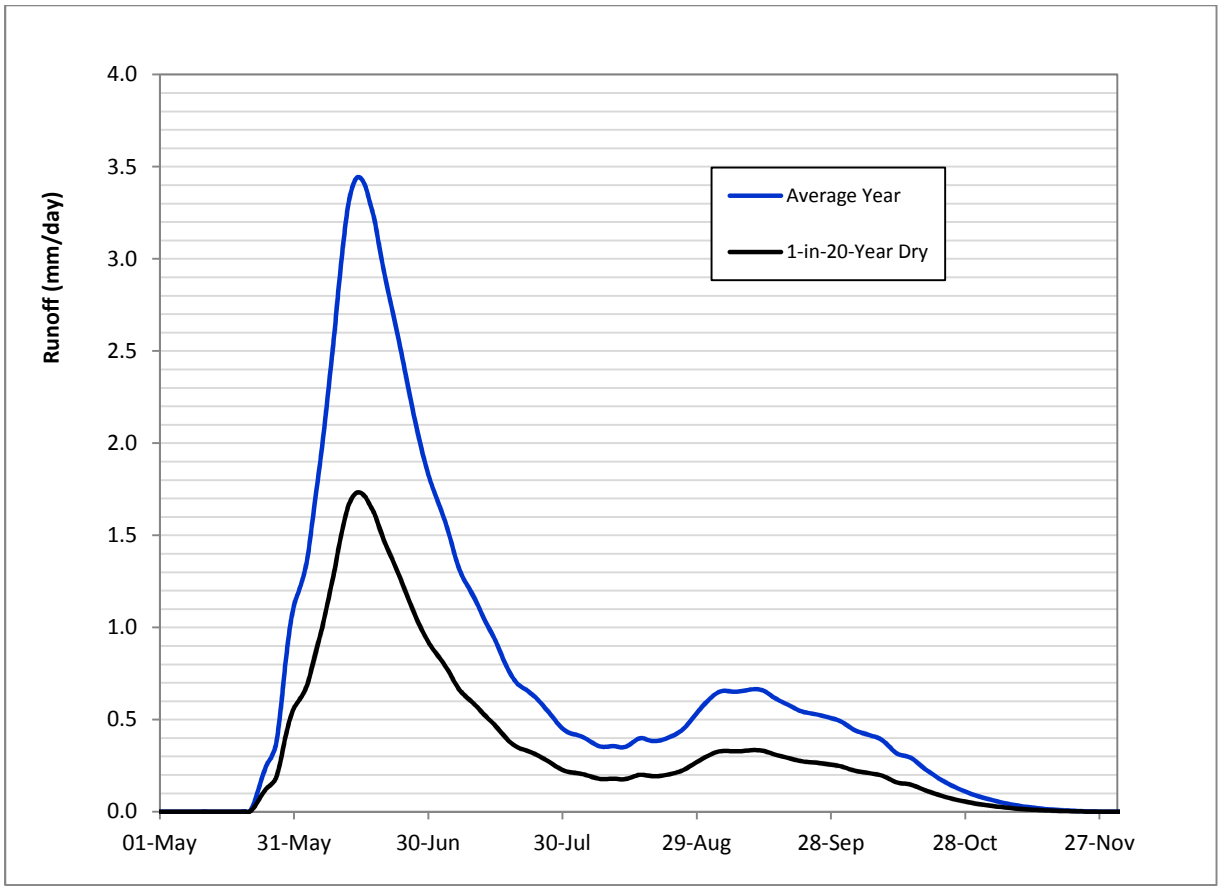

Figure A-3. Daily Distribution on Annual Runoff in Goose Property Watersheds (SRK 2015a)

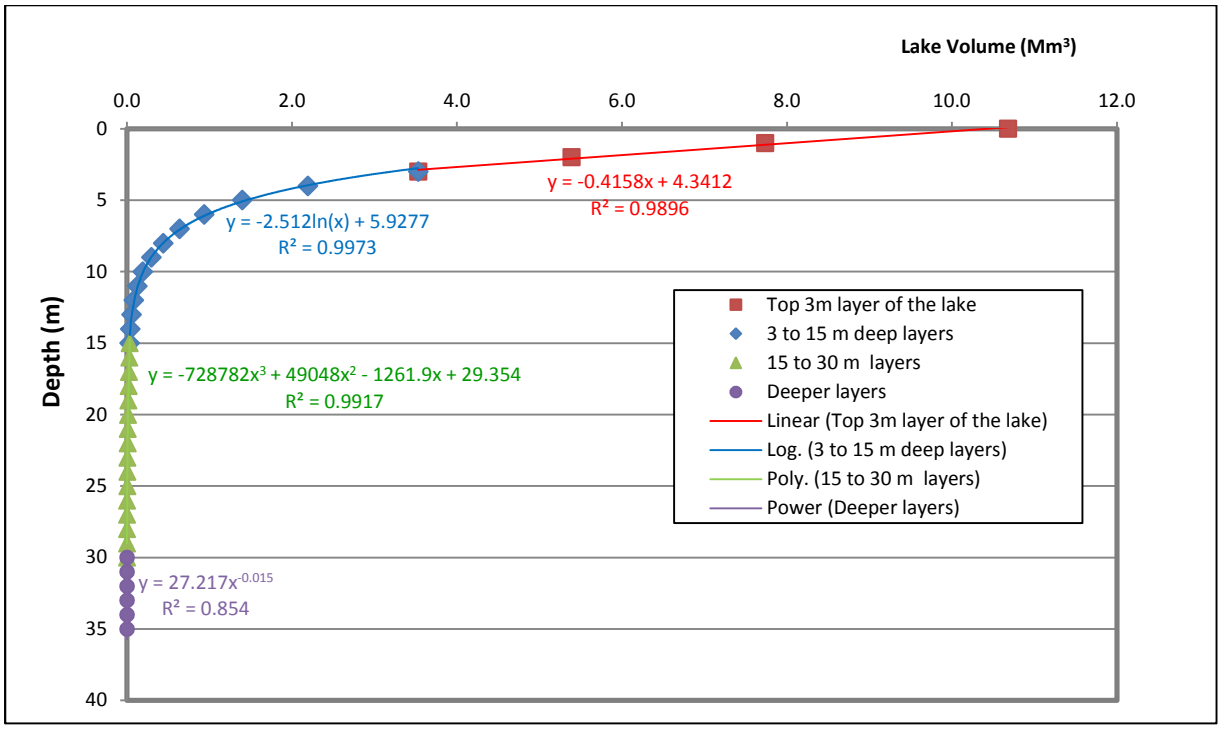

Figure A-4. Volume-Depth Curve for Goose Lake based on Bathymetric Survey Results

