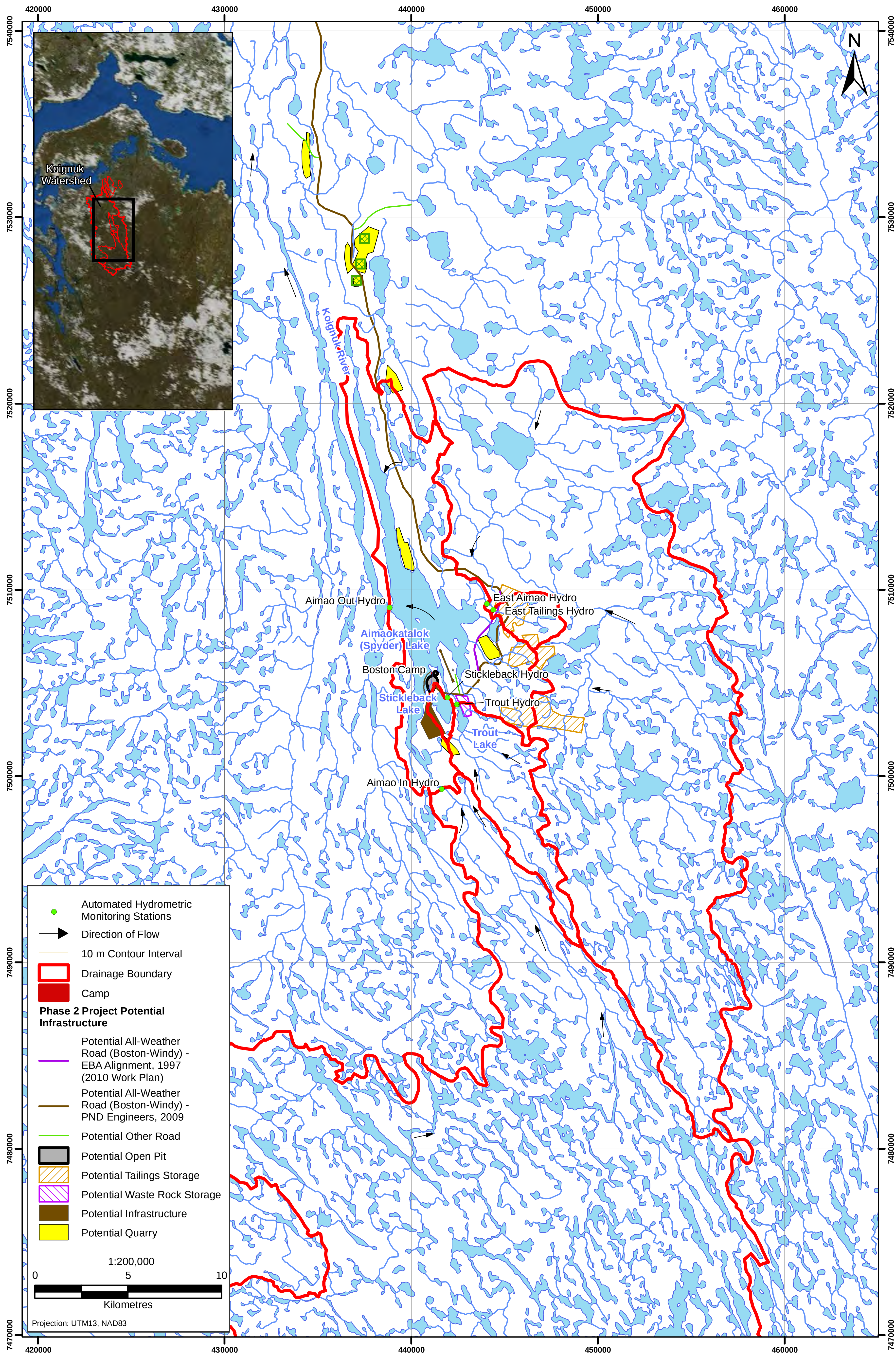

Figure3.1-2

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Figure 3.1-2

Location of 2011 Hydrometric Stations within the Boston Area, Hope Bay Belt Project

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The remobilized hydrometric stations that monitored stream and lake water levels consisted of a 0-5 psi vented Aquistar PT-2X Smart Sensor® (Instrumentation Northwest Inc.). The sensor combines a pressure transducer and data logger in one small diameter unit. The unit recorded the water level at ten minute intervals. The sensor and cabling were inserted into a flexible aluminum conduit with one end of the conduit attached to a 1.5 m long angle iron which anchored the transducer to the lake or channel bottom. In rocky substrates, the angle iron was placed directly on the lake or stream bed whereas in fine-grained substrates, the angle iron was attached to a wooden frame to spread the weight evenly and prevent the assembly from sinking into the substrate.

At Ogama Lake outflow, the angle iron and transducer were oriented vertically and anchored by 1.3 cm diameter pieces of rebar into the bedrock embankment. A standard 1 m WSC staff gauge graduated to 0.01 m was also installed to allow for visual measurements of stage.

At all the remobilized monitoring stations recording stream and lake water levels, the end connector of the sensor was housed in a steel waterproof enclosure located along the adjacent lake shores or channel banks above the high water mark. The angle iron assembly was installed as deep as possible in the water to allow for monitoring of low lake and stream levels. Illustrations of station layouts are provided in Plate 3.2-1.

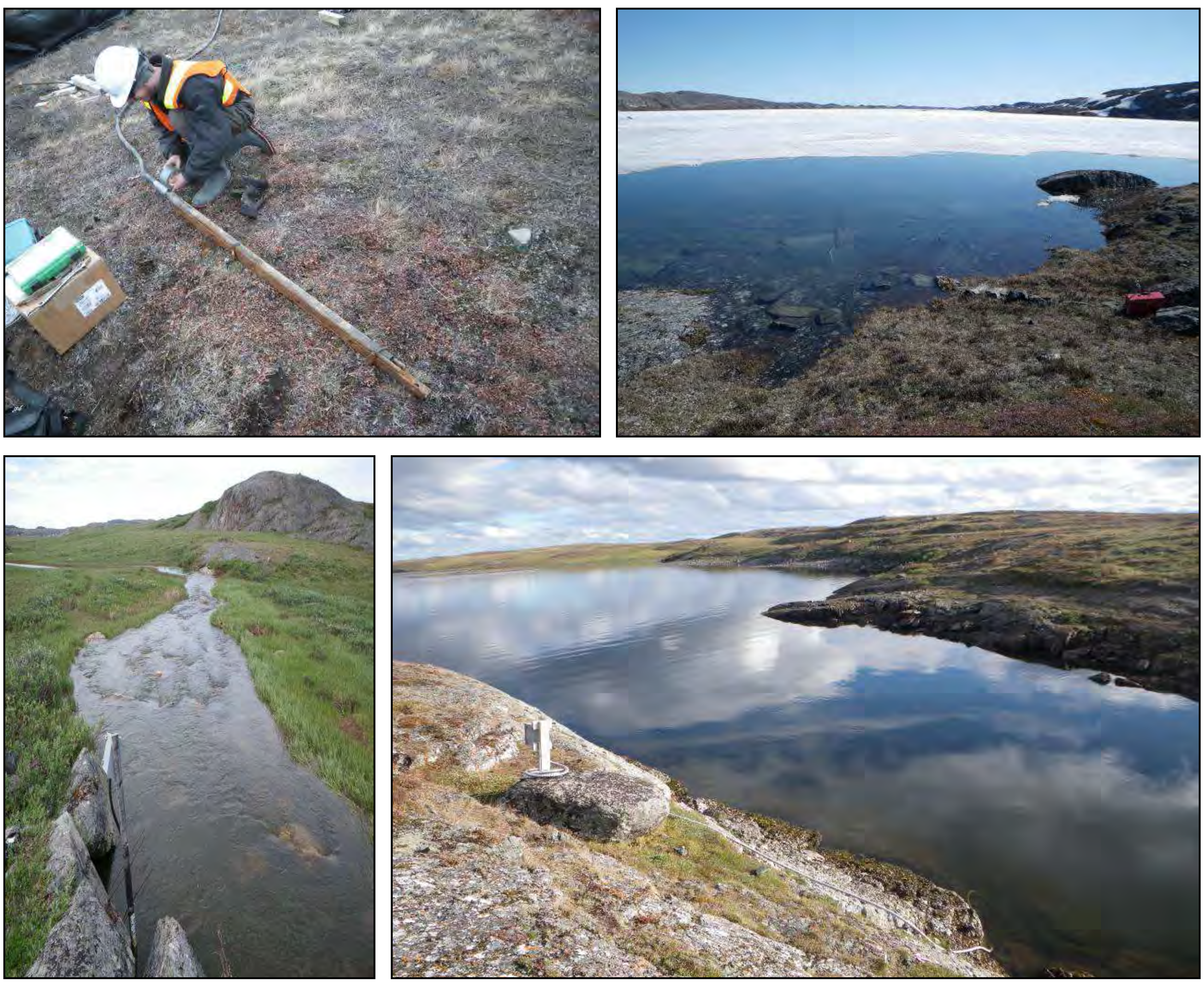

Plate 3.2-1. Photographs illustrating the range of site conditions that need to be considered for the hydrometric station layouts.

The existing hydrometric stations located at Doris and Tail lakes had a different setup. The stations consisted of a 10 psi vented KPSI 730-series solid-state pressure transducer (Measurement Specialties Inc.) paired with a DD-320 data logger (Optimum Instruments Inc.). The data logger recorded lake water levels every 15 minutes. The pressure transducer and cabling were inserted through a 10 cm diameter steel pipe anchored to an on-shore bedrock outcrop; the pipe was set in the lake to a depth below 5 m. The data logger was housed in a steel enclosure located along the lake shoreline above the high water mark.

The tidal gauge operated at Roberts Bay consisted of a Levelogger® M-10 pressure transducer/data logger combination (Solinst Canada Ltd.). The Levelogger® was attached to a floating marker and anchored to the ocean bottom. The unit recorded water levels every 10 minutes. A Barologger® (Solinst Canada Ltd.) was installed on shore and recorded atmospheric pressure to correct the Levelogger absolute pressure readings.

3.3 HYDROMETRIC LEVELLING SURVEYS

Benchmarks established in 2009 were used as survey control points along the channel banks, lake, and ocean shores at each of the monitoring stations that were operated in 2011. During the remobilization of the stations, the elevations of the pressure transducer and water level, relative to the station datum, were surveyed using an engineer’s level and stadia rod. Survey control points were also established at the new stations added to the hydrometric monitoring network in 2011. Pressure transducer and water level elevations at the new stations relative to the station datum were also surveyed. During subsequent site visits, additional hydrometric levelling surveys were carried out at each station to check and verify pressure transducer readings, as well as to determine the reliability of the water level data that were recorded between site visits.

3.4 CURRENT VELOCITY MEASUREMENTS AND DISCHARGE CALCULATIONS

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 range of discharges under different flow conditions. In 2011, five site visits were conducted during early-June, mid-June, mid-July, mid-August, and mid-September time periods.

At the lake outlets, current velocity measurements were obtained by measuring water velocities using a current velocity meter with an electromagnetic sensor (Flo-Mate 2000® by Marsh-McBirney Inc.). A fixed sampling interval of 40 seconds was selected for each velocity measurement, during which an average velocity was determined.

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. 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).

Water discharges were computed from the water current velocity measurements using the mid-section method. The partial discharges across the channel are summed to obtain the total estimated discharge for the gauged section.

At some hydrometric stations, either water depths or current velocity conditions were too high during the open water season to allow field personnel to safely wade and measure discharge with a handheld current velocity meter. As a result, discharge was measured at these stations by means of a StreamPro® (Teledyne RD Instruments) acoustic Doppler current profiler (ADCP) following standard operating procedures (Rehmel, Stewart, and Morlock 2003; WSC 2004).

In the Doris/Madrid area, the ADCP unit was used at the Koignuk River for all discharge measurements during the open water season. The ADCP unit was mounted onto a tethered floating platform and towed by a boat across the channel.

In the Boston area, the ADCP was used for all discharge measurements at the outflow of Aimaokatalok Lake (hydrometric station Aimao Out-Hydro). The ADCP was also employed for both measurements in June 2011 at the eastern tributary of Aimaokatalok Lake (hydrometric station East Aimao-Hydro) and at Aimaokatalok River (hydrometric station Aimao In-Hydro). At these locations, the ADCP floating platform was tethered to a cableway that spanned the channel. The cableway was used to draw the ADCP unit across the channel.

In all cases where the ADCP was deployed, measurements of current velocity, water depth, and the position of the unit across the channel section were automatically recorded. A single channel section or transect produced one measurement of mean discharge. At least four valid transects were collected during each site visit to reduce the effects of turbulence, directional bias, or other random errors. Results of a single transect were considered as valid if they were within 5% of the observed mean flow average of all previous results. The resulting mean discharge value was reported as the estimated discharge for the river. The range between the recorded measurements was used as the error associated with the average discharge.

3.5 STAGE DISCHARGE RATING CURVES

The 2011 discharge measurements were used to generate stage-discharge relations for each hydrometric station. Stage-discharge relations were expressed as rating curves. Stage-discharge rating curves (rating curves) are hydraulic functions used to convert water level data (stage) recorded by the hydrometric monitoring stations into a 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, it is recommended that between 10 and 15 manual stream flow measurements (well distributed through the range of flows) be collected. 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 measuring discharge during high flow periods, 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. The stage-discharge relations in this report were extrapolated to values equal to 1.5 times the highest measured discharge (International Organization for Standardization 2010). Any discharge extrapolation beyond this limit is not recommended as the resulting value will have high uncertainty associated with it. In this report, discharges above the extrapolation limit were assigned an E data grade; where E represents an estimated data point.

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; International Organization for Standardization 2010). Rating curves are hydraulic functions expressed as a parabolic equation 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].

The Aquarius™ interface allows the user to draw the rating curve in a logarithmic plot; therefore, transforming equation (1) to:

$$Log\ Q = log\ C + b\ log\ (h - a) \qquad (2)$$

which is in the form of the equation of a straight line. The user can then determine characteristics that are evident in logarithmic plots and relate to the type of control, the stream cross section, cross-section shape changes, and shifting control patterns (Sauer 2002).

3.6 LAKE LEVELS

Sub-hourly water level data (m) were used to calculate a mean daily water level for the four hydrometric stations that recorded lake water levels in the Doris/Madrid area (Patch-Hydro, PO-Hydro, Reference B-Hydro, Roberts-Hydro, and Wolverine-Hydro) and for one station in the Boston Area (Aimao Out Hydro).

3.7 TIDE LEVELS

The periodic rise and fall of the ocean was recorded every 15 minutes by a datalogger. These data were used to calculate the mean hourly ocean water level. The elevation of the tide gauge relative to a geodetic benchmark (elevation 2.945 masl) was determined using an engineer's level and stadia rod.

3.8 DISCHARGE HYDROGRAPHS

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 discharge data, rising limbs of the hydrographs were estimated assuming a logarithmic growth function. Based on field observations, the 2011 freshet began during the second week of June, a week later than it occurred in 2010. After the removal of the pressure transducers in the fall, hydrograph recession limbs were estimated by assuming a stream channel freeze-up date and a linear decay function. Other functions were considered (e.g., logarithmic, polynomial equations) however the linear decay function was used because it was considered to be the most conservative and consistent with results that were obtained in previous years (Rescan 2009).

For all hydrometric stations located along lakes in the Doris/Madrid area, it was assumed that the outlet streams ceased to flow following a prolonged period of sub-zero temperatures. From previous monitoring years, it was estimated that flows from Tail Lake (a small drainage area) and Doris Lake (a larger drainage area) ceased following 74 and 252 negative degree-days below a base temperature of 0°C (Rescan 2009). From previous monitoring years, it was estimated that flows from Doris Lake ceased following 252 negative degree-days below a base temperature of 0°C (Golder and Associates 2009). This assumption was applied to the 2011 observed daily mean air temperatures from the Doris meteorological station, however, data was only available until the end of October. With the data available, a date of zero flow for Doris Lake was estimated to occur on November 10. Discharge at all basins within the Doris-Roberts, Windy-Glenn, and Reference-B watersheds, were assumed to cease on the same estimated date as Doris Lake.

Due to its larger drainage area, the Koignuk River (2,937 km^2) was assumed to stop flowing on December 1. To confirm, the daily discharge data (2005-2008) from a similarly sized WSC station at Kendall River (2,790 km^2) showed that the river stopped flowing each year between mid-to-late November. In comparison, the Koignuk drainage area is 5% larger than the Kendall Watershed. The Koignuk River is also located farther north and has a climate more influenced by its proximity to the ocean. Thus, the assumption that the Koignuk River stops flowing by December 1 each year was considered to be reasonable. Ice drilling during the 2009 and 2010 winters at the confluence point of the Koignuk at Hope Bay further confirmed that the river does not flow year round. In late April 2009, under-ice water was reached after drilling at the confluence point but no water discharge could be measured (Rescan 2010a). Further, salinity samples taken on the same date indicated no evidence of freshwater input from the river into Hope Bay (Rescan 2010b). In April 2010, ice drilling where the Koignuk River drains into Hope Bay revealed that the channel was frozen all the way to its bed. The channel bed was less than one metre below the ice surface, and no water was flowing at that time of year (Rescan 2011a).

The same assumption that uses the concept of negative degree days below a base temperature of 0°C was used for the estimation of freeze-up date for streams in the Boston area. When the assumption was applied to the 2011 observed daily mean air temperatures from the Boston meteorological station, negative degree-day 74 corresponded to October 23 and negative degree-day 252 was assumed to be equal to November 10.

Using the same rationale, November 10 was assumed as the freeze-up date for the Aimaokatalok Lake inflow, the Eastern tributary of Aimaokatalok Lake and Trout Lake outflow. October 23 was assumed as the freeze up date for the streams draining past the hydrometric stations at East Tailings-Hydro and Stickleback Hydro because of their comparatively small drainage areas.

In 2010, it was assumed that the outflow channel from Aimaokatalok Lake remained open during the winter season (Rescan 2011b). Given that another warm winter occurred during the 2010/2011 winter, the same assumption was applied in 2011.

3.9 HYDROLOGIC INDICES

Calculated annual runoff, mean annual flow, peak flows, and low flows are important hydrologic indices that provide useful information when undertaking a hydrologic assessment for the engineering planning and design of mine project infrastructure, as well as when managing the water resources once a mine has entered operations.

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

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.

Peak flows represent the maximum flow rate that a drainage basin will produce 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 open channel ditches and 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

4.1 DORIS/MADRID AREA

4.1.1 Discharge Measurements

Two discharge measurements were completed during the June freshet period at each hydrometric station. Additional measurements were conducted in July, August, September, and October 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 A1).

Table 4.1-1. Summary of Completed Discharge Measurements in the Doris/Madrid Area in 2011

Hydrometric Station and Drainage Area	Date Measured	Pressure Transducer Stage (m)*	Measured Discharge (m^3/s)	Method (Equipment Used)
TL-2 Doris-Hydro ($94.6\ km^2$)	June 15	99.017	1.42	Velocity-Area (Flo-Mate current meter)
	June 21	99.345	4.92	Velocity-Area (Flo-Mate current meter)
	July 24	98.974	1.26	Velocity-Area (Flo-Mate current meter)
	August 18	98.742	0.42	Velocity-Area (Flo-Mate current meter)
	September 27	98.812	0.67	Velocity-Area (Flo-Mate current meter)
TL-3 Doris-Hydro ($95.3\ km^2$)	June 19	97.927	4.46 (E)	Velocity-Area (ADCP)†
	June 22	97.999	6.46 (E)	Velocity-Area (ADCP) †
	July 21	97.517	1.31	Velocity-Area (Flo-Mate current meter)
	July 22	97.531	1.37	Velocity-Area (Flo-Mate current meter)
	July 24	97.486	1.13	Velocity-Area (Flo-Mate current meter)
	August 17	97.189	0.47	Velocity-Area (Flo-Mate current meter)
	September 25	97.276	0.66	Velocity-Area (Flo-Mate current meter)
Roberts-Hydro ($97.9\ km^2$)	June 17	99.517	4.60	Velocity-Area (Flo-Mate current meter)
	June 21	99.471	6.82	Velocity-Area (Flo-Mate current meter)
	July 22	99.048	1.06	Velocity-Area (Flo-Mate current meter)
	September 25	99.034	0.80	Velocity-Area (Flo-Mate current meter)
Koignuk-Hydro ($2,937\ km^2$)	June 18	99.985	135.00	Velocity-Area (ADCP)†
	June 23	100.559	221.67	Velocity-Area (ADCP) †
	July 23	98.649	36.19	Velocity-Area (ADCP) †
	August 17	98.107	6.87	Velocity-Area (ADCP) †
	September 24	98.320	14.10	Velocity-Area (ADCP) †
Ogama-Hydro ($75\ km^2$)	June 15	98.899	4.33	Velocity-Area (Flo-Mate current meter)
	June 21	98.880	4.07	Velocity-Area (Flo-Mate current meter)
	July 21	98.553	0.89	Velocity-Area (Flo-Mate current meter)
	August 14	98.380	0.24	Velocity-Area (Flo-Mate current meter)
	September 23	98.440	0.55	Velocity-Area (Flo-Mate current meter)

(continued)

Table 4.1-1. Summary of Completed Discharge Measurements in the Doris/Madrid Area in 2011 (completed)

Hydrometric Station and Drainage Area	Date Measured	Pressure Transducer Stage (m)*	Measured Discharge (m^3/s)	Method (Equipment Used)
Patch-Hydro ($32\ km^2$)	June 17	99.246	0.94	Velocity-Area (Flo-Mate current meter)
	June 21	99.265	1.31	Velocity-Area (Flo-Mate current meter)
	July 16	99.118	0.69	Velocity-Area (Flo-Mate current meter)
	August 16	98.922	0.15	Velocity-Area (Flo-Mate current meter)
	September 23	98.935	0.25	Velocity-Area (Flo-Mate current meter)
PO-Hydro ($68\ km^2$)	June 12	99.484	0.35	Velocity-Area (Flo-Mate current meter)
	June 20	99.739	4.43	Velocity-Area (Flo-Mate current meter)
	July 16	99.542	1.06	Velocity-Area (Flo-Mate current meter)
	August 16	99.338	0.19	Velocity-Area (Flo-Mate current meter)
	September	99.401	0.53	Velocity-Area (Flo-Mate current meter)
Reference B-Hydro ($159\ km^2$)	June 18	98.483	11.30	Velocity-Area (Flo-Mate current meter)
	June 22	98.606	14.62	Velocity-Area (Flo-Mate current meter)
	July 20	98.183	1.77	Velocity-Area (Flo-Mate current meter)
	August 15	97.959	0.21	Velocity-Area (Flo-Mate current meter)
	September 22	98.125	1.18	Velocity-Area (Flo-Mate current meter)

† Discharge measured by means of an acoustic Doppler current profiler.
[a] Station not installed.
** Pressure transducer stage referenced to site-specific arbitrary datum.*
*** Flow under ice conditions, discharge was underestimated.*

Surface water flows were not measured at the hydrometric station Wolverine-Hydro because, as in 2010, there was no defined outlet channel. Instead, negligible amounts of unmeasureable flow were observed spread over marsh-like features that exist at the north and south-east ends of the lake.

4.1.2 Lake Levels

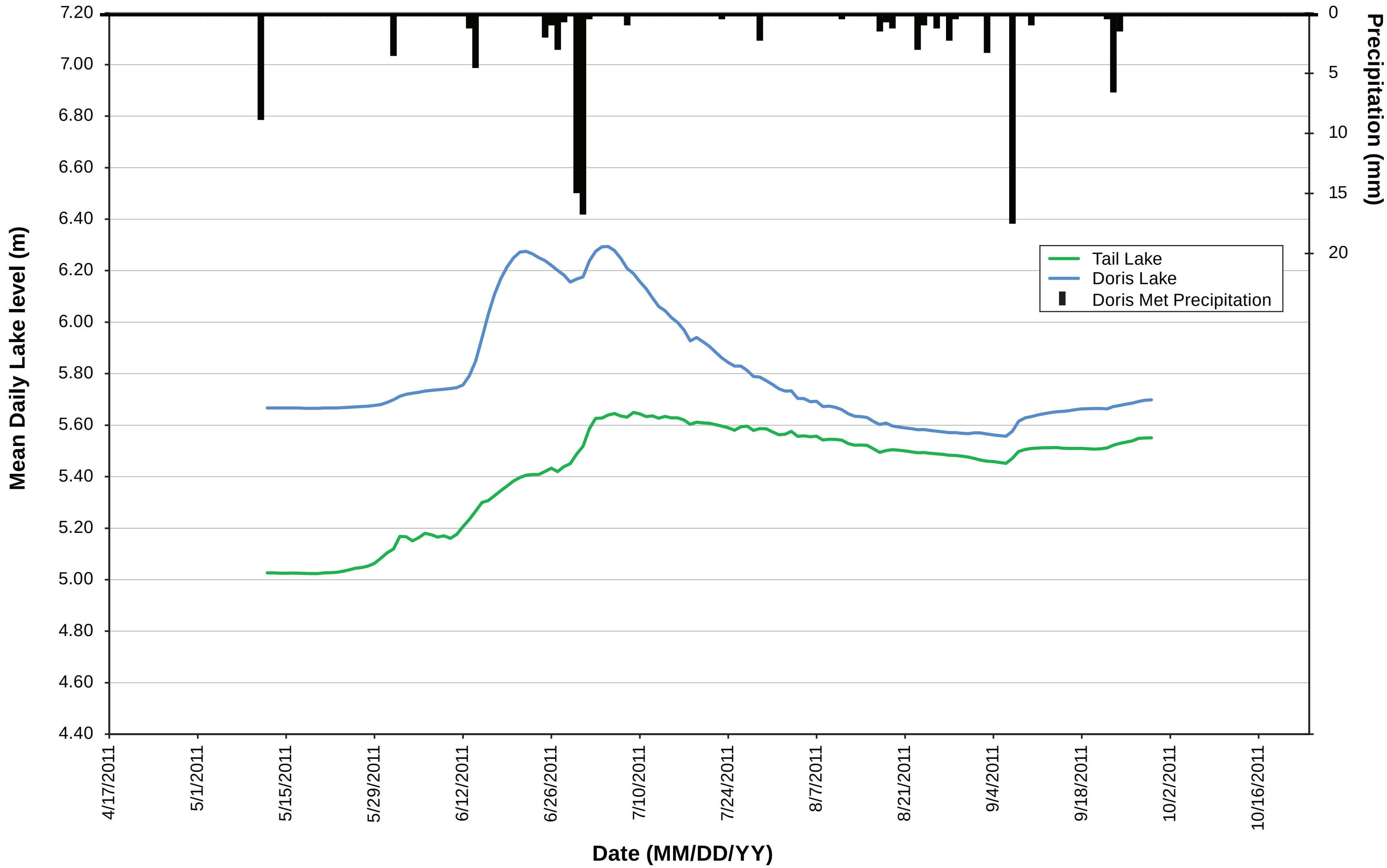
Lake levels were recorded at Doris, Patch, PO, Roberts, Tail, Windy, Wolverine, and Reference B lakes. The mean level variation for lakes in the northern part of the belt was 0.525 m, ranging from 0.235 m at Windy Lake to 0.737 m at Doris Lake (Table 4.1-2). Mean daily lake levels are presented in Figures 4.1-1 to 4.1-4 and in tabular form in Appendix A2.

Table 4.1-2. Recorded Lake Water Levels for the 2011 Open Water Season in the Doris/Madrid Area

Lake	Min Water Level (m)	Max Water Level (m)	Water Level Change (m)	Lake Area (km^2)
Doris	97.725	98.462	0.737	3.4
Tail	94.545	95.171	0.626	0.8
Roberts	98.871	99.429	0.558	5.3
Windy	95.386	95.621	0.235	3.6
Patch	98.872	99.309	0.437	5.7
PO	99.281	99.925	0.644	0.8
Wolverine	98.627	98.883	0.256	1.0
Reference B	97.916	98.627	0.711	10.6

Water levels are referenced to pressure transducer.

PROJECT # 1009-008-04 ILLUSTRATION # a34429n December 21, 2011



Note: Lake water levels referenced to pressure transducer.

Figure 4.1-1

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2011 Recorded Lake Water Levels in the Doris/Madrid Area

Figure 4.1-1

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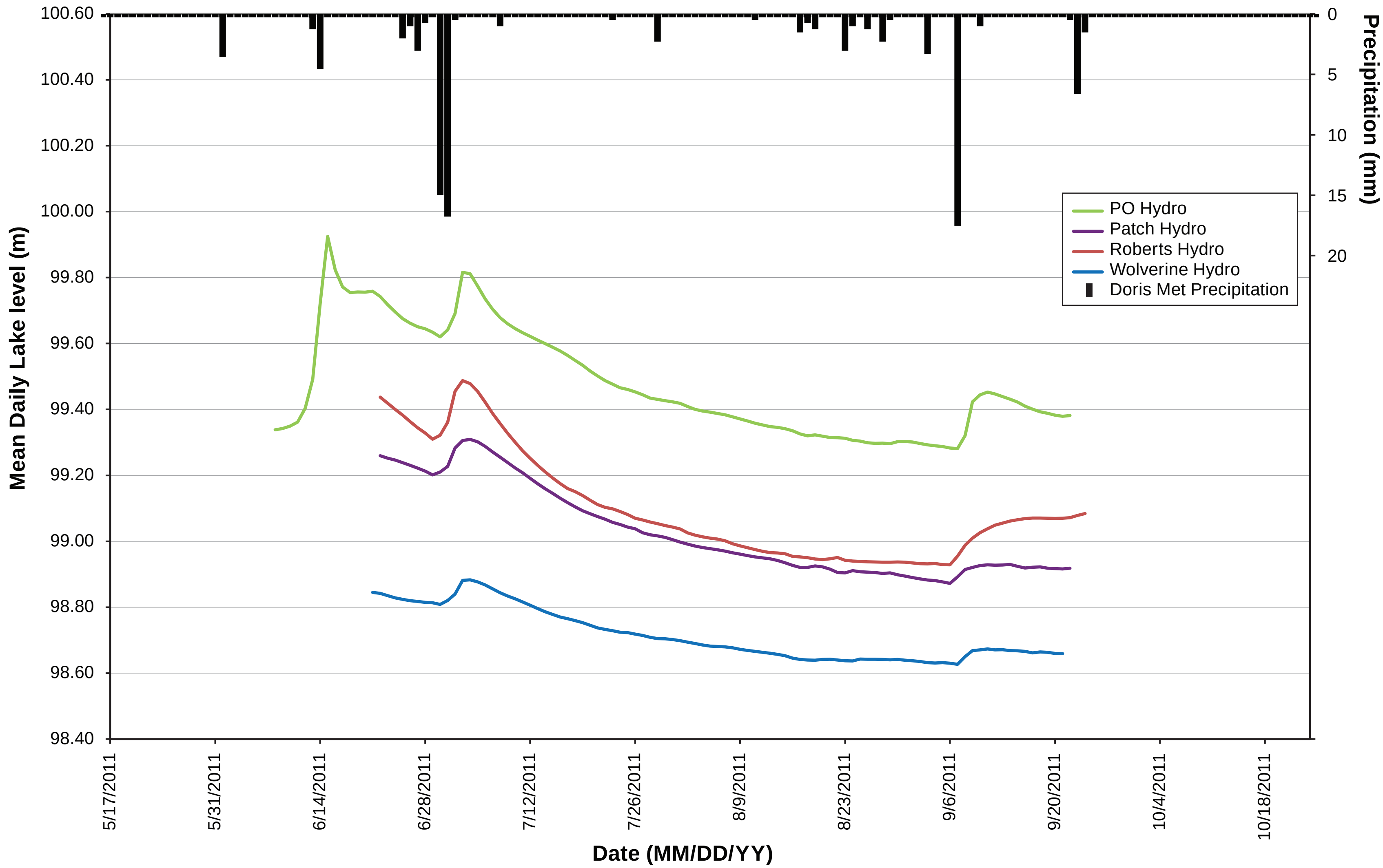

Note: Lake water levels referenced to site-specific arbitrary datum.

Figure 4.1-2

NEWMONT NORTH AMERICA

2011 Recorded Lake Water Levels in the Doris/Madrid Area

Figure 4.1-2

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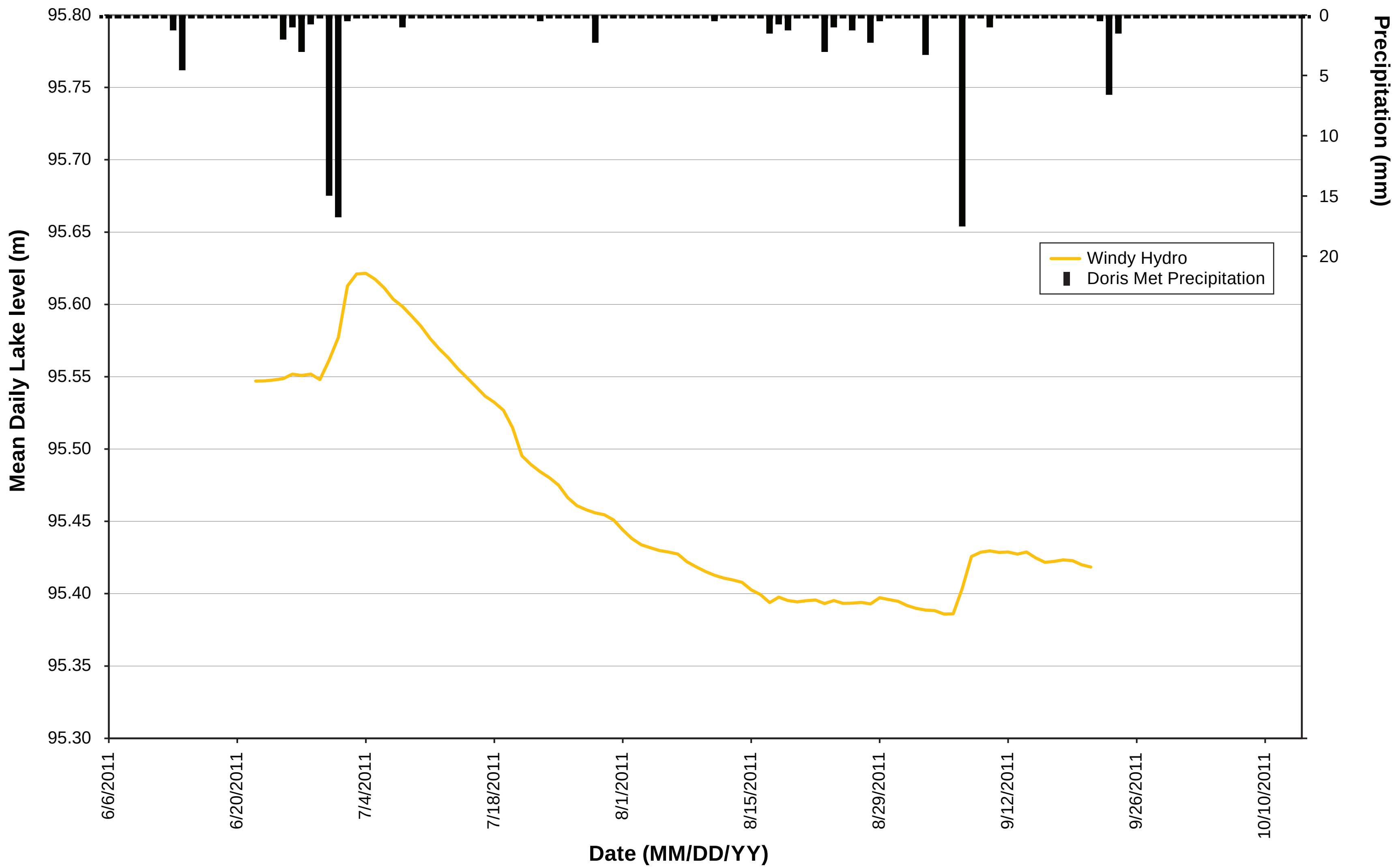

Note: Lake water levels referenced to site-specific arbitrary datum.

Figure 4.1-3

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2011 Recorded Lake Water Levels in the Doris/Madrid Area

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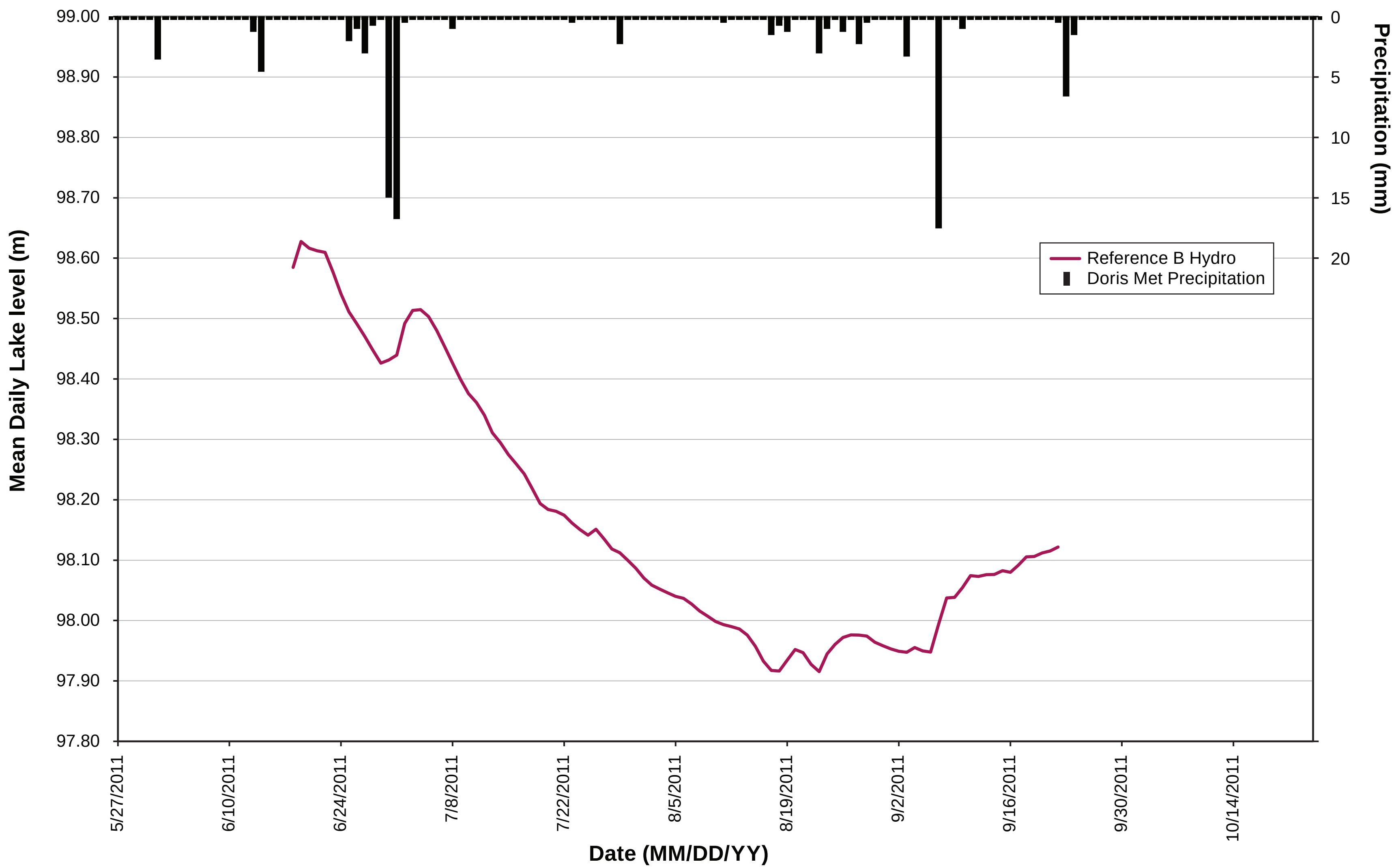

Note: Lake water levels referenced to site-specific arbitrary datum.