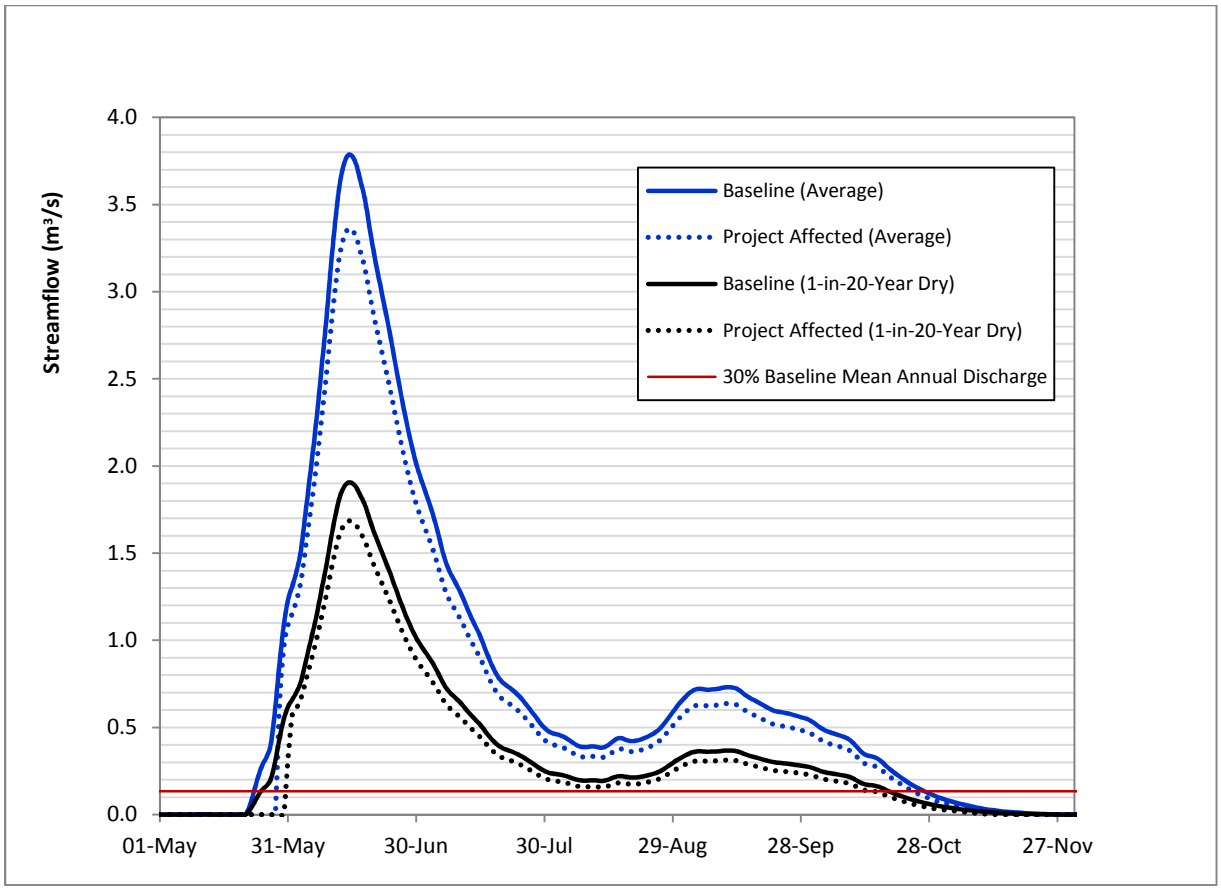

Figure A-5. Baseline and Project-affected Flows at Goose Outflow (PN3)

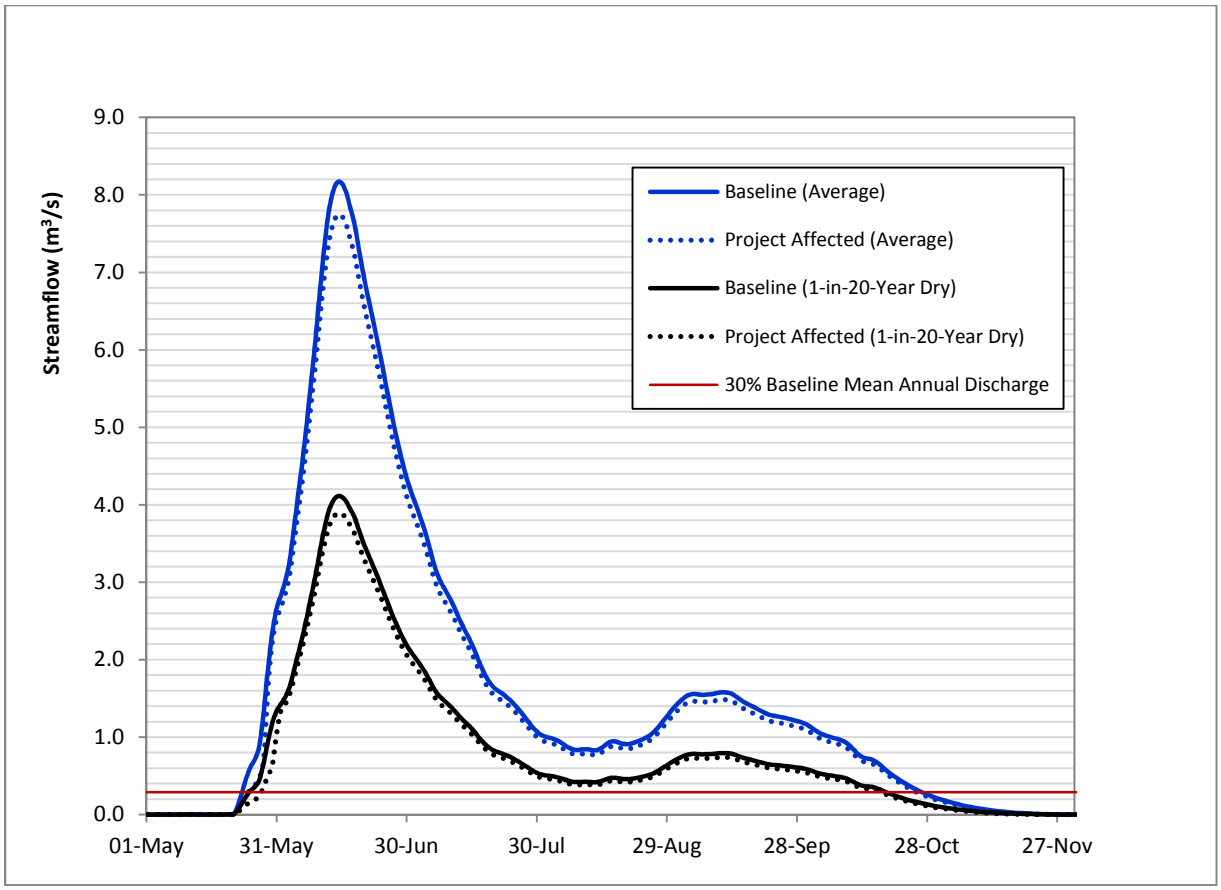

Figure A-6. Baseline and Project-affected Flows at Propeller Outflow (PN2)

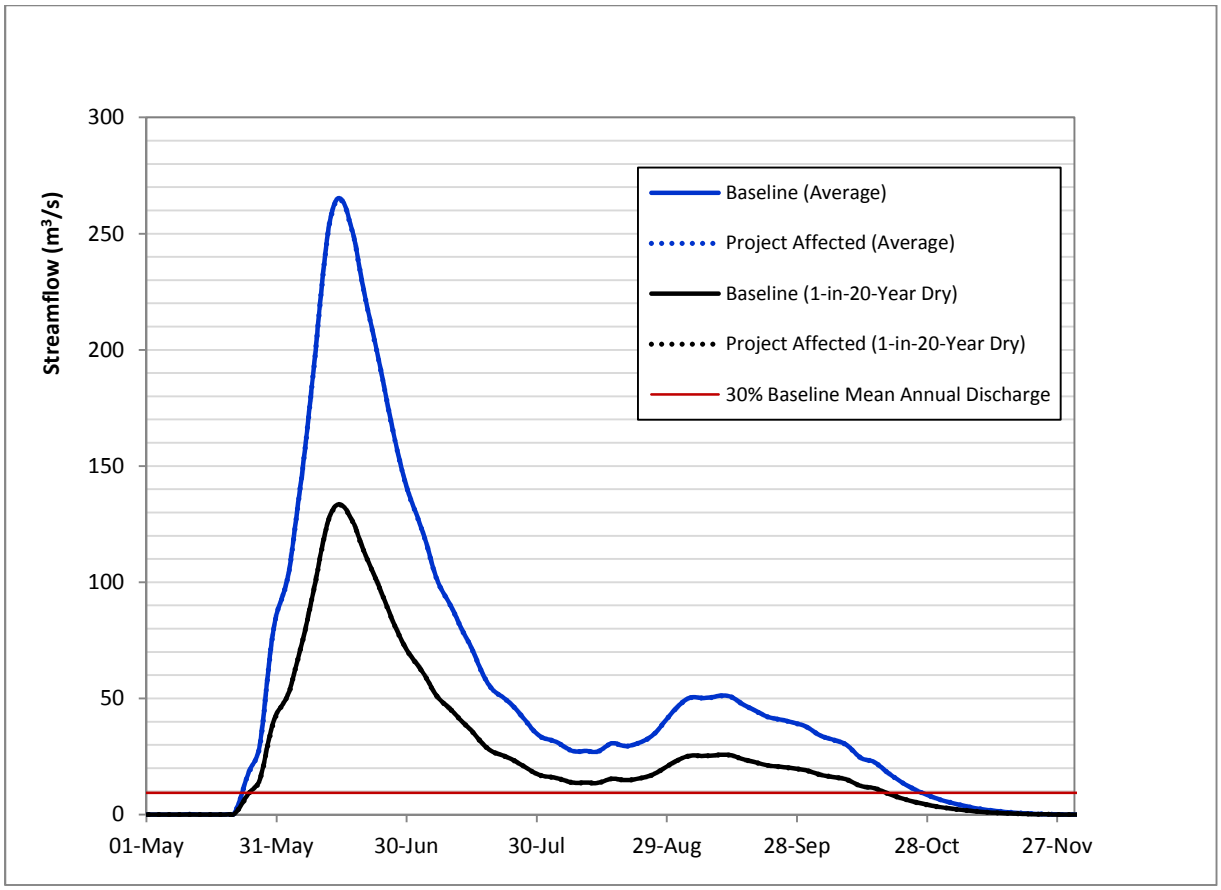

Figure A-7. Baseline and Project-affected Flows at Ellice River (PN1)

Appendix V6-1F

Effects of Proposed Water Withdrawal on Hydrologic Indices of Big Lake

Sabina
GOLD & SILVER CORP.