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2011 Recorded Lake Water Levels in the Doris/Madrid Area

Figure 4.1-4

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Lake water level variation for Doris Lake was 0.737 m, with two distinct high water levels recorded during the monitoring period (Figure 4.1-4). The first high water level occurred on June 22 and was 99.443 m; it was generated by the spring freshet. The second and highest recorded water level of 99.462 m occurred on July 5, and occurred when 32 mm of rain fell between June 30 and July 1. This event occurred prior to the full recession of the freshet event. After July 5, lake water levels declined at a steady rate until water levels were augmented by rainfall events that occurred on September 6, 7 and later in the month.

4.1.3 Tide Variations

The data recorded by the tide gauge primarily reflect changes in tide height, but also reflect waves and wind-driven seiches within Roberts Bay. Tides with one cycle (one high and one low) per lunar day (24 hours, 50 minutes) are diurnal and tides with two cycles per lunar day are semi-diurnal. The results from Roberts Bay (Figure 4.1-5) show that the tides in Roberts Bay are predominantly semi-diurnal. A diurnal tide frequency also occurs every two weeks preceding the spring tides of the new and full moons. Hence, the tides in Roberts Bay are classified as mixed tides.

The tides in Roberts Bay were microtidal (less than 2 m tide range). Daily tide ranges were generally between 0.25 and 0.35 m (average: 0.30 ± 0.07 m), with a maximum tidal range (the difference between high and low water in one tidal cycle) of 0.33 m on September 20, 2011 during the spring tide.

4.1.4 Stage-discharge Relations

At all five hydrometric stations, the data collected in 2011 were combined with the data collected in 2009 and 2010 in order to increase the range and the robustness of the rating curves. In addition, higher flows measured in 2011 helped to better define the upper end of the rating curve at most stations.

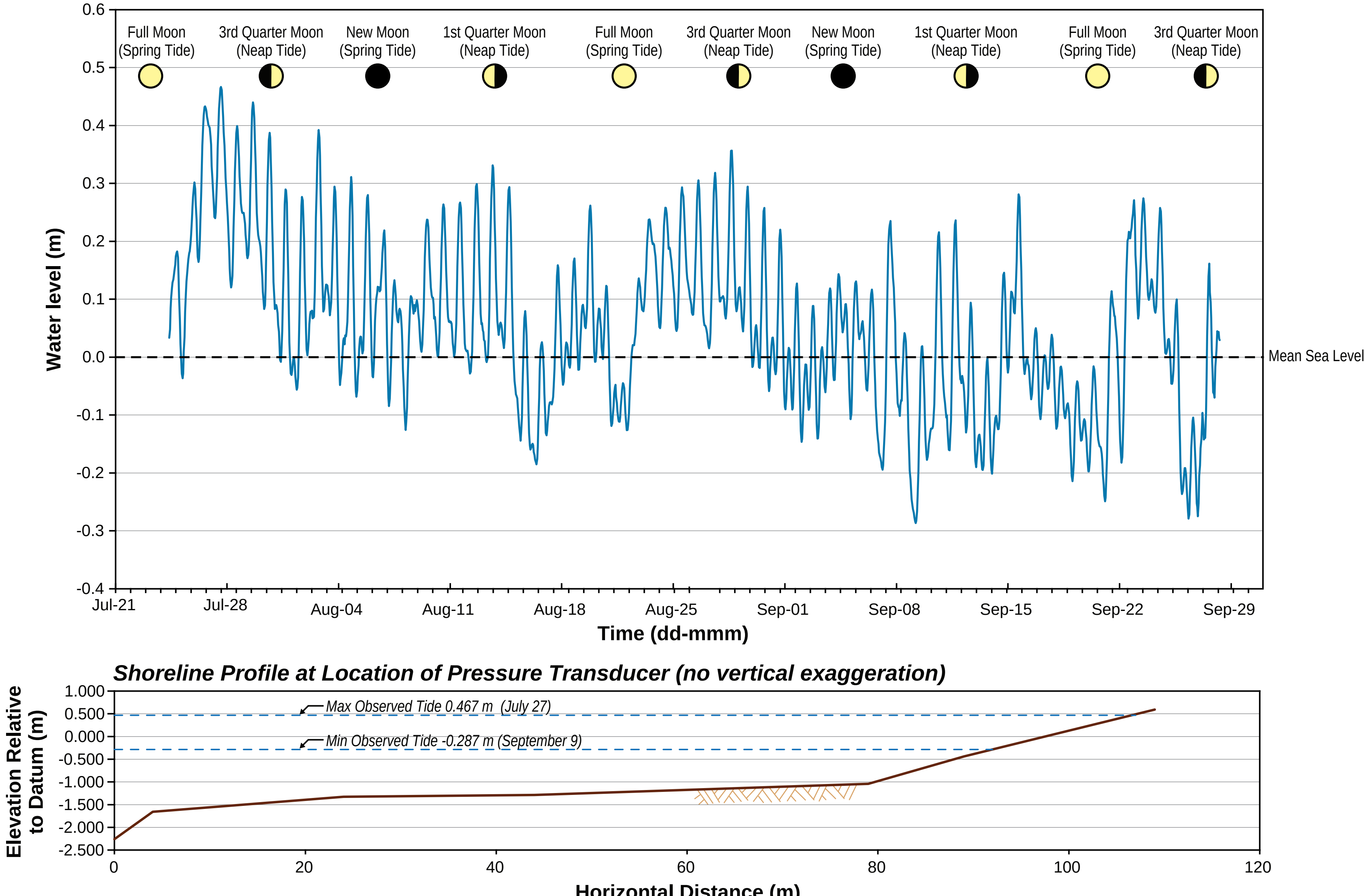
Rating equations for each station are summarized in Table 4.1-3; the rating curves are provided in Appendix A3. Survey control points at each lake and stream level station are provided in Appendix A4.

Table 4.1-3. Summary of 2011 Stage-discharge Rating Equations in the Doris/Madrid Area

Hydrometric Station	Rating Equation $Q = C\ (h-a)^b$
TL-2 Doris-Hydro	
low stage	$Q = 1.43\ (h - 96.60)^{2.10}$
high stage	$Q = 7.44\ (h - 97.10)^{2.03}$
TL-3 Doris-Hydro	
low stage	$Q = 1.68\ (h - 98.20)^{2.04}$
high stage	$Q = 8.73\ (h - 98.57)^{2.08}$
Roberts-Hydro	$Q = 15.11\ (h - 98.78)^{2.04}$
Koignuk-Hydro	$Q = 24.55\ (h - 97.486)^{2.00}$
Ogama-Hydro	
low stage	$Q = 8.94\ (h - 98.16)^{2.69}$
high stage	$Q = 3.90\ (h - 98.05)^{2.36}$
Patch-Hydro	$Q = 2.77\ (h - 98.51)^{2.98}$
PO-Hydro	$Q = 16.42\ (h - 99.17)^{2.44}$
Reference B-Hydro	$Q = 24.88\ (h - 97.76)^{2.95}$

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

PROJECT # 1009-008-04 ILLUSTRATION # a33789w November 28, 2011



Note: Sea levels are referenced to a geodetic datum (elevation 2.945 masl).

Figure 4.1-5

NEWMONT NORTH AMERICA

Tidal Fluctuation at Roberts Bay, July to September 2011

Figure 4.1-5

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At TL-2, TL-3, and Ogama-Hydro hydrometric stations, two (high and low) stage-discharge rating curves were found to provide a better fit to the observed data than single stage-discharge rating curve and were used to generate hydrographs for each station. Low flows appeared to be well confined by the outlet channels. However, overbank flow conditions during the spring freshet period resulted in a shift in the slope of the rating curve at higher stages (see Appendix A3).

4.1.5 Annual Discharge Hydrographs

Annual hydrographs were generated for the four hydrometric stations recording water levels (Doris-Hydro, Ogama-Hydro, Roberts-Hydro and Koignuk-Hydro) as well as for the channel outflow of five of the eight hydrometric stations monitoring lake water levels. These are individually presented in Appendix A5. Due to the lack of well-defined flows at the Wolverine-Hydro hydrometric station, a rating curve and a hydrograph could not be generated.

Annual hydrographs are presented as mean daily discharges (Figures 4.1-6 and 4.1-7) for the open-water season (early June to early November). Mean daily discharge is the average discharge calculated over a 24-hour period. This value is often referred to as the daily discharge.

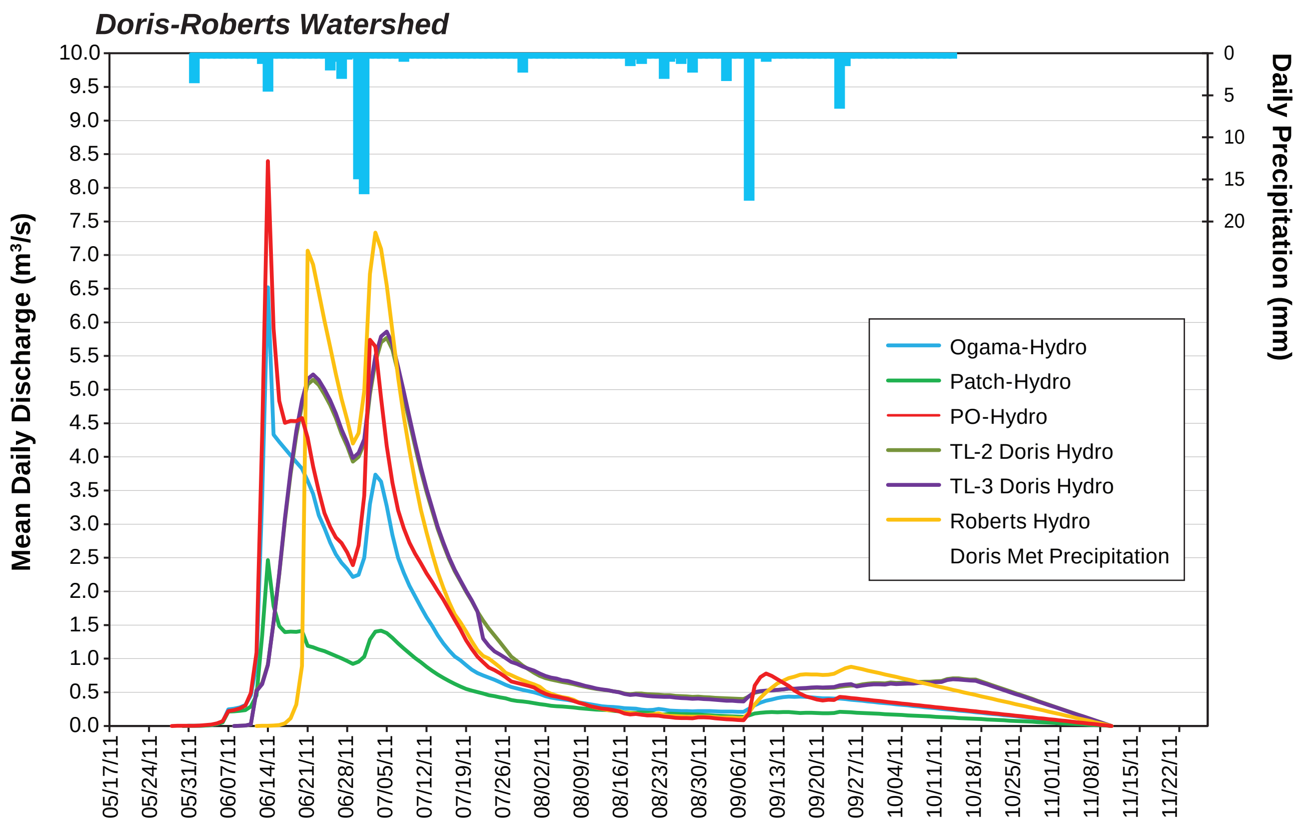
The mean daily discharge hydrographs show that the onset of the spring freshet occurred in early June throughout the watersheds in the Doris/Madrid area. Annual peak flows occurred in mid-June with the timing of the maximum discharges varying across the area. Patch-Hydro, PO-Hydro and Ogama-Hydro all peaked around June 14 as a result of snow melt. A lower secondary peak occurred on July 3 or 4 and was related to the June 30/July 1 rain event (Figure 4.1-6). For the two Doris-Hydro stations, the peaks occurred on June 22 and July 5. For Roberts-Hydro station the peaks occurred on June 21 and July 3. Unlike the Patch, PO and Ogama stations where the first peak was the highest discharge, for the Doris-Hydro and Roberts-Hydro stations the secondary peak was more significant. The differences appear to be related to drainage area response times, as the Patch, PO, and Ogama stations responded rapidly to the melt, with the flows well into the recession limb of the hydrograph when the rain event occurred. In contrast, the Doris-Roberts stations peaked a few days later, and though still within the recession limb of the hydrograph, were relatively nearer to the maximum flow.

The Koignuk-Hydro hydrograph shows the primary peak occurred on June 23, with a secondary peak on July 4 (Figure 4.1-5). For the Reference B-Hydro station the first peak occurred on June 19 and a smaller secondary peak occurred on July 4 (Figure 4.1-7). For both of these stations the initial snow melt induced peak was the larger flow event.

Following the rain event, discharge steadily decreased throughout the Doris/Madrid area until early September. After that daily discharges were augmented by a number of rainfall events that occurred during the month of September. By the end of September, discharge continued to recede until freeze-up.

4.1.5.1 Monthly Volumetric Outflow

The monthly and total annual volumetric water outflows for each of the basins in the Doris/Madrid areas are presented in Table 4.1-4 and Figures 4.1-8 and 4.1-9. Discharge outflows from each of the monitored drainages were generally found to be a function of drainage area. The minimum yield was observed at Patch-Hydro (drainage area = 32 km^2) which had a total annual water output of 5.57 million cubic meters. The maximum yield was 575.18 million m^3 over the year at Koignuk River (drainage area = 2,937 km^2).



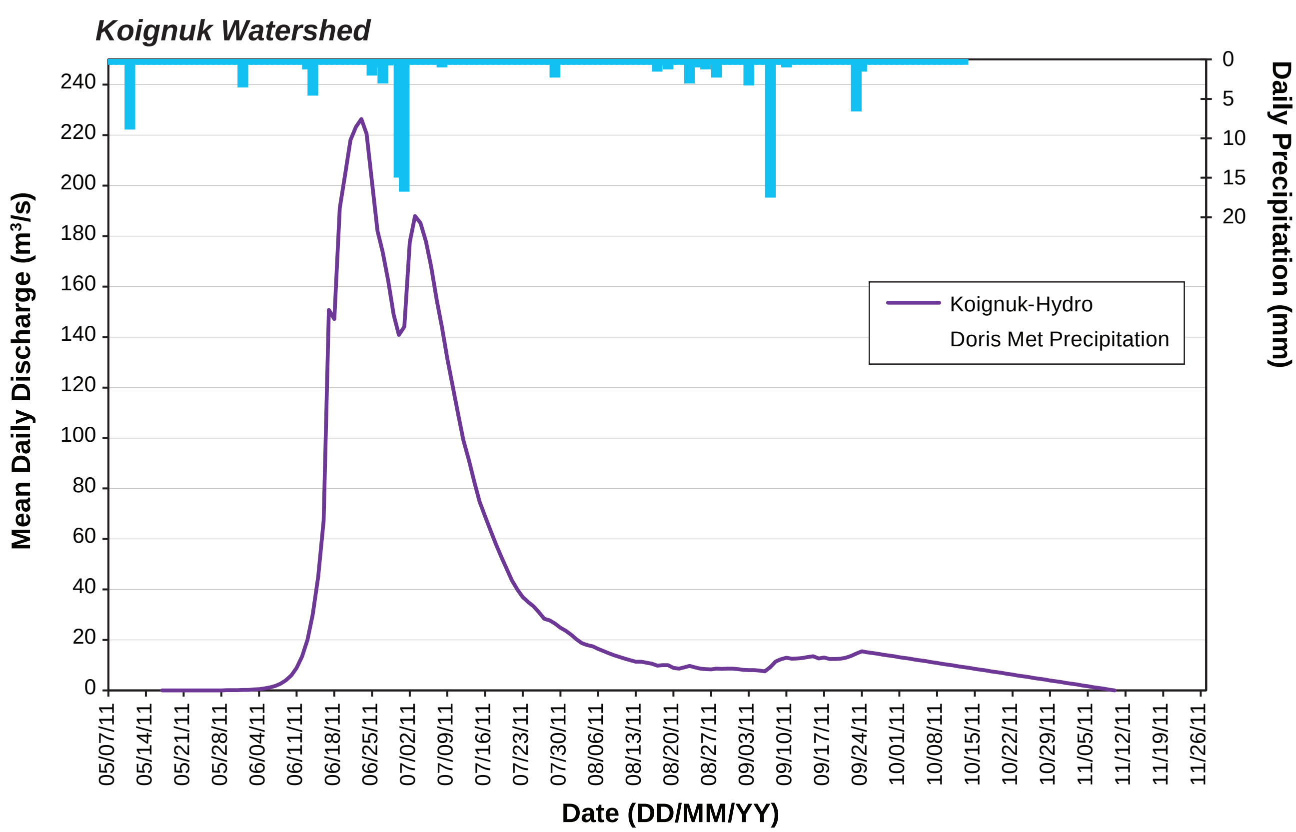


Figure 4.1-6

2011 Annual Flow Discharge Hydrographs

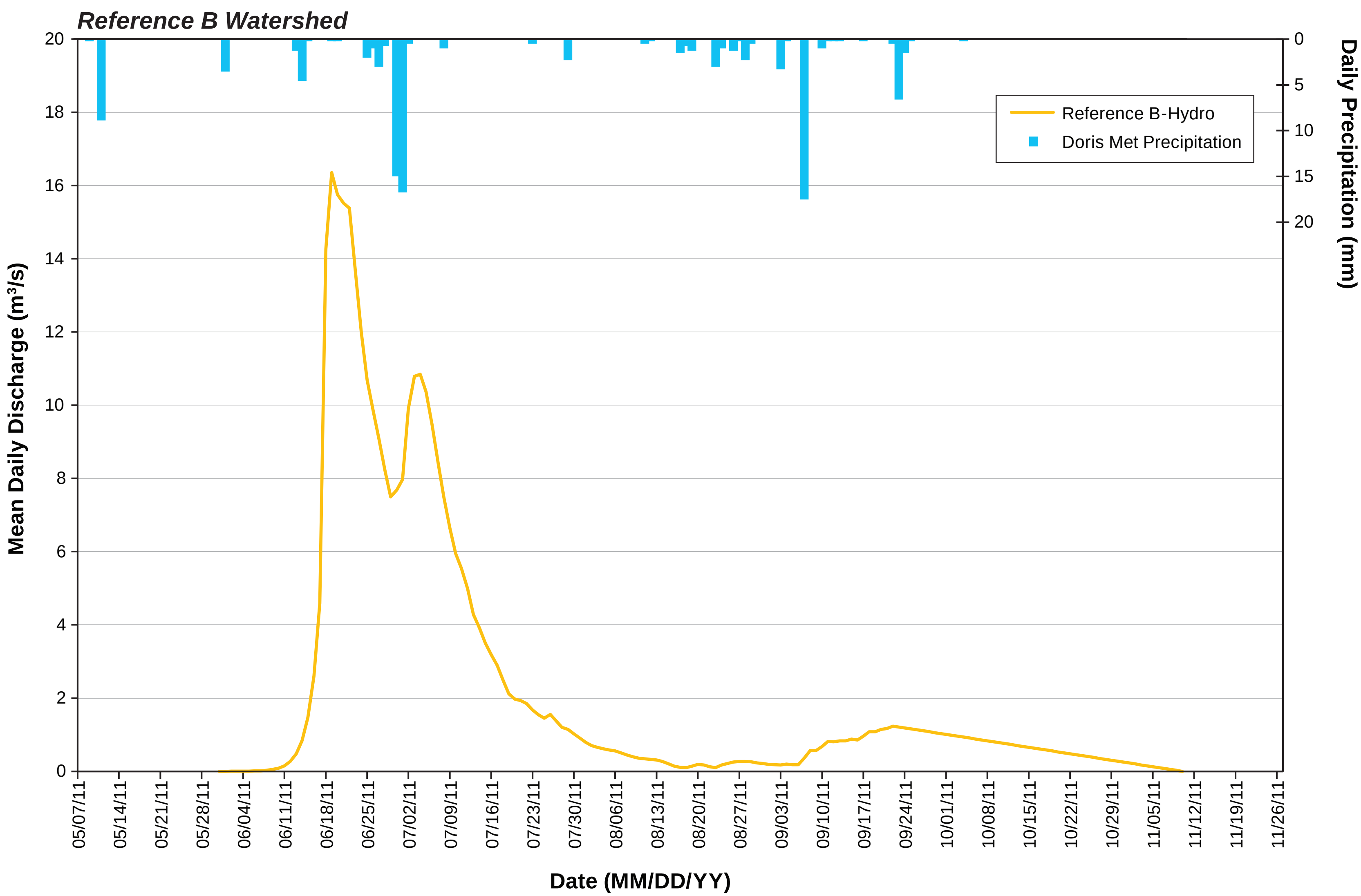


Figure 4.1-7

2011 Annual Flow Discharge Hydrographs

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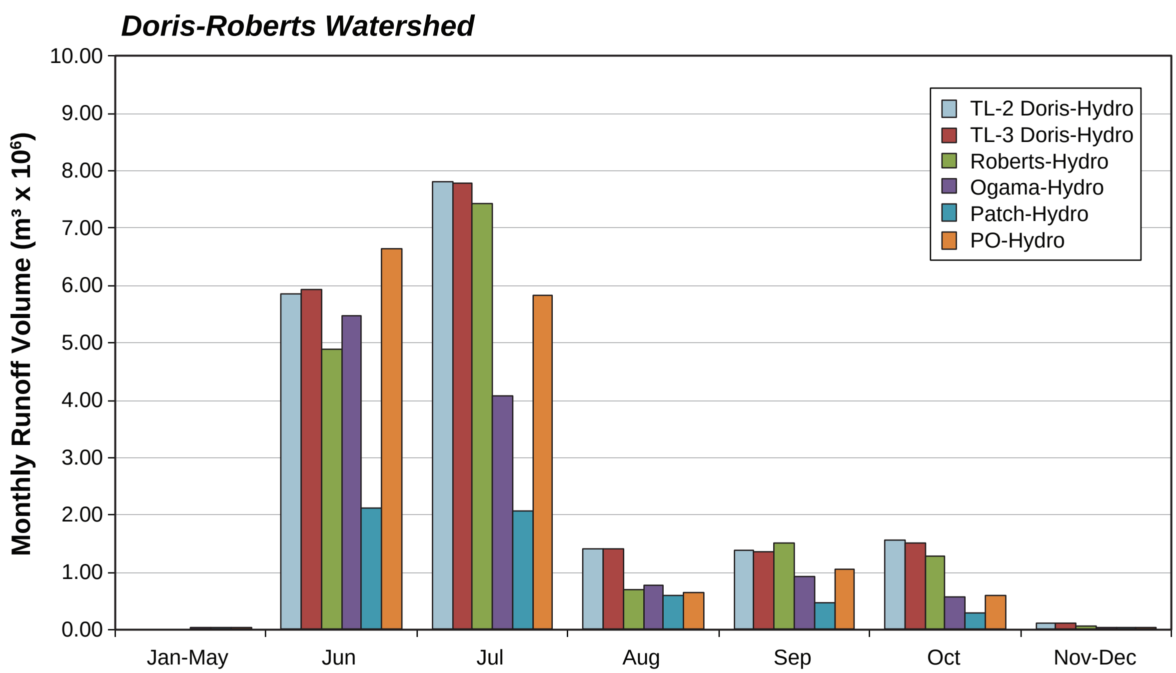

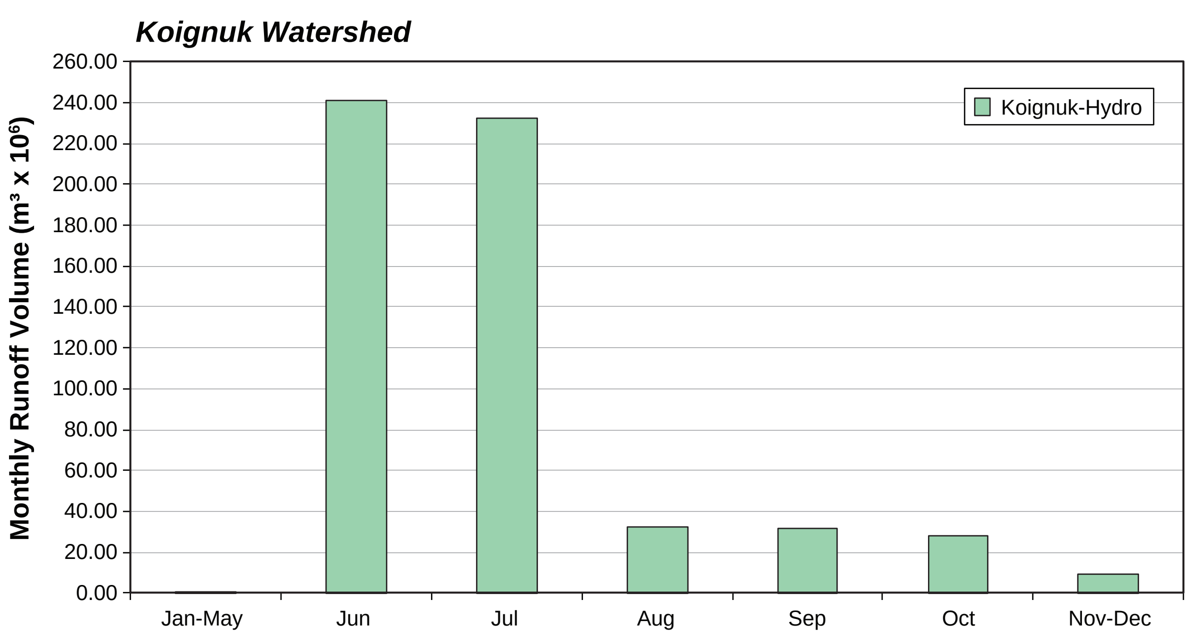

Figure 4.1-8

2011 Monthly Volumetric Outflow
Doris/Madrid Area

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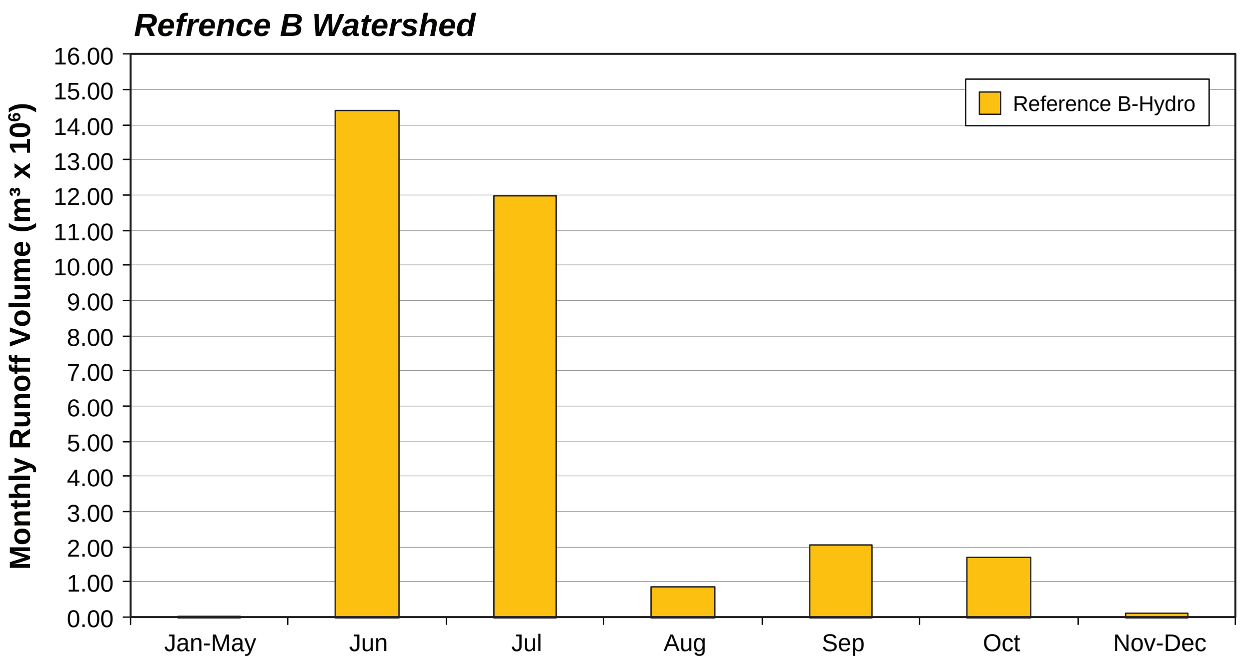


2011 Monthly Volumetric Outflow Doris/Madrid Area

Figure 4.1-9

Table 4.1-4. Monthly Volumetric Outflow in the Doris/Madrid Area ($m^3 \times 10^6$)

Hydrometric Station	Jan - May	Jun	Jul	Aug	Sep	Oct	Nov - Dec	Total
TL-2 Doris-Hydro	<0.01	5.86	7.80	1.42	1.38	1.55	0.11	18.12
TL-3 Doris-Hydro	<0.01	5.93	7.79	1.41	1.37	1.52	0.11	18.12
Ogama-Hydro	<0.01	5.58	4.08	0.79	0.92	0.57	0.03	12.0
Patch-Hydro	<0.01	2.16	2.06	0.60	0.48	0.29	0.02	5.61
PO-Hydro	<0.01	6.51	5.62	0.65	1.05	0.60	0.04	14.50
Koignuk	0.03	241.32	232.59	32.35	31.70	28.04	9.14	575.18
Reference B	<0.01	14.40	11.96	0.87	2.07	1.69	0.10	31.09
Roberts-Hydro	<0.01	4.89	7.42	0.69	1.51	1.28	0.07	15.87

4.1.6 Hydrologic Indices

4.1.6.1 Annual Runoff

In 2011, the average calculated annual runoff for all the gauged watersheds in the Doris/Madrid area was 161 mm. It ranged from a low of 106 mm at Ogama-Hydro to a high of 200 mm at PO-Hydro. Average calculated runoff was higher in the Koignuk Watershed (175 mm) than in the Reference B Watershed (174 mm) and the Doris-Roberts Watershed (158 mm). The average estimated annual runoff for the open-water season from the gauged watersheds in the northern part of the belt was 185 mm; ranging from a low of 160 mm to a high of 213 mm at Ogama-Hydro and PO-Hydro, respectively (Table 4.1-5).

Table 4.1-5. 2011 Annual Runoff and Mean Annual Discharge in the Doris/Madrid Area

Hydrometric Station	Drainage Area (km^2)	Percent lake coverage in watershed[†]	Calculated Annual Runoff (mm)	Estimated Annual Runoff[b] (mm)	Mean Annual Discharge[a] (m^3/s)
Doris-Roberts Watershed					
TL-2 Doris Hydro	94.6	20	184 (June 12 to October 17)	191	1.58
TL-3 Doris Hydro	95.3	20	183 (June 12 to October 17)	190	1.58
Roberts-Hydro	97.9	17	144 (June 21 to September 25)	162	1.68
Ogama-Hydro	75	19	106 (June 21 to September 23)	160	0.89
Patch-Hydro	32	27	123 (June 21 to September 23)	175	0.42
PO-Hydro	68	19	200 (June 7 to September 23)	213	1.06
Koignuk Watershed					
Koignuk-Hydro	2,937	18	175 (June 17 to September 24)	191	36.90
Reference B Watershed					
Reference B-Hydro	159	26	174 (June 18 to September 26)	196	2.35
Mean			*161*	*185*	

[a] MAD based on estimated annual runoff.
[b] Estimated for the 2011 open water season.
[†] this percentage includes depressions (lakes, ponds, and wetlands) that can store water in the catchment.

In 2011, conditions were wetter than in 2010. The annual runoff in 2011 was 31% greater than in 2010. The estimated annual runoff values from the gauged watersheds in the Doris/Madrid area for 2009, 2010 and 2011 were 116 mm, 141 mm, and 185 mm respectively.

The mean annual discharge was calculated as an average of the daily discharge values from June to November and ranged from 0.42 m^3/s to 36.90 m^3/s at Patch-Hydro and Koignuk-Hydro stations respectively (Table 4.1-5).

4.1.6.2 Monthly Runoff Distribution

The monthly distribution of runoff is similar among the gauged basins in the Doris/Madrid area. On average, approximately 90% of the runoff occurred between June and July. The maximum monthly runoff occurred during June in most of the watersheds, except for the two Doris-Hydro stations and Roberts Hydro where it occurred during July (Table 4.1-6; Figures 4.1-10 and 4.1-11). The difference in monthly runoff distributions depended upon the watershed response to the late June-early July rain event.

Table 4.1-6. 2011 Monthly Runoff Distribution (mm) in the Doris/Madrid Area

Hydrometric Station	Jan-May	Jun	Jul	Aug	Sep	Oct	Nov-Dec
Doris-Roberts Watershed							
TL-2 Doris-Hydro	*0*	*62*	82	15	15	*10*	*0*
TL-3 Doris Hydro	*0*	*62*	82	15	14	*10*	*0*
Roberts-Hydro	*0*	*49*	76	7	12	*0*	*0*
Ogama-Hydro	*0*	*74*	54	10	12	*8*	*0*
Patch-Hydro	*0*	*66*	65	19	15	*9*	*1*
PO-Hydro	*0*	*96*	83	10	15	*9*	*1*
Koignuk Watershed							
Koignuk-Hydro	*0*	*82*	79	11	11	*8*	*0*
Reference B Watershed							
Reference B-Hydro	*0*	*91*	75	5	13	*11*	*1*

Note: Italicized values are based on estimated mean daily discharge data.

4.1.6.3 Peak and Low Flows

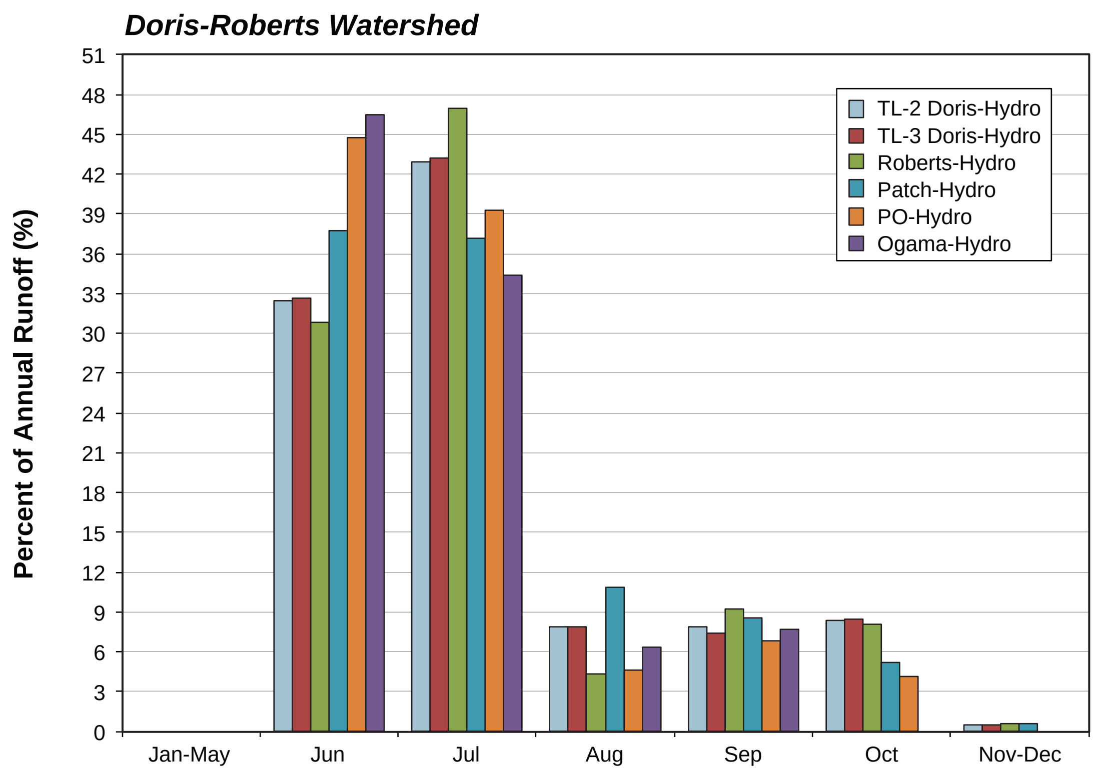
Instantaneous peak flows for the majority of the basins located within the Doris/Madrid area occurred in early-July and ranged from 2.53 m^3/s at Patch-Hydro to 299.50 m^3/s at Koignuk-Hydro. Instantaneous peak unit yields ranged from 62.19 $L/s/km^2$ at TL-2 (Doris-Hydro) to 141.24 $L/s/km^2$ at Patch -Hydro (Table 4.1-7). In the table, values followed by the letter E indicate that the discharge was estimated.