Memorandum

DATE:	November 12, 2015
TO:	Max Brownhill, R.P.Bio (Sabina)
FROM:	Ali Naghibi, Ph.D., P.Eng. (ERM); Cameron Evans, B.A.Sc., EIT (ERM)
CC:	Deborah Muggli, Ph.D., M.Sc., R.P.Bio. (ERM); Cameron McCarthy, M.A.Sc, P.Eng., P.Geo. (ERM)
SUBJECT:	**Back River Project – Effects of Proposed Water Withdrawal on Hydrologic Indices of Big Lake**

1. Background

Water withdrawal from Big Lake has the potential to interact with surface water hydrology within the Local Study Area (LSA) of the Back River Project (the Project). A water balance model (SRK 2015a, Appendix V2-7H) with monthly input data was used to predict the effects of the Project on streamflows during different phases of the Project.

Winter water withdrawal from Big Lake can delay the onset of lake outflow. This delay is a fraction of a month and cannot be captured by a model with monthly input data and time-step. Likewise, baseline flows during the month of May occur only during a few days. Therefore, effects of the aforementioned delay on lake outflows in May cannot be addressed by a model with monthly input data.

This memorandum presents the findings of a spreadsheet model that was developed with daily input data and time-step to assess effects of the Project on the outflow and volume of Big Lake.

2. Summary

Up to 350 m^3/day of year-round withdrawal from Big Lake is proposed for domestic uses. Impacts of the proposed withdrawal on Big Lake Outflow (PN14 in Figure A-1), as well as flows at the downstream boundary of the western portion of the Goose Property LSA (PN5 in Figure A-1), are summarized in Table 2-1. Results are provided for both average and 1-in-20-year dry hydrologic conditions (SRK 2015a).

Big Lake annual outflow (PN14) will be reduced by 2.3% during average and 4.5% during dry conditions, in response to the water withdrawal from Big Lake. Onset of flow above the useful flow threshold (i.e., 30% of mean annual discharge; Volume 6, Chapter 6) will be delayed by 5 to 6 days, respectively. The winter withdrawal volume (0.1 Mm^3) was less than the maximum allowable withdrawal based on the DFO (2010) protocol for over-wintering habitat (0.5 Mm^3). Maximum water level drawdown during the winter, compared to the baseline condition, was 2 cm. (Table 2-1).

Annual outflow of the LSA (PN5) will be reduced by 0.5% during average and 1.1% during dry conditions. This is for the western portion of the LSA that does not flow through Goose Lake. Onset of flow above the useful flow threshold (i.e., 30% of mean annual discharge) will be delayed by 0 to 2 days during average and dry conditions (Table 2-1).

Table 2-1. Hydrologic Effects of Water Withdrawal on Big Lake Outflow (PN14) and Western Outflow of the Goose Property Local Study Area (PN5)

Hydrologic Alteration Parameter	Estimated Value	
	Average Condition	1-in-20-Year Dry Condition
Big Lake (PN14)		
Decrease of annual lake outflow	0.004 m^3/s ; 2.3% of baseline flow	0.004 m^3/s ; 4.5% of baseline flow
Delay in onset of lake outflow[1]	5 days	6 days
Decrease of minimum water surface elevation in the lake	0.02 m	0.02 m
LSA Outflow-Western Location (PN5)		
Decrease of annual flow	0.004 m^3/s ; 0.5% of baseline flow	0.004 m^3/s ; 1.1% of baseline flow
Delay in onset of flow[1]	0 days	2 days

[1] *Above the useful flow threshold (30% of mean annual discharge)*

3. Assumptions and Data Sources

The annual runoff estimate for the Goose Property LSA watersheds is 149 mm during average conditions and 75 mm during 1-in-20-year dry conditions (SRK 2015a). Daily distribution of annual runoff is shown in Figure A-2 (SRK 2015a).

The proposed water withdrawal from Big Lake is 350 m^3/day (year-round) for domestic uses.

Big Lake volume data were based on the 2012 bathymetry survey (Rescan 2012). The depth-volume relationship based on the bathymetry survey is shown in Figure A-3. The full lake volume during the bathymetry survey was 12.1 Mm^3; the volume of the lake under 2 m ice cover would be approximately 5.0 Mm^3. It is seen that the depth-volume relationship in the top 3 m layer of the lake can be sufficiently represented by a linear equation (Figure A-3). That is, 1.0 Mm^3 change in the lake volume will result in a 30 cm change in the water elevation.

4. Analysis and Results

Impacts of water withdrawal on Big Lake Outflow and water surface elevation were estimated using a flow continuity scheme with daily time-steps (Equation 1).

Winter water withdrawal from Big Lake will lower the water level below the invert elevation because the flows cease during winter (Rescan 2014). This lowered water level is represented as lake volume deficit (Def_i) at the end of each time-step (i). That is, volume of water that should be added to the lake before it starts overflowing. The simulation starts on January 1st, with a presumed Def_1, which is identified through a recursive trial-and-error exercise to reach equilibrium (i.e., $Def_1 = Def_{365}$). At each time-step, lake deficit (Def_i) will be updated based on the balance of baseline lake outflow ($Q_{b,i}$), water withdrawal from the lake (W_i), and lake deficit at the end of previous time-step (Def_{i-1} ; Equation 1).

When the lake was overflowing (i.e., $Def_i = 0$), it was assumed that baseline lake outflow ($Q_{b,i}$) would be reduced by the sum of water withdrawal from the lake (W_i) and lake deficit at the end of previous time-step (Def_{i-1}), i.e., no attenuation was considered (Equation 1).

$$\begin{cases} if\ Q_{b,i} - W_i - Def_{i-1} \leq 0 \rightarrow \begin{cases} Def_i = Def_{i-1} + W_i - Q_{b,i} \\ Q_{w,i} = 0 \end{cases} \\ if\ Q_{b,i} - W_i - Def_{i-1} > 0 \rightarrow \begin{cases} Def_i = 0 \\ Q_{w,i} = Q_{b,i} - W_i - Def_{i-1} \end{cases} \end{cases}$$

Equation (1)

Where

i : daily time-steps (day)
Def_i : lake volume deficit at the end of time-step i (Mm^3). That is, volume of water that should be added to the lake before it starts overflowing.
W_i : water withdrawal from lake at time-step i (Mm^3)
$Q_{b,i}$: baseline lake outflow during time-step i (Mm^3)
$Q_{w,i}$: lake outflow, after water withdrawal and upstream diversions, during time-step i (Mm^3)

Baseline daily runoff estimates during average and 1-in-20-year dry conditions (Figure A-2) were used as the lake baseline outflow time-series ($Q_{b,i}$) in Equation 1. The volume-depth curve, based on bathymetry (Figure A-3) was used to estimate the water surface elevation corresponding to lake volume deficit conditions.

Baseline and simulated Project-affected daily outflows at PN14 and PN5 during average and 1-in-20-year dry conditions are shown in Figures A-4 and A-5. Effects of water withdrawal on hydrologic indices, i.e., difference between baseline and Project-affected conditions, at Big Lake (PN14) and the western outflow of the Goose Property LSA (PN5) are summarized in Tables 4-1 and 4-2 and briefly described in the following sections. Implications to fish and fish habitat are explained in Volume 6, Chapter 6.

Reduction of volumetric flow at PN5 in response to water withdrawal from Big Lake would be the same as volumetric flow reduction at PN14 because there is no watershed disturbances downstream of PN14. However, baseline flows at PN5 are higher than those of PN14; therefore, relative flow reductions, i.e., percent of baseline flow, at PN5 are less than those of PN14 (Tables 4-1 and 4-2).

4.1 Big Lake

Hydrological analysis results (Table 4-1) show that average annual outflows at Big Outflow are expected to be reduced by 2.3% (during average years) to 4.5% (during dry years) compared to baseline flows.

Winter withdrawal volume (i.e., up to 0.1 Mm^3) is less than the maximum allowable withdrawal (10% of lake volume under a 2 m ice depth) based on the DFO (2010) protocol for over-wintering habitat (i.e., 10% of 5.0 Mm^3). Maximum water level drawdown during the winter, compared to baseline conditions is 2 cm.

The active withdrawal occurring over winter months will result in a water level that is below the elevation required for lake outflow. The delay in onset of flow (defined when a minimum flow of 30% of mean annual discharge is attained) is 5 days during average conditions, and 6 days during 1-in-20-year dry conditions. Furthermore, predictions also indicate that flow will cease more rapidly (1 day) in autumn. Therefore, the duration of the open-water season will be reduced by 6 and 7 days during average and dry years, respectively (Table 4-1).

Table 4-1. Predicted Hydrologic Indices at Big Lake Outflow (PN14) during Baseline and Project Conditions

Parameter		Average Condition	1-in-20-Year Dry Condition
Mean annual lake outflow	Baseline (m^3/s)	0.175	0.088
	Project Affected (m^3/s)	0.171	0.084
	Flow Reduction (m^3/s)	0.004	0.004
	Flow Reduction (% of Baseline)	2.3%	4.5%
Date at onset of lake outflow[1]	Baseline	24-May	25-May
	Project Affected	29-May	31-May
	Delayed Onset (days)	5	6
Date at flow ceasing[1]	Baseline	27-Oct	19-Oct
	Project Affected	26-Oct	18-Oct
	Accelerated Ceasing (days)	1	1
Total number of flow days[1]	Baseline	156	147
	Project Affected	150	140
	Reduction of Flow Days (days)	6	7
Maximum Decrease of lake level in winter	(m)	0.02	0.02
Maximum winter withdrawal	(% of under ice volume)	2.0%	2.0%

[1] *Flows less than a minimum useful flow threshold (i.e., 30% of mean annual discharge) were considered zero.*

4.2 Goose Property Local Study Area Western Outflow

The catchment area of the western Goose Property LSA (PN5; 158 km^2) is approximately four times that of the Big Lake Outflow (PN14; 37 km^2). Therefore, effects of the Project on PN5 are less notable than the effects on PN14. Average annual flows at PN5 are reduced by 0.5% (during average years) to 1.1% (during dry years) compared to baseline flows (Table 4-1).

The water withdrawal from Big Lake during winter months will result in a delay (2 days) in onset of flow, above the 30% of mean annual discharge threshold, at the western Goose Property LSA outflow during 1-in-20-year dry conditions. No delay in onset of flow is predicted for average conditions. Flow ceasing date in autumn is not anticipated to change due to water withdrawal from Big Lake. Therefore, the duration of the open-water season will be reduced by 0 and 2 days during average and dry years, respectively (Table 4-2).

5. Conclusions

This study assumes 350 m^3/day (year-round) water withdrawal from Big Lake for domestic uses. Effects of this withdrawal on hydrologic indices of Big Lake are estimated to be low. Annual lake outflow during 1-in-20-year conditions will be reduced by 4.5%. Lake elevation during winter months will be decreased by up to 2 cm, and onset of lake outflow will be delayed by up to 6 days compared to baseline conditions.

Similarly, effects on hydrologic indices of the western Goose Property LSA outflow are estimated to be low. Annual flow during 1-in-20-year conditions will be reduced by 1.1% and onset of flow will be delayed by up to 2 days compared to baseline conditions.

Table 4-2. Predicted Hydrologic Indices at the Western Goose Property Local Study Area Outflow (PN5) during Baseline and Project Conditions

Parameter		Average Condition	1-in-20-Year Dry Condition
Mean annual lake outflow	Baseline (m^3/s)	0.749	0.377
	Project Affected (m^3/s)	0.745	0.373
	Flow Reduction (m^3/s)	0.004	0.004
	Flow Reduction (% of Baseline)	0.5%	1.1%
Date at onset of lake outflow[1]	Baseline	24-May	25-May
	Project Affected	24-May	27-May
	Delayed Onset (days)	0	2
Date at flow ceasing[1]	Baseline	27-Oct	19-Oct
	Project Affected	27-Oct	19-Oct
	Accelerated Ceasing (days)	0	0
Total number of flow days[1]	Baseline	156	147
	Project Affected	156	145
	Reduction of Flow Days (days)	0	2

[1] *Flows less than a minimum useful flow threshold (i.e., 30% of mean annual discharge) were considered zero.*

6. Disclaimer

This memorandum was prepared by ERM-Rescan for Sabina Gold & Silver (Sabina). The content reflects ERM's best judgment in light of the information available to it at the time of preparation and the uncertainty associated with such information. Any third party use of this study, or any reliance on it, is the responsibility of such third parties.