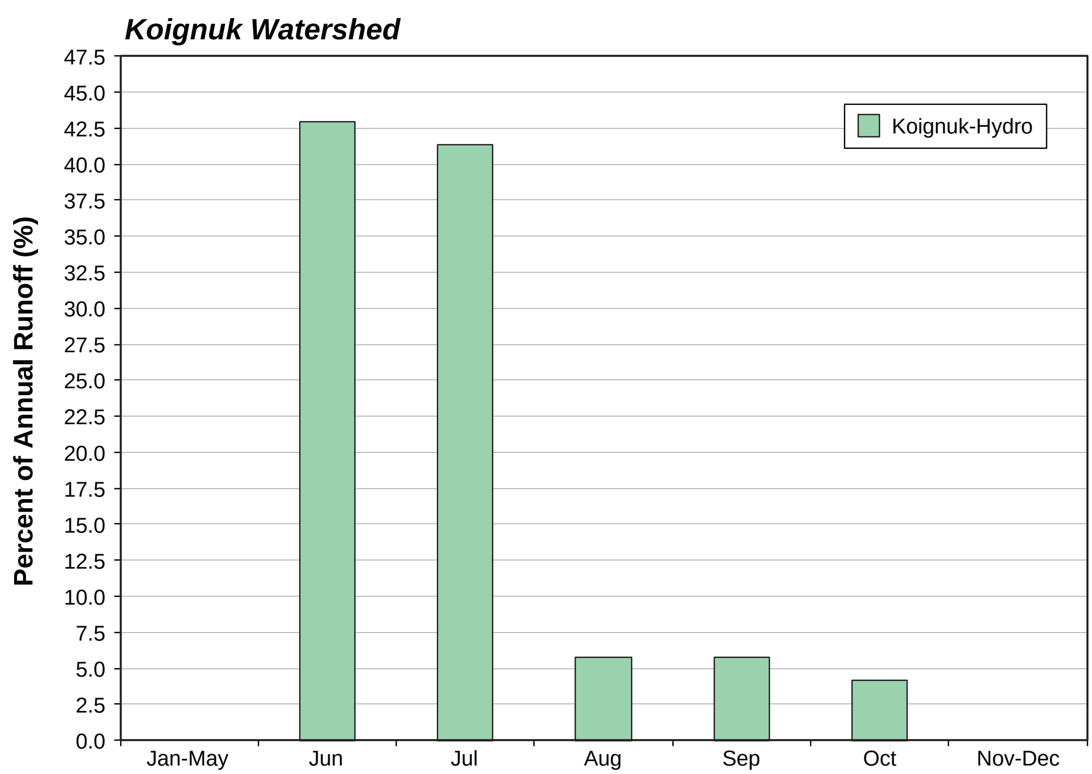
The observed low flows at the hydrometric stations in the northern part of the belt occurred in early September in most watersheds, except at Reference B-Hydro where they occurred in late September (Table 4.1-8). Low flows ranged from 0.084 m^3/s at PO-Hydro to 7.585 m^3/s at Koignuk-Hydro.

4.2 BOSTON AREA

4.2.1 Discharge Measurements

Two 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 30 measurements. The measurements were collected through the open water season in order to obtain a range of discharges at different flow conditions (Table 4.2-1 and Appendix B1).





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Monthly Runoff Distribution for 2011 for Watersheds in the Doris/Madrid Area

Figure 4.1-10

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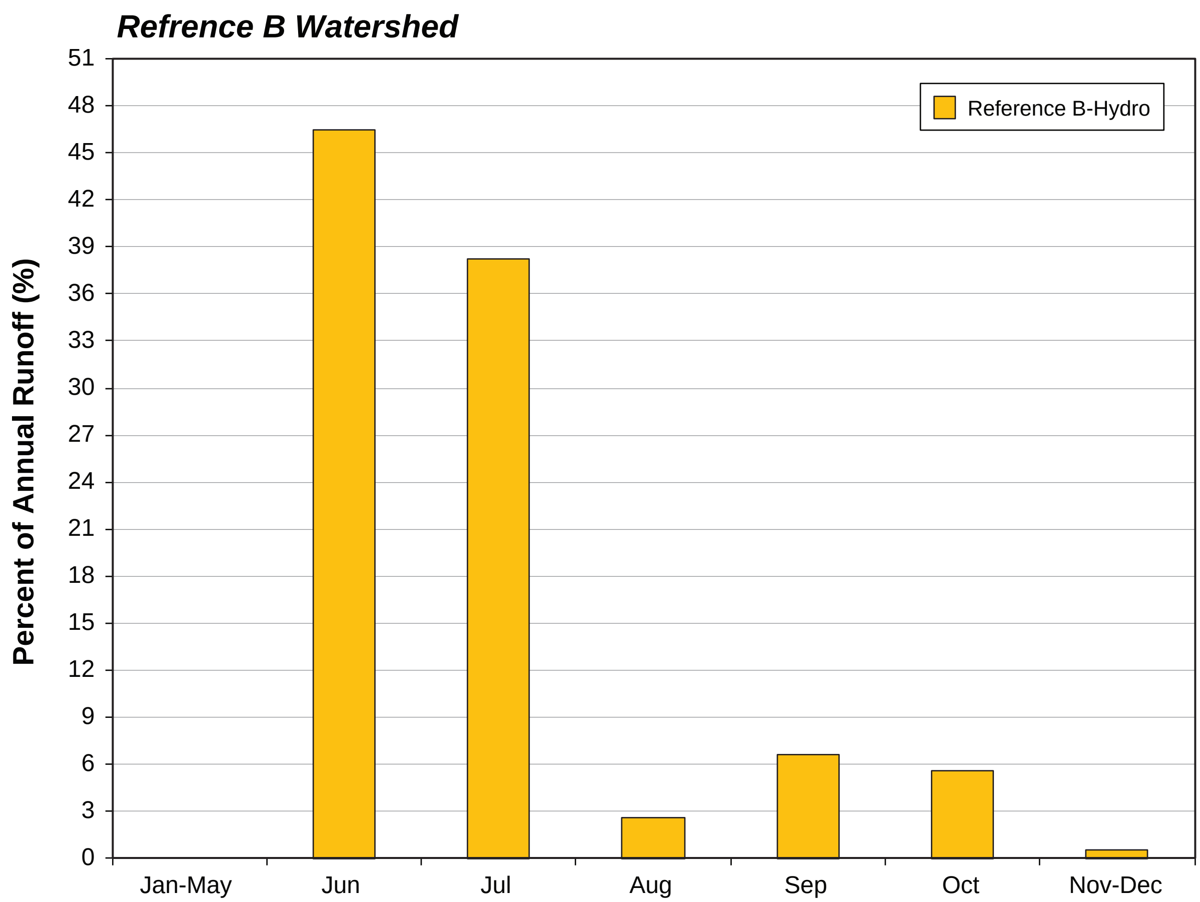


Figure 4.1-11

Monthly Runoff Distribution for 2011 for Watersheds in the Doris/Madrid Area

Table 4.1-7. 2011 Annual Peak Flow and Unit Yield in the Doris/Madrid Area

Hydrometric Station	Drainage Area (km^2)	Peak Flow (m^3/s)			Peak Unit Yield ($L/s/km^2$)	
		Instantaneous	Daily	Date	Instantaneous	Daily
Doris-Roberts Watersheds						
TL-2 Doris-Hydro	94.6	5.88	5.77	July 5	62.19	60.90
TL-3 Doris-Hydro	95.3	5.96 E	5.86	July 5	62.51 E	61.50 E
Ogama-Hydro	75	7.69 E	6.66	July 3	102.52 E	88.83
Patch-Hydro	32	2.88 E	2.51	July 4	89.91 E	78.43
PO-Hydro	68	10.44	9.03	June 14	153.47	132.77
Roberts-Hydro	97.9	7.47	7.34	July 3	76.35	75.00
Koignuk Watershed						
Koignuk-Hydro	2,937	299.50	226.44	June 23	101.98	77.10
Reference B Watershed						
Reference B-Hydro	159	19.51	16.36	June 19	122.72	102.88

E- estimated value.

Table 4.1-8. Daily Low Flows (July to September 2011) in the Doris/Madrid Area

Hydrometric Station	Daily Low Flow (m^3/s)	Date	Drainage Area (km^2)	% Lake Coverage In Watershed
Doris-Roberts Watersheds				
TL-2 Doris-Hydro	0.400	September 6	94.6	20
TL-3 Doris-Hydro	0.365	September 6	95.3	20
Ogama-Hydro	0.210	September 6	32	27
Patch-Hydro	0.134	September 6	68	19
PO-Hydro	0.084	September 6	98	17
Roberts-Hydro	0.116	September 3	97.9	17
Koignuk Watersheds				
Koignuk-Hydro	7.585	September 6	2,937	18
Reference B Watershed				
Reference B-Hydro	0.102	September 23	159	26

Note: Based on mean daily flows (m^3/s).

4.2.2 Lake Levels

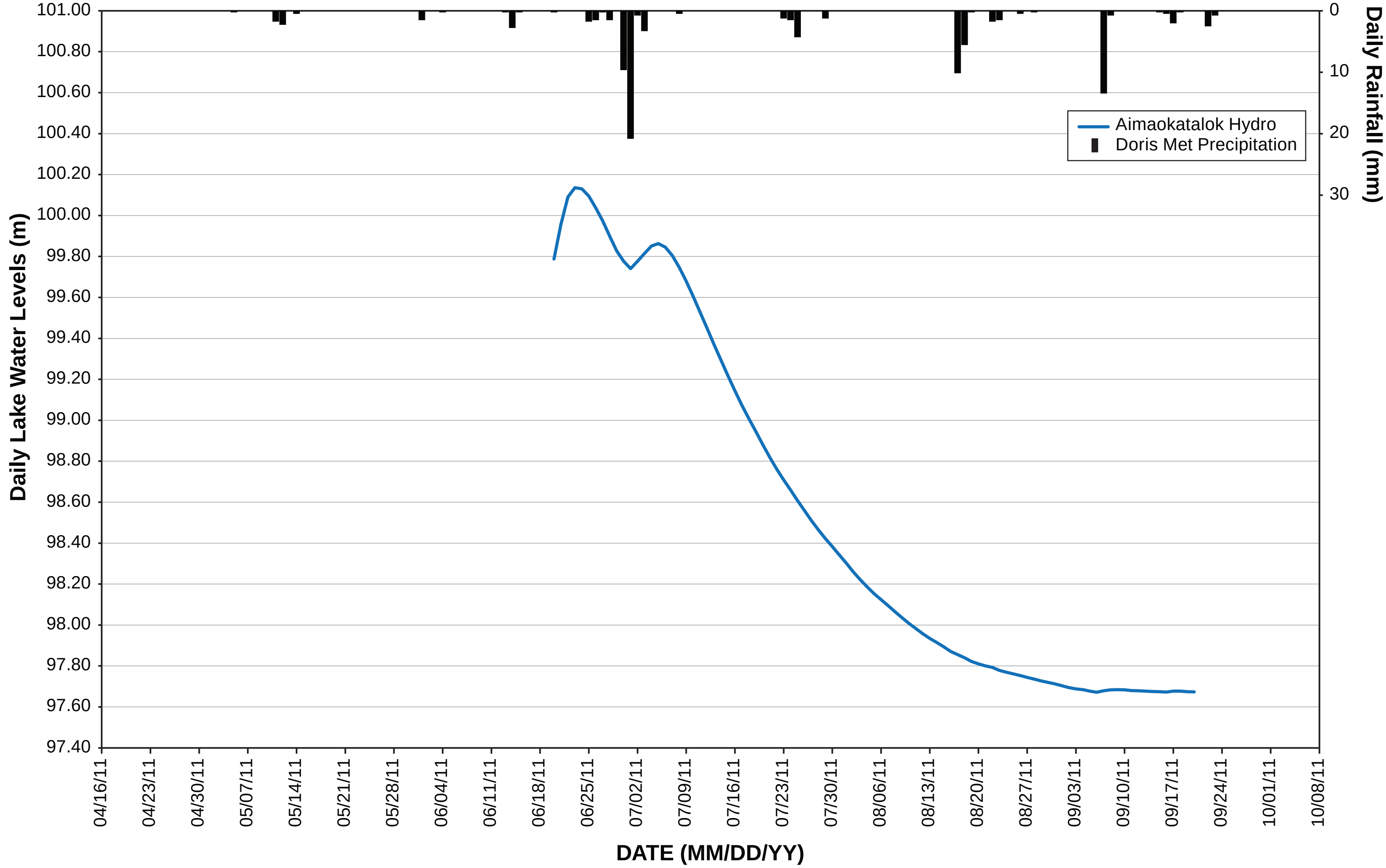
The estimated level variation for Aimaokatalok Lake was 2.46 m, ranging from a low of 97.67 m on September 6, 2011 to a high of 100.14 m on June 23, 2011 (Figure 4.2-1).

Lake water level variation for Doris Lake was 2.46 m, with two distinct high water levels recorded during the monitoring period (Figure 4.2-1). The first and highest water level occurred on June 23 and was 100.15 m; it was generated by the spring freshet. The second high recorded water level of 99.86 m occurred on July 5, and occurred when 35 mm of rain fell between June 30 and July 3. This event occurred prior to the full recession of the freshet event. After July 5, lake water levels declined at a steady rate and were not affected by rainfall events that occurred in late-August and early-September. The 2011 estimated mean daily lake levels are presented in tabular form in Appendix B2.

Table 4.2-1. Summary of 2011 Discharge Measurements in the Boston Area

Hydrometric Station and Drainage Area	Date Measured	Pressure Transducer Stage (m)[a]	Measured Discharge (m^3/s)	Method (Equipment Used)
Aimao Out-Hydro ($1,224\ km^2$)	June 16	98.318	13.5	Velocity-Area (ADCP)[b]
	June 20	99.710	65.0	Velocity-Area (ADCP)
	July 17	99.069	34.8	Velocity-Area (ADCP)
	August 24	97.771	4.72	Velocity-Area (ADCP)
	September 20	97.679	3.24	Velocity-Area (ADCP)
Aimao In-Hydro ($725\ km^2$)	June 14	99.564	24.7	Velocity-Area (ADCP)
	June 20	100.303	89.6 (E)	Velocity-Area (ADCP)
	July 18	99.069	7.77	Velocity-Area (Flo-Mate current meter)
	August 20	98.752	1.10	Velocity-Area (Flo-Mate current meter)
	September 19	98.578	1.29	Velocity-Area (Flo-Mate current meter)
East Aimao-Hydro ($363\ km^2$)	June 12	98.384	3.55	Velocity-Area (Flo-Mate current meter)
	June 20	98.919	51.43	Velocity-Area (ADCP)
	July 18	98.347	3.69	Velocity-Area (Flo-Mate current meter)
	August 21	98.169	0.53	Velocity-Area (Flo-Mate current meter)
	September 19	98.222	1.01	Velocity-Area (Flo-Mate current meter)
East Tailings-Hydro ($8\ km^2$)	June 12	99.658	0.28	Velocity-Area (Flo-Mate current meter)
	June 19	99.702	0.36	Velocity-Area (Flo-Mate current meter)
	July 19	99.470	0.0021	Velocity-Area (Flo-Mate current meter)
	August 22	99.454	0.0008	Velocity-Area (Flo-Mate current meter)
	September 19	99.491	0.019	Velocity-Area (Flo-Mate current meter)
Trout-Hydro ($27\ km^2$)	June 11	97.632	1.36	Velocity-Area (Flo-Mate current meter)
	June 19	97.791	2.13	Velocity-Area (Flo-Mate current meter)
	July 19	97.357	0.06	Velocity-Area (Flo-Mate current meter)
	August 20	97.322	0.01	Velocity-Area (Flo-Mate current meter)
	September 20	97.405	0.15	Velocity-Area (Flo-Mate current meter)
Stickleback-Hydro ($2.6\ km^2$)	June 19	97.524	0.112	Velocity-Area (Flo-Mate current meter)
	June 22	97.799	0.43	Velocity-Area (Flo-Mate current meter)
	July 19	97.357	0.034	Velocity-Area (Flo-Mate current meter)
	August 22	97.219	0.0012	Velocity-Area (Flo-Mate current meter)
	September 20	97.253	0.006	Velocity-Area (Flo-Mate current meter)

[a] *Pressure transducer stage referenced to site-specific arbitrary datum.*
[b] *Discharge measured with an acoustic Doppler current profiler.*
n/a - not applicable station was not active due to damage by floating ice.
E- estimated value.



Note: Lake water levels referenced to site-specific arbitrary datum.

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2011 Lake Water Levels at Aimaokatalok Lake

Figure 4.2-1

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4.2.3 Stage-discharge Relations

The work program for 2011 included the construction of the hydrometric monitoring stations and the completion of manual water velocity measurements and discharge calculations. Discharge measurements taken in 2010 and 2011 were used in the development of rating equations for the hydrometric stations in the Boston area. Rating equations are summarized in Table 4.2-2. The rating curves are provided in Appendix B3. The survey control points used at each of the hydrometric stations are provided in Appendix B4.

Table 4.2-2. Summary of 2011 Rating Equations for Hydrometric Stations in the Boston Area

Hydrometric Station	Rating Equation $Q = C\ (h\text{-}a)^b$
Aimao Out-Hydro	$Q = 8.86(h - 97.06)^{2.02}$
Aimao In-Hydro	$Q = 17.76(h - 98.39)^{2.48}$
East Aimao-Hydro	$Q = 52.01(h - 97.98)^{2.64}$
East Tailings-Hydro†	$Q = 8069.11(h - 99.41)^{2.45}$
Stickleback-Hydro	$Q = 1.18(h - 97.19)^{2.00}$
Trout-Hydro†	$Q = 7300.01\ (h - 97.82)^{1.86}$

Q= discharge [m^3/s]; C= constant; h= recorded stage [m];
a = stage at zero flow (datum correction) [m].
^{b} constant.
† this rating equation calculates discharge in L/s.

4.2.4 Annual Discharge Hydrographs

Hydrographs were generated for all six of the hydrometric stations that were monitoring stream water levels in the Boston area (for detailed hydrographs in tabular and graphical form refer to Appendix B4).

Annual hydrographs in the Boston area are presented as mean daily discharges (Figure 4.2-2) and as monthly volumetric outflow (Figure 4.2-3) for the open-water season.

The mean daily discharge hydrographs show that the onset of the spring freshet occurred in early June throughout the watersheds in the Boston area. Annual peak flows occurred in mid- to late-June in most watersheds. Peak flows in most watersheds resulted from inputs of water from melting snow (between June 13 and 23, 2011). All the watersheds in the Boston area exhibited an additional but lower peak in response to 39 mm of precipitation that fell between June 25 and July 3, 2011.

After the late-spring rain events, discharge steadily decreased throughout the Boston area until the early September rains. Freeze up was assumed to occur around November 10 for all stations except Aimao Out. During the winter of 2009-2010, the outlet channel at Aimao Out-Hydro remained open. The same condition was assumed for the 2010-2011 winter as well as for the 2011-2012 winter. As a result, a freeze-up date was not considered at this site.

4.2.4.1 Monthly Volumetric Outflow

The monthly and total annual volumetric water outflows for each of the drainages in the Boston area are presented in Table 4.2-3 and Figure 4.2-3. Outflows from each of the monitored drainages were generally found to be a function of drainage area. The minimum outflow was observed at Stickleback-Hydro (drainage area = 2.6 km^2) which had a total annual water output of 0.51×10^6 m^3. The maximum outflow was 265.02×10^6 m^3 over the year at Aimao Out-Hydro (drainage area = 1,224 km^2).

PROJECT # 1009-008-04 ILLUSTRATION # a34508w December 23, 2011

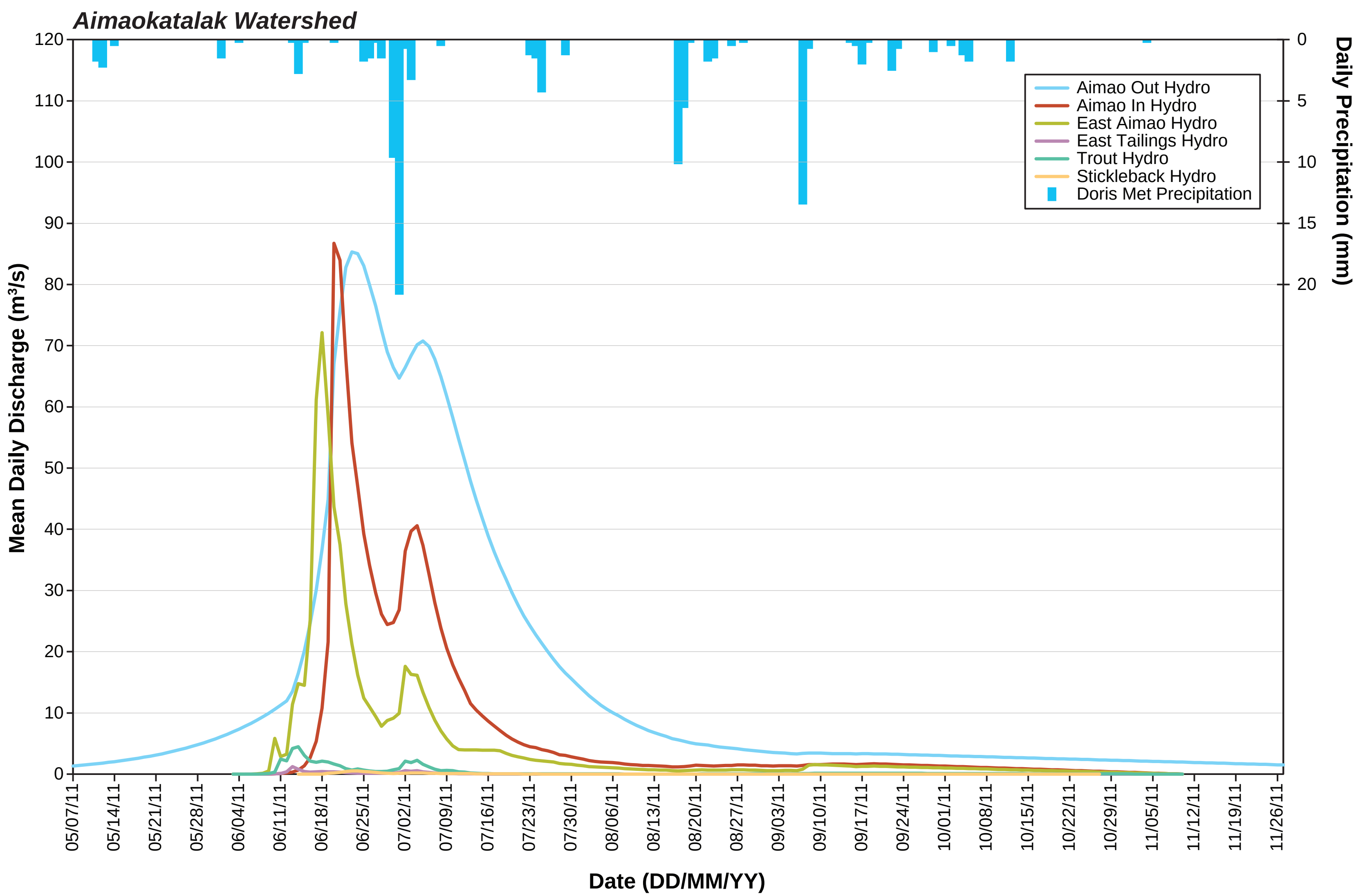

Figure 4.2-2

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2011 Annual Discharge Hydrographs in the Boston Area

Figure 4.2-2

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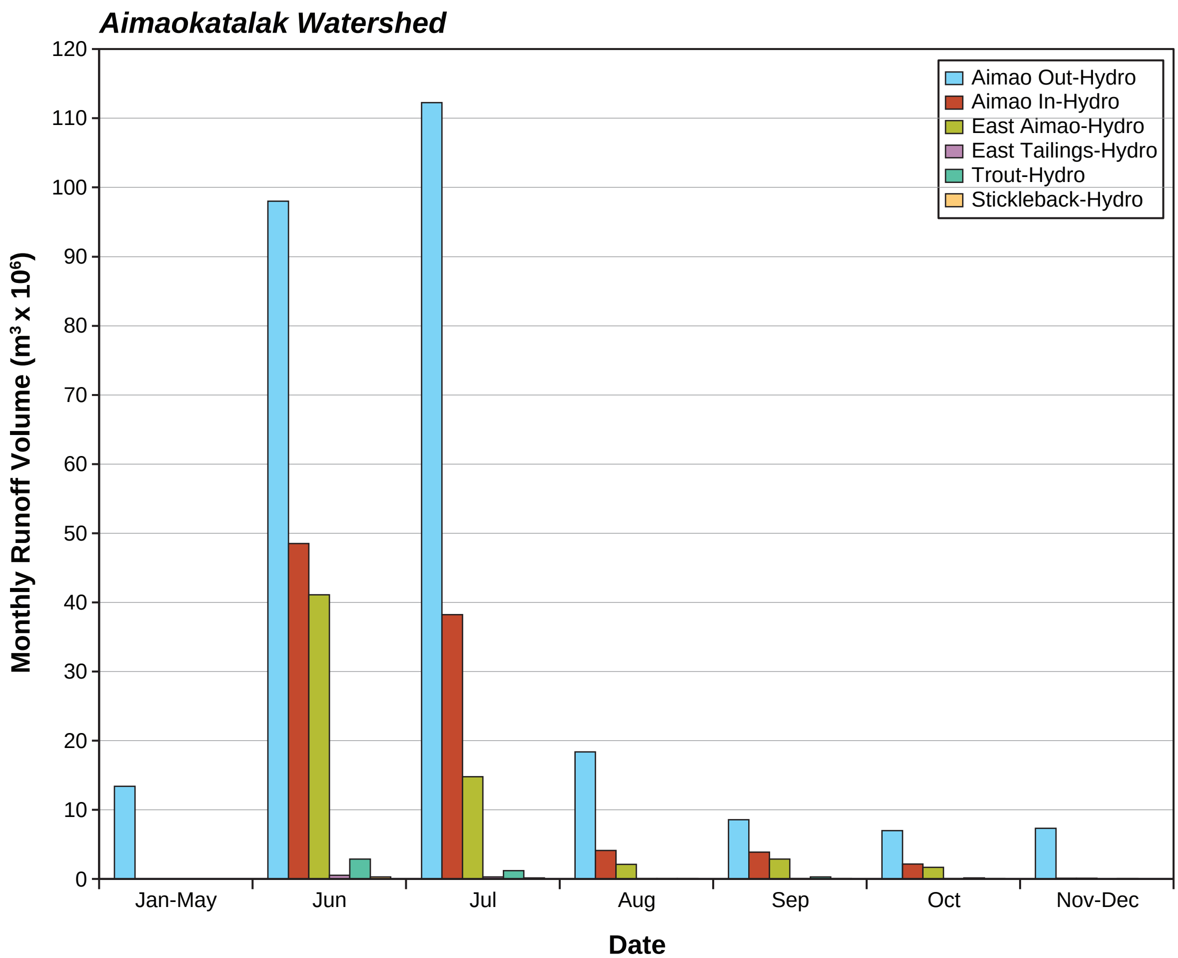


Figure 4.2-3

2011 Monthly Volumetric Outflow in the Boston Area

Table 4.2-3. Monthly Volumetric Outflows in the Boston Area (× 10^6 m^3)

Hydrometric Station	Jan - May	Jun	Jul	Aug	Sep	Oct	Nov - Dec	Total
Aimao Out-Hydro	13.41	98.03	112.25	18.39	8.58	7.01	7.36	265.02
Aimao In-Hydro	0.00	48.49	38.22	4.11	3.90	2.17	0.13	97.02
East Aimao-Hydro	0.00	55.99	15.24	1.96	2.70	1.56	0.09	77.54
East Tailings-Hydro	0.00	0.569	0.292	<0.01	0.029	<0.01	0.00	0.901
Trout-Hydro	<0.01	2.905	1.23	0.079	0.296	0.178	0.01	4.70
Stickleback-Hydro	0.00	0.31	0.19	0.01	0.01	0.00	0.00	0.51

4.2.5 Hydrologic Indices

4.2.5.1 Calculated Annual Runoff

In 2011, the calculated average runoff from gauged watersheds in the Boston area was 146 mm, ranging from a low of 109 mm at East Tailings-Hydro, to a high of 194 mm at Stickleback -Hydro. The estimated average runoff for the open-water season from gauged watersheds in the Boston area was 158 mm, ranging from 113 mm to 206 mm at East Tailings-Hydro and Aimao Out-Hydro, respectively. The differences between the estimated annual runoff values for the Aimao In-Hydro and Aimao Out-Hydro hydrometric stations, was that no freeze up was assumed for the Aimao Out station. Thus runoff was assumed to occur over a longer period (Table 4.2-4).

Table 4.2-4. 2011 Annual Runoff and Mean Annual Discharge in the Boston Area

Hydrometric Station	Drainage Area (km^2)	Percent lake coverage in watershed	Calculated Runoff (mm)	Estimated Annual Runoff (mm)	Mean Annual Discharge (m^3/s)
Aimao Out-Hydro	1,224	22	171 (June 20 to September 20)	206	7.98
Aimao In-Hydro	725	21	124 (June 20 to September 19)	134	7.32
East Aimao-Hydro	363	15	165 (June 10 to September 19)	172	4.74
East Tailings-Hydro	8	7	109 (June 12 to September 19)	113	0.070
Trout-Hydro	31.9	7	137 (June 11 to September 20)	147	0.36
Stickleback-Hydro	2.6	41	194 (June 19 to September 20)	197	0.044
Mean			*146*	*158*	

MAD was calculated using mean daily discharge values from June to October at the East Aimao-Hydro and East-Tail-Hydro hydrometric stations, and from January to December for the Aimao Out-Hydro hydrometric station. Calculated MAD ranged from 0.044 m^3/s to 7.98 m^3/s at the Stickleback-Hydro and Aimao Out-Hydro hydrometric stations, respectively (Table 4.2-4).

4.2.5.2 Monthly Runoff Distribution

The maximum monthly runoff occurred during June for most of the basins in the Boston area. The exception was Aimao Out-Hydro where the maximum occurred in early July. In 2010, 80% of the annual runoff occurred during June in these basins. However, with the summer rain event in 2011 the majority of the annual runoff occurred in June and July. The Aimao Out-Hydro hydrometric station was the only station to have July as the greater month. This suggests that Aimaokatalok Lake played a significant storage role for both the snow melt and precipitation driven flow events (Table 4.2-5, Figure 4.2-4).

Table 4.2-5. 2011 Monthly Runoff Distribution (mm) in the Boston Area

Hydrometric Station	Jan-May	Jun	Jul	Aug	Sep	Oct	Nov-Dec
Aimao Out-Hydro	10	*80*	92	15	*7*	*6*	*6*
Aimao In-Hydro	0	*67*	53	6	*5*	*3*	*0*
East Aimao-Hydro	0	*113*	41	6	*8*	*5*	0
East Tailings-Hydro	0	*71*	37	0.4	*4*	*1*	0
Trout-Hydro	0	*91*	39	2	*9*	*6*	0
Stickleback-Hydro	0	*119*	72	3	*2*	*2*	0

Note: Italicized values are based on estimated mean daily discharge data.

4.2.5.3 Peak and Low Flows

The observed instantaneous peak flows for the basins in the Boston Area occurred in mid- to late-June and ranged from 0.51 m^3/s at Stickleback-Hydro to 95.41 m^3/s at Aimao In-Hydro (Table 4.2-6). It should be noted that the estimated value for East Aimao-Hydro is beyond the measured discharges and thus should be treated with caution. Instantaneous peak unit yields ranged from 70.24 $L/s/km^2$ at Aimao Out-Hydro to 297.54 $L/s/km^2$ at East Tailings-Hydro (Figure 4.2-3).

Table 4.2-6. 2011 Annual Peak Flow and Unit Yield in the Boston Area

Station Name	Drainage Area (km^2)	Peak Flow (m^3/s)			Peak Unit Yield ($L/s/km^2$)	
		Instantaneous	Daily	Date	Instantaneous	Daily
Aimao Out-Hydro	1,224	85.98	85.31	June 23	70.24	69.69
Aimao In-Hydro	725	95.41	86.72	June 20	131.59	119.61
East Aimao-Hydro	363	93.51 E	72.13 E	June 18	257.59 E	189.70 E
East Tailings-Hydro	8	2.38	1.23	June 13	297.54	153.91
Trout-Hydro	31.9	6.19	4.78	June 14	194.07	140.36
Stickleback-Hydro	2.6	0.51	0.50	June 23	196.20	193.14

E = estimated values.

The observed low flows at the hydrometric stations located within the Boston area occurred in mid-August in most watersheds. The exception were the stations Aimao Out-Hydro and Stickleback-Hydro station where the peak flows occurred in early-September (Table 4.2-7). Minimum flows ranged from below 0.01 m^3/s at the stations East Tailings-Hydro, Trout-Hydro, and Stickleback stations, to 3.29 m^3/s at Aimao Out-Hydro.

Table 4.2-7. Daily Minimum Flows (July to September 2011) in the Boston Area

Station	Daily Minimum Flow		Date	Drainage Area (km^2)
	(m^3/s)	(l/s)		
Aimao Out-Hydro	3.29	3290	September 6	1,224
Aimao In-Hydro	1.17	1170	August 17	725
East Aimao-Hydro	0.539	539	August 17	363
East Tailings-Hydro	<0.01	0.00175	August 16	8
Trout-Hydro	<0.01	3.52	August 16	31.9
Stickleback-Hydro	<0.01	0.427	September 2	2.6

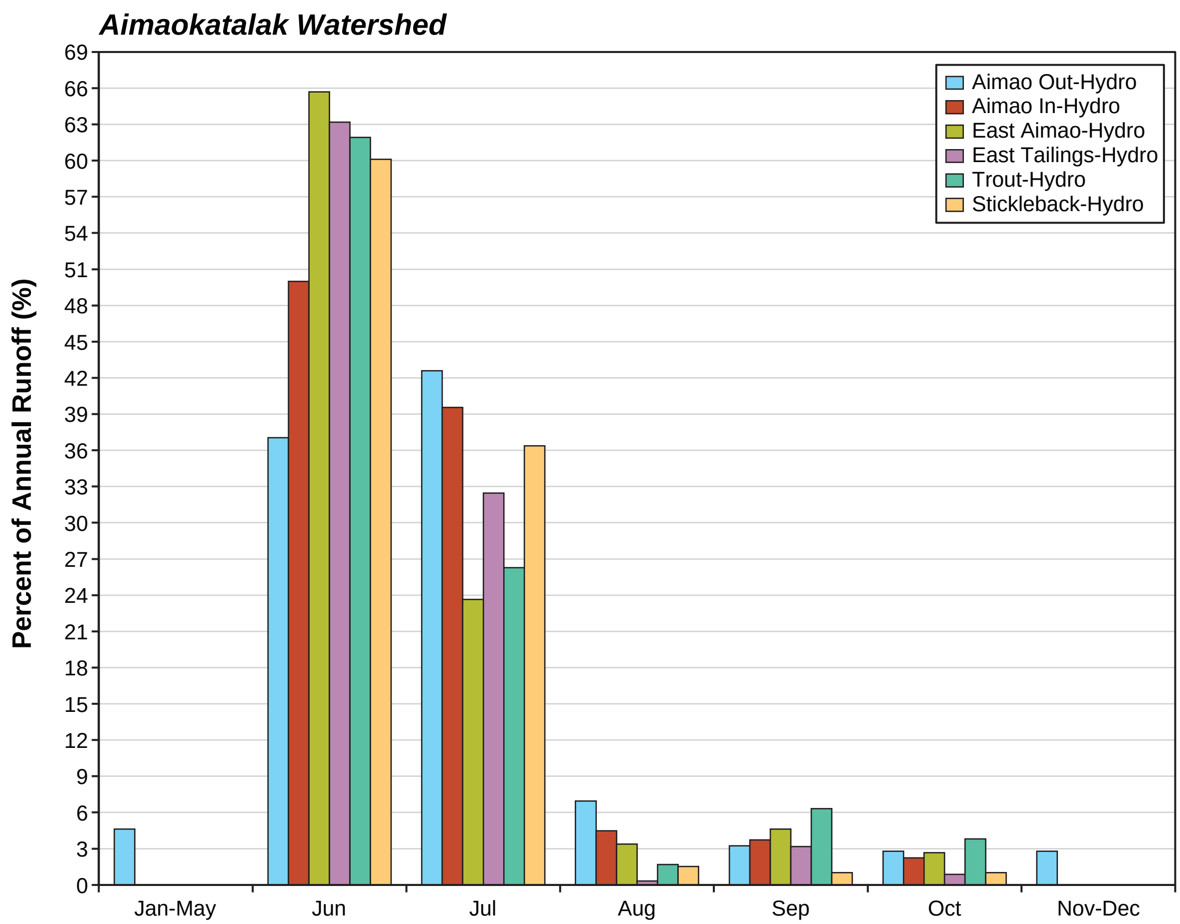


Figure 4.2-4

Monthly Runoff Distribution for 2011 in the Boston Area

5. Discussion

5. Discussion

5.1 GENERAL CLIMATIC CONDITIONS OF THE STUDY AREA

According to the Climate Trends and Variations Bulletin (Environment Canada 2011), the Hope Bay Project is located within the Arctic Tundra climate region of Canada. General climatic conditions for the region in 2011 can be summarized as follows:

- The winter (December, January, and February) of 2010/2011 was 4.6°C above the normal for the region and was the second warmest winter on record (1948-2011).
- The 2010/2011 winter was considered wetter than a normal year, having a departure from the mean of 13.6% (rank 26/64). It is important to note that the last two winters were also wetter than normal having departures from the mean of 16.1% (2010) and 15.9% (2009) respectively.
- Temperatures during the spring (March, April, and May) of 2011 were 0.3°C above the normal. Precipitation was drier than the normal and showed a departure from the mean of -35% (rank 60/64).