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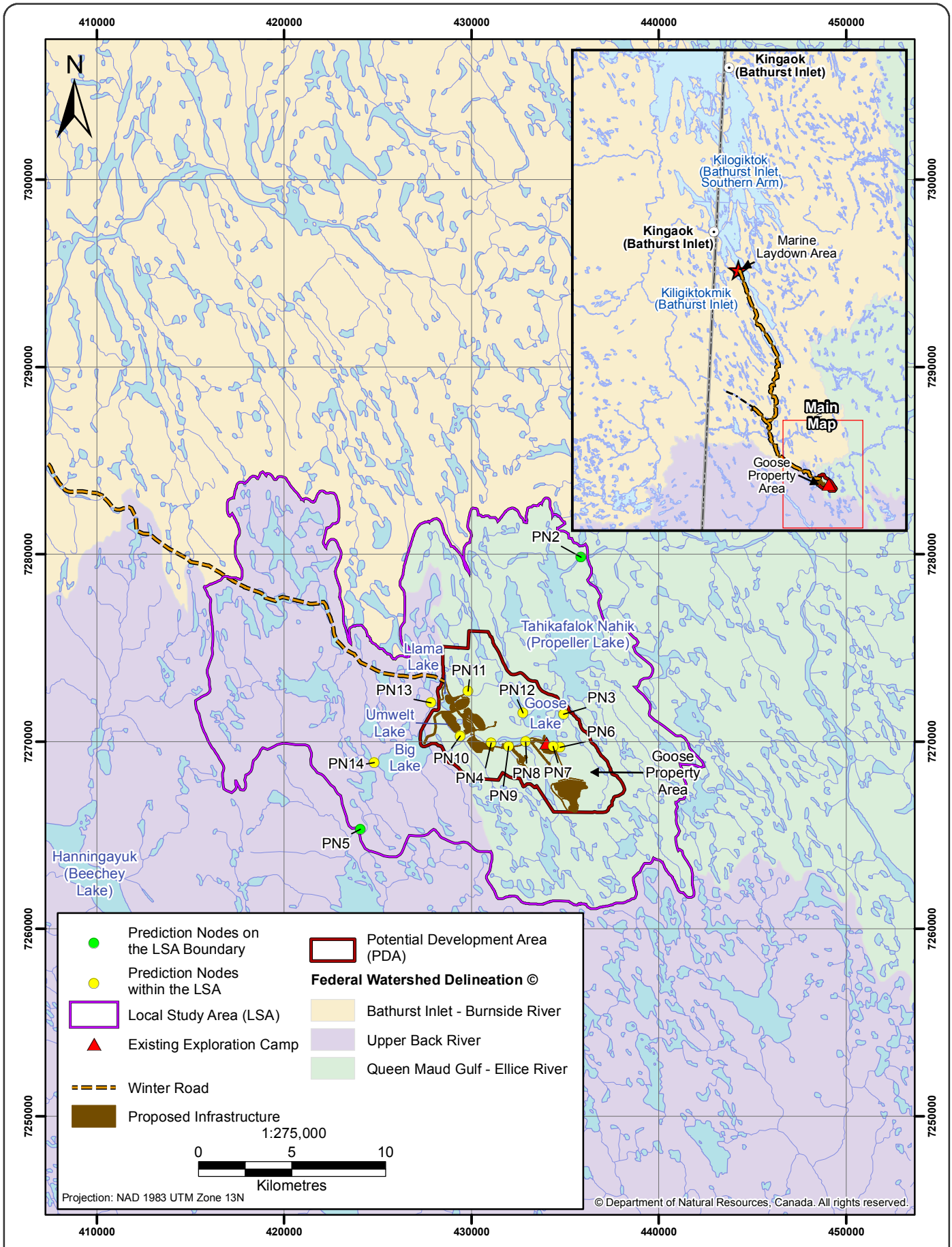
SRK. 2015b. Back River Project Site-Wide Water Management Report. Prepared for Sabina Gold & Silver Corp. by SRK Consulting (Canada) Inc.

- Appendix A -

Figures and Graphs



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Surface Water Hydrology Prediction Nodes within the Local Study Area