5.2 COMPARISON OF 2011 DATA TO HISTORICAL SITE DATA

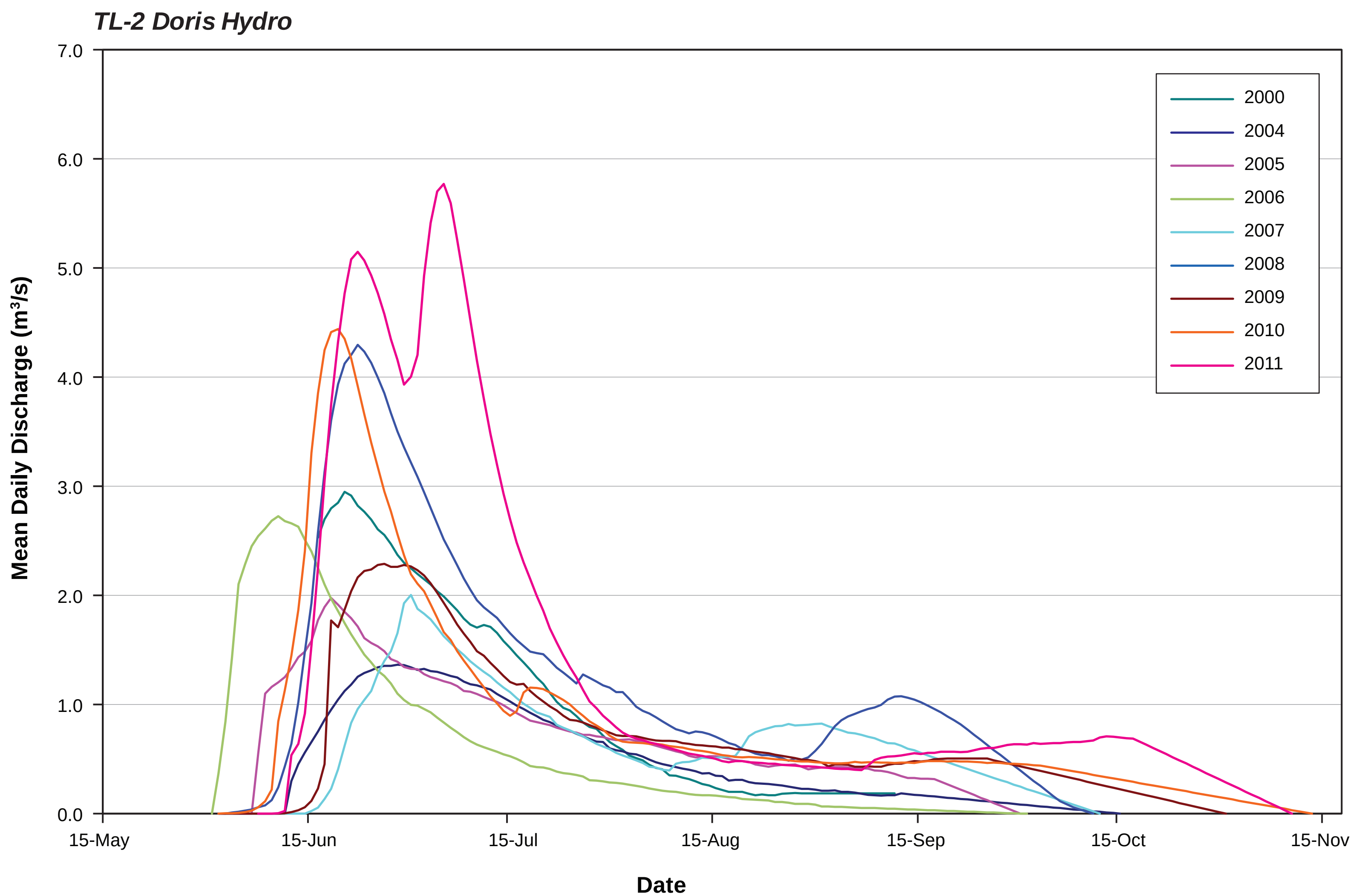
In summary, 2011 was considered as a year with winter conditions that were warmer and wetter than normal, and spring conditions that were almost normal but drier. These conditions were partially reflected in the hydrologic response of the drainage basins located in the Hope Bay Belt Project area. The large early summer rain event was the dominant climatic anomaly for the year.

Figures 5.2-1 to 5.2-12 show the 2011 hydrographs for site-specific hydrometric stations along with the available historical data. In most basins in the Doris/Madrid area, the flows during 2011 equalled or exceeded the flows registered during 2010, which was previously the year that produced the flow of record at most stations. In the Boston area, flow conditions were above average, but below the 2008 hydrograph which produced the flow of record at sites located in this area.

5.3 COMPARISON OF RESULTS BETWEEN THE DORIS/MADRID AND BOSTON AREAS

Geographically, the Doris/Madrid and Boston study areas are approximately 60 km apart. The results obtained in 2011 show that hydrologic conditions in the two areas are similar. Observed runoff patterns are consistent with hydrologic conditions of the Arctic-nival regime. Seasonal peak flows are caused by snowmelt. Freshet high flows are followed by rapid recession to base flow, which is occasionally punctuated by rainstorm-generated peaks (Woo 1990). The timing of the freshet was similar in the Doris/Madrid and Boston areas with flow beginning in the first week of June peaking approximately two weeks after streams began to flow, between June 10 and 19.

Further, basins in the Doris/Madrid and Boston areas produced relatively similar amounts of runoff in 2011. Mean calculated runoff values were 162 mm for the Doris/Madrid area and 147 mm for the Boston area. Values of mean estimated annual runoff for 2011 were also in close agreement.



Doris/Madrid Historical Hydrographs

Figure 5.2-1

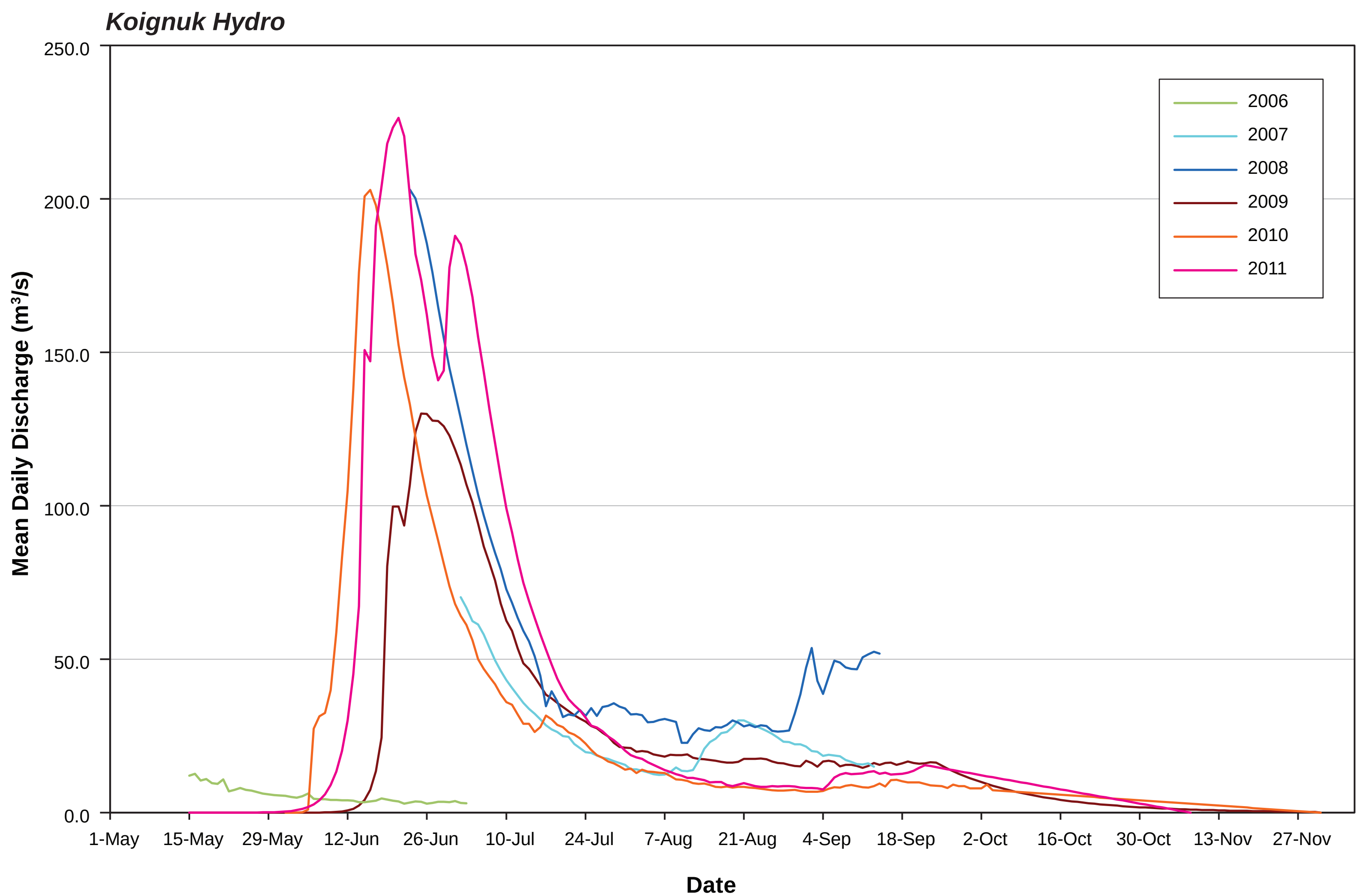


Figure 5.2-2

Doris/Madrid Historical Hydrographs

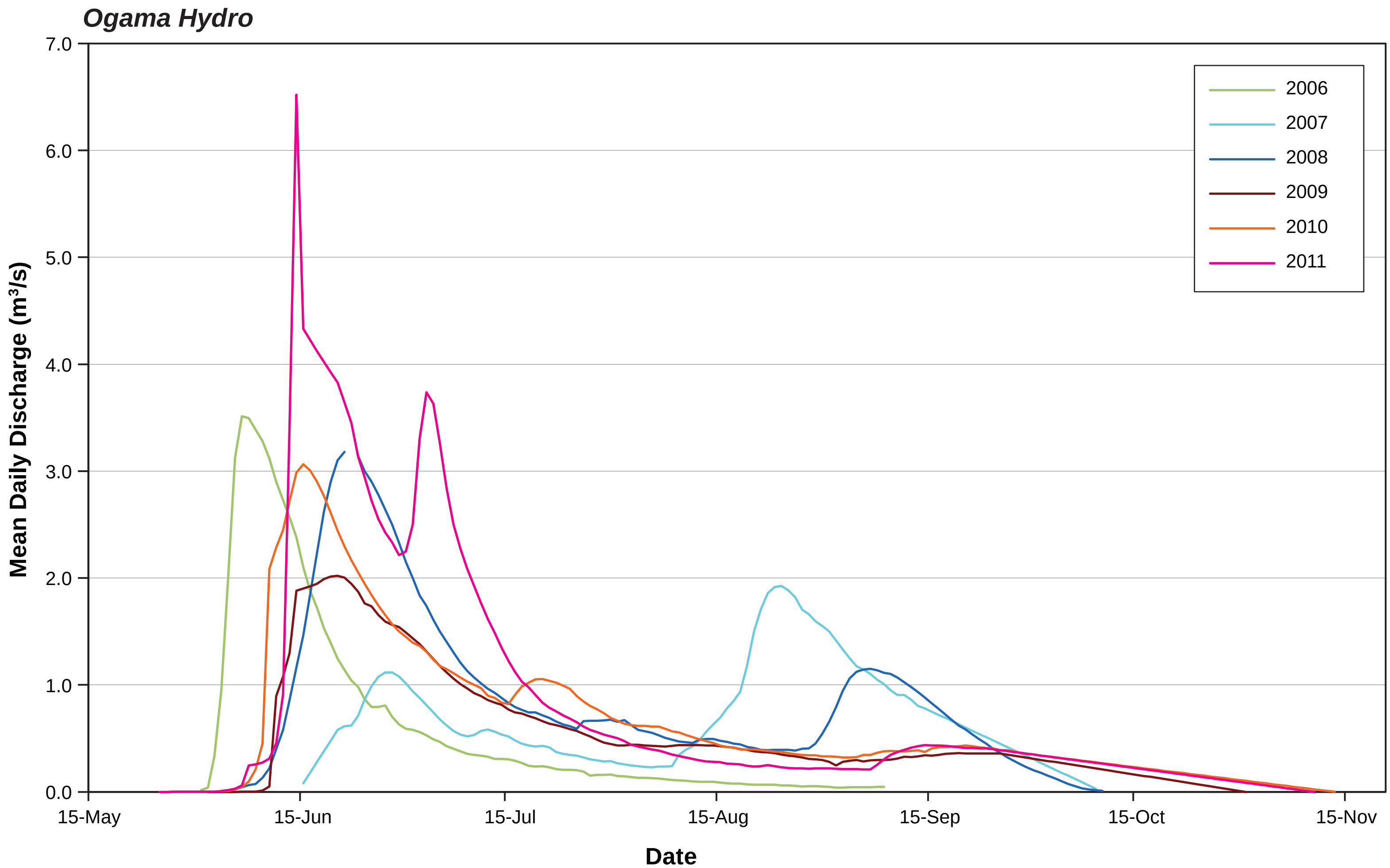


Figure 5.2-3

Doris/Madrid Historical Hydrographs

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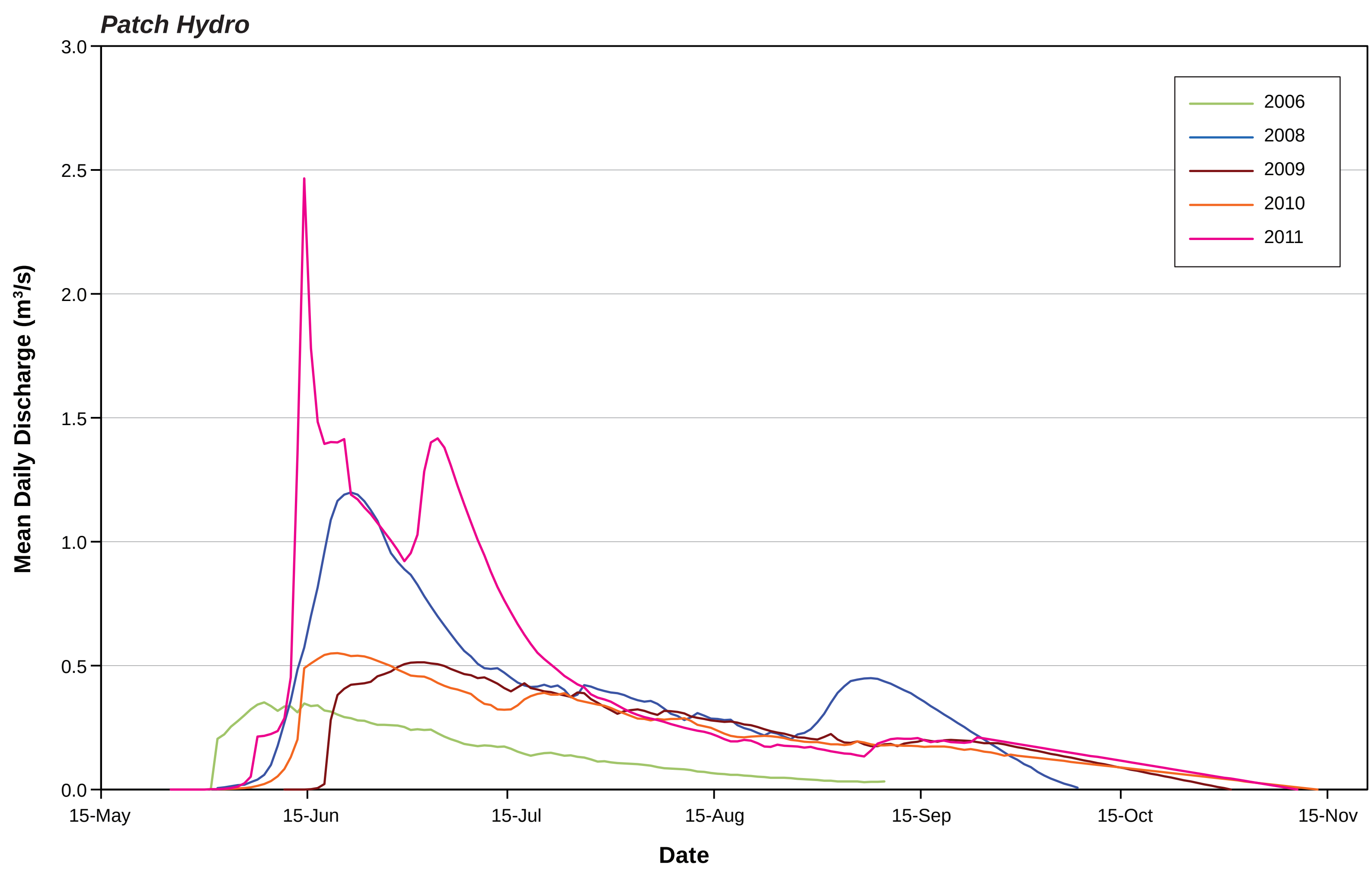
Figure 5.2-3



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Doris/Madrid Historical Hydrographs

Figure 5.2-4

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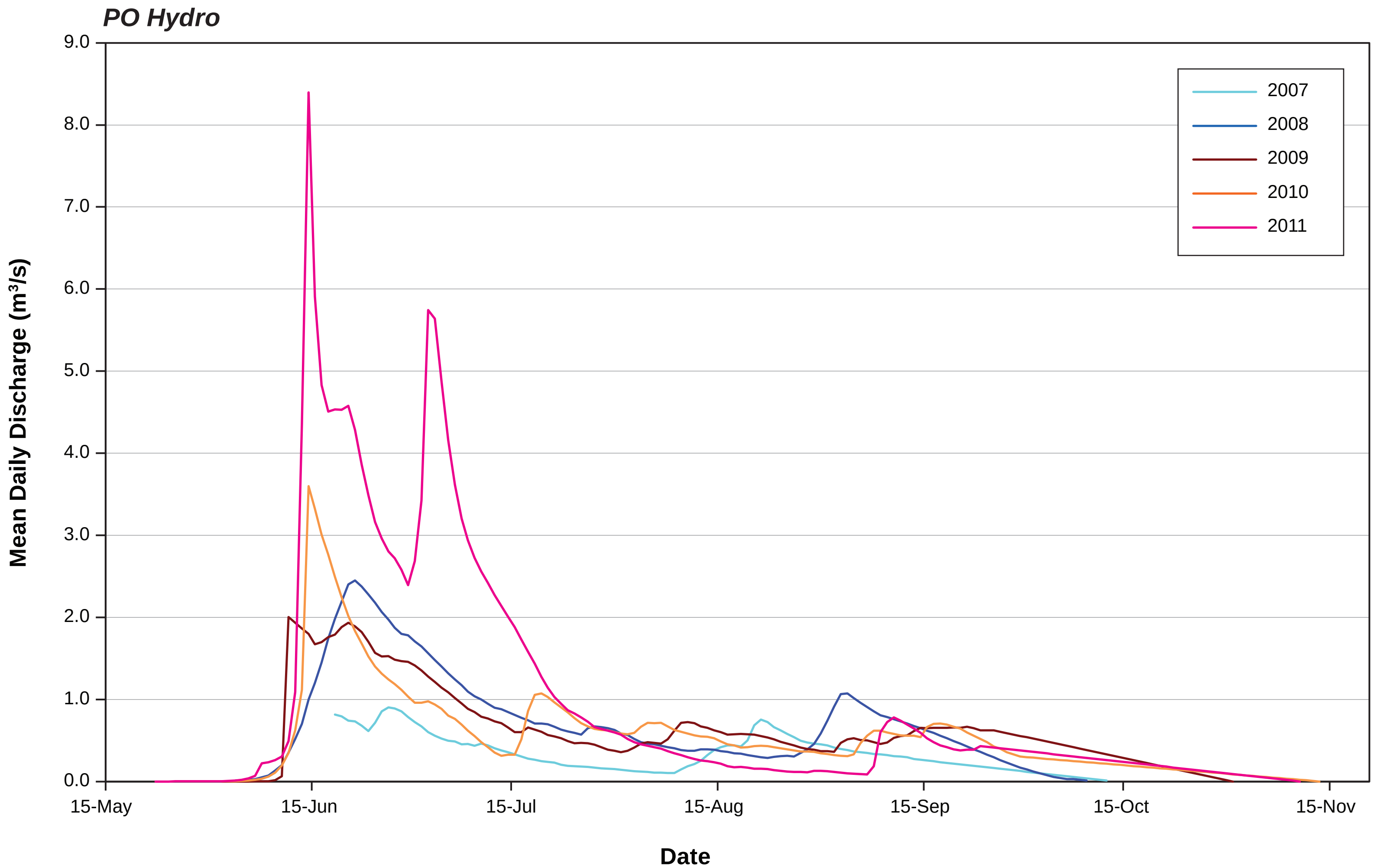

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Doris/Madrid Historical Hydrographs

Figure 5.2-5

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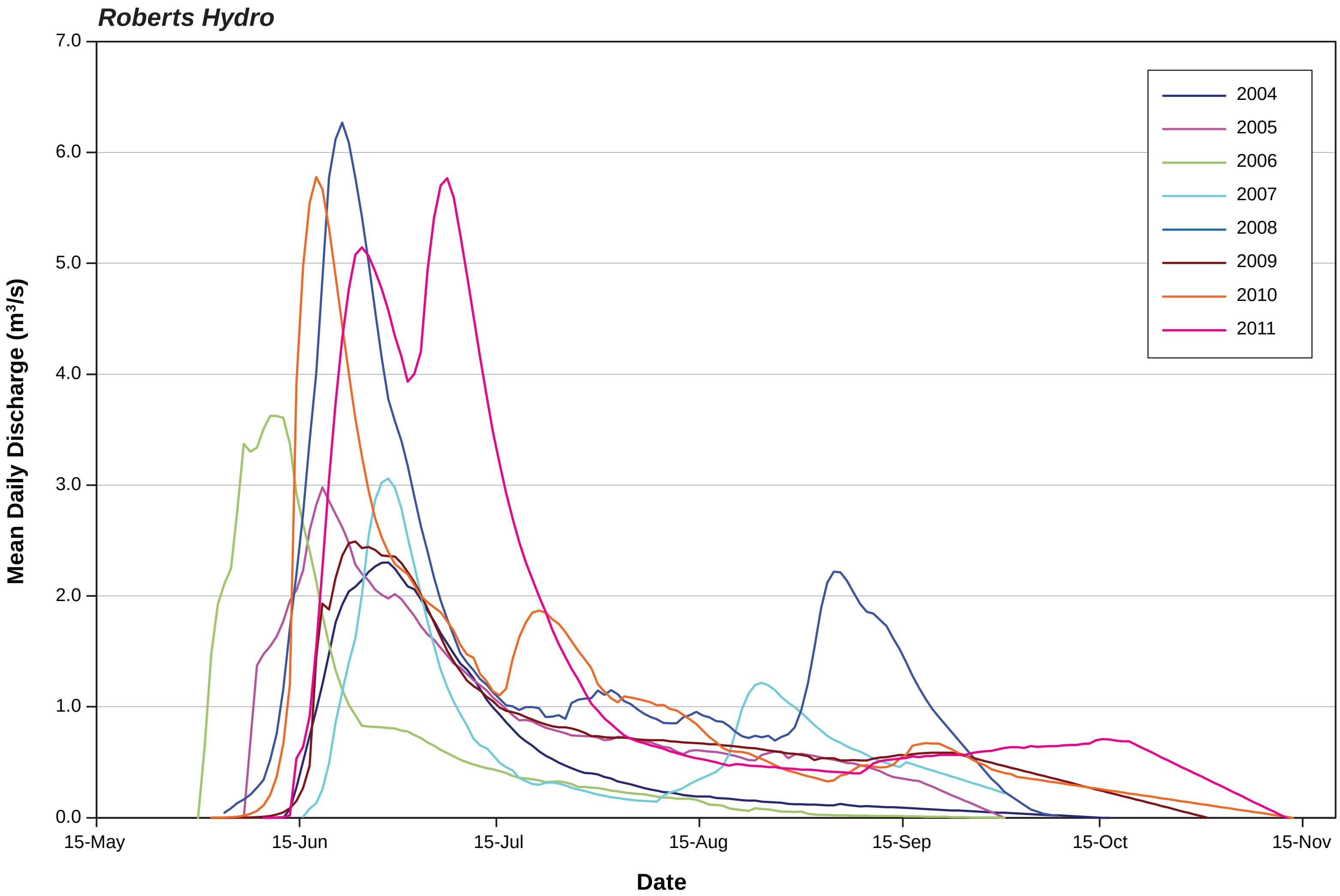
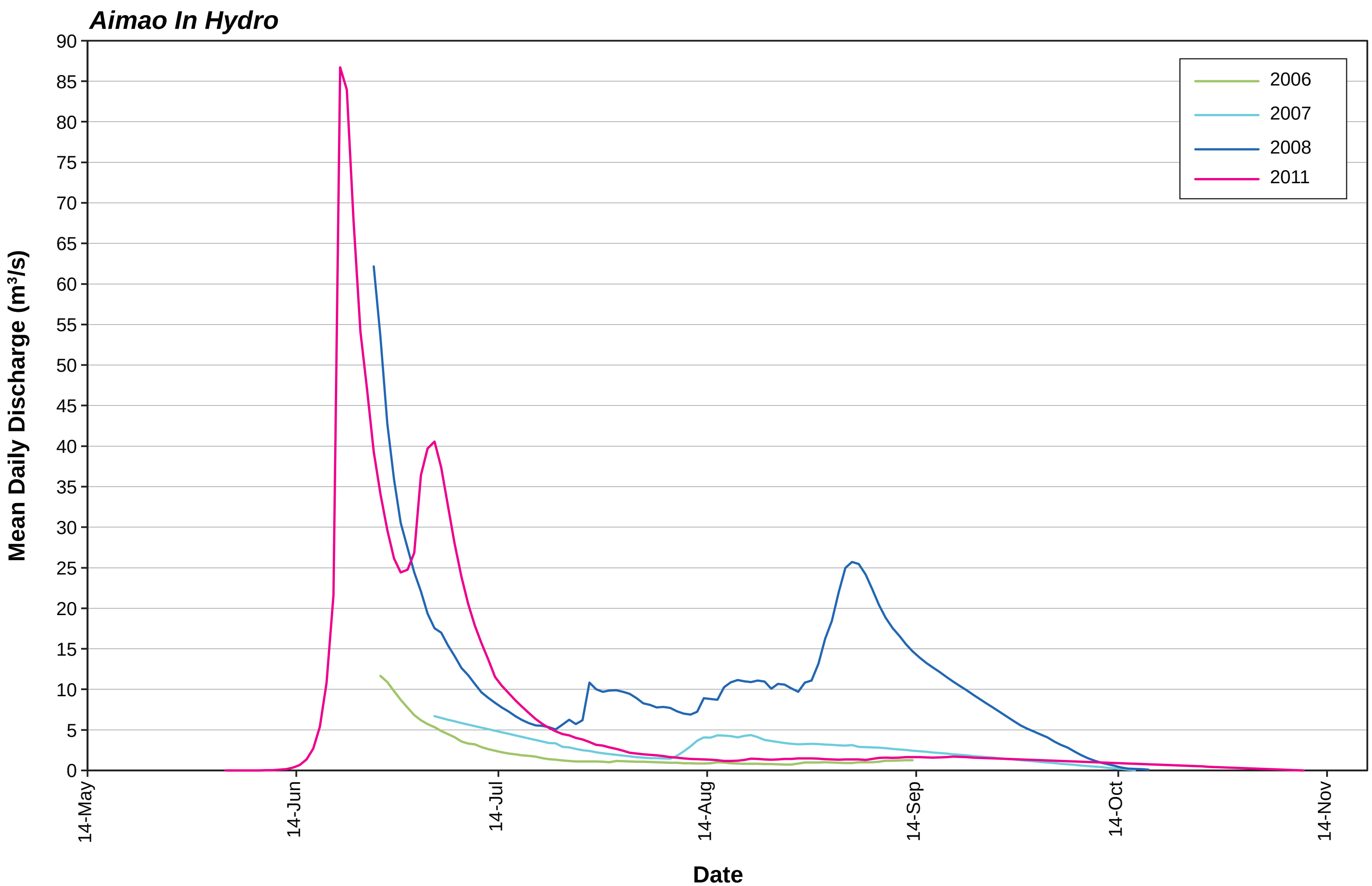


Figure 5.2-6

Doris/Madrid Historical Hydrographs



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Boston Historical Hydrographs

Figure 5.2-7

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PROJECT # 1009-008-04 ILLUSTRATION # a34441n December 21, 2011

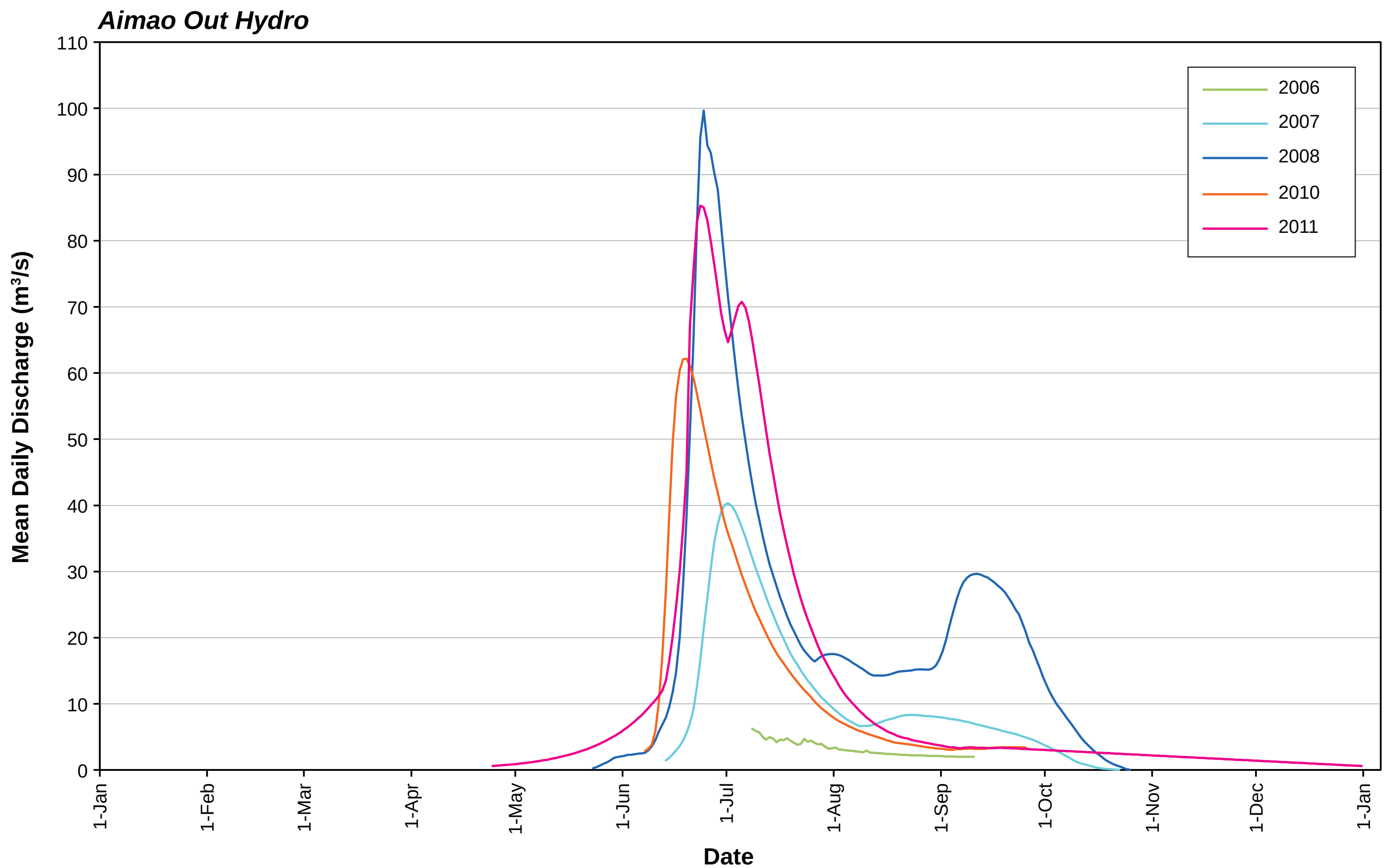

Figure 5.2-8

Boston Historical Hydrographs

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Figure 5.2-8

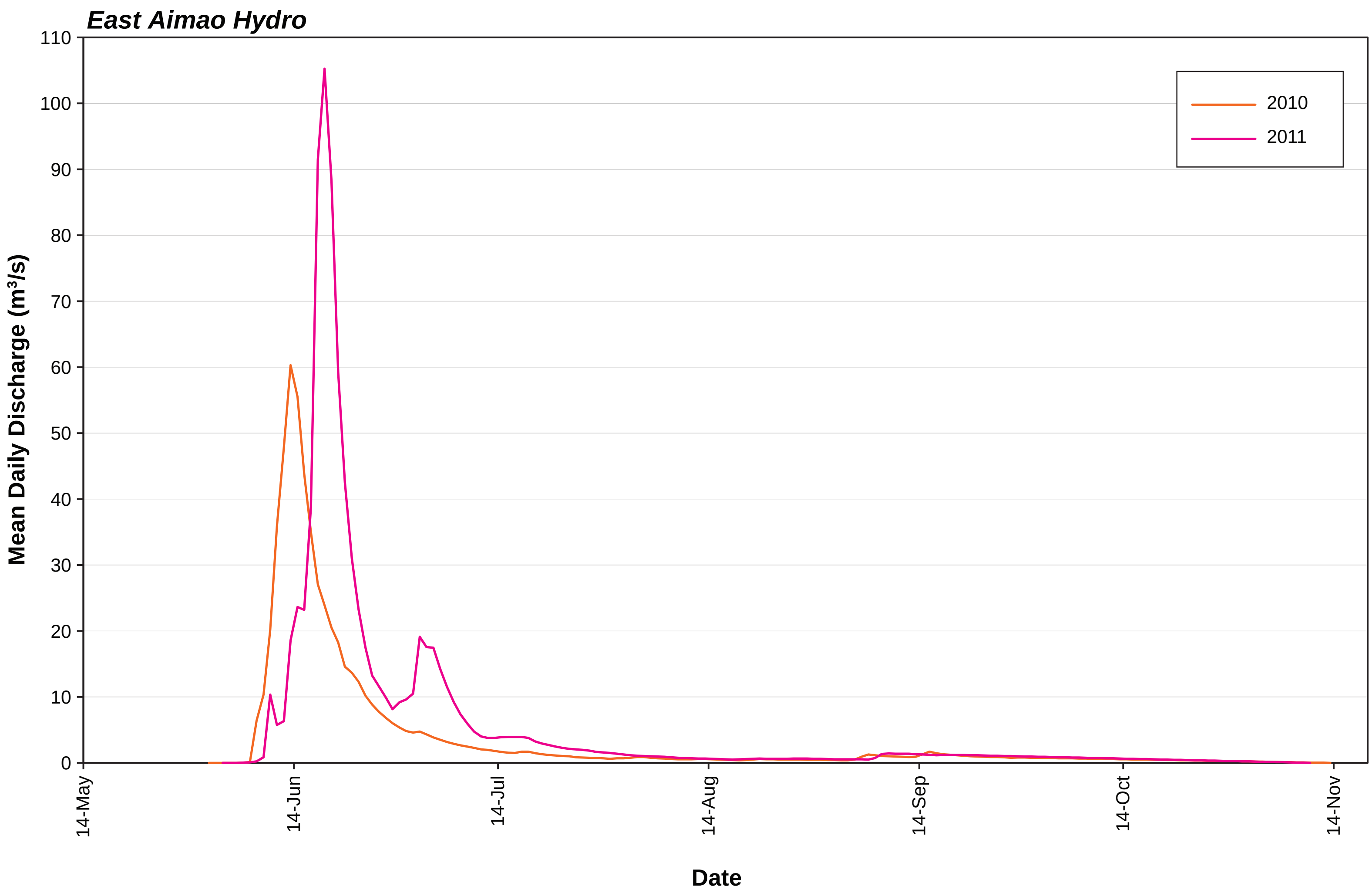

Figure 5.2-9

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Boston Historical Hydrographs

Figure 5.2-9

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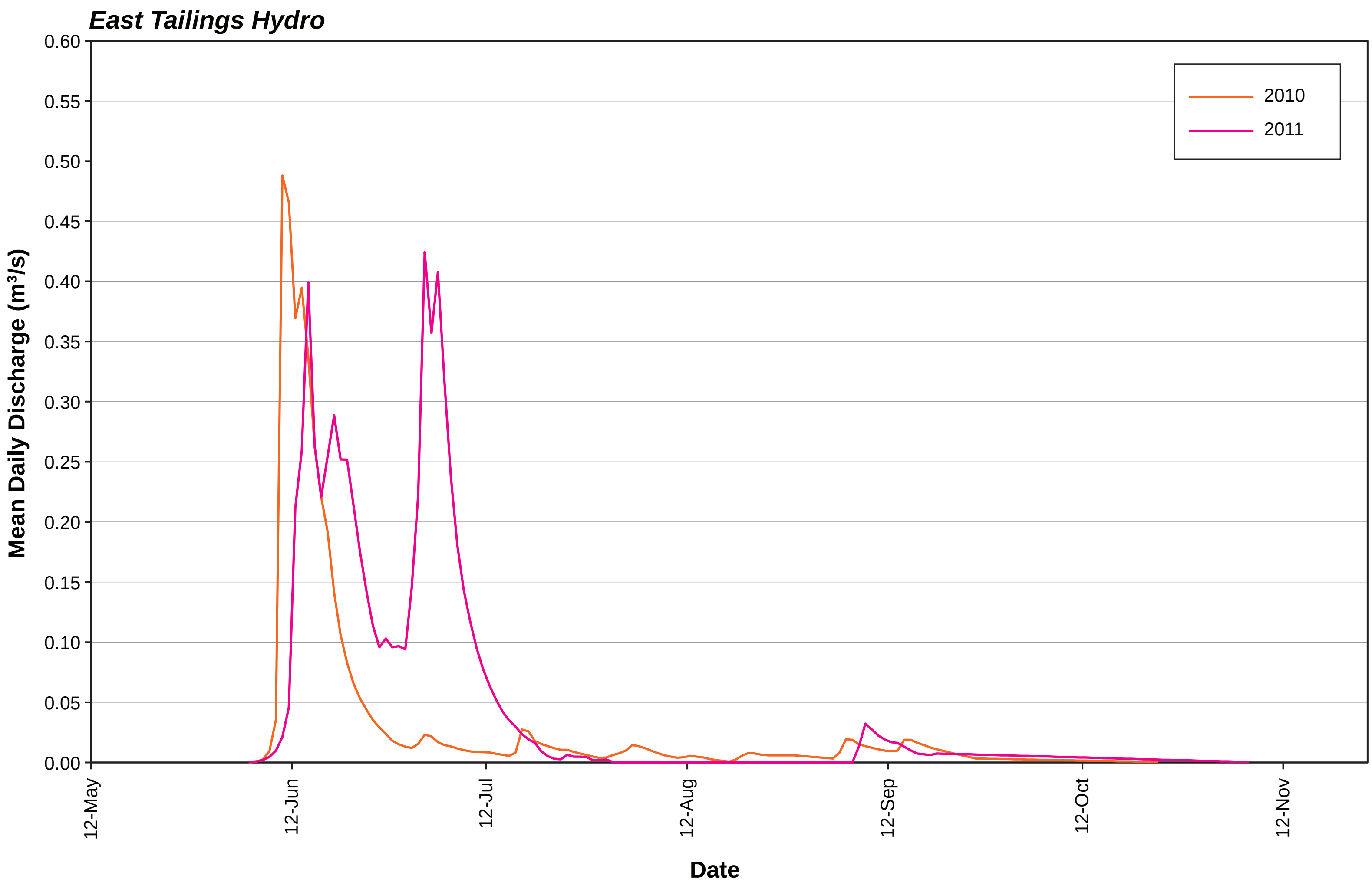