Figure A-1

Rescan an ERM company

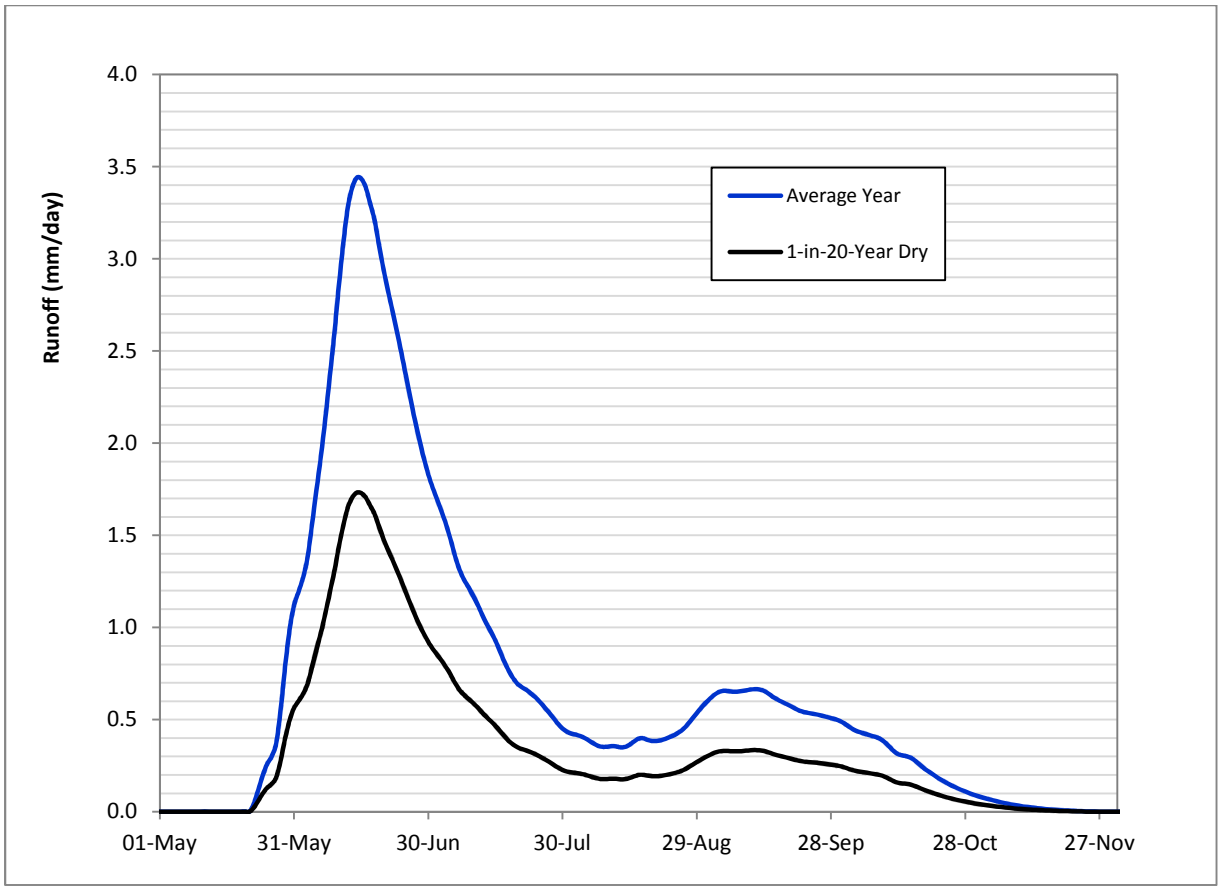

Figure A-2. Daily Distribution on Annual Runoff in Goose Property Watersheds (SRK 2015a)