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Boston Historical Hydrographs

Figure 5.2-10

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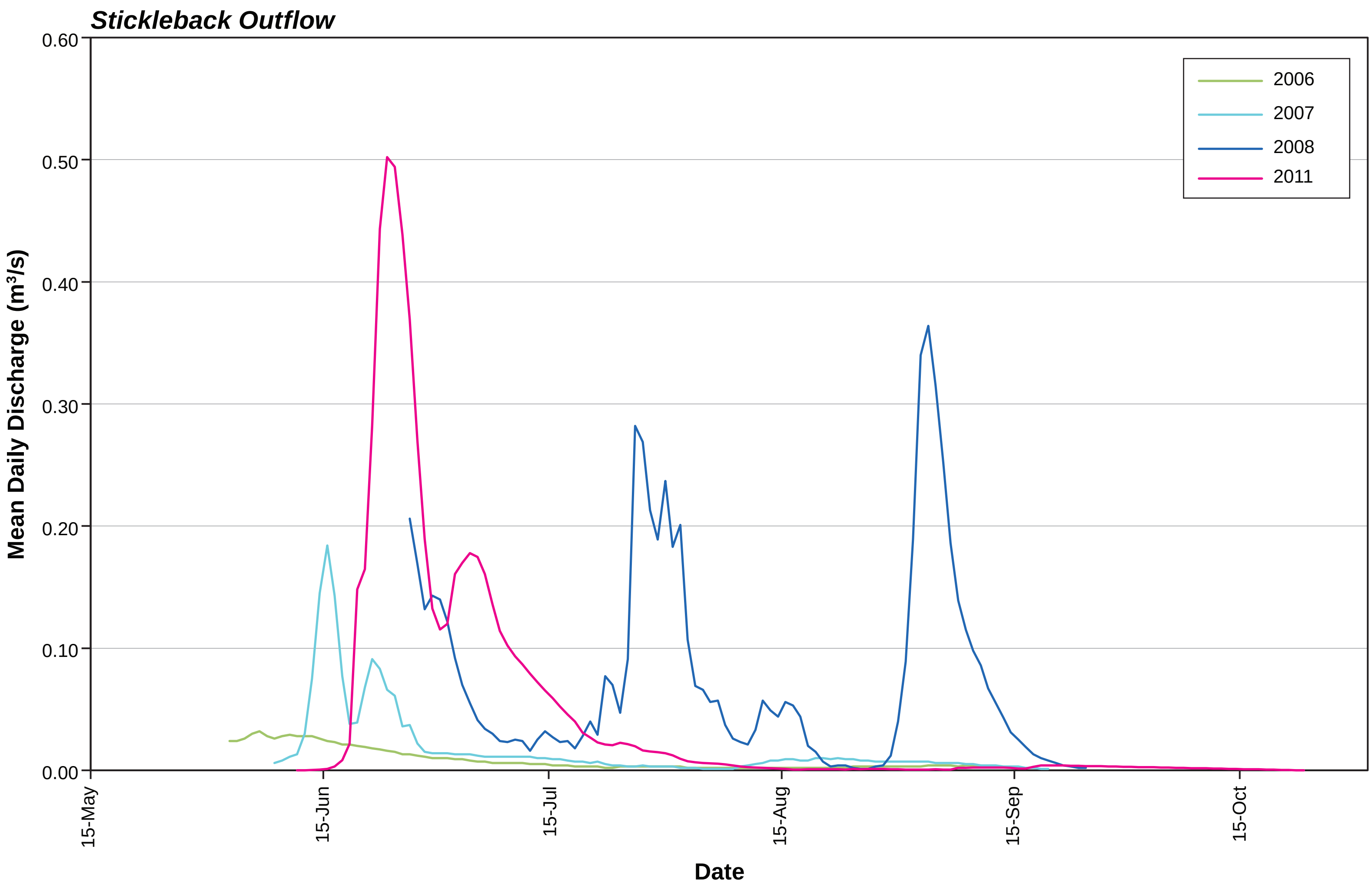
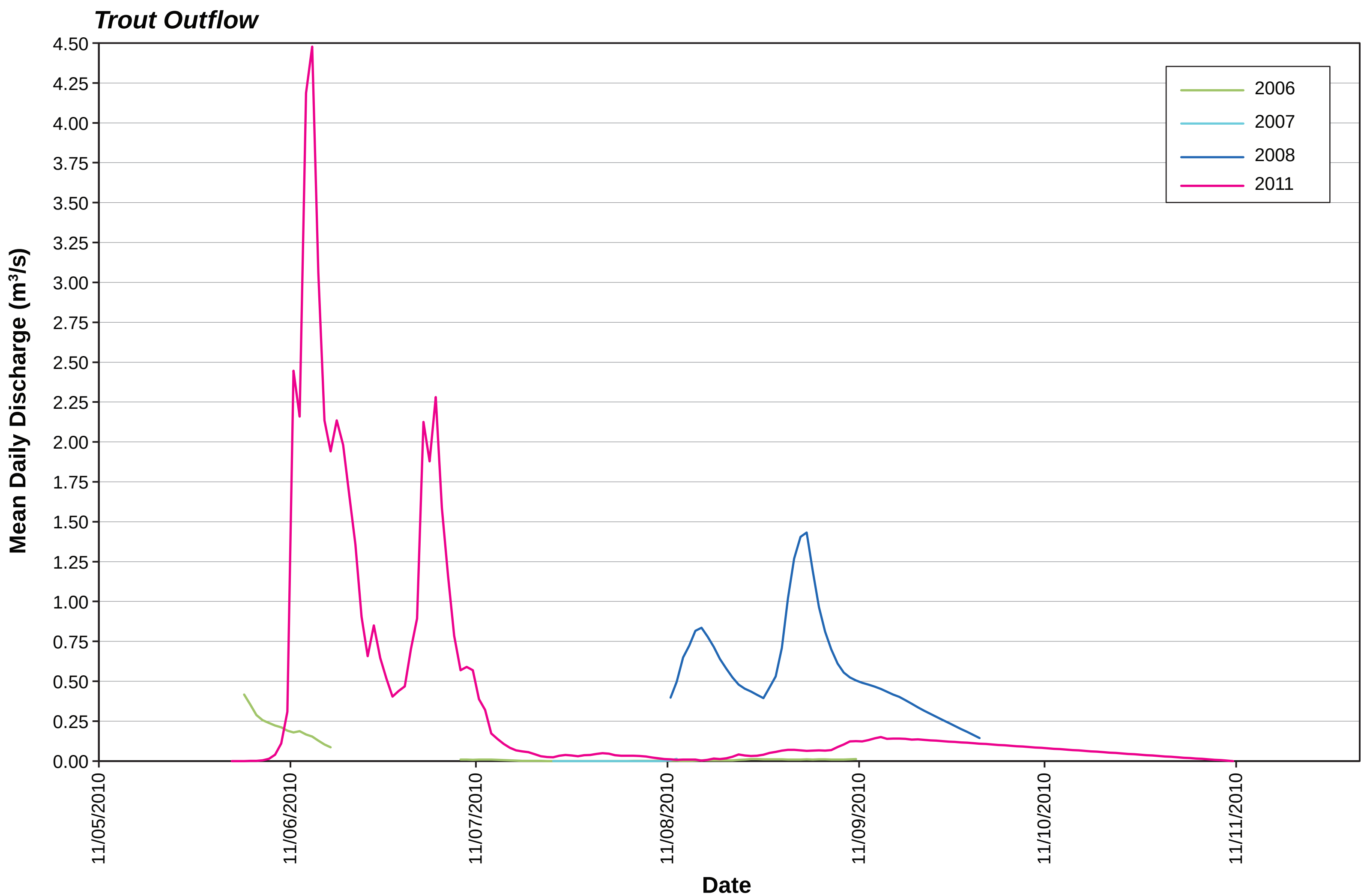


Figure 5.2-11

Boston Historical Hydrographs



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Boston Historical Hydrographs

Figure 5.2-12

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Figure 5.2-12

The estimated mean annual runoff was 185 mm for the Doris/Madrid area and 159 mm for the Boston area (Table 5.3-1). The main difference between the two areas is in how they responded to the spring rain event. The Doris/Madrid area had a much stronger response to the rains, illustrated by the dominant peak flows the rains generated at the hydrometric stations. This response may suggest that the active layer may be a little thinner in the Doris/Madrid area in comparison to the Boston area, where the rain effect was dampened.

Table 5.3-1. 2011 Annual Runoff and Mean Annual Flow

Project Area	Mean Calculated Runoff (mm)	Estimated Mean Annual Runoff (mm)
Doris/Madrid	161	185
Boston	146	158

5.4 2011 RESULTS IN THE REGIONAL CONTEXT

The hydrologic observations from the drainage basins in the Boston and Doris/Madrid areas were compared to results from the flood frequency analysis (FFA). This was completed in order to evaluate how the 2011 hydrologic results compared to available long-term datasets. The datasets included a synthetic dataset for selected stations based on a water balance model and a dataset compiled from three Water Survey of Canada hydrometric stations near the Project area.

Following a number of years of on-site data collection, a detailed water balance model was completed in 2008 for 10 lakes in the Doris/Madrid area (Golder and Associates 2009). The water balance model was set up using a daily time step for the period of 1948 to 2008. Based on long-term climate records from Cambridge Bay, a synthetic precipitation record was derived for the Doris/Madrid area. The calibrated model was used to generate a daily time series for each lake outflow, and frequency analysis was performed to characterize key hydrologic parameters (Tables 5.4-1 and 5.4-2). Note that for four of the stations included in the original analysis (Tail, Little Roberts, Windy, and Glenn) discharge measurements are no longer conducted at each site.

Table 5.4-1. Summary of Estimated Annual Runoff (mm) Values by Different Recurrence Intervals for the Lakes in the Doris/Madrid Area

		Hydrologic Condition										
		Dry					*Mean*	*Wet*				
		Recurrence Interval (years)										
Station Names	**2011 Estimated Annual Runoff**	**100**	**50**	**20**	**10**	**5**	**2**	**5**	**10**	**20**	**50**	**100**
Patch Outflow	175	35	40	48	56	66	87	114	131	148	168	182
PO Outflow	213	54	59	66	74	84	105	131	147	162	181	194
Ogama Outflow	160	52	57	65	72	82	103	129	146	161	179	193
Tail Outflow	N/A	25	30	37	44	53	72	96	111	124	141	153
Doris Outflow	191	47	52	60	68	77	99	125	141	157	176	189
Roberts Outflow	162	39	44	52	60	70	92	119	136	152	171	185
Little Roberts Outflow	N/A	44	49	57	64	74	96	122	138	154	172	186
Windy Outflow	N/A	19	23	31	39	50	73	104	124	144	169	188
Glenn Outflow	N/A	41	45	51	58	67	86	111	128	143	164	179
Average Annual Runoff		*40*	*44*	*52*	*59*	*69*	*90*	*117*	*134*	*149*	*169*	*183*

Source: Golder and Associates (2009).
N/A-stream flow monitoring stations are no longer active at these sites.

Table 5.4-2. Summary of Estimated Daily Peak Flows by Different Recurrence Intervals for the Lakes in the Doris/Madrid Area

	Observed Daily Peak Flows (m^3/s)				Daily Peak Flows (m^3/s) Recurrence Interval (years)					
Station Name	**2008**	**2009**	**2010**	**2011**	**2**	**5**	**10**	**20**	**50**	**100**
Patch Outflow	1.20	0.51	0.55	2.51	0.693	0.995	1.22	1.45	1.78	2.06
PO Outflow	2.45	2.00	3.60	9.03	1.29	1.74	2.04	2.34	2.74	3.04
Ogama Outflow	3.18	2.02	3.06	6.66	1.41	1.88	2.18	2.48	2.85	3.12
Tail Outflow	0.20	0.12	0.19	N/A	0.122	0.171	0.211	0.256	0.326	0.389
Doris Outflow	4.29	2.29	4.44	5.77	1.68	2.21	2.55	2.87	3.27	3.56
Roberts Outflow	6.27	2.49	5.78	7.33	2.13	3	3.64	4.3	5.22	5.97
Little Roberts Outflow	11.3	N/A	N/A	N/A	3.82	5.18	6.07	6.94	8.05	8.89
Windy Outflow	0.32	0.37	0.46	N/A	0.304	0.48	0.621	0.776	1.01	1.22
Glenn Outflow	0.80	1.12	N/A	N/A	0.484	0.687	0.839	1.00	1.23	1.43

Note: Recurrence Interval data from Golder and Associates (2009).
N/A - stream flow monitoring stations are no longer active at these sites.

The average runoff values for different drainage basins resulting from the frequency analysis are shown in Table 5.4-1. The estimated annual runoff values for 2011 can be compared against these results to put the estimated annual runoff results in a temporal context. For the stations that are still monitored, the results for the 2011 year vary. For the Doris and PO Outflows the estimated annual runoff was associated with hydrologic wet conditions exceeding the 1-in-100 year wet recurrence interval. Roberts Outflow was slightly below the 1-in-100 year recurrence interval, Patch Outflow was less than the 1-in-50 year recurrence interval, and Ogama was less than the 1-in-20 year recurrence interval. Annual runoff data seem to suggest a wetter than average year for the monitoring stations located within the Belt.

The daily peak flows for the different stations are shown in Table 5.4-2. Included in the table are the observed data for 2008-2011. As can be seen from the table, the 2011 observed data for all of the stations exceeded the 1-in-100 year recurrence interval.

The objective of the 2011 FFA was to update a previous analysis conducted by Rescan for the 2009 Hydrology Baseline Report (Rescan 2010a). The analysis was conducted for stations monitoring watersheds with drainage areas greater than 100 km^2, which were not included in the original Golder and Associates (2009) analysis. This analysis is relevant for the following four hydrometric stations: Koignuk-Hydro, Reference B-Hydro, Aimao Out-Hydro, and East Aimao-Hydro. The FFA was completed using HYFRAN-Plus™ Software system (INRS-ETE). The software package contains eighteen statistical distributions to fit the data, and contains screen tests for data independence, homogeneity and stationarity. As a general rule, frequency analysis is cautioned when working with records shorter than 10 years and in estimating frequencies of expected hydrologic events greater than twice the record length (Viessman [Jr.] and Lewis 1996). The program was used to analyze the records of three WSC stations located near the Belt: Freshwater Creek (10TF001), Tree River (10QA001), and Ellice River (10QD001). The results of this analysis are presented in Table 5.4-3.

The results from the FFA conducted on the three WSC stations were combined with the data presented in Table 5.4-2 to develop regional regression equations between daily discharges of various recurrence intervals and drainage area. Drainage areas from the four on-site hydrometric stations were combined into the resulting regression equations to determine the discharges associated with a given recurrence interval (presented in Table 5.4-4). In the table the observed daily peak flows for 2011 were included. Similarly to the data presented in Table 5.4-2 all of the 2011 discharges exceeded the 1-in-100 year recurrence interval.

Table 5.4-3. Summary Estimated Daily Peak Flows by Different Recurrence Intervals for Selected Water Survey of Canada Stations

Station Name	Years of Record	Daily Peak Flow (m^3/s) Recurrence Interval (years) 2	5	10	20	50	100
Freshwater Creek	28	43.3	58	68	77.6	90.4	100
Tree River	37	122	161	186	210	241	264
Ellice River	32	1370	1650	1800	1920	2070	2160

Table 5.4-4. Summary Estimated Daily Peak Flows by Different Recurrence Intervals for On-site Monitoring Stations with Drainage Areas Larger than 100 km²

Station Name	Drainage Area (km^2)	2011 (m^3/s)	Daily Peak Flow (m^3/s) Recurrence Interval (years) 2	5	10	20	50	100
Koignuk-Hydro	2,937	226	88.5	118.9	134.3	149.7	168.7	181.2
Reference B-Hydro	159	16	3.7	5.3	6.2	7.1	8.4	9.4
Aimao Out-Hydro	1,224	85	34.2	46.6	53.2	60	68.7	74.6
East Aimao-Hydro	363	105	9.1	12.7	14.7	16.9	19.7	21.8

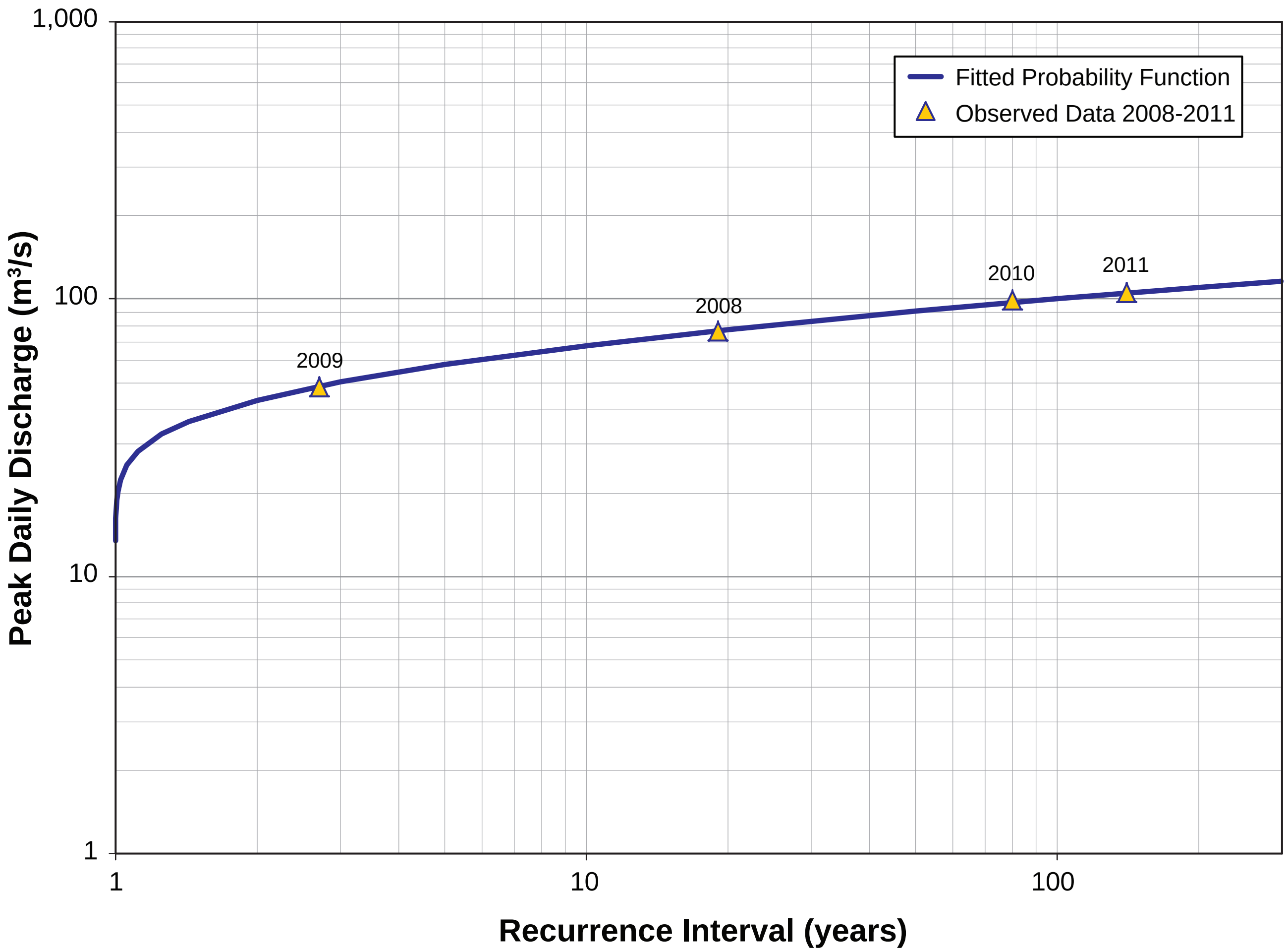
These results suggest that the observed flows in 2011 exceeded the 1-in-100 year recurrence interval for most hydrometric stations located within the Hope Bay Belt. To corroborate this finding, the analysis of the Freshwater Creek WSC hydrometric station was investigated in more detail. This station was selected because it was the only one of the three WSC regional stations which had useful stream flow data for 2011. Figure 5.4-1 is a plot of discharge versus recurrence interval for Freshwater Creek; the observed maximum daily discharges between 2008 and 2010 are also identified. A peak flow estimate for 2011 is also included in the diagram, but is an underestimate as the WSC gauge was offline for three days in June during the 2011 peak flow event. The figure shows that 2011 was an abnormally wet year, with an estimated recurrence interval of 1 in 140 years. This result supports our findings in the Project area.

Low flows recorded in 2011 at the Doris/Madrid drainage basins were associated with different recurrence intervals (Table 5.4-5). Low flows at Patch outflow were smaller than the estimated magnitude of events associated with a 1-in-2 year recurrence interval. At Patch and Roberts outflows low flows exceeded the magnitude of events with a 1-in-50 year recurrence interval. The low flow at Doris Outflow (TL-2) was near the magnitude of an event associated with a 1-in-2 year recurrence interval.

Table 5.4-5. Summary of 2011 7-Day Low-Flows and Estimated 7-Day Low-Flows by Different Recurrence Intervals for the Lakes in the Doris/Madrid Area

Station Name	August 7-day Low Flow (m^3/s) in 2011	August 7-day Low Flow (m^3/s) Recurrence Interval (years) 2	5	10	20	50	100
Patch Outflow	0.170	0.138	0.085	0.068	0.056	0.046	0.041
PO Outflow	0.121	0.464	0.331	0.281	0.246	0.213	0.194
Ogama Outflow	0.220	0.502	0.352	0.295	0.255	0.218	0.196
Doris Outflow (TL-2)	0.436	0.579	0.381	0.308	0.257	0.21	0.183
Roberts Outflow	0.139	0.459	0.284	0.227	0.189	0.155	0.137

Note: Recurrence interval data from Golder and Associates (2009).



Note: the solid line denotes the Log-Pearson Type III function distribution fitted to peak flow data from 1975 to 2010.

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Results of Flood Frequency Analysis for WSC Station (10TF001) Freshwater Creek near Cambridge Bay

Figure 5.4-1

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6. Summary

6. Summary

A network of 19 hydrometric monitoring stations within the Hope Bay Belt was operated during 2011. In the Doris/Madrid area, 10 hydrometric monitoring stations were remobilized, one new station was installed, and two existing lake level stations were maintained. In the Boston area five hydrometric monitoring stations were remobilized and one new station was installed.

The 2011 open water period extended from early-June until mid-November. The runoff estimates for drainage basins located within the Study Area varied. The estimated mean annual runoff was 185 mm for basins in the Doris/Madrid area, and 158 mm for basins in the Boston area (Table 6-1).

Table 6-1. 2011 Annual Runoff and Mean Annual Discharge for Drainage Basins Located within the Doris/Madrid and Boston Areas

Hydrometric Station	Drainage Area (km^2)	Percent lake coverage in watershed	Calculated Runoff (mm)	Estimated Annual Runoff[b] (mm)	Mean Annual Discharge[a] (m^3/s)
Doris/Madrid Area					
TL-2 Doris Hydro	94.6	20	184 (June 12 to October 17)	191	1.58
TL-3 Doris Hydro	95.3	20	183 (June 12 to October 17)	190	1.58
Roberts-Hydro	97.9	17	144 (June 21 to September 25)	162	1.68
Ogama-Hydro	75	19	106 (June 21 to September 23)	158	0.88
Patch-Hydro	32	27	123 (June 21 to September 23)	174	0.41
PO-Hydro	68	19	205 (June 7 to September 23)	218	1.08
Koignuk-Hydro	2,937	18	175 (June 17 to September 24)	191	36.90
Reference B-Hydro	159	26	174 (June 18 to September 26)	196	2.35
Boston Area					
Aimao Out-Hydro	1,224	22	171 (June 20 to September 20)	206	7.98
Aimao In-Hydro	725	21	124 (June 20 to September 19)	134	7.32
East Aimao-Hydro	363	15	206 (June 10 to September 19)	214	5.87
East Tailings-Hydro	8	7	73 (June 12 to September 19)	76	0.047
Trout-Hydro	31.9	7	116 (June 11 to September 20)	126	0.30
Stickleback-Hydro	2.6	40	194 (June 19 to September 20)	198	0.044
Mean			*156*	*174*	

[a] *MAD based on estimated annual runoff.*
[b] *Estimated for the 2011 open water season.*

Hydrologic conditions in 2011 were wetter than the two previous monitoring years. The estimated 2011 annual runoff values were approximately 31% higher than in 2010. In terms of annual runoff, the mean estimate for the Doris/Madrid area exceeded the magnitude associated with a 1-in-100 year recurrence interval (Table 6-2).

Table 6-2. Summary of Estimated Annual Runoff (mm) Values by Different Recurrence Intervals for the Lakes in the Doris/Madrid Area

	Hydrologic Condition										
	Dry					*Mean*	*Wet*				
	Recurrence Interval (years)										
Station Name	**100**	**50**	**20**	**10**	**5**	**2**	**5**	**10**	**20**	**50**	**100**
Patch Outflow	35	40	48	56	66	87	114	131	148	168	182
PO Outflow	54	59	66	74	84	105	131	147	162	181	194
Ogama Outflow	52	57	65	72	82	103	129	146	161	179	193
Doris Outflow	47	52	60	68	77	99	125	141	157	176	189
Roberts Outflow	39	44	52	60	70	92	119	136	152	171	185
Average Annual Runoff	*45*	*50*	*58*	*66*	*76*	*97*	*124*	*140*	*156*	*175*	*189*

Source: Golder and Associates (2009).

The timing of the annual peak flows varied among the monitored watersheds located within the Phase 2 Project Area. Two distinct high water events were observed at the stations located in the Doris/Madrid area. The first event occurred during the spring freshet period in mid- June and was largely driven by snowmelt. This event was the annual peak for stations Patch-Hydro, Ogama-Hydro, PO-Hydro, Reference-B-Hydro, and Koignuk-Hydro. The second event occurred in early-July and was largely driven 32 mm of rain that fell between June 30 and July 1. This event was the annual peak for stations TL2 (Doris Upstream), TL3 (Doris Downstream), and Roberts-Hydro. Annual peakflows in the Doris/Madrid area ranged from 2.53 m^3/s at Patch-hydro to 299.5 m^3/s at Koignuk-Hydro. Two distinct high water events were also observed in the monitored basins located within the Boston area; however, the annual peak in these basins occurred during the freshet period in mid- to late-June and was driven by snowmelt. The annual peaks in the Boston area ranged from 0.51 m^3/s at Stickleback-Hydro to 95.41 m^3/s at Aimao In-Hydro (Table 6-3). Peak flows in most of the drainage basins in the Phase 2 Project Area exceeded the magnitude of events associated with a 1-in-100 year recurrence interval (Table 6-4).

Observed low flows for the drainage basins in the Doris/Madrid area occurred between early-to late-September and ranged from 0.084 m^3/s at PO-Hydro to 7.58 m^3/s at Koignuk-Hydro. The observed low flows for the drainage basins in the Boston area occurred in mid-August in most watersheds and ranged from below 0.01 m^3/s at the stations East Tailings-Hydro, Trout-Hydro, and Stickleback-Hydro, to 3.29 m^3/s at Aimao Out-Hydro (Table 6-5).

In the Doris/Madrid area, changes in lake water levels recorded from June 1 to October 3 ranged from 0.235 m at Windy Lake to 0.737 m at Doris Lake, respectively. In the Boston area, lake level variation for Aimaokatalok Lake was 2.46 m.

Tide levels were measured by a hydrometric station installed near the existing jetty located in the southern part of Roberts Bay from July 24 to September 28. The tides in Roberts Bay were microtidal (< 2 m tidal range) and semi-diurnal. Daily tide ranges were generally between 0.25 and 0.35 m (average: 0.30±0.07 m), with a maximum tidal range (the difference between high and low water in one tidal cycle) of 0.33 m on September 20, 2011 during the spring tide.

Table 6-3. 2011 Annual Peak Flows for Drainage Basins located within the Doris/Madrid and Boston Areas

Hydrometric Station	Drainage Area (km^2)	Peak Flow (m^3/s)		
		Instantaneous	Daily	Date
Doris/Madrid Area				
TL-2 Doris-Hydro	94.6	5.88	5.77	July 5
TL-3 Doris-Hydro	95.3	5.96 E	5.86	July 5
Ogama-Hydro	75	7.69 E	6.66	July 3
Patch-Hydro	32	2.88 E	2.51	July 4
PO-Hydro	68	10.44	9.03	June 14
Roberts-Hydro	97.9	7.47	7.34	July 3
Koignuk-Hydro	2,937	299.50	226.44	June 23
Reference B-Hydro	159	19.51	16.36	June 19
Boston Area				
Aimao Out-Hydro	1,224	85.98	85.31	June 23
Aimao In-Hydro	725	95.41	86.72	June 20
East Aimao-Hydro	363	93.51 E	72.13 E	June 18
East Tailings-Hydro	8	2.38	1.23	June 13
Trout-Hydro	31.9	6.19	4.78	June 14
Stickleback-Hydro	2.6	0.51	0.50	June 23

Table 6-4. Summary of Estimated Daily Peak Flows by Different Recurrence Intervals for the Stations in the Doris/Madrid and Boston Areas

Station Name	Peak Daily Flow (m^3/s)	
	Recurrence Interval (years)	
	2	100
Doris/Madrid Area		
Patch Outflow	0.693	2.06
PO Outflow	1.29	3.04
Ogama Outflow	1.41	3.12
Doris Outflow	1.68	3.56
Roberts Outflow	2.13	5.97
Koignuk-Hydro	88.5	180.6
Reference B-Hydro	3.7	9.4
Boston Area		
Aimao Out-Hydro	34.2	74.4
East Aimao-Hydro	9.2	21.7

Table 6-5. 2011 Annual Low Flows in the Doris/Madrid and Boston Areas

Hydrometric Station	Daily Low Flow (m^3/s)	Date	Drainage Area (km^2)
Doris/Madrid Area			
TL-2 Doris-Hydro	0.400	September 6	94.6
TL-3 Doris-Hydro	0.365	September 6	95.3
Ogama-Hydro	0.210	September 6	32
Patch-Hydro	0.134	September 6	68
PO-Hydro	0.084	September 6	98
Roberts-Hydro	0.116	September 3	97.9
Koignuk-Hydro	7.585	September 6	2,937
Reference B-Hydro	0.102	September 23	159
Boston Area			
Aimao Out-Hydro	3.29	September 6	1,224
Aimao In-Hydro	1.17	August 17	725
East Aimao-Hydro	0.539	August 17	363
East Tailings-Hydro	<0.01	August 16	8
Trout-Hydro	<0.01	August 16	31.9
Stickleback-Hydro	<0.01	September 2	2.6

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Engineers and Scientists

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Appendix A1

Discharge Measurements
Doris/Madrid Area

Rescan
Engineers and Scientists

Appendix A1-1. Discharge Measurements at Koignuk-Hydro in 2011

Date Monitored:	18-Jun-11	**Mean Discharge Q (m^3/s):**	**135.00**
Start Time (24 hr):	19:18	**% Measured:**	85.90
End Time (24 hr):	19:30	**Stage (m):**	**99.584**
Personnel:	Craig Hatt; Max Taylor		
Method:	Velocity-Area		
Instrument:	Acoustic Doppler Current Profiler		

	Discharge Q (m^3/s)						% Bad	
Transect	**Top**	**Mid**	**Bottom**	**Left**	**Right**	**Total Q**	**Ens**	**Bins**
1	7.94	111.00	10.70	-0.086	0.138	130.00	11	10
2	8.92	117.00	13.00	-0.135	-0.058	139.00	29	10
3	7.14	120.00	9.34	0.028	0.203	136.00	34	8
Mean	**8.00**	**116.00**	**11.00**	**-0.064**	**0.094**	**135.00**	**25**	**10**

Date Monitored:	23-Jun-11	**Mean Discharge Q (m^3/s):**	**221.67**
Start Time (24 hr):	10:44	**% Measured:**	78.32
End Time (24 hr):	10:54	**Stage (m):**	**100.158**
Personnel:	Craig Hatt; Max Taylor		
Method:	Velocity-Area		
Instrument:	Acoustic Doppler Current Profiler		

	Discharge Q (m^3/s)						% Bad	
Transect	**Top**	**Mid**	**Bottom**	**Left**	**Right**	**Total Q**	**Ens**	**Bins**
1	14.85	173.24	23.54	0.292	12.631	224.54	5	22
2	15.09	171.15	25.84	0.867	6.176	219.12	9	18
3	14.89	174.61	27.59	2.323	0.942	220.35	0	20
4	14.73	175.48	28.37	0.787	3.299	222.67	3	20
Mean	**14.73**	**173.62**	**26.33**	**1.067**	**5.762**	**221.67**	**4**	**20**

Date Monitored:	23-Jul-11	**Mean Discharge Q (m^3/s):**	**36.19**
Start Time (24 hr):	13:19	**% Measured:**	74.01
End Time (24 hr):	13:31	**Stage (m):**	**98.221**
Personnel:	Craig Hatt and Assistant		
Method:	Velocity-Area		
Instrument:	Acoustic Doppler Current Profiler		

	Discharge Q (m^3/s)						% Bad	
Transect	**Top**	**Mid**	**Bottom**	**Left**	**Right**	**Total Q**	**Ens**	**Bins**
1	4.752	26.68	4.051	0.079	0.52	36.082	0	4
2	4.147	28.069	3.687	0.496	-0.063	36.336	0	3
3	5.329	26.058	4.553	0.059	0.162	36.16	0	2
4	4.972	26.325	4.28	0.53	0.065	36.172	0	4
Mean	**4.8**	**26.783**	**4.143**	**0.291**	**0.171**	**36.188**	**0**	**3**

Appendix A1-1. Discharge Measurements at Koignuk-Hydro in 2011

Date Monitored:	17-Aug-11			**Mean Discharge Q (m^3/s):**			**6.87**	
Start Time (24 hr):	10:22			**% Measured:**			54.84	
End Time (24 hr):	10:48			**Stage (m):**			**97.644**	
Personnel:	Craig Hatt and Assistant							
Method:	Velocity-Area							
Instrument:	Acoustic Doppler Current Profiler							
	Discharge Q (m^3/s)						**% Bad**	
Transect	**Top**	**Mid**	**Bottom**	**Left**	**Right**	**Total Q**	**Ens**	**Bins**
1	1.693	3.737	0.986	0.082	0.336	6.834	1	5
2	1.748	3.817	1.07	-0.044	0.375	6.967	1	6
3	1.675	3.955	1.04	-0.029	0.349	6.99	1	9
4	1.637	3.7	0.996	0.022	0.524	6.878	1	6
5	1.663	3.628	0.976	0.036	0.377	6.68	1	4
Mean	**1.683**	**3.767**	**1.014**	**0.014**	**0.392**	**6.87**	**1**	**6**

Date Monitored:	24-Sep-11			**Mean Discharge Q (m^3/s):**			**14.10**	
Start Time (24 hr):	11:49			**% Measured:**			63.90	
End Time (24 hr):	12:22			**Stage (m):**			**97.862**	
Personnel:	Craig Hatt and Assistant							
Method:	Velocity-Area							
Instrument:	Acoustic Doppler Current Profiler							
	Discharge Q (m^3/s)						**% Bad**	
Transect	**Top**	**Mid**	**Bottom**	**Left**	**Right**	**Total Q**	**Ens**	**Bins**
1	3.24	8.87	2.16	0.037	0.278	14.6	2	10
2	2.83	8.85	1.71	0.083	0.37	13.8	0	2
3	2.84	8.92	1.68	0.067	0.331	13.8	0	2
4	2.96	9.36	1.78	0.086	0.307	14.5	0	1
5	2.89	9.02	1.72	0.11	0.326	14.1	0	2
6	2.94	9.15	1.73	0.082	0.359	14.3	1	2
7	2.73	8.77	1.64	0.099	0.201	13.4	0	2
Mean	**2.92**	**8.99**	**1.77**	**0.081**	**0.31**	**14.1**	**0**	**3**

Appendix A1-2. Discharge Measurements at Ogama-Hydro in 2011

Date Monitored:	15-Jun-11				**Discharge:**	**4.33** m³/s			
Start Time (24 hr):									
End Time (24 hr):	16:40								
Personnel:	Craig Hatt; Max Taylor								
Method:	Velocity-Area								
Instrument:	Flow Mate 2000 with top setting rod								
Stage:	**98.899**								

Notes	Station (m)	Depth (m)	Width (m)	Area (m^2)	60% Velocity (m/s)	20% Velocity (m/s)	80% Velocity (m/s)	Velocity (m/s)	Q (m^3/s)	% of Total Q
Right Bank	25.60	0.00	0.30	0.02	0.00			0.00	0.00	0.0
	25.00	0.13	0.80	0.10	0.00			0.00	0.00	0.0
	24.00	0.06	1.00	0.06	0.00			0.00	0.00	0.0
	23.00	0.13	1.00	0.13	0.05			0.05	0.01	0.2
	22.00	0.15	1.00	0.15	0.09			0.09	0.01	0.3
	21.00	0.16	1.00	0.16	0.07			0.07	0.01	0.3
	20.00	0.12	1.00	0.12	0.01			0.01	0.00	0.0
	19.00	0.22	1.00	0.22	0.01			0.01	0.00	0.1
	18.00	0.30	1.00	0.30	0.12			0.12	0.04	0.8
	17.00	0.36	1.00	0.36	0.03			0.03	0.01	0.2
	16.00	0.52	1.00	0.52	-0.01			-0.01	-0.01	-0.1
	15.00	0.52	1.00	0.52	0.13			0.13	0.07	1.6
	14.00	0.56	1.00	0.56	0.28			0.28	0.16	3.6
	13.00	0.57	0.88	0.50	0.23			0.23	0.11	2.6
	12.25	0.59	0.75	0.44	0.19			0.19	0.08	1.9
	11.50	0.61	0.75	0.46	0.23			0.23	0.11	2.4
	10.75	0.62	0.75	0.47	0.28			0.28	0.13	3.0
	10.00	0.72	0.75	0.54	0.44			0.44	0.24	5.5
	9.25	0.78	0.75	0.59		0.63	0.53	0.58	0.34	7.8
	8.50	0.86	0.75	0.65		0.66	0.49	0.58	0.37	8.6
	7.75	0.80	0.75	0.60		0.71	0.55	0.63	0.38	8.7
	7.00	0.88	0.75	0.66		0.73	0.47	0.60	0.40	9.1
	6.25	0.91	0.75	0.68		0.73	0.55	0.64	0.44	10.1
	5.50	0.92	0.75	0.69		0.69	0.49	0.59	0.41	9.4
	4.75	0.82	0.75	0.62		0.63	0.51	0.57	0.35	8.1
	4.00	0.71	0.75	0.53	0.50			0.50	0.27	6.2
	3.25	0.50	0.75	0.38	0.42			0.42	0.16	3.6
	2.50	0.38	0.75	0.29	0.42			0.42	0.12	2.8
	1.75	0.48	0.75	0.36	0.25			0.25	0.09	2.1
start of shrubs	1.00	0.41	0.88	0.36	0.08			0.08	0.03	0.7
	0.00	0.13	1.00	0.13	0.04			0.04	0.01	0.1
	-1.00	0.36	1.00	0.36	0.02			0.02	0.01	0.2
	-2.00	0.18	1.00	0.180	0.00			0	0.000	0.0
	-3.00	0.18	1.00	0.180	0.02			0.02	0.004	0.1
Left Bank	-4.00	0.00	0.50	0.045	0.00			0	0.000	0.0
Total Q									**4.33**	

Appendix A1-2. Discharge Measurements at Ogama-Hydro in 2011

Date Monitored:	21-Jun-11					**Discharge:**		**4.07** m^3/s		
Start Time (24 hr):	13:15									
End Time (24 hr):										
Personnel:	Craig Hatt; Max Taylor									
Method:	Velocity-Area									
Instrument:	Flow Mate 2000 with top setting rod									
Stage:	**98.880**									
Notes	**Station (m)**	**Depth (m)**	**Width (m)**	**Area (m^2)**	**60% Velocity (m/s)**	**20% Velocity (m/s)**	**80% Velocity (m/s)**	**Velocity (m/s)**	**Q (m^3/s)**	**% of Total Q**
Right Bank	1.00	0.00	0.50	0.04	0.00			0.00	0.00	0.0
	2.00	0.14	1.00	0.14	0.01			0.01	0.00	0.0
	3.00	0.28	1.00	0.28	0.00			0.00	0.00	0.0
	4.00	0.22	1.00	0.22	0.02			0.02	0.00	0.1
	5.00	0.16	1.00	0.16	0.00			0.00	0.00	0.0
	6.00	0.26	1.00	0.26	0.00			0.00	0.00	0.0
	7.00	0.25	1.00	0.25	0.00			0.00	0.00	0.0
	8.00	0.40	1.00	0.40	0.03			0.03	0.01	0.3
	9.00	0.53	1.00	0.53	0.02			0.02	0.01	0.3
	10.00	0.50	1.00	0.50	0.00			0.00	0.00	0.0
	11.00	0.52	1.00	0.52	0.13			0.13	0.07	1.7
	12.00	0.56	1.00	0.56	0.28			0.28	0.16	3.9
	13.00	0.58	0.88	0.51	0.22			0.22	0.11	2.7
	13.75	0.60	0.75	0.45	0.24			0.24	0.11	2.7
	14.50	0.64	0.75	0.48	0.25			0.25	0.12	2.9
	15.25	0.67	0.75	0.50	0.36			0.36	0.18	4.4
	16.00	0.71	0.75	0.53	0.56			0.56	0.30	7.3
	16.75	0.88	0.75	0.66		0.66	0.38	0.52	0.34	8.4
	17.50	0.86	0.75	0.65		0.62	0.41	0.52	0.33	8.2
	18.25	0.82	0.75	0.62		0.67	0.48	0.58	0.35	8.7
	19.00	0.90	0.75	0.68		0.73	0.5	0.62	0.42	10.2
	19.75	0.91	0.75	0.68		0.7	0.44	0.57	0.39	9.6
	20.50	0.80	0.75	0.60		0.63	0.48	0.56	0.33	8.2
	21.25	0.82	0.75	0.62		0.61	0.45	0.53	0.33	8.0
	22.00	0.54	0.88	0.47	0.42			0.42	0.20	4.9
	23.00	0.44	1.00	0.44	0.35			0.35	0.15	3.8
	24.00	0.44	1.00	0.44	0.30			0.30	0.13	3.2
	25.00	0.41	1.00	0.41	0.04			0.04	0.02	0.4
	26.00	0.30	1.00	0.30	0.01			0.01	0.00	0.1
	27.00	0.12	1.00	0.12	0.01			0.01	0.00	0.0
	28.00	0.08	1.00	0.08	0.00			0.00	0.00	0.0
	29.00	0.19	1.00	0.19	0.01			0.01	0.00	0.0
Left Bank	30.00	0.00	0.50	0.05	0.00			0.00	0.00	0.0
Total Q									**4.07**	

Appendix A1-2. Discharge Measurements at Ogama-Hydro in 2011

Date Monitored:	21-Jul-11				**Discharge:**	**0.89**			
Start Time (24 hr):									
End Time (24 hr):	14:50								
Personnel:	Craig Hatt and Assistant								
Method:	Velocity-Area								
Instrument:	Flow Mate 2000 with top setting rod								
Stage:	**0.556**								
Notes	**Station (m)**	**Depth (m)**	**Width (m)**	**Area (m^2)**	**60% Velocity (m/s)**	**20% Velocity (m/s)**	**80% Velocity (m/s)**	**Velocity (m/s)**	**Q (m^3/s)**	**% of Total Q**
Left Bank	1.80	0.00	0.10	0.00	0.00			0.00	0.00	0.0
	2.00	0.08	0.25	0.02	0.01			0.01	0.00	0.0
	2.30	0.16	0.35	0.06	0.01			0.01	0.00	0.1
	2.70	0.20	0.28	0.06	0.09			0.09	0.00	0.6
	2.85	0.38	0.15	0.06	0.23			0.23	0.01	1.5
	3.00	0.42	0.13	0.05	0.55			0.55	0.03	3.2
	3.10	0.42	0.10	0.04	0.69			0.69	0.03	3.3
	3.20	0.45	0.10	0.04	0.79			0.79	0.04	4.0
	3.30	0.48	0.10	0.05	0.59			0.59	0.03	3.2
	3.40	0.45	0.15	0.07	0.60			0.60	0.04	4.6
	3.60	0.46	0.20	0.09	0.49			0.49	0.05	5.1
	3.80	0.51	0.20	0.10	0.56			0.56	0.06	6.4
	4.00	0.46	0.20	0.09	0.68			0.68	0.06	7.0
	4.20	0.46	0.20	0.09	0.75			0.75	0.07	7.8
	4.40	0.49	0.20	0.10	0.64			0.64	0.06	7.0
	4.60	0.50	0.20	0.10	0.50			0.50	0.05	5.6
	4.80	0.50	0.20	0.10	0.65			0.65	0.07	7.3
	5.00	0.46	0.20	0.09	0.58			0.58	0.05	6.0
	5.20	0.32	0.20	0.06	0.67			0.67	0.04	4.8
	5.40	0.33	0.20	0.07	0.66			0.66	0.04	4.9
	5.60	0.36	0.20	0.07	0.57			0.57	0.04	4.6
	5.80	0.40	0.20	0.08	0.59			0.59	0.05	5.3
	6.00	0.32	0.20	0.06	0.54			0.54	0.03	3.9
	6.20	0.26	0.20	0.05	0.41			0.41	0.02	2.4
	6.40	0.22	0.20	0.04	0.20			0.20	0.01	1.0
	6.60	0.18	0.20	0.04	0.02			0.02	0.00	0.1
	6.80	0.14	0.20	0.03	0.03			0.03	0.00	0.1
	7.00	0.14	0.20	0.03	0.05			0.05	0.00	0.2
	7.20	0.12	0.25	0.03	0.04			0.04	0.00	0.1
	7.50	0.10	0.40	0.04	0.01			0.01	0.00	0.0
Right Bank	8.00	0.00	0.25	0.01	0.00			0.00	0.00	0.0
Total Q									**0.89**	

Appendix A1-2. Discharge Measurements at Ogama-Hydro in 2011

Date Monitored:	14-Aug-11					**Discharge:**		**0.24** m^3/s	
Start Time (24 hr):									
End Time (24 hr):	15:20								
Personnel:	Craig Hatt and Assistant								
Method:	Velocity-Area								
Instrument:	Flow Mate 2000 with top setting rod								
Stage:	**98.380**								

Notes	**Station (m)**	**Depth (m)**	**Width (m)**	**Area (m^2)**	**60% Velocity (m/s)**	**20% Velocity (m/s)**	**80% Velocity (m/s)**	**Velocity (m/s)**	**Q (m^3/s)**	**% of Total Q**
Right Bank	1.15	0.00	0.03	0.003	0.00			0.00	0.0000	0.0
	1.20	0.22	0.10	0.02	0.05			0.05	0.0011	0.5
	1.35	0.24	0.15	0.04	0.21			0.21	0.0076	3.1
	1.50	0.28	0.15	0.04	0.21			0.21	0.0088	3.6
	1.65	0.24	0.15	0.04	0.29			0.29	0.0104	4.3
	1.80	0.29	0.15	0.04	0.27			0.27	0.0117	4.8
	1.95	0.27	0.15	0.04	0.16			0.16	0.0065	2.7
	2.10	0.34	0.15	0.05	0.20			0.20	0.0102	4.2
	2.25	0.34	0.15	0.05	0.29			0.29	0.0148	6.1
	2.40	0.32	0.15	0.05	0.35			0.35	0.0168	6.9
	2.55	0.30	0.15	0.05	0.35			0.35	0.0158	6.5
	2.70	0.31	0.15	0.05	0.28			0.28	0.0130	5.3
	2.85	0.29	0.15	0.04	0.29			0.29	0.0126	5.2
	3.00	0.33	0.15	0.05	0.36			0.36	0.0178	7.3
	3.15	0.32	0.15	0.05	0.36			0.36	0.0173	7.1
	3.30	0.33	0.15	0.05	0.32			0.32	0.0158	6.5
	3.45	0.30	0.15	0.05	0.25			0.25	0.0113	4.6
rock upstream	3.60	0.30	0.15	0.05	0.11			0.11	0.0050	2.0
	3.75	0.28	0.15	0.04	0.22			0.22	0.0092	3.8
	3.90	0.26	0.15	0.04	0.27			0.27	0.0105	4.3
	4.05	0.26	0.15	0.04	0.24			0.24	0.0094	3.8
	4.20	0.23	0.15	0.03	0.33			0.33	0.0114	4.7
	4.35	0.20	0.15	0.03	0.20			0.20	0.0060	2.5
	4.50	0.10	0.15	0.02	0.03			0.03	0.0005	0.2
	4.65	0.08	0.20	0.02	0.00			0.00	0.0000	0.0
Left Bank	4.90	0.00	0.13	0.01	0.00			0.00	0.0000	0.0
Total Q									**0.24**	

Appendix A1-2. Discharge Measurements at Ogama-Hydro in 2011

Date Monitored:	23-Sep-11					**Discharge:**	**0.55** m^3/s		
Start Time (24 hr):									
End Time (24 hr):	14:20								
Personnel:	Craig Hatt and Assistant								
Method:	Velocity-Area								
Instrument:	Flow Mate 2000 with top setting rod								
Stage:	**98.440**								

Notes	Station (m)	Depth (m)	Width (m)	Area (m^2)	60% Velocity (m/s)	20% Velocity (m/s)	80% Velocity (m/s)	Velocity (m/s)	Q (m^3/s)	% of Total Q
Right Bank	2.00	0.00	0.20	0.01	0.00			0.00	0.00	0.0
	2.40	0.10	0.35	0.04	0.02			0.02	0.00	0.1
	2.70	0.1	0.20	0.02	0.01			0.01	0.00	0.0
	2.80	0.30	0.15	0.05	0.16			0.16	0.01	1.3
	3.00	0.31	0.20	0.06	0.44			0.44	0.03	5.0
	3.20	0.36	0.20	0.07	0.47			0.47	0.03	6.2
	3.40	0.36	0.20	0.07	0.33			0.33	0.02	4.4
	3.60	0.39	0.15	0.06	0.25			0.25	0.01	2.7
	3.70	0.42	0.10	0.04	0.35			0.35	0.01	2.7
	3.80	0.40	0.10	0.04	0.42			0.42	0.02	3.1
	3.90	0.40	0.10	0.04	0.42			0.42	0.02	3.1
	4.00	0.40	0.10	0.04	0.52			0.52	0.02	3.8
	4.10	0.40	0.10	0.04	0.56			0.56	0.02	4.1
	4.20	0.37	0.10	0.04	0.57			0.57	0.02	3.9
	4.30	0.41	0.10	0.04	0.56			0.56	0.02	4.2
	4.40	0.35	0.10	0.04	0.59			0.59	0.02	3.8
	4.50	0.40	0.10	0.04	0.56			0.56	0.02	4.1
	4.60	0.42	0.10	0.04	0.50			0.50	0.02	3.9
	4.70	0.38	0.10	0.04	0.63			0.63	0.02	4.4
	4.80	0.40	0.10	0.04	0.54			0.54	0.02	4.0
	4.90	0.42	0.10	0.04	0.41			0.41	0.02	3.2
	5.00	0.40	0.10	0.04	0.46			0.46	0.02	3.4
	5.10	0.37	0.10	0.04	0.38			0.38	0.01	2.6
	5.20	0.36	0.15	0.05	0.29			0.29	0.02	2.9
	5.40	0.35	0.20	0.07	0.42			0.42	0.03	5.4
	5.60	0.34	0.20	0.07	0.45			0.45	0.03	5.6
	5.80	0.32	0.20	0.06	0.48			0.48	0.03	5.6
	6.00	0.26	0.20	0.05	0.36			0.36	0.02	3.4
	6.20	0.16	0.20	0.03	0.42			0.42	0.01	2.5
	6.40	0.14	0.20	0.03	0.14			0.14	0.00	0.7
	6.60	0.10	0.35	0.04	0.01			0.01	0.00	0.1
Left Bank	7.10	0.00	0.25	0.01	0.00			0.00	0.00	0.0
Total Q									**0.55**	

Appendix A1-3. Discharge Measurements at Patch-Hydro in 2011

Date Monitored:	17-Jun-11					**Discharge:**		**0.94** m^3/s		
Start Time (24 hr):										
End Time (24 hr):	10:40									
Personnel:	Craig Hatt; Max Taylor									
Method:	Velocity-Area									
Instrument:	Flow Mate 2000 with top setting rod									
Stage:	**99.246**									
Notes	**Station (m)**	**Depth (m)**	**Width (m)**	**Area (m^2)**	**60% Velocity (m/s)**	**20% Velocity (m/s)**	**80% Velocity (m/s)**	**Velocity (m/s)**	**Q (m^3/s)**	**% of Total Q**
Right Bank	2.30	0.00	0.35	0.02	0.00			0.00	0.00	0.0
	3.00	0.10	0.60	0.06	0.00			0.00	0.00	0.0
	3.50	0.16	0.50	0.08	0.08			0.08	0.01	0.7
	4.00	0.18	0.50	0.09	0.11			0.11	0.01	1.1
	4.50	0.21	0.50	0.11	0.21			0.21	0.02	2.4
	5.00	0.28	0.50	0.14	0.30			0.30	0.04	4.5
	5.50	0.34	0.50	0.17	0.21			0.21	0.04	3.8
	6.00	0.36	0.50	0.18	0.25			0.25	0.05	4.8
	6.50	0.40	0.50	0.20	0.23			0.23	0.05	4.9
	7.00	0.46	0.50	0.23	0.25			0.25	0.06	6.1
	7.50	0.44	0.50	0.22	0.27			0.27	0.06	6.3
	8.00	0.52	0.50	0.26	0.33			0.33	0.09	9.2
	8.50	0.53	0.50	0.27	0.33			0.33	0.09	9.3
	9.00	0.50	0.50	0.25	0.29			0.29	0.07	7.7
	9.50	0.50	0.50	0.25	0.29			0.29	0.07	7.7
	10.00	0.48	0.50	0.24	0.25			0.25	0.06	6.4
	10.50	0.52	0.50	0.26	0.26			0.26	0.07	7.2
	11.00	0.50	0.50	0.25	0.21			0.21	0.05	5.6
	11.50	0.36	0.50	0.18	0.06			0.06	0.01	1.2
	12.00	0.35	0.50	0.18	0.13			0.13	0.02	2.4
	12.50	0.30	0.50	0.15	0.10			0.10	0.02	1.6
	13.00	0.28	0.50	0.14	0.20			0.20	0.03	3.0
	13.50	0.26	0.50	0.13	0.07			0.07	0.01	1.0
	14.00	0.25	0.75	0.19	0.05			0.05	0.01	1.0
	15.00	0.23	1.00	0.23	0.05			0.05	0.01	1.2
	16.00	0.16	1.00	0.16	0.05			0.05	0.01	0.9
Left Bank	17.00	0.00	0.50	0.04	0.00			0.00	0.00	0.0
Total Q									**0.94**	

Appendix A1-3. Discharge Measurements at Patch-Hydro in 2011

Date Monitored:	21-Jun-11					**Discharge:**		**1.31** m^3/s		
Start Time (24 hr):	11:30									
End Time (24 hr):										
Personnel:	Craig Hatt; Max Taylor									
Method:	Velocity-Area									
Instrument:	Flow Mate 2000 with top setting rod									
Stage:	**99.265**									
	Station	**Depth**	**Width**	**Area**	**60% Velocity**	**20% Velocity**	**80% Velocity**	**Velocity**	**Q**	**% of**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**(m/s)**	**(m/s)**	**(m/s)**	**(m/s)**	**(m^3/s)**	**Total Q**
Left Bank	15.20	0.00	0.55	0.05	0.00			0.00	0.00	0.0
	14.10	0.18	1.05	0.19	0.01			0.01	0.00	0.1
	13.10	0.24	1.00	0.24	0.00			0.00	0.00	0.0
	12.10	0.27	1.00	0.27	0.02			0.02	0.01	0.4
	11.10	0.32	0.75	0.24	0.18			0.18	0.04	3.3
	10.60	0.33	0.50	0.17	0.16			0.16	0.03	2.0
	10.10	0.35	0.50	0.18	0.21			0.21	0.04	2.8
	9.60	0.39	0.50	0.20	0.16			0.16	0.03	2.4
	9.10	0.52	0.50	0.26	0.29			0.29	0.08	5.7
	8.60	0.54	0.50	0.27	0.35			0.35	0.09	7.2
	8.10	0.51	0.50	0.26	0.40			0.40	0.10	7.8
	7.60	0.49	0.50	0.25	0.32			0.32	0.08	6.0
	7.10	0.50	0.50	0.25	0.40			0.40	0.10	7.6
	6.60	0.56	0.50	0.28	0.41			0.41	0.11	8.7
	6.10	0.57	0.50	0.29	0.39			0.39	0.11	8.5
	5.60	0.48	0.50	0.24	0.33			0.33	0.08	6.0
	5.10	0.46	0.50	0.23	0.34			0.34	0.08	6.0
	4.60	0.40	0.50	0.20	0.33			0.33	0.07	5.0
	4.10	0.40	0.50	0.20	0.34			0.34	0.07	5.2
	3.60	0.38	0.50	0.19	0.37			0.37	0.07	5.4
	3.10	0.30	0.50	0.15	0.39			0.39	0.06	4.5
	2.60	0.21	0.50	0.11	0.35			0.35	0.04	2.8
	2.10	0.18	0.50	0.09	0.21			0.21	0.02	1.4
	1.60	0.18	0.50	0.09	0.16			0.16	0.01	1.1
	1.10	0.11	0.55	0.06	0.04			0.04	0.00	0.2
Right Bank	0.50	0.00	0.30	0.02	0.00			0.00	0.00	0.0
Total Q									**1.31**	

Appendix A1-3. Discharge Measurements at Patch-Hydro in 2011

Date Monitored:	16-Jul-11				**Discharge:**		**0.69** m^3/s		
Start Time (24 hr):									
End Time (24 hr):	14:05								
Personnel:	Craig Hatt and Assistant								
Method:	Velocity-Area								
Instrument:	Flow Mate 2000 with top setting rod								
Stage:	**99.118**								

Notes	**Station (m)**	**Depth (m)**	**Width (m)**	**Area (m^2)**	**60% Velocity (m/s)**	**20% Velocity (m/s)**	**80% Velocity (m/s)**	**Velocity (m/s)**	**Q (m^3/s)**	**% of Total Q**
Right Bank	1.60	0.00	0.40	0.02	0.00			0.00	0.00	0.0
	2.40	0.08	0.70	0.06	0.03			0.03	0.00	0.2
	3.00	0.18	0.55	0.10	0.07			0.07	0.01	1.0
	3.50	0.25	0.40	0.10	0.23			0.23	0.02	3.3
	3.80	0.27	0.30	0.08	0.21			0.21	0.02	2.5
	4.10	0.30	0.30	0.09	0.17			0.17	0.02	2.2
	4.40	0.30	0.30	0.09	0.21			0.21	0.02	2.7
	4.70	0.33	0.30	0.10	0.17			0.17	0.02	2.4
	5.00	0.34	0.30	0.10	0.20			0.20	0.02	3.0
	5.30	0.34	0.30	0.10	0.19			0.19	0.02	2.8
	5.60	0.35	0.30	0.11	0.31			0.31	0.03	4.7
	5.90	0.39	0.30	0.12	0.41			0.41	0.05	7.0
	6.20	0.41	0.30	0.12	0.45			0.45	0.06	8.0
	6.50	0.42	0.30	0.13	0.47			0.47	0.06	8.6
	6.80	0.40	0.30	0.12	0.35			0.35	0.04	6.1
	7.10	0.39	0.30	0.12	0.37			0.37	0.04	6.3
	7.40	0.38	0.30	0.11	0.32			0.32	0.04	5.3
	7.70	0.40	0.30	0.12	0.39			0.39	0.05	6.8
	8.00	0.38	0.30	0.11	0.38			0.38	0.04	6.3
	8.30	0.40	0.30	0.12	0.30			0.30	0.04	5.2
	8.60	0.40	0.30	0.12	0.32			0.32	0.04	5.6
	8.90	0.36	0.30	0.11	0.28			0.28	0.03	4.4
	9.20	0.36	0.40	0.14	0.23			0.23	0.03	4.8
	9.70	0.30	0.40	0.12	0.01			0.01	0.00	0.2
	10.00	0.24	0.40	0.10	0.02			0.02	0.00	0.3
	10.50	0.20	0.50	0.10	0.01			0.01	0.00	0.1
	11.00	0.16	0.50	0.08	0.01			0.01	0.00	0.1
	11.50	0.14	0.50	0.07	-0.01			-0.01	0.00	-0.1
Left Bank	12.00	0.00	0.25	0.02	0.00			0.00	0.00	0.0
Total Q									**0.69**	

Appendix A1-3. Discharge Measurements at Patch-Hydro in 2011

Date Monitored:	16-Aug-11					**Discharge:**	**0.15** m^3/s		
Start Time (24 hr):									
End Time (24 hr):	12:50								
Personnel:	Craig Hatt and Assistant								
Method:	Velocity-Area								
Instrument:	Flow Mate 2000 with top setting rod								
Stage:	**98.922**								

Notes	Station (m)	Depth (m)	Width (m)	Area (m^2)	60% Velocity (m/s)	20% Velocity (m/s)	80% Velocity (m/s)	Velocity (m/s)	Q (m^3/s)	% of Total Q
Right Bank	1.00	0.00	0.20	0.01	0.00			0.00	0.00	0.0
	1.40	0.09	0.45	0.04	0.00			0.00	0.00	0.0
	1.90	0.08	0.50	0.04	0.00			0.00	0.00	0.0
	2.40	0.12	0.33	0.04	0.02			0.02	0.00	0.5
	2.55	0.12	0.15	0.02	0.06			0.06	0.00	0.7
	2.70	0.12	0.15	0.02	0.19			0.19	0.00	2.3
	2.85	0.13	0.15	0.02	0.18			0.18	0.00	2.4
	3.00	0.20	0.15	0.03	0.34			0.34	0.01	6.9
	3.15	0.22	0.15	0.03	0.30			0.30	0.01	6.7
	3.30	0.20	0.15	0.03	0.29			0.29	0.01	5.9
	3.45	0.20	0.10	0.02	0.27			0.27	0.01	3.7
	3.50	0.21	0.08	0.02	0.31			0.31	0.00	3.3
	3.60	0.18	0.10	0.02	0.42			0.42	0.01	5.1
	3.70	0.18	0.13	0.02	0.34			0.34	0.01	5.2
	3.85	0.21	0.15	0.03	0.22			0.22	0.01	4.7
	4.00	0.18	0.15	0.03	0.23			0.23	0.01	4.2
	4.15	0.16	0.11	0.02	0.41			0.41	0.01	5.0
	4.23	0.16	0.07	0.01	0.44			0.44	0.01	3.6
	4.30	0.16	0.08	0.01	0.52			0.52	0.01	4.2
	4.38	0.15	0.08	0.01	0.47			0.47	0.01	3.6
	4.45	0.15	0.08	0.01	0.48			0.48	0.01	3.7
	4.53	0.16	0.07	0.01	0.39			0.39	0.00	3.2
	4.60	0.16	0.07	0.01	0.31			0.31	0.00	2.5
	4.68	0.18	0.08	0.01	0.41			0.41	0.01	3.7
	4.75	0.20	0.11	0.02	0.45			0.45	0.01	6.9
	4.90	0.22	0.13	0.03	0.44			0.44	0.01	8.2
	5.00	0.18	0.10	0.02	0.29			0.29	0.01	3.5
	5.10	0.12	0.10	0.01	0.04			0.04	0.00	0.3
Left Bank	5.20	0.00	0.05	0.00	0.00			0.00	0.00	0.0
Total Q									**0.15**	

Appendix A1-3. Discharge Measurements at Patch-Hydro in 2011

Date Monitored:	23-Sep-11					**Discharge:**		**0.25** m^3/s		
Start Time (24 hr):	9:10									
End Time (24 hr):										
Personnel:	Craig Hatt and Assistant									
Method:	Velocity-Area									
Instrument:	Flow Mate 2000 with top setting rod									
Stage:	**99.348**									
Notes	**Station (m)**	**Depth (m)**	**Width (m)**	**Area (m^2)**	**60% Velocity (m/s)**	**20% Velocity (m/s)**	**80% Velocity (m/s)**	**Velocity (m/s)**	**Q (m^3/s)**	**% of Total Q**
Right Bank	0.90	0.00	0.30	0.01	0.00			0.00	0.00	0.0
	1.50	0.09	0.55	0.05	0.01			0.01	0.00	0.2
	2.00	0.15	0.50	0.08	0.01			0.01	0.00	0.3
	2.50	0.19	0.50	0.10	0.04			0.04	0.00	1.5
	3.00	0.22	0.35	0.08	0.01			0.01	0.00	0.3
	3.20	0.21	0.20	0.04	0.03			0.03	0.00	0.5
	3.40	0.26	0.20	0.05	0.08			0.08	0.00	1.6
	3.60	0.28	0.20	0.06	0.13			0.13	0.01	2.9
	3.80	0.29	0.20	0.06	0.19			0.19	0.01	4.4
	4.00	0.28	0.20	0.06	0.33			0.33	0.02	7.3
	4.20	0.26	0.20	0.05	0.28			0.28	0.01	5.7
	4.40	0.26	0.20	0.05	0.37			0.37	0.02	7.6
	4.60	0.26	0.20	0.05	0.26			0.26	0.01	5.3
	4.80	0.27	0.20	0.05	0.42			0.42	0.02	9.0
	5.00	0.26	0.20	0.05	0.38			0.38	0.02	7.8
	5.20	0.28	0.20	0.06	0.34			0.34	0.02	7.5
	5.40	0.26	0.20	0.05	0.23			0.23	0.01	4.7
	5.60	0.30	0.20	0.06	0.25			0.25	0.02	5.9
	5.80	0.28	0.20	0.06	0.25			0.25	0.01	5.5
	6.00	0.26	0.20	0.05	0.23			0.23	0.01	4.7
	6.20	0.26	0.20	0.05	0.14			0.14	0.01	2.9
	6.40	0.28	0.20	0.06	0.14			0.14	0.01	3.1
	6.60	0.27	0.20	0.05	0.25			0.25	0.01	5.3
	6.80	0.26	0.20	0.05	0.24			0.24	0.01	4.9
	7.00	0.24	0.20	0.05	0.05			0.05	0.00	0.9
	7.20	0.18	0.40	0.07	0.00			0.00	0.00	0.0
Left Bank	7.80	0.00	0.30	0.03	0.00			0.00	0.00	0.0
Total Q									**0.25**	

Appendix A1-4. Discharge Measurements at PO-Hydro in 2011

Date Monitored:	12-Jun-11					**Discharge:**	**0.35** m^3/s		
Start Time (24 hr):									
End Time (24 hr):	14:30								
Personnel:	Craig Hatt; Max Taylor								
Method:	Velocity-Area								
Instrument:	Flow Mate 2000 with top setting rod								
Stage:	**99.665**								

Notes	**Station (m)**	**Depth (m)**	**Width (m)**	**Area (m^2)**	**60% Velocity (m/s)**	**20% Velocity (m/s)**	**80% Velocity (m/s)**	**Velocity (m/s)**	**Q (m^3/s)**	**% of Total Q**
Left Bank	14.20	0.00	0.50	0.06	0.00			0.00	0.00	0.0
	13.20	0.24	1.00	0.24	0.00			0.00	0.00	0.0
	12.20	0.36	1.00	0.36	0.00			0.00	0.00	0.0
	11.20	0.36	1.00	0.36	0.01			0.01	0.00	1.0
	10.20	0.41	0.65	0.27	0.03			0.03	0.01	2.3
	9.90	0.45	0.30	0.14	0.11			0.11	0.01	4.2
	9.60	0.47	0.23	0.11	0.21			0.21	0.02	6.3
	9.45	0.50	0.15	0.07	0.17			0.17	0.01	3.6
	9.30	0.53	0.15	0.08	0.18			0.18	0.01	4.1
	9.15	0.56	0.15	0.08	0.22			0.22	0.02	5.2
	9.00	0.60	0.15	0.09	0.29			0.29	0.03	7.4
	8.85	0.64	0.15	0.10	0.21			0.21	0.02	5.7
	8.70	0.58	0.15	0.09	0.28			0.28	0.02	6.9
	8.55	0.60	0.15	0.09	0.26			0.26	0.02	6.6
	8.40	0.58	0.15	0.09	0.32			0.32	0.03	7.9
	8.25	0.59	0.15	0.09	0.28			0.28	0.02	7.0
	8.10	0.59	0.15	0.09	0.27			0.27	0.02	6.8
	7.95	0.59	0.15	0.09	0.23			0.23	0.02	5.8
	7.80	0.54	0.15	0.08	0.22			0.22	0.02	5.1
	7.65	0.46	0.15	0.07	0.10			0.10	0.01	2.0
	7.50	0.45	0.23	0.10	0.06			0.06	0.01	1.7
	7.20	0.46	0.30	0.14	0.06			0.06	0.01	2.3
	6.90	0.36	0.30	0.11	0.12			0.12	0.01	3.7
	6.60	0.37	0.30	0.11	0.09			0.09	0.01	2.8
	6.30	0.36	0.30	0.11	0.05			0.05	0.01	1.5
	6.00	0.36	0.65	0.23	0.00			0.00	0.00	0.0
	5.00	0.34	1.00	0.34	0.00			0.00	0.00	0.0
	4.00	0.34	1.00	0.34	0.00			0.00	0.00	0.0
Right Bank	3.00	0.29	0.50	0.16	0.00			0.00	0.00	0.0
Total Q									**0.35**	

Appendix A1-4. Discharge Measurements at PO-Hydro in 2011

Date Monitored:	20-Jun-11	**Discharge:**	**4.43** m^3/s
Start Time (24 hr):			
End Time (24 hr):	16:00		
Personnel:	Craig Hatt; Max Taylor		
Method:	Velocity-Area		
Instrument:	Flow Mate 2000 with top setting rod		
Stage:	**99.924**		

Notes	**Station (m)**	**Depth (m)**	**Width (m)**	**Area (m^2)**	**60% Velocity (m/s)**	**20% Velocity (m/s)**	**80% Velocity (m/s)**	**Velocity (m/s)**	**Q (m^3/s)**	**% of Total Q**
Right Bank	1.20	0.00	0.25	0.02	0.00			0.00	0.00	0.0
	1.70	0.19	0.65	0.12	0.00			0.00	0.00	0.0
	2.50	0.28	0.65	0.18	0.00			0.00	0.00	0.0
	3.00	0.36	0.50	0.18	0.10			0.10	0.02	0.4
	3.50	0.24	0.50	0.12	0.19			0.19	0.02	0.5
	4.00	0.28	0.50	0.14	0.12			0.12	0.02	0.4
	4.50	0.37	0.50	0.19	0.17			0.17	0.03	0.7
	5.00	0.40	0.50	0.20	0.00			0.00	0.00	0.0
	5.50	0.37	0.50	0.19	0.25			0.25	0.05	1.0
	6.00	0.48	0.50	0.24	0.66			0.66	0.16	3.6
	6.50	0.40	0.40	0.16	0.88			0.88	0.14	3.2
	6.80	0.38	0.30	0.11	0.90			0.90	0.10	2.3
	7.10	0.37	0.30	0.11	0.94			0.94	0.10	2.4
	7.40	0.32	0.30	0.10	1.07			1.07	0.10	2.3
	7.70	0.32	0.30	0.10	1.16			1.16	0.11	2.5
	8.00	0.40	0.30	0.12	1.31			1.31	0.16	3.5
	8.30	0.46	0.30	0.14	1.41			1.41	0.19	4.4
	8.60	0.52	0.30	0.16	1.31			1.31	0.20	4.6
	8.90	0.52	0.30	0.16	1.11			1.11	0.17	3.9
	9.20	0.62	0.30	0.19	1.29			1.29	0.24	5.4
	9.50	0.75	0.30	0.23	1.37			1.37	0.31	7.0
	9.80	0.80	0.30	0.24		1.75	1.4	1.58	0.38	8.5
	10.10	0.83	0.30	0.25		1.63	1.33	1.48	0.37	8.3
	10.40	0.79	0.30	0.24		1.65	0.96	1.31	0.31	7.0
	10.70	0.80	0.30	0.24		1.54	1.11	1.33	0.32	7.2
	11.00	0.78	0.30	0.23		1.39	1	1.20	0.28	6.3
	11.30	0.44	0.30	0.13	0.84			0.84	0.11	2.5
	11.60	0.48	0.30	0.14	0.87			0.87	0.13	2.8
	11.90	0.52	0.30	0.16	1.15			1.15	0.18	4.0
	12.20	0.52	0.30	0.16	0.85			0.85	0.13	3.0
	12.50	0.49	0.40	0.20	0.32			0.32	0.06	1.4
	13.00	0.42	0.75	0.32	0.07			0.07	0.02	0.5
	14.00	0.30	0.95	0.29	0.04			0.04	0.01	0.3
Left Bank	14.90	0.00	0.45	0.07	0.00			0.00	0.00	0.0
Total Q									**4.43**	

Appendix A1-4. Discharge Measurements at PO-Hydro in 2011

Date Monitored:	16-Jul-11				**Discharge:**		**1.06** m^3/s		
Start Time (24 hr):									
End Time (24 hr):	15:31								
Personnel:	Craig Hatt and Assistant								
Method:	Velocity-Area								
Instrument:	Flow Mate 2000 with top setting rod								
Stage:	**99.717**								