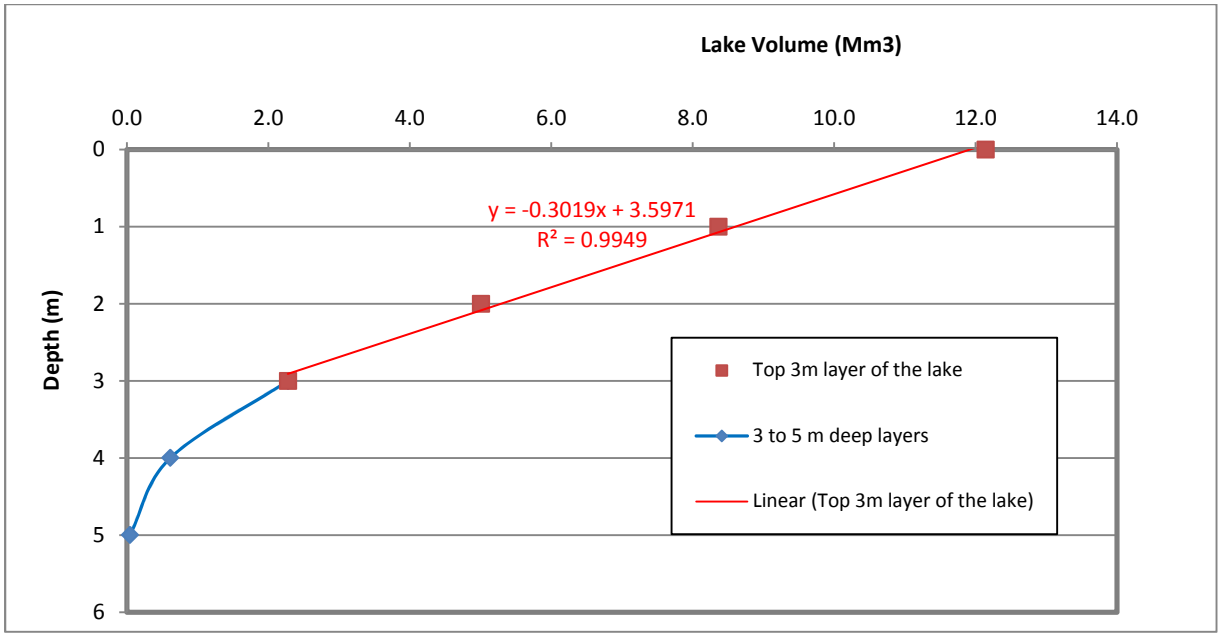

Figure A-3. Volume-Depth Curve for Big Lake based on Bathymetric Survey Results

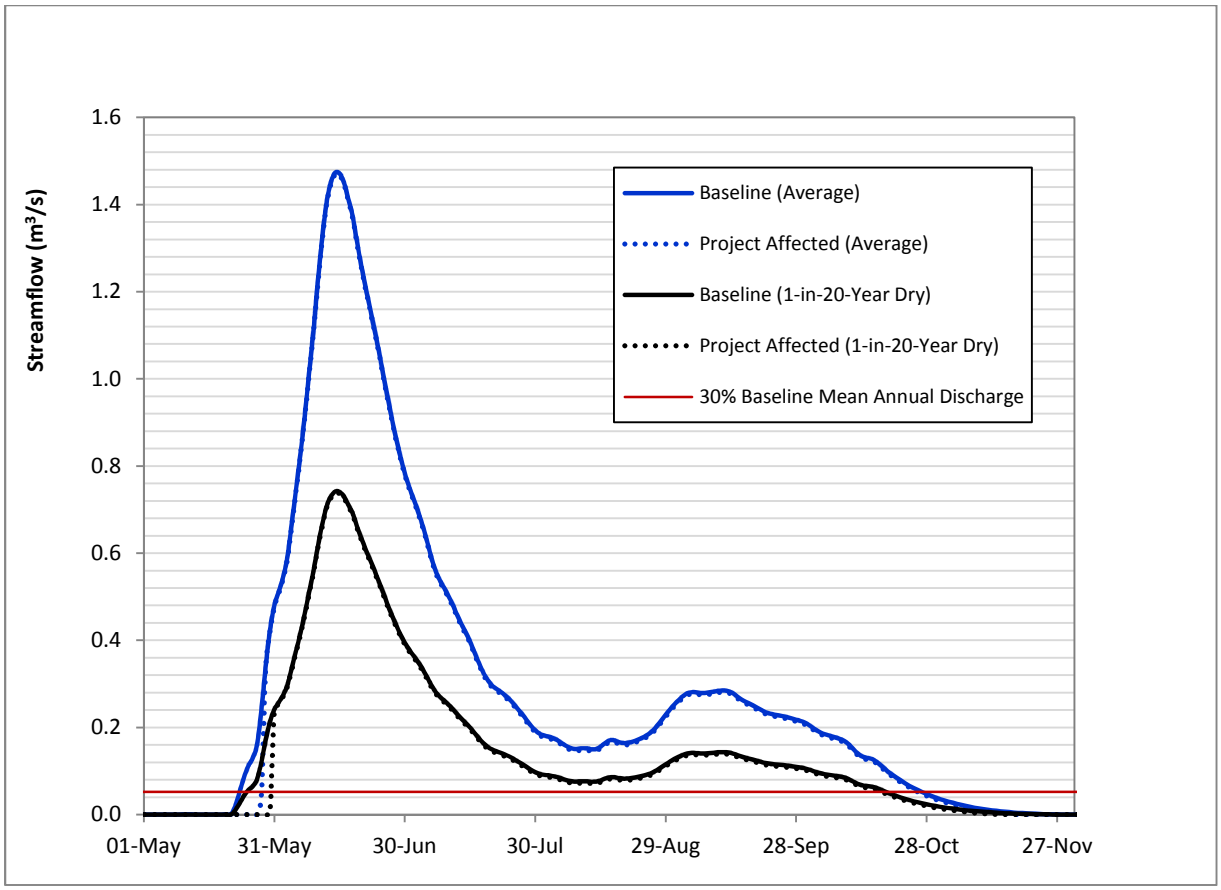

Figure A-4. Baseline and Project-affected Flows at Big Lake Outflow (PN14)

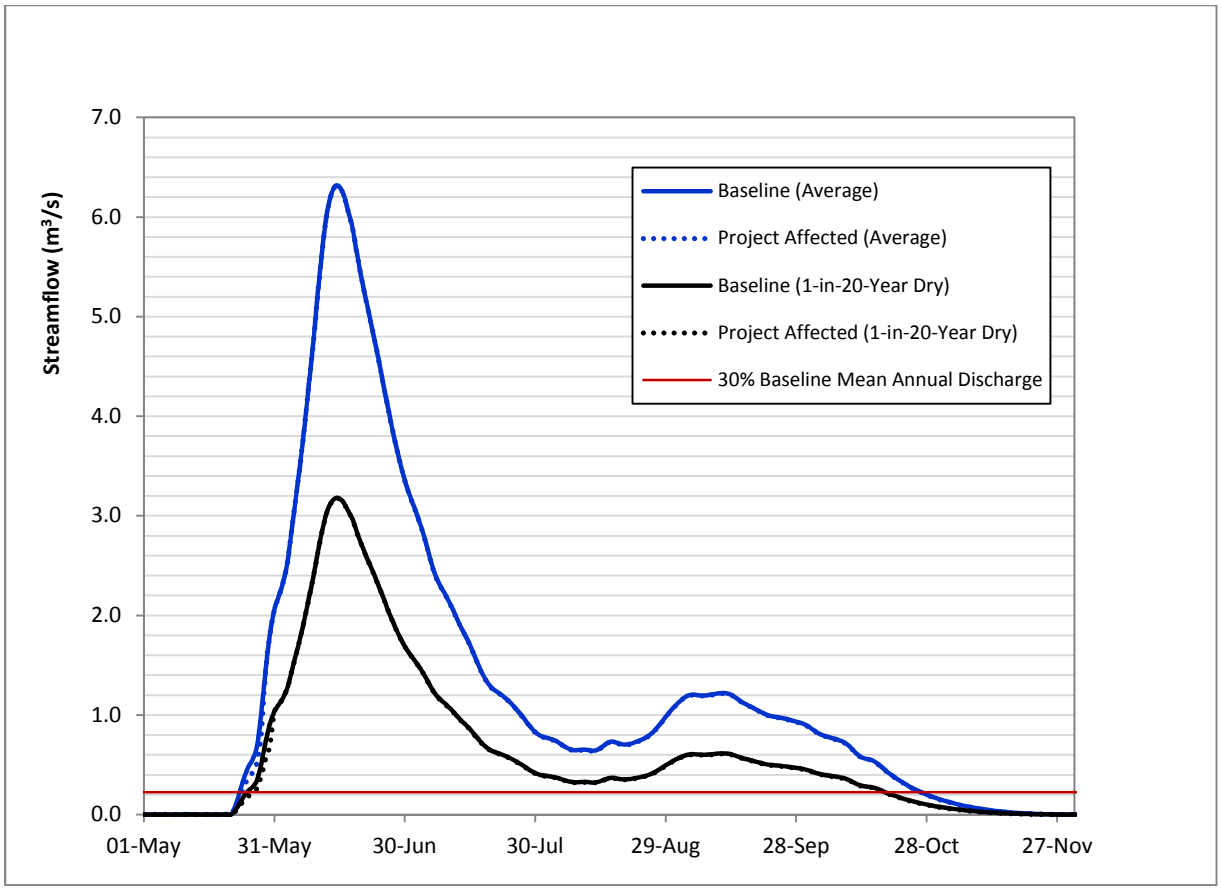

Figure A-5. Baseline and Project-affected Flows at the LSA Outflow (PN5)