Notes	Station (m)	Depth (m)	Width (m)	Area (m^2)	60% Velocity (m/s)	20% Velocity (m/s)	80% Velocity (m/s)	Velocity (m/s)	Q (m^3/s)	% of Total Q
Right Bank	1.30	0.00	0.45	0.02	0.00			0.00	0.00	0.0
	2.20	0.09	0.85	0.08	0.00			0.00	0.00	0.0
	3.00	0.13	0.80	0.10	0.00			0.00	0.00	0.0
	3.80	0.20	0.75	0.15	0.00			0.00	0.00	0.0
	4.50	0.22	0.50	0.11	0.01			0.01	0.00	0.1
	4.80	0.28	0.20	0.06	0.32			0.32	0.02	1.7
	4.90	0.40	0.10	0.04	0.58			0.58	0.02	2.2
	5.00	0.55	0.10	0.05	0.71			0.71	0.04	3.7
	5.10	0.60	0.10	0.06	0.86			0.86	0.05	4.9
	5.20	0.66	0.10	0.07	0.96			0.96	0.06	6.0
	5.30	0.67	0.10	0.07	1.06			1.06	0.07	6.7
	5.40	0.65	0.10	0.07	1.11			1.11	0.07	6.8
	5.50	0.70	0.10	0.07	1.15			1.15	0.08	7.6
	5.60	0.70	0.10	0.07	1.17			1.17	0.08	7.7
	5.70	0.68	0.10	0.07	1.17			1.17	0.08	7.5
	5.80	0.68	0.10	0.07	1.09			1.09	0.07	7.0
	5.90	0.66	0.10	0.07	1.04			1.04	0.07	6.5
	6.00	0.65	0.10	0.06	1.05			1.05	0.07	6.4
	6.10	0.63	0.10	0.06	1.00			1.00	0.06	5.9
	6.20	0.57	0.10	0.06	1.07			1.07	0.06	5.7
	6.30	0.58	0.10	0.06	0.91			0.91	0.05	5.0
	6.40	0.54	0.10	0.05	0.78			0.78	0.04	4.0
	6.50	0.46	0.10	0.05	0.62			0.62	0.03	2.7
	6.60	0.46	0.10	0.05	0.19			0.19	0.01	0.8
	6.70	0.36	0.15	0.05	0.06			0.06	0.00	0.3
	6.90	0.28	0.20	0.06	0.04			0.04	0.00	0.2
	7.10	0.22	0.25	0.06	0.04			0.04	0.00	0.2
	7.40	0.24	0.35	0.08	0.03			0.03	0.00	0.2
	7.80	0.20	0.60	0.12	0.04			0.04	0.00	0.5
Left Bank	8.60	0.00	0.40	0.04	0.00			0.00	0.00	0.0
Total Q									**1.06**	

Appendix A1-4. Discharge Measurements at PO-Hydro in 2011

Date Monitored:	16-Aug-11					**Discharge:**		**0.19** m^3/s	
Start Time (24 hr):	15:45								
End Time (24 hr):									
Personnel:	Craig Hatt and Assistant								
Method:	Velocity-Area								
Instrument:	Flow Mate 2000 with top setting rod								
Stage:	**99.519**								

Notes	**Station (m)**	**Depth (m)**	**Width (m)**	**Area (m^2)**	**60% Velocity (m/s)**	**20% Velocity (m/s)**	**80% Velocity (m/s)**	**Velocity (m/s)**	**Q (m^3/s)**	**% of Total Q**
Right Bank	0.80	0.00	0.05	0.00	0.00			0.00	0.00	0.0
	0.90	0.18	0.10	0.02	0.00			0.00	0.00	0.0
	1.00	0.34	0.10	0.03	0.08			0.08	0.00	1.5
	1.10	0.40	0.10	0.04	0.25			0.25	0.01	5.3
	1.20	0.44	0.10	0.04	0.33			0.33	0.01	7.8
	1.30	0.44	0.08	0.03	0.36			0.36	0.01	6.3
	1.35	0.45	0.05	0.02	0.39			0.39	0.01	4.7
	1.40	0.44	0.05	0.02	0.40			0.40	0.01	4.7
	1.45	0.46	0.05	0.02	0.37			0.37	0.01	4.5
	1.50	0.48	0.05	0.02	0.38			0.38	0.01	4.9
	1.55	0.49	0.05	0.02	0.36			0.36	0.01	4.7
	1.60	0.49	0.05	0.02	0.41			0.41	0.01	5.4
	1.65	0.49	0.05	0.02	0.41			0.41	0.01	5.4
	1.70	0.48	0.05	0.02	0.39			0.39	0.01	5.0
	1.75	0.48	0.05	0.02	0.40			0.40	0.01	5.1
	1.80	0.48	0.05	0.02	0.36			0.36	0.01	4.6
	1.85	0.46	0.05	0.02	0.39			0.39	0.01	4.8
	1.90	0.46	0.05	0.02	0.36			0.36	0.01	4.4
	1.95	0.38	0.05	0.02	0.35			0.35	0.01	3.6
	2.00	0.38	0.08	0.03	0.33			0.33	0.01	5.0
	2.10	0.42	0.10	0.04	0.24			0.24	0.01	5.4
	2.20	0.38	0.10	0.04	0.20			0.20	0.01	4.1
	2.30	0.34	0.10	0.03	0.11			0.11	0.00	2.0
	2.40	0.32	0.10	0.03	0.04			0.04	0.00	0.7
	2.50	0.27	0.10	0.03	0.01			0.01	0.00	0.1
	2.60	0.24	0.10	0.02	0.00			0.00	0.00	0.0
	2.70	0.17	0.10	0.02	0.01			0.01	0.00	0.1
	2.80	0.10	0.10	0.01	0.00			0.00	0.00	0.0
Left Bank	2.90	0.00	0.05	0.00	0.00			0.00	0.00	0.0
Total Q									**0.19**	

Appendix A1-4. Discharge Measurements at PO-Hydro in 2011

Date Monitored:	23-Sep-11	**Discharge:**	**0.53** m^3/s
Start Time (24 hr):			
End Time (24 hr):	11:50		
Personnel:	Craig Hatt and Assistant		
Method:	Velocity-Area		
Instrument:	Flow Mate 2000 with top setting rod		
Stage:	**99.592**		

Notes	Station (m)	Depth (m)	Width (m)	Area (m^2)	60% Velocity (m/s)	20% Velocity (m/s)	80% Velocity (m/s)	Velocity (m/s)	Q (m^3/s)	% of Total Q
Left Bank	5.50	0.00	0.13	0.01	0.00			0.00	0.00	0.0
	5.25	0.11	0.30	0.03	0.03			0.03	0.00	0.2
	4.90	0.16	0.23	0.04	0.02			0.02	0.00	0.1
	4.80	0.31	0.10	0.03	0.04			0.04	0.00	0.2
	4.70	0.33	0.10	0.03	0.37			0.37	0.01	2.3
	4.60	0.37	0.10	0.04	0.63			0.63	0.02	4.4
	4.50	0.38	0.10	0.04	0.72			0.72	0.03	5.1
	4.40	0.39	0.10	0.04	0.83			0.83	0.03	6.1
	4.30	0.45	0.10	0.05	0.81			0.81	0.04	6.8
	4.20	0.48	0.10	0.05	0.80			0.80	0.04	7.2
	4.10	0.49	0.10	0.05	0.69			0.69	0.03	6.3
	4.00	0.44	0.10	0.04	0.67			0.67	0.03	5.5
	3.90	0.44	0.10	0.04	0.66			0.66	0.03	5.5
	3.80	0.44	0.10	0.04	0.70			0.70	0.03	5.8
	3.70	0.38	0.10	0.04	0.81			0.81	0.03	5.8
	3.60	0.36	0.10	0.04	0.79			0.79	0.03	5.3
	3.50	0.36	0.10	0.04	0.73			0.73	0.03	4.9
	3.40	0.40	0.10	0.04	0.62			0.62	0.02	4.7
	3.30	0.41	0.10	0.04	0.54			0.54	0.02	4.2
	3.20	0.40	0.10	0.04	0.58			0.58	0.02	4.4
	3.10	0.38	0.10	0.04	0.62			0.62	0.02	4.4
	3.00	0.38	0.10	0.04	0.58			0.58	0.02	4.1
	2.90	0.30	0.10	0.03	0.48			0.48	0.01	2.7
	2.80	0.30	0.10	0.03	0.38			0.38	0.01	2.1
	2.70	0.32	0.10	0.03	0.03			0.03	0.00	0.2
	2.60	0.26	0.35	0.09	0.03			0.03	0.00	0.5
	2.00	0.20	0.50	0.10	0.04			0.04	0.00	0.8
	1.60	0.17	0.50	0.09	0.02			0.02	0.00	0.3
Right Bank	1.00	0.00	0.30	0.03	0.00			0.00	0.00	0.0
Total Q									**0.53**	

Appendix A1-5. Discharge Measurements at Reference B-Hydro in 2011

Date Monitored:	18-Jun-11					**Discharge:**		**11.29** m^3/s		
Start Time (24 hr):	14:00									
End Time (24 hr):										
Personnel:	Craig Hatt; Max Taylor									
Method:	Velocity-Area									
Instrument:	Flow Mate 2000 with top setting rod									
Stage:	**98.631**									
Notes	**Station (m)**	**Depth (m)**	**Width (m)**	**Area (m^2)**	**60% Velocity (m/s)**	**20% Velocity (m/s)**	**80% Velocity (m/s)**	**Velocity (m/s)**	**Q (m^3/s)**	**% of Total Q**
Right Bank	2.60	0.00	0.20	0.03	0.00			0.00	0.00	0.0
	3.00	0.26	1.20	0.31	0.30			0.30	0.09	0.8
	5.00	0.96	1.50	1.44		0.55	0.31	0.43	0.62	5.5
	6.00	1.25	0.85	1.06		0.67	0.38	0.53	0.56	4.9
	6.70	0.39	1.00	0.39	0.55			0.55	0.21	1.9
	8.00	0.32	1.15	0.37	0.44			0.44	0.16	1.4
	9.00	0.50	1.00	0.50	0.23			0.23	0.12	1.0
	10.00	0.40	1.00	0.40	0.32			0.32	0.13	1.1
	11.00	0.50	1.00	0.50	0.27			0.27	0.14	1.2
	12.00	0.64	1.50	0.96	0.25			0.25	0.24	2.1
	14.00	0.60	1.70	1.02	0.30			0.30	0.31	2.7
	15.40	0.54	0.95	0.51	0.46			0.46	0.24	2.1
	15.90	0.17	0.80	0.14	0.13			0.13	0.02	0.2
	17.00	0.12	0.85	0.10	0.80			0.80	0.08	0.7
	17.60	0.40	1.30	0.52	0.38			0.38	0.20	1.8
	19.60	0.54	2.20	1.19	0.39			0.39	0.46	4.1
	22.00	0.62	2.20	1.36	0.28			0.28	0.38	3.4
	24.00	0.69	2.00	1.38	0.44			0.44	0.61	5.4
Marked in Field Notes as:	26.00	0.60	1.75	1.05	0.40			0.40	0.42	3.7
27.5	27.50	0.88	1.75	1.54		0.04	0.15	0.10	0.15	1.3
25.5	29.50	0.90	2.00	1.80		0.29	0.25	0.27	0.49	4.3
23.5	31.50	0.88	2.00	1.76		0.5	0.18	0.34	0.60	5.3
21.5	33.50	0.85	2.00	1.70		0.17	0.07	0.12	0.20	1.8
19.5	35.50	0.70	2.00	1.40	0.48			0.48	0.67	6.0
17.5	37.50	0.72	2.00	1.44	0.72			0.72	1.04	9.2
15.5	39.50	0.50	2.00	1.00	0.89			0.89	0.89	7.9
13.5	41.50	0.42	2.00	0.84	0.87			0.87	0.73	6.5
11.5	43.50	0.30	2.00	0.60	0.78			0.78	0.47	4.1
9.5	45.50	0.30	2.00	0.60	0.54			0.54	0.32	2.9
7.5	47.50	0.45	1.75	0.79	0.75			0.75	0.59	5.2
6	49.00	0.28	1.15	0.32	0.27			0.27	0.09	0.8
5.2	49.80	0.18	0.45	0.08	0.07			0.07	0.01	0.1
5.1	49.90	0.08	1.50	0.12	0.12			0.12	0.01	0.1
2.2	52.80	0.08	2.30	0.18	0.12			0.12	0.02	0.2
0.5	54.50	0.28	1.35	0.38	0.09			0.09	0.03	0.3
Left Bank	55.50	0.00	0.50	0.07	0.00			0.00	0.00	0.0
Total Q									**11.29**	

Appendix A1-5. Discharge Measurements at Reference B-Hydro in 2011

Date Monitored:	22-Jun-11					**Discharge:**		**14.60** m^3/s	
Start Time (24 hr):	13:00								
End Time (24 hr):									
Personnel:	Craig Hatt; Max Taylor								
Method:	Velocity-Area								
Instrument:	Flow Mate 2000 with top setting rod								
Stage:	**98.610**								

Notes	Station (m)	Depth (m)	Width (m)	Area (m^2)	60% Velocity (m/s)	20% Velocity (m/s)	80% Velocity (m/s)	Velocity (m/s)	Q (m^3/s)	% of Total Q
Right Bank; Marked in notes as 28	-26.00	0.00	0.75	0.21	0.00			0.00	0.00	0.0
26.5	-24.50	0.56	1.75	0.98	0.09			0.09	0.09	0.6
24.5	-22.50	0.34	1.25	0.43	0.40			0.40	0.17	1.2
24	-22.00	0.62	0.70	0.43	0.45			0.45	0.20	1.3
23.1	-21.10	0.35	0.95	0.33	0.51			0.51	0.17	1.2
22.1	-20.10	0.86	1.05	0.90		0.83	0.1	0.47	0.42	2.9
21	-19.00	0.75	1.55	1.16	-0.04			-0.04	-0.05	-0.3
19	-17.00	0.51	2.00	1.02	0.00			0.00	0.00	0.0
17	-15.00	0.48	2.00	0.96	0.14			0.14	0.13	0.9
15	-13.00	0.40	2.00	0.80	0.38			0.38	0.30	2.1
13	-11.00	0.71	2.00	1.42	0.37			0.37	0.53	3.6
11	-9.00	0.80	2.00	1.60		0.56	0.36	0.46	0.74	5.0
9	-7.00	0.92	2.00	1.84		0.38	0.29	0.34	0.62	4.2
7	-5.00	0.86	2.00	1.72		0.41	0.28	0.35	0.59	4.1
5	-3.00	0.84	2.00	1.68		0.58	0.25	0.42	0.70	4.8
3	-1.00	0.88	2.00	1.76		0.64	0.51	0.58	1.01	6.9
1	1.00	0.92	2.00	1.84		0.67	0.34	0.51	0.93	6.4
	3.00	0.86	2.00	1.72		0.55	0.48	0.52	0.89	6.1
	5.00	0.84	2.00	1.68		0.76	0.53	0.65	1.08	7.4
	7.00	0.70	2.00	1.40	0.59			0.59	0.83	5.7
	9.00	0.82	2.00	1.64		0.69	0.48	0.59	0.96	6.6
	11.00	0.72	2.00	1.44	0.54			0.54	0.78	5.3
	13.00	0.66	2.00	1.32	0.68			0.68	0.90	6.1
	15.00	0.70	2.00	1.40	0.74			0.74	1.04	7.1
	17.00	0.76	2.00	1.52	0.36			0.36	0.55	3.7
	19.00	0.63	2.00	1.26	0.42			0.42	0.53	3.6
	21.00	0.34	2.00	0.68	0.32			0.32	0.22	1.5
	23.00	0.36	2.00	0.72	0.29			0.29	0.21	1.4
	25.00	0.24	2.00	0.48	0.01			0.01	0.00	0.0
	27.00	0.33	2.00	0.66	0.11			0.11	0.07	0.5
	29.00	0.10	2.00	0.20	0.00			0.00	0.00	0.0
	31.00	0.22	1.50	0.33	0.02			0.02	0.01	0.0
	32.00	0.18	1.00	0.18	0.03			0.03	0.01	0.0
Left Bank	33.00	0.00	0.50	0.05	0.00			0.00	0.00	0.0
Total Q									**14.60**	

Appendix A1-5. Discharge Measurements at Reference B-Hydro in 2011

Date Monitored:	20-Jul-11				**Discharge:**		**1.77** m^3/s		
Start Time (24 hr):	11:40								
End Time (24 hr):									
Personnel:	Craig Hatt and Assistant								
Method:	Velocity-Area								
Instrument:	Flow Mate 2000 with top setting rod								
Stage:	**98.183**								

Notes	Station (m)	Depth (m)	Width (m)	Area (m^2)	60% Velocity (m/s)	20% Velocity (m/s)	80% Velocity (m/s)	Velocity (m/s)	Q (m^3/s)	% of Total Q
Right Bank	0.30	0.00	0.35	0.02	0.00			0.00	0.00	0.0
	1.00	0.12	0.85	0.10	0.03			0.03	0.00	0.2
	2.00	0.08	1.00	0.08	0.03			0.03	0.00	0.1
	3.00	0.12	1.00	0.12	0.02			0.02	0.00	0.1
	4.00	0.12	1.00	0.12	0.01			0.01	0.00	0.1
	5.00	0.16	1.00	0.16	0.03			0.03	0.00	0.3
	6.00	0.31	1.00	0.31	0.02			0.02	0.01	0.4
	7.00	0.18	1.00	0.18	0.03			0.03	0.01	0.3
	8.00	0.4	1.00	0.40	0.01			0.01	0.00	0.2
	9.00	0.21	1.00	0.21	0.02			0.02	0.00	0.2
	10.00	0.21	1.00	0.21	0.03			0.03	0.01	0.4
	11.00	0.28	1.00	0.28	0.01			0.01	0.00	0.2
	12.00	0.36	1.00	0.36	0.03			0.03	0.01	0.6
	13.00	0.23	1.00	0.23	0.06			0.06	0.01	0.8
	14.00	0.45	1.00	0.45	0.03			0.03	0.01	0.8
	15.00	0.43	1.00	0.43	0.05			0.05	0.02	1.2
	16.00	0.56	1.00	0.56	0.07			0.07	0.04	2.2
	17.00	0.6	1.00	0.60	0.06			0.06	0.04	2.0
	18.00	0.54	1.00	0.54	0.05			0.05	0.03	1.5
	19.00	0.50	1.00	0.50	0.07			0.07	0.04	2.0
	20.00	0.38	1.00	0.38	0.08			0.08	0.03	1.7
	21.00	0.73	1.00	0.73	0.08			0.08	0.06	3.3
	22.00	0.90	1.00	0.90		0.07	0.07	0.07	0.06	3.6
	23.00	0.87	1.00	0.87		0.09	0.07	0.08	0.07	3.9
	24.00	0.81	1.00	0.81		0.09	0.06	0.08	0.06	3.4
	25.00	0.88	1.00	0.88		0.09	0.08	0.09	0.07	4.2
	26.00	0.90	1.00	0.90		0.1	0.07	0.09	0.08	4.3
	27.00	0.94	1.00	0.94		0.11	0.07	0.09	0.08	4.8
	28.00	0.92	1.00	0.92		0.11	0.09	0.10	0.09	5.2
	29.00	1.00	1.00	1.00		0.1	0.07	0.09	0.09	4.8
	30.00	1.08	1.00	1.08		0.1	0.08	0.09	0.10	5.5
	31.00	1.00	1.00	1.00		0.11	0.07	0.09	0.09	5.1
	32.00	0.84	1.00	0.84		0.1	0.1	0.10	0.08	4.7
	33.00	0.78	1.00	0.78		0.11	0.08	0.10	0.07	4.2
	34.00	0.83	1.00	0.83		0.1	0.08	0.09	0.07	4.2
	35.00	0.80	1.00	0.80		0.09	0.07	0.08	0.06	3.6
	36.00	0.72	1.00	0.72	0.09			0.09	0.06	3.7
	37.00	0.67	1.00	0.67	0.07			0.07	0.05	2.7
	38.00	0.54	1.00	0.54	0.08			0.08	0.04	2.4
	39.00	0.50	1.00	0.50	0.08			0.08	0.04	2.3
	40.00	0.46	1.00	0.46	0.07			0.07	0.03	1.8
	41.00	0.46	1.00	0.46	0.06			0.06	0.03	1.6
	42.00	0.24	1.00	0.24	0.07			0.07	0.02	0.9
	43.00	0.27	1.00	0.27	0.05			0.05	0.01	0.8
	44.00	0.40	1.00	0.40	0.05			0.05	0.02	1.1
	45.00	0.38	1.00	0.38	0.05			0.05	0.02	1.1
	46.00	0.32	1.00	0.32	0.05			0.05	0.02	0.9
	47.00	0.36	1.00	0.36	0.03			0.03	0.01	0.6
	48.00	0.18	1.00	0.18	0.00			0.00	0.00	0.0
Left Bank	49.00	0.00	0.50	0.05	0.00			0.00	0.00	0.0
Total Q									**1.77**	

Appendix A1-5. Discharge Measurements at Reference B-Hydro in 2011

Date Monitored:	15-Aug-11				**Discharge:**		**0.20** m^3/s		
Start Time (24 hr):	9:50								
End Time (24 hr):									
Personnel:	Craig Hatt and Assistant								
Method:	Velocity-Area								
Instrument:	Flow Mate 2000 with top setting rod								
Stage:	**97.959**								

Notes	**Station (m)**	**Depth (m)**	**Width (m)**	**Area (m^2)**	**60% Velocity (m/s)**	**20% Velocity (m/s)**	**80% Velocity (m/s)**	**Velocity (m/s)**	**Q (m^3/s)**	**% of Total Q**
Right Bank	2.00	0.00	1.00	0.09	0.00			0.00	0.00	0.0
	4.00	0.18	2.00	0.36	0.00			0.00	0.00	0.0
	6.00	0.22	2.00	0.44	0.01			0.01	0.00	2.2
	8.00	0.15	2.00	0.30	0.01			0.01	0.00	1.5
	10.00	0.14	2.00	0.28	0.01			0.01	0.00	1.4
	12.00	0.43	2.00	0.86	0.00			0.00	0.00	0.0
	14.00	0.42	2.00	0.84	0.02			0.02	0.02	8.4
	16.00	0.54	2.00	1.08	0.02			0.02	0.02	10.7
	18.00	0.60	2.00	1.20	0.01			0.01	0.01	6.0
	20.00	0.72	2.00	1.44	0.01			0.01	0.01	7.2
	22.00	0.68	2.00	1.36	0.01			0.01	0.01	6.8
	24.00	0.74	2.00	1.48	0.01			0.01	0.01	7.4
	26.00	0.80	2.00	1.60		0	0	0.00	0.00	0.0
	28.00	0.86	2.00	1.72		0.01	0	0.01	0.01	4.3
	30.00	0.90	2.00	1.80		-0.01	0.01	0.00	0.00	0.0
	32.00	0.90	2.00	1.80		0	-0.01	-0.01	-0.01	-4.5
	34.00	0.78	2.00	1.56		0.02	0.02	0.02	0.03	15.5
	36.00	0.65	2.00	1.30	0.01			0.01	0.01	6.5
	38.00	0.57	2.00	1.14	0.01			0.01	0.01	5.7
	40.00	0.58	1.80	1.04	0.02			0.02	0.02	10.4
	41.60	0.90	1.60	1.44		0.02	0.01	0.02	0.02	10.7
Left Bank	43.20	0.00	0.80	0.36	0.00			0.00	0.00	0.0
Total Q									**0.20**	

Appendix A1-5. Discharge Measurements at Reference B-Hydro in 2011

Date Monitored:	22-Sep-11				**Discharge:**		**1.18** m^3/s		
Start Time (24 hr):	11:15								
End Time (24 hr):									
Personnel:	Craig Hatt and Assistant								
Method:	Velocity-Area								
Instrument:	Flow Mate 2000 with top setting rod								
Stage:	**98.125**								

Notes	**Station (m)**	**Depth (m)**	**Width (m)**	**Area (m^2)**	**60% Velocity (m/s)**	**20% Velocity (m/s)**	**80% Velocity (m/s)**	**Velocity (m/s)**	**Q (m^3/s)**	**% of Total Q**
Right Bank	1.00	0.00	1.00	0.14	0.00			0.00	0.00	0.0
	3.00	0.14	1.85	0.26	0.00			0.00	0.00	0.0
	4.70	0.24	1.45	0.35	0.01			0.01	0.00	0.3
	5.90	0.28	1.65	0.46	0.01			0.01	0.00	0.4
	8.00	0.20	2.05	0.41	-0.01			-0.01	0.00	-0.3
	10.00	0.24	2.00	0.48	0.00			0.00	0.00	0.0
	12.00	0.18	2.00	0.36	0.02			0.02	0.01	0.6
	14.00	0.23	2.00	0.46	0.03			0.03	0.01	1.2
	16.00	0.42	2.00	0.84	0.02			0.02	0.02	1.4
	18.00	0.32	1.90	0.61	0.04			0.04	0.02	2.1
	19.80	0.50	2.00	1.00	0.01			0.01	0.01	0.8
	22.00	0.57	2.10	1.20	0.04			0.04	0.05	4.1
	24.00	0.52	2.00	1.04	0.05			0.05	0.05	4.4
	26.00	0.94	2.00	1.88		0.05	0.02	0.04	0.07	5.6
	28.00	0.90	2.00	1.80		0.06	0.05	0.06	0.10	8.4
	30.00	0.86	2.00	1.72		0.07	0.05	0.06	0.10	8.8
	32.00	0.88	2.00	1.76		0.07	0.06	0.07	0.11	9.7
	34.00	0.92	2.00	1.84		0.07	0.05	0.06	0.11	9.4
	36.00	0.96	2.00	1.92		0.07	0.06	0.07	0.12	10.6
	38.00	0.76	2.00	1.52	0.08			0.08	0.12	10.3
	40.00	0.74	2.00	1.48	0.06			0.06	0.09	7.5
	42.00	0.70	2.00	1.40	0.04			0.04	0.06	4.8
	44.00	0.80	2.00	1.60		0.06	0.02	0.04	0.06	5.4
	46.00	0.70	2.00	1.40	0.03			0.03	0.04	3.6
	48.00	0.30	1.75	0.53	0.02			0.02	0.01	0.9
	49.50	0.16	1.30	0.21	0.01			0.01	0.00	0.2
Left Bank	50.60	0.00	0.55	0.04	0.00			0.00	0.00	0.0
Total Q									**1.18**	

Appendix A2

Summary of Daily Mean Lake Water Level
Doris/Madrid Area

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Appendix A2-1. Summary of Daily Mean Water Level (m) at Doris Lake Station in 2011

Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)
1-Jan	*97.813*	1-Mar	*97.819*	1-May	*97.826*	1-Jul	98.344	1-Sep	97.738	1-Nov	
2-Jan	*97.813*	2-Mar	*97.819*	2-May	*97.826*	2-Jul	98.405	2-Sep	97.738	2-Nov	
3-Jan	*97.814*	3-Mar	*97.822*	3-May	*97.825*	3-Jul	98.443	3-Sep	97.734	3-Nov	
4-Jan	*97.813*	4-Mar	*97.822*	4-May	*97.826*	4-Jul	98.461	4-Sep	97.730	4-Nov	
5-Jan	*97.813*	5-Mar	*97.821*	5-May	*97.825*	5-Jul	98.462	5-Sep	97.728	5-Nov	
6-Jan	*97.813*	6-Mar	*97.821*	6-May	*97.825*	6-Jul	98.446	6-Sep	97.725	6-Nov	
7-Jan	*97.813*	7-Mar	*97.822*	7-May	*97.825*	7-Jul	98.416	7-Sep	97.744	7-Nov	
8-Jan	*97.813*	8-Mar	*97.823*	8-May	*97.825*	8-Jul	98.377	8-Sep	97.783	8-Nov	
9-Jan	*97.813*	9-Mar	*97.824*	9-May	*97.825*	9-Jul	98.357	9-Sep	97.797	9-Nov	
10-Jan	*97.813*	10-Mar	*97.823*	10-May	*97.825*	10-Jul	98.325	10-Sep	97.801	10-Nov	
11-Jan	*97.814*	11-Mar	*97.824*	11-May	*97.831*	11-Jul	98.298	11-Sep	97.807	11-Nov	
12-Jan	*97.815*	12-Mar	*97.823*	12-May	*97.835*	12-Jul	98.262	12-Sep	97.813	12-Nov	
13-Jan	*97.815*	13-Mar	*97.823*	13-May	*97.835*	13-Jul	98.229	13-Sep	97.817	13-Nov	
14-Jan	*97.815*	14-Mar	*97.823*	14-May	*97.835*	14-Jul	98.212	14-Sep	97.820	14-Nov	
15-Jan	*97.811*	15-Mar	*97.824*	15-May	*97.835*	15-Jul	98.186	15-Sep	97.822	15-Nov	
16-Jan	*97.811*	16-Mar	*97.824*	16-May	*97.835*	16-Jul	98.167	16-Sep	97.824	16-Nov	
17-Jan	*97.812*	17-Mar	*97.824*	17-May	*97.835*	17-Jul	98.138	17-Sep	97.828	17-Nov	
18-Jan	*97.811*	18-Mar	*97.824*	18-May	*97.834*	18-Jul	98.095	18-Sep	97.831	18-Nov	
19-Jan	*97.812*	19-Mar	*97.823*	19-May	*97.833*	19-Jul	98.109	19-Sep	97.832	19-Nov	
20-Jan	*97.812*	20-Mar	*97.823*	20-May	*97.833*	20-Jul	98.092	20-Sep	97.833	20-Nov	
21-Jan	*97.813*	21-Mar	*97.823*	21-May	*97.835*	21-Jul	98.074	21-Sep	97.833	21-Nov	
22-Jan	*97.812*	22-Mar	*97.822*	22-May	*97.835*	22-Jul	98.051	22-Sep	97.831	22-Nov	
23-Jan	*97.813*	23-Mar	*97.822*	23-May	*97.835*	23-Jul	98.029	23-Sep	97.841	23-Nov	
24-Jan	*97.814*	24-Mar	*97.822*	24-May	*97.836*	24-Jul	98.012	24-Sep	97.845	24-Nov	
25-Jan	*97.815*	25-Mar	*97.822*	25-May	*97.838*	25-Jul	97.998	25-Sep	97.850	25-Nov	
26-Jan	*97.815*	26-Mar	*97.822*	26-May	*97.839*	26-Jul	97.998	26-Sep	97.854	26-Nov	
27-Jan	*97.816*	27-Mar	*97.822*	27-May	*97.840*	27-Jul	97.981	27-Sep	97.860	27-Nov	
28-Jan	*97.816*	28-Mar	*97.822*	28-May	*97.842*	28-Jul	97.957	28-Sep	97.865	28-Nov	
29-Jan	*97.814*	29-Mar	*97.822*	29-May	*97.844*	29-Jul	97.955	29-Sep	97.866	29-Nov	
30-Jan	*97.813*	30-Mar	*97.821*	30-May	*97.848*	30-Jul	97.941	30-Sep		30-Nov	
31-Jan	*97.814*	31-Mar	*97.821*	31-May	*97.857*	31-Jul	97.926	1-Oct		1-Dec	
1-Feb	*97.813*	1-Apr	*97.821*	1-Jun	97.867	1-Aug	97.910	2-Oct		2-Dec	
2-Feb	*97.813*	2-Apr	*97.822*	2-Jun	97.880	2-Aug	97.901	3-Oct		3-Dec	
3-Feb	*97.812*	3-Apr	*97.823*	3-Jun	97.888	3-Aug	97.901	4-Oct		4-Dec	
4-Feb	*97.813*	4-Apr	*97.823*	4-Jun	97.892	4-Aug	97.872	5-Oct		5-Dec	
5-Feb	*97.813*	5-Apr	*97.822*	5-Jun	97.896	5-Aug	97.871	6-Oct		6-Dec	
6-Feb	*97.815*	6-Apr	*97.822*	6-Jun	97.901	6-Aug	97.859	7-Oct		7-Dec	
7-Feb	*97.813*	7-Apr	*97.822*	7-Jun	97.903	7-Aug	97.861	8-Oct		8-Dec	
8-Feb	*97.814*	8-Apr	*97.824*	8-Jun	97.905	8-Aug	97.841	9-Oct		9-Dec	
9-Feb	*97.814*	9-Apr	*97.824*	9-Jun	97.908	9-Aug	97.842	10-Oct		10-Dec	
10-Feb	*97.813*	10-Apr	*97.825*	10-Jun	97.910	10-Aug	97.837	11-Oct		11-Dec	
11-Feb	*97.813*	11-Apr	*97.824*	11-Jun	97.914	11-Aug	97.828	12-Oct		12-Dec	
12-Feb	*97.813*	12-Apr	*97.821*	12-Jun	97.924	12-Aug	97.812	13-Oct		13-Dec	
13-Feb	*97.814*	13-Apr	*97.822*	13-Jun	97.960	13-Aug	97.803	14-Oct		14-Dec	
14-Feb	*97.815*	14-Apr	*97.822*	14-Jun	98.016	14-Aug	97.801	15-Oct		15-Dec	
15-Feb	*97.816*	15-Apr	*97.822*	15-Jun	98.105	15-Aug	97.798	16-Oct		16-Dec	
16-Feb	*97.817*	16-Apr	*97.821*	16-Jun	98.197	16-Aug	97.783	17-Oct		17-Dec	
17-Feb	*97.816*	17-Apr	*97.821*	17-Jun	98.276	17-Aug	97.771	18-Oct		18-Dec	
18-Feb	*97.817*	18-Apr	*97.822*	18-Jun	98.337	18-Aug	97.776	19-Oct		19-Dec	
19-Feb	*97.817*	19-Apr	*97.822*	19-Jun	98.383	19-Aug	97.765	20-Oct		20-Dec	
20-Feb	*97.817*	20-Apr	*97.823*	20-Jun	98.418	20-Aug	97.761	21-Oct		21-Dec	
21-Feb	*97.818*	21-Apr	*97.824*	21-Jun	98.440	21-Aug	97.757	22-Oct		22-Dec	
22-Feb	*97.818*	22-Apr	*97.824*	22-Jun	98.443	22-Aug	97.754	23-Oct		23-Dec	
23-Feb	*97.819*	23-Apr	*97.824*	23-Jun	98.433	23-Aug	97.750	24-Oct		24-Dec	
24-Feb	*97.819*	24-Apr	*97.824*	24-Jun	98.419	24-Aug	97.751	25-Oct		25-Dec	
25-Feb	*97.818*	25-Apr	*97.824*	25-Jun	98.407	25-Aug	97.747	26-Oct		26-Dec	
26-Feb	*97.818*	26-Apr	*97.824*	26-Jun	98.389	26-Aug	97.745	27-Oct		27-Dec	
27-Feb	*97.819*	27-Apr	*97.823*	27-Jun	98.369	27-Aug	97.742	28-Oct		28-Dec	
28-Feb	*97.820*	28-Apr	*97.825*	28-Jun	98.351	28-Aug	97.739	29-Oct		29-Dec	
		29-Apr	*97.826*	29-Jun	98.324	29-Aug	97.739	30-Oct		30-Dec	
		30-Apr	*97.826*	30-Jun	98.336	30-Aug	97.736	31-Oct		31-Dec	
						31-Aug	97.735				

Note: lake water levels affected by ice conditions are italicized.

Appendix A2-2. Summary of Daily Mean Water Level (m) at Tail Lake Station in 2011

Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)
1-Jan		1-Mar		1-May		1-Jul	95.040	1-Sep	94.993	1-Nov	
2-Jan		2-Mar		2-May		2-Jul	95.108	2-Sep	94.986	2-Nov	
3-Jan		3-Mar		3-May		3-Jul	95.148	3-Sep	94.982	3-Nov	
4-Jan		4-Mar		4-May		4-Jul	95.150	4-Sep	94.981	4-Nov	
5-Jan		5-Mar		5-May		5-Jul	95.161	5-Sep	94.978	5-Nov	
6-Jan		6-Mar		6-May		6-Jul	95.167	6-Sep	94.974	6-Nov	
7-Jan		7-Mar		7-May		7-Jul	95.158	7-Sep	94.994	7-Nov	
8-Jan		8-Mar		8-May		8-Jul	95.153	8-Sep	95.020	8-Nov	
9-Jan		9-Mar		9-May		9-Jul	95.171	9-Sep	95.028	9-Nov	
10-Jan		10-Mar		10-May		10-Jul	95.166	10-Sep	95.032	10-Nov	
11-Jan		11-Mar		11-May		11-Jul	95.155	11-Sep	95.033	11-Nov	
12-Jan		12-Mar		12-May	*94.549*	12-Jul	95.158	12-Sep	95.035	12-Nov	
13-Jan		13-Mar		13-May	*94.548*	13-Jul	95.149	13-Sep	95.035	13-Nov	
14-Jan		14-Mar		14-May	*94.547*	14-Jul	95.156	14-Sep	95.035	14-Nov	
15-Jan		15-Mar		15-May	*94.547*	15-Jul	95.151	15-Sep	95.033	15-Nov	
16-Jan		16-Mar		16-May	*94.548*	16-Jul	95.151	16-Sep	95.031	16-Nov	
17-Jan		17-Mar		17-May	*94.547*	17-Jul	95.142	17-Sep	95.032	17-Nov	
18-Jan		18-Mar		18-May	*94.546*	18-Jul	95.125	18-Sep	95.032	18-Nov	
19-Jan		19-Mar		19-May	*94.545*	19-Jul	95.133	19-Sep	95.030	19-Nov	
20-Jan		20-Mar		20-May	*94.546*	20-Jul	95.131	20-Sep	95.029	20-Nov	
21-Jan		21-Mar		21-May	*94.549*	21-Jul	95.129	21-Sep	95.031	21-Nov	
22-Jan		22-Mar		22-May	*94.549*	22-Jul	95.124	22-Sep	95.034	22-Nov	
23-Jan		23-Mar		23-May	*94.551*	23-Jul	95.118	23-Sep	95.044	23-Nov	
24-Jan		24-Mar		24-May	*94.555*	24-Jul	95.112	24-Sep	95.051	24-Nov	
25-Jan		25-Mar		25-May	*94.560*	25-Jul	95.102	25-Sep	95.056	25-Nov	
26-Jan		26-Mar		26-May	*94.566*	26-Jul	95.116	26-Sep	95.061	26-Nov	
27-Jan		27-Mar		27-May	*94.570*	27-Jul	95.119	27-Sep	95.070	27-Nov	
28-Jan		28-Mar		28-May	94.575	28-Jul	95.102	28-Sep	95.072	28-Nov	
29-Jan		29-Mar		29-May	94.586	29-Jul	95.108	29-Sep	95.073	29-Nov	
30-Jan		30-Mar		30-May	94.605	30-Jul	95.108	30-Sep		30-Nov	
31-Jan		31-Mar		31-May	94.626	31-Jul	95.096	1-Oct		1-Dec	
1-Feb		1-Apr		1-Jun	94.642	1-Aug	95.085	2-Oct		2-Dec	
2-Feb		2-Apr		2-Jun	94.690	2-Aug	95.087	3-Oct		3-Dec	
3-Feb		3-Apr		3-Jun	94.689	3-Aug	95.098	4-Oct		4-Dec	
4-Feb		4-Apr		4-Jun	94.672	4-Aug	95.079	5-Oct		5-Dec	
5-Feb		5-Apr		5-Jun	94.685	5-Aug	95.081	6-Oct		6-Dec	
6-Feb		6-Apr		6-Jun	94.702	6-Aug	95.077	7-Oct		7-Dec	
7-Feb		7-Apr		7-Jun	94.697	7-Aug	95.079	8-Oct		8-Dec	
8-Feb		8-Apr		8-Jun	94.688	8-Aug	95.065	9-Oct		9-Dec	
9-Feb		9-Apr		9-Jun	94.693	9-Aug	95.067	10-Oct		10-Dec	
10-Feb		10-Apr		10-Jun	94.683	10-Aug	95.067	11-Oct		11-Dec	
11-Feb		11-Apr		11-Jun	94.698	11-Aug	95.064	12-Oct		12-Dec	
12-Feb		12-Apr		12-Jun	94.728	12-Aug	95.050	13-Oct		13-Dec	
13-Feb		13-Apr		13-Jun	94.756	13-Aug	95.044	14-Oct		14-Dec	
14-Feb		14-Apr		14-Jun	94.788	14-Aug	95.045	15-Oct		15-Dec	
15-Feb		15-Apr		15-Jun	94.821	15-Aug	95.044	16-Oct		16-Dec	
16-Feb		16-Apr		16-Jun	94.829	16-Aug	95.030	17-Oct		17-Dec	
17-Feb		17-Apr		17-Jun	94.848	17-Aug	95.017	18-Oct		18-Dec	
18-Feb		18-Apr		18-Jun	94.868	18-Aug	95.024	19-Oct		19-Dec	
19-Feb		19-Apr		19-Jun	94.886	19-Aug	95.027	20-Oct		20-Dec	
20-Feb		20-Apr		20-Jun	94.905	20-Aug	95.025	21-Oct		21-Dec	
21-Feb		21-Apr		21-Jun	94.919	21-Aug	95.022	22-Oct		22-Dec	
22-Feb		22-Apr		22-Jun	94.928	22-Aug	95.019	23-Oct		23-Dec	
23-Feb		23-Apr		23-Jun	94.930	23-Aug	95.015	24-Oct		24-Dec	
24-Feb		24-Apr		24-Jun	94.931	24-Aug	95.016	25-Oct		25-Dec	
25-Feb		25-Apr		25-Jun	94.942	25-Aug	95.013	26-Oct		26-Dec	
26-Feb		26-Apr		26-Jun	94.955	26-Aug	95.011	27-Oct		27-Dec	
27-Feb		27-Apr		27-Jun	94.942	27-Aug	95.008	28-Oct		28-Dec	
28-Feb		28-Apr		28-Jun	94.961	28-Aug	95.005	29-Oct		29-Dec	
		29-Apr		29-Jun	94.973	29-Aug	95.004	30-Oct		30-Dec	
		30-Apr		30-Jun	95.010	30-Aug	95.002	31-Oct		31-Dec	
						31-Aug	94.998				

Note: lake water levels affected by ice conditions are italicized.

Appendix A2-3. Summary of Daily Mean Water Level (m) at Roberts Lake Station in 2011

Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)
1-Jan		1-Mar		1-May		1-Jul	99.303	1-Sep	98.876	1-Nov	
2-Jan		2-Mar		2-May		2-Jul	99.397	2-Sep	98.874	2-Nov	
3-Jan		3-Mar		3-May		3-Jul	99.429	3-Sep	98.873	3-Nov	
4-Jan		4-Mar		4-May		4-Jul	99.420	4-Sep	98.874	4-Nov	
5-Jan		5-Mar		5-May		5-Jul	99.397	5-Sep	98.871	5-Nov	
6-Jan		6-Mar		6-May		6-Jul	99.364	6-Sep	98.871	6-Nov	
7-Jan		7-Mar		7-May		7-Jul	99.329	7-Sep	98.897	7-Nov	
8-Jan		8-Mar		8-May		8-Jul	99.299	8-Sep	98.930	8-Nov	
9-Jan		9-Mar		9-May		9-Jul	99.270	9-Sep	98.952	9-Nov	
10-Jan		10-Mar		10-May		10-Jul	99.242	10-Sep	98.968	10-Nov	
11-Jan		11-Mar		11-May		11-Jul	99.216	11-Sep	98.980	11-Nov	
12-Jan		12-Mar		12-May		12-Jul	99.194	12-Sep	98.991	12-Nov	
13-Jan		13-Mar		13-May		13-Jul	99.173	13-Sep	98.997	13-Nov	
14-Jan		14-Mar		14-May		14-Jul	99.152	14-Sep	99.003	14-Nov	
15-Jan		15-Mar		15-May		15-Jul	99.134	15-Sep	99.007	15-Nov	
16-Jan		16-Mar		16-May		16-Jul	99.117	16-Sep	99.011	16-Nov	
17-Jan		17-Mar		17-May		17-Jul	99.102	17-Sep	99.012	17-Nov	
18-Jan		18-Mar		18-May		18-Jul	99.093	18-Sep	99.012	18-Nov	
19-Jan		19-Mar		19-May		19-Jul	99.081	19-Sep	99.012	19-Nov	
20-Jan		20-Mar		20-May		20-Jul	99.066	20-Sep	99.011	20-Nov	
21-Jan		21-Mar		21-May		21-Jul	99.053	21-Sep	99.012	21-Nov	
22-Jan		22-Mar		22-May		22-Jul	99.045	22-Sep	99.014	22-Nov	
23-Jan		23-Mar		23-May		23-Jul	99.040	23-Sep	99.020	23-Nov	
24-Jan		24-Mar		24-May		24-Jul	99.032	24-Sep	99.026	24-Nov	
25-Jan		25-Mar		25-May		25-Jul	99.023	25-Sep	99.029	25-Nov	
26-Jan		26-Mar		26-May		26-Jul	99.012	26-Sep		26-Nov	
27-Jan		27-Mar		27-May		27-Jul	99.007	27-Sep		27-Nov	
28-Jan		28-Mar		28-May		28-Jul	99.000	28-Sep		28-Nov	
29-Jan		29-Mar		29-May		29-Jul	98.995	29-Sep		29-Nov	
30-Jan		30-Mar		30-May		30-Jul	98.990	30-Sep		30-Nov	
31-Jan		31-Mar		31-May		31-Jul	98.985	1-Oct		1-Dec	
1-Feb		1-Apr		1-Jun		1-Aug	98.979	2-Oct		2-Dec	
2-Feb		2-Apr		2-Jun		2-Aug	98.968	3-Oct		3-Dec	
3-Feb		3-Apr		3-Jun		3-Aug	98.961	4-Oct		4-Dec	
4-Feb		4-Apr		4-Jun		4-Aug	98.955	5-Oct		5-Dec	
5-Feb		5-Apr		5-Jun		5-Aug	98.951	6-Oct		6-Dec	
6-Feb		6-Apr		6-Jun		6-Aug	98.949	7-Oct		7-Dec	
7-Feb		7-Apr		7-Jun		7-Aug	98.943	8-Oct		8-Dec	
8-Feb		8-Apr		8-Jun		8-Aug	98.934	9-Oct		9-Dec	
9-Feb		9-Apr		9-Jun		9-Aug	98.928	10-Oct		10-Dec	
10-Feb		10-Apr		10-Jun		10-Aug	98.922	11-Oct		11-Dec	
11-Feb		11-Apr		11-Jun		11-Aug	98.917	12-Oct		12-Dec	
12-Feb		12-Apr		12-Jun		12-Aug	98.912	13-Oct		13-Dec	
13-Feb		13-Apr		13-Jun		13-Aug	98.908	14-Oct		14-Dec	
14-Feb		14-Apr		14-Jun		14-Aug	98.906	15-Oct		15-Dec	
15-Feb		15-Apr		15-Jun		15-Aug	98.904	16-Oct		16-Dec	
16-Feb		16-Apr		16-Jun		16-Aug	98.896	17-Oct		17-Dec	
17-Feb		17-Apr		17-Jun		17-Aug	98.895	18-Oct		18-Dec	
18-Feb		18-Apr		18-Jun		18-Aug	98.892	19-Oct		19-Dec	
19-Feb		19-Apr		19-Jun		19-Aug	98.888	20-Oct		20-Dec	
20-Feb		20-Apr		20-Jun		20-Aug	98.887	21-Oct		21-Dec	
21-Feb		21-Apr		21-Jun	99.387	21-Aug	98.889	22-Oct		22-Dec	
22-Feb		22-Apr		22-Jun	99.379	22-Aug	98.893	23-Oct		23-Dec	
23-Feb		23-Apr		23-Jun	99.361	23-Aug	98.884	24-Oct		24-Dec	
24-Feb		24-Apr		24-Jun	99.342	24-Aug	98.882	25-Oct		25-Dec	
25-Feb		25-Apr		25-Jun	99.324	25-Aug	98.881	26-Oct		26-Dec	
26-Feb		26-Apr		26-Jun	99.305	26-Aug	98.879	27-Oct		27-Dec	
27-Feb		27-Apr		27-Jun	99.287	27-Aug	98.879	28-Oct		28-Dec	
28-Feb		28-Apr		28-Jun	99.271	28-Aug	98.879	29-Oct		29-Dec	
		29-Apr		29-Jun	99.252	29-Aug	98.879	30-Oct		30-Dec	
		30-Apr		30-Jun	99.264	30-Aug	98.879	31-Oct		31-Dec	
						31-Aug	98.878				

Note: lake water levels affected by ice conditions are italicized.

Appendix A2-4. Summary of Daily Mean Water Level (m) at Windy Lake Station in 2011

Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)
1-Jan		1-Mar		1-May		1-Jul	95.577	1-Sep	95.392	1-Nov	
2-Jan		2-Mar		2-May		2-Jul	95.613	2-Sep	95.390	2-Nov	
3-Jan		3-Mar		3-May		3-Jul	95.621	3-Sep	95.389	3-Nov	
4-Jan		4-Mar		4-May		4-Jul	95.621	4-Sep	95.388	4-Nov	
5-Jan		5-Mar		5-May		5-Jul	95.617	5-Sep	95.386	5-Nov	
6-Jan		6-Mar		6-May		6-Jul	95.611	6-Sep	95.386	6-Nov	
7-Jan		7-Mar		7-May		7-Jul	95.604	7-Sep	95.404	7-Nov	
8-Jan		8-Mar		8-May		8-Jul	95.599	8-Sep	95.426	8-Nov	
9-Jan		9-Mar		9-May		9-Jul	95.592	9-Sep	95.429	9-Nov	
10-Jan		10-Mar		10-May		10-Jul	95.585	10-Sep	95.430	10-Nov	
11-Jan		11-Mar		11-May		11-Jul	95.576	11-Sep	95.429	11-Nov	
12-Jan		12-Mar		12-May		12-Jul	95.569	12-Sep	95.429	12-Nov	
13-Jan		13-Mar		13-May		13-Jul	95.563	13-Sep	95.427	13-Nov	
14-Jan		14-Mar		14-May		14-Jul	95.556	14-Sep	95.429	14-Nov	
15-Jan		15-Mar		15-May		15-Jul	95.549	15-Sep	95.425	15-Nov	
16-Jan		16-Mar		16-May		16-Jul	95.543	16-Sep	95.422	16-Nov	
17-Jan		17-Mar		17-May		17-Jul	95.537	17-Sep	95.422	17-Nov	
18-Jan		18-Mar		18-May		18-Jul	95.532	18-Sep	95.423	18-Nov	
19-Jan		19-Mar		19-May		19-Jul	95.527	19-Sep	95.423	19-Nov	
20-Jan		20-Mar		20-May		20-Jul	95.515	20-Sep	95.420	20-Nov	
21-Jan		21-Mar		21-May		21-Jul	95.495	21-Sep	95.418	21-Nov	
22-Jan		22-Mar		22-May		22-Jul	95.489	22-Sep	95.419	22-Nov	
23-Jan		23-Mar		23-May		23-Jul	95.484	23-Sep		23-Nov	
24-Jan		24-Mar		24-May		24-Jul	95.480	24-Sep		24-Nov	
25-Jan		25-Mar		25-May		25-Jul	95.475	25-Sep		25-Nov	
26-Jan		26-Mar		26-May		26-Jul	95.466	26-Sep		26-Nov	
27-Jan		27-Mar		27-May		27-Jul	95.461	27-Sep		27-Nov	
28-Jan		28-Mar		28-May		28-Jul	95.458	28-Sep		28-Nov	
29-Jan		29-Mar		29-May		29-Jul	95.456	29-Sep		29-Nov	
30-Jan		30-Mar		30-May		30-Jul	95.455	30-Sep		30-Nov	
31-Jan		31-Mar		31-May		31-Jul	95.451	1-Oct		1-Dec	
1-Feb		1-Apr		1-Jun		1-Aug	95.444	2-Oct		2-Dec	
2-Feb		2-Apr		2-Jun		2-Aug	95.438	3-Oct		3-Dec	
3-Feb		3-Apr		3-Jun		3-Aug	95.434	4-Oct		4-Dec	
4-Feb		4-Apr		4-Jun		4-Aug	95.432	5-Oct		5-Dec	
5-Feb		5-Apr		5-Jun		5-Aug	95.430	6-Oct		6-Dec	
6-Feb		6-Apr		6-Jun		6-Aug	95.429	7-Oct		7-Dec	
7-Feb		7-Apr		7-Jun		7-Aug	95.427	8-Oct		8-Dec	
8-Feb		8-Apr		8-Jun		8-Aug	95.422	9-Oct		9-Dec	
9-Feb		9-Apr		9-Jun		9-Aug	95.419	10-Oct		10-Dec	
10-Feb		10-Apr		10-Jun		10-Aug	95.415	11-Oct		11-Dec	
11-Feb		11-Apr		11-Jun		11-Aug	95.413	12-Oct		12-Dec	
12-Feb		12-Apr		12-Jun		12-Aug	95.411	13-Oct		13-Dec	
13-Feb		13-Apr		13-Jun		13-Aug	95.410	14-Oct		14-Dec	
14-Feb		14-Apr		14-Jun		14-Aug	95.408	15-Oct		15-Dec	
15-Feb		15-Apr		15-Jun		15-Aug	95.403	16-Oct		16-Dec	
16-Feb		16-Apr		16-Jun		16-Aug	95.399	17-Oct		17-Dec	
17-Feb		17-Apr		17-Jun		17-Aug	95.394	18-Oct		18-Dec	
18-Feb		18-Apr		18-Jun		18-Aug	95.398	19-Oct		19-Dec	
19-Feb		19-Apr		19-Jun		19-Aug	95.395	20-Oct		20-Dec	
20-Feb		20-Apr		20-Jun		20-Aug	95.394	21-Oct		21-Dec	
21-Feb		21-Apr		21-Jun	95.546	21-Aug	95.395	22-Oct		22-Dec	
22-Feb		22-Apr		22-Jun	95.547	22-Aug	95.396	23-Oct		23-Dec	
23-Feb		23-Apr		23-Jun	95.547	23-Aug	95.393	24-Oct		24-Dec	
24-Feb		24-Apr		24-Jun	95.548	24-Aug	95.395	25-Oct		25-Dec	
25-Feb		25-Apr		25-Jun	95.549	25-Aug	95.393	26-Oct		26-Dec	
26-Feb		26-Apr		26-Jun	95.552	26-Aug	95.393	27-Oct		27-Dec	
27-Feb		27-Apr		27-Jun	95.551	27-Aug	95.394	28-Oct		28-Dec	
28-Feb		28-Apr		28-Jun	95.552	28-Aug	95.393	29-Oct		29-Dec	
		29-Apr		29-Jun	95.548	29-Aug	95.397	30-Oct		30-Dec	
		30-Apr		30-Jun	95.561	30-Aug	95.396	31-Oct		31-Dec	
						31-Aug	95.395				

Appendix A2-5. Summary of Daily Mean Water Level (m) at Patch Lake Station in 2011

Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)
1-Jan		1-Mar		1-May		1-Jul	99.227	1-Sep	98.890	1-Nov	
2-Jan		2-Mar		2-May		2-Jul	99.283	2-Sep	98.886	2-Nov	
3-Jan		3-Mar		3-May		3-Jul	99.306	3-Sep	98.882	3-Nov	
4-Jan		4-Mar		4-May		4-Jul	99.309	4-Sep	98.881	4-Nov	
5-Jan		5-Mar		5-May		5-Jul	99.302	5-Sep	98.877	5-Nov	
6-Jan		6-Mar		6-May		6-Jul	99.288	6-Sep	98.872	6-Nov	
7-Jan		7-Mar		7-May		7-Jul	99.271	7-Sep	98.892	7-Nov	
8-Jan		8-Mar		8-May		8-Jul	99.255	8-Sep	98.914	8-Nov	
9-Jan		9-Mar		9-May		9-Jul	99.239	9-Sep	98.920	9-Nov	
10-Jan		10-Mar		10-May		10-Jul	99.223	10-Sep	98.926	10-Nov	
11-Jan		11-Mar		11-May		11-Jul	99.208	11-Sep	98.928	11-Nov	
12-Jan		12-Mar		12-May		12-Jul	99.191	12-Sep	98.927	12-Nov	
13-Jan		13-Mar		13-May		13-Jul	99.174	13-Sep	98.928	13-Nov	
14-Jan		14-Mar		14-May		14-Jul	99.159	14-Sep	98.930	14-Nov	
15-Jan		15-Mar		15-May		15-Jul	99.145	15-Sep	98.924	15-Nov	
16-Jan		16-Mar		16-May		16-Jul	99.131	16-Sep	98.919	16-Nov	
17-Jan		17-Mar		17-May		17-Jul	99.117	17-Sep	98.921	17-Nov	
18-Jan		18-Mar		18-May		18-Jul	99.105	18-Sep	98.922	18-Nov	
19-Jan		19-Mar		19-May		19-Jul	99.092	19-Sep	98.918	19-Nov	
20-Jan		20-Mar		20-May		20-Jul	99.083	20-Sep	98.917	20-Nov	
21-Jan		21-Mar		21-May		21-Jul	99.075	21-Sep	98.916	21-Nov	
22-Jan		22-Mar		22-May		22-Jul	99.067	22-Sep	98.918	22-Nov	
23-Jan		23-Mar		23-May		23-Jul	99.057	23-Sep		23-Nov	
24-Jan		24-Mar		24-May		24-Jul	99.051	24-Sep		24-Nov	
25-Jan		25-Mar		25-May		25-Jul	99.043	25-Sep		25-Nov	
26-Jan		26-Mar		26-May		26-Jul	99.038	26-Sep		26-Nov	
27-Jan		27-Mar		27-May		27-Jul	99.026	27-Sep		27-Nov	
28-Jan		28-Mar		28-May		28-Jul	99.020	28-Sep		28-Nov	
29-Jan		29-Mar		29-May		29-Jul	99.016	29-Sep		29-Nov	
30-Jan		30-Mar		30-May		30-Jul	99.012	30-Sep		30-Nov	
31-Jan		31-Mar		31-May		31-Jul	99.005	1-Oct		1-Dec	
1-Feb		1-Apr		1-Jun		1-Aug	98.997	2-Oct		2-Dec	
2-Feb		2-Apr		2-Jun		2-Aug	98.991	3-Oct		3-Dec	
3-Feb		3-Apr		3-Jun		3-Aug	98.985	4-Oct		4-Dec	
4-Feb		4-Apr		4-Jun		4-Aug	98.981	5-Oct		5-Dec	
5-Feb		5-Apr		5-Jun		5-Aug	98.978	6-Oct		6-Dec	
6-Feb		6-Apr		6-Jun		6-Aug	98.974	7-Oct		7-Dec	
7-Feb		7-Apr		7-Jun		7-Aug	98.970	8-Oct		8-Dec	
8-Feb		8-Apr		8-Jun		8-Aug	98.965	9-Oct		9-Dec	
9-Feb		9-Apr		9-Jun		9-Aug	98.961	10-Oct		10-Dec	
10-Feb		10-Apr		10-Jun		10-Aug	98.957	11-Oct		11-Dec	
11-Feb		11-Apr		11-Jun		11-Aug	98.953	12-Oct		12-Dec	
12-Feb		12-Apr		12-Jun		12-Aug	98.949	13-Oct		13-Dec	
13-Feb		13-Apr		13-Jun		13-Aug	98.946	14-Oct		14-Dec	
14-Feb		14-Apr		14-Jun		14-Aug	98.942	15-Oct		15-Dec	
15-Feb		15-Apr		15-Jun		15-Aug	98.935	16-Oct		16-Dec	
16-Feb		16-Apr		16-Jun		16-Aug	98.927	17-Oct		17-Dec	
17-Feb		17-Apr		17-Jun		17-Aug	98.920	18-Oct		18-Dec	
18-Feb		18-Apr		18-Jun		18-Aug	98.921	19-Oct		19-Dec	
19-Feb		19-Apr		19-Jun		19-Aug	98.925	20-Oct		20-Dec	
20-Feb		20-Apr		20-Jun		20-Aug	98.922	21-Oct		21-Dec	
21-Feb		21-Apr		21-Jun		21-Aug	98.915	22-Oct		22-Dec	
22-Feb		22-Apr		22-Jun	99.259	22-Aug	98.905	23-Oct		23-Dec	
23-Feb		23-Apr		23-Jun	99.252	23-Aug	98.904	24-Oct		24-Dec	
24-Feb		24-Apr		24-Jun	99.247	24-Aug	98.911	25-Oct		25-Dec	
25-Feb		25-Apr		25-Jun	99.238	25-Aug	98.908	26-Oct		26-Dec	
26-Feb		26-Apr		26-Jun	99.230	26-Aug	98.906	27-Oct		27-Dec	
27-Feb		27-Apr		27-Jun	99.222	27-Aug	98.905	28-Oct		28-Dec	
28-Feb		28-Apr		28-Jun	99.213	28-Aug	98.902	29-Oct		29-Dec	
		29-Apr		29-Jun	99.202	29-Aug	98.904	30-Oct		30-Dec	
		30-Apr		30-Jun	99.210	30-Aug	98.898	31-Oct		31-Dec	
						31-Aug	98.894				

Appendix A2-6. Summary of Daily Mean Water Level (m) at PO Lake Station in 2011

Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)
1-Jan		1-Mar		1-May		1-Jul	99.691	1-Sep	99.297	1-Nov	
2-Jan		2-Mar		2-May		2-Jul	99.816	2-Sep	99.293	2-Nov	
3-Jan		3-Mar		3-May		3-Jul	99.811	3-Sep	99.289	3-Nov	
4-Jan		4-Mar		4-May		4-Jul	99.774	4-Sep	99.287	4-Nov	
5-Jan		5-Mar		5-May		5-Jul	99.736	5-Sep	99.283	5-Nov	
6-Jan		6-Mar		6-May		6-Jul	99.704	6-Sep	99.281	6-Nov	
7-Jan		7-Mar		7-May		7-Jul	99.678	7-Sep	99.321	7-Nov	
8-Jan		8-Mar		8-May		8-Jul	99.660	8-Sep	99.423	8-Nov	
9-Jan		9-Mar		9-May		9-Jul	99.645	9-Sep	99.444	9-Nov	
10-Jan		10-Mar		10-May		10-Jul	99.633	10-Sep	99.453	10-Nov	
11-Jan		11-Mar		11-May		11-Jul	99.622	11-Sep	99.447	11-Nov	
12-Jan		12-Mar		12-May		12-Jul	99.610	12-Sep	99.439	12-Nov	
13-Jan		13-Mar		13-May		13-Jul	99.600	13-Sep	99.431	13-Nov	
14-Jan		14-Mar		14-May		14-Jul	99.589	14-Sep	99.423	14-Nov	
15-Jan		15-Mar		15-May		15-Jul	99.577	15-Sep	99.410	15-Nov	
16-Jan		16-Mar		16-May		16-Jul	99.564	16-Sep	99.401	16-Nov	
17-Jan		17-Mar		17-May		17-Jul	99.549	17-Sep	99.393	17-Nov	
18-Jan		18-Mar		18-May		18-Jul	99.534	18-Sep	99.388	18-Nov	
19-Jan		19-Mar		19-May		19-Jul	99.517	19-Sep	99.382	19-Nov	
20-Jan		20-Mar		20-May		20-Jul	99.502	20-Sep	99.379	20-Nov	
21-Jan		21-Mar		21-May		21-Jul	99.487	21-Sep	99.381	21-Nov	
22-Jan		22-Mar		22-May		22-Jul	99.477	22-Sep	99.381	22-Nov	
23-Jan		23-Mar		23-May		23-Jul	99.466	23-Sep		23-Nov	
24-Jan		24-Mar		24-May		24-Jul	99.460	24-Sep		24-Nov	
25-Jan		25-Mar		25-May		25-Jul	99.453	25-Sep		25-Nov	
26-Jan		26-Mar		26-May		26-Jul	99.445	26-Sep		26-Nov	
27-Jan		27-Mar		27-May		27-Jul	99.434	27-Sep		27-Nov	
28-Jan		28-Mar		28-May		28-Jul	99.431	28-Sep		28-Nov	
29-Jan		29-Mar		29-May		29-Jul	99.427	29-Sep		29-Nov	
30-Jan		30-Mar		30-May		30-Jul	99.423	30-Sep		30-Nov	
31-Jan		31-Mar		31-May		31-Jul	99.418	1-Oct		1-Dec	
1-Feb		1-Apr		1-Jun		1-Aug	99.409	2-Oct		2-Dec	
2-Feb		2-Apr		2-Jun		2-Aug	99.401	3-Oct		3-Dec	
3-Feb		3-Apr		3-Jun		3-Aug	99.395	4-Oct		4-Dec	
4-Feb		4-Apr		4-Jun		4-Aug	99.392	5-Oct		5-Dec	
5-Feb		5-Apr		5-Jun		5-Aug	99.388	6-Oct		6-Dec	
6-Feb		6-Apr		6-Jun		6-Aug	99.384	7-Oct		7-Dec	
7-Feb		7-Apr		7-Jun		7-Aug	99.377	8-Oct		8-Dec	
8-Feb		8-Apr		8-Jun	*99.342*	8-Aug	99.371	9-Oct		9-Dec	
9-Feb		9-Apr		9-Jun	*99.350*	9-Aug	99.365	10-Oct		10-Dec	
10-Feb		10-Apr		10-Jun	*99.362*	10-Aug	99.358	11-Oct		11-Dec	
11-Feb		11-Apr		11-Jun	*99.403*	11-Aug	99.353	12-Oct		12-Dec	
12-Feb		12-Apr		12-Jun	*99.491*	12-Aug	99.348	13-Oct		13-Dec	
13-Feb		13-Apr		13-Jun	*99.719*	13-Aug	99.345	14-Oct		14-Dec	
14-Feb		14-Apr		14-Jun	*99.925*	14-Aug	99.341	15-Oct		15-Dec	
15-Feb		15-Apr		15-Jun	*99.823*	15-Aug	99.335	16-Oct		16-Dec	
16-Feb		16-Apr		16-Jun	*99.772*	16-Aug	99.325	17-Oct		17-Dec	
17-Feb		17-Apr		17-Jun	*99.755*	17-Aug	99.320	18-Oct		18-Dec	
18-Feb		18-Apr		18-Jun	*99.756*	18-Aug	99.323	19-Oct		19-Dec	
19-Feb		19-Apr		19-Jun	*99.756*	19-Aug	99.319	20-Oct		20-Dec	
20-Feb		20-Apr		20-Jun	99.759	20-Aug	99.315	21-Oct		21-Dec	
21-Feb		21-Apr		21-Jun	99.743	21-Aug	99.314	22-Oct		22-Dec	
22-Feb		22-Apr		22-Jun	99.718	22-Aug	99.312	23-Oct		23-Dec	
23-Feb		23-Apr		23-Jun	99.696	23-Aug	99.306	24-Oct		24-Dec	
24-Feb		24-Apr		24-Jun	99.675	24-Aug	99.304	25-Oct		25-Dec	
25-Feb		25-Apr		25-Jun	99.662	25-Aug	99.299	26-Oct		26-Dec	
26-Feb		26-Apr		26-Jun	99.651	26-Aug	99.297	27-Oct		27-Dec	
27-Feb		27-Apr		27-Jun	99.645	27-Aug	99.298	28-Oct		28-Dec	
28-Feb		28-Apr		28-Jun	99.634	28-Aug	99.296	29-Oct		29-Dec	
		29-Apr		29-Jun	99.620	29-Aug	99.302	30-Oct		30-Dec	
		30-Apr		30-Jun	99.642	30-Aug	99.303	31-Oct		31-Dec	
						31-Aug	99.301				

Appendix A2-7. Summary of Daily Mean Water Level (m) at Wolverine Lake Station in 2011

Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)
1-Jan		1-Mar		1-May		1-Jul	98.840	1-Sep	98.635	1-Nov	
2-Jan		2-Mar		2-May		2-Jul	98.881	2-Sep	98.632	2-Nov	
3-Jan		3-Mar		3-May		3-Jul	98.883	3-Sep	98.631	3-Nov	
4-Jan		4-Mar		4-May		4-Jul	98.877	4-Sep	98.632	4-Nov	
5-Jan		5-Mar		5-May		5-Jul	98.867	5-Sep	98.630	5-Nov	
6-Jan		6-Mar		6-May		6-Jul	98.855	6-Sep	98.627	6-Nov	
7-Jan		7-Mar		7-May		7-Jul	98.844	7-Sep	98.650	7-Nov	
8-Jan		8-Mar		8-May		8-Jul	98.834	8-Sep	98.668	8-Nov	
9-Jan		9-Mar		9-May		9-Jul	98.825	9-Sep	98.671	9-Nov	
10-Jan		10-Mar		10-May		10-Jul	98.816	10-Sep	98.673	10-Nov	
11-Jan		11-Mar		11-May		11-Jul	98.806	11-Sep	98.670	11-Nov	
12-Jan		12-Mar		12-May		12-Jul	98.796	12-Sep	98.671	12-Nov	
13-Jan		13-Mar		13-May		13-Jul	98.786	13-Sep	98.668	13-Nov	
14-Jan		14-Mar		14-May		14-Jul	98.778	14-Sep	98.668	14-Nov	
15-Jan		15-Mar		15-May		15-Jul	98.770	15-Sep	98.666	15-Nov	
16-Jan		16-Mar		16-May		16-Jul	98.765	16-Sep	98.662	16-Nov	
17-Jan		17-Mar		17-May		17-Jul	98.759	17-Sep	98.664	17-Nov	
18-Jan		18-Mar		18-May		18-Jul	98.753	18-Sep	98.663	18-Nov	
19-Jan		19-Mar		19-May		19-Jul	98.745	19-Sep	98.660	19-Nov	
20-Jan		20-Mar		20-May		20-Jul	98.737	20-Sep	98.659	20-Nov	
21-Jan		21-Mar		21-May		21-Jul	98.732	21-Sep	98.659	21-Nov	
22-Jan		22-Mar		22-May		22-Jul	98.729	22-Sep		22-Nov	
23-Jan		23-Mar		23-May		23-Jul	98.724	23-Sep		23-Nov	
24-Jan		24-Mar		24-May		24-Jul	98.723	24-Sep		24-Nov	
25-Jan		25-Mar		25-May		25-Jul	98.718	25-Sep		25-Nov	
26-Jan		26-Mar		26-May		26-Jul	98.714	26-Sep		26-Nov	
27-Jan		27-Mar		27-May		27-Jul	98.709	27-Sep		27-Nov	
28-Jan		28-Mar		28-May		28-Jul	98.704	28-Sep		28-Nov	
29-Jan		29-Mar		29-May		29-Jul	98.704	29-Sep		29-Nov	
30-Jan		30-Mar		30-May		30-Jul	98.702	30-Sep		30-Nov	
31-Jan		31-Mar		31-May		31-Jul	98.698	1-Oct		1-Dec	
1-Feb		1-Apr		1-Jun		1-Aug	98.694	2-Oct		2-Dec	
2-Feb		2-Apr		2-Jun		2-Aug	98.690	3-Oct		3-Dec	
3-Feb		3-Apr		3-Jun		3-Aug	98.685	4-Oct		4-Dec	
4-Feb		4-Apr		4-Jun		4-Aug	98.682	5-Oct		5-Dec	
5-Feb		5-Apr		5-Jun		5-Aug	98.680	6-Oct		6-Dec	
6-Feb		6-Apr		6-Jun		6-Aug	98.680	7-Oct		7-Dec	
7-Feb		7-Apr		7-Jun		7-Aug	98.677	8-Oct		8-Dec	
8-Feb		8-Apr		8-Jun		8-Aug	98.672	9-Oct		9-Dec	
9-Feb		9-Apr		9-Jun		9-Aug	98.669	10-Oct		10-Dec	
10-Feb		10-Apr		10-Jun		10-Aug	98.666	11-Oct		11-Dec	
11-Feb		11-Apr		11-Jun		11-Aug	98.663	12-Oct		12-Dec	
12-Feb		12-Apr		12-Jun		12-Aug	98.660	13-Oct		13-Dec	
13-Feb		13-Apr		13-Jun		13-Aug	98.657	14-Oct		14-Dec	
14-Feb		14-Apr		14-Jun		14-Aug	98.653	15-Oct		15-Dec	
15-Feb		15-Apr		15-Jun		15-Aug	98.645	16-Oct		16-Dec	
16-Feb		16-Apr		16-Jun		16-Aug	98.642	17-Oct		17-Dec	
17-Feb		17-Apr		17-Jun		17-Aug	98.640	18-Oct		18-Dec	
18-Feb		18-Apr		18-Jun		18-Aug	98.639	19-Oct		19-Dec	
19-Feb		19-Apr		19-Jun		19-Aug	98.642	20-Oct		20-Dec	
20-Feb		20-Apr		20-Jun		20-Aug	98.642	21-Oct		21-Dec	
21-Feb		21-Apr		21-Jun	98.842	21-Aug	98.640	22-Oct		22-Dec	
22-Feb		22-Apr		22-Jun	98.835	22-Aug	98.637	23-Oct		23-Dec	
23-Feb		23-Apr		23-Jun	98.828	23-Aug	98.637	24-Oct		24-Dec	
24-Feb		24-Apr		24-Jun	98.824	24-Aug	98.643	25-Oct		25-Dec	
25-Feb		25-Apr		25-Jun	98.820	25-Aug	98.642	26-Oct		26-Dec	
26-Feb		26-Apr		26-Jun	98.817	26-Aug	98.642	27-Oct		27-Dec	
27-Feb		27-Apr		27-Jun	98.814	27-Aug	98.641	28-Oct		28-Dec	
28-Feb		28-Apr		28-Jun	98.814	28-Aug	98.640	29-Oct		29-Dec	
		29-Apr		29-Jun	98.809	29-Aug	98.641	30-Oct		30-Dec	
		30-Apr		30-Jun	98.820	30-Aug	98.639	31-Oct		31-Dec	
						31-Aug	98.637				

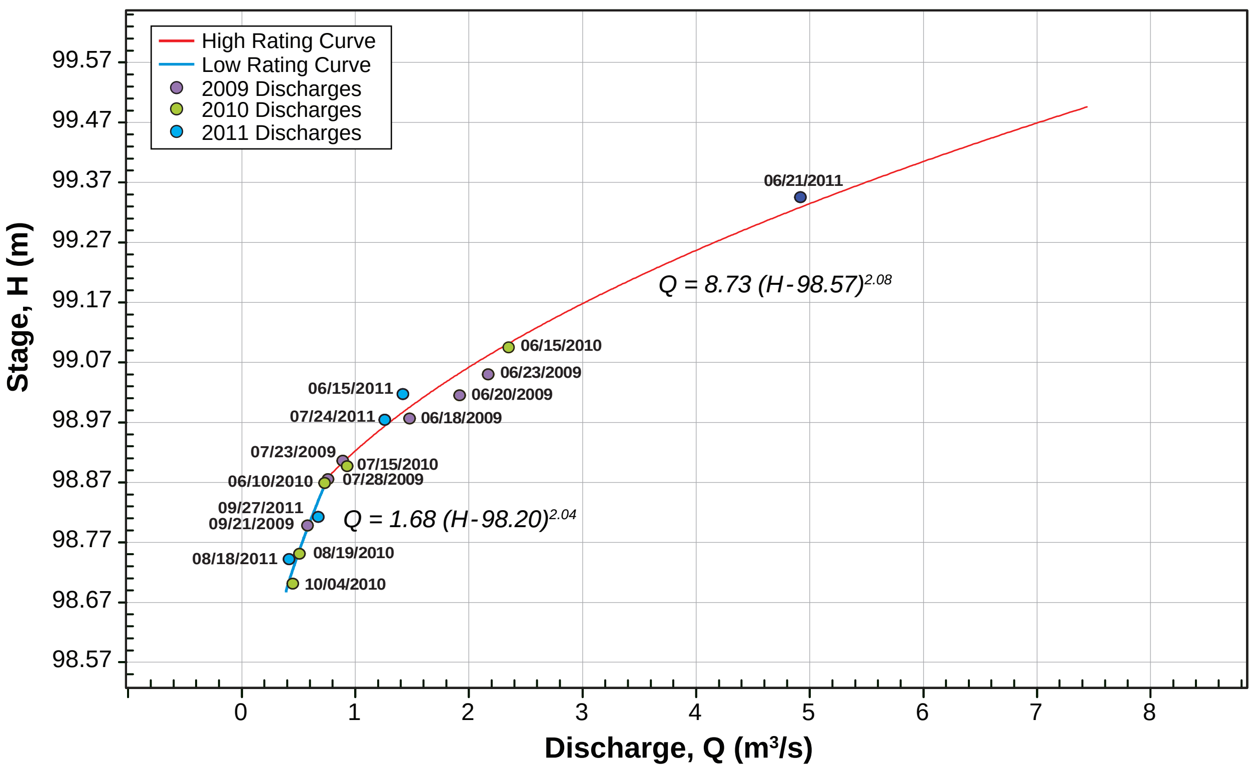
Appendix A2-8. Summary of Daily Mean Water Level (m) at Reference B Lake Station in 2011

Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)	Date	Water Level (m)
1-Jan		1-Mar		1-May		1-Jul	98.440	1-Sep	97.953	1-Nov	
2-Jan		2-Mar		2-May		2-Jul	98.492	2-Sep	97.949	2-Nov	
3-Jan		3-Mar		3-May		3-Jul	98.514	3-Sep	97.947	3-Nov	
4-Jan		4-Mar		4-May		4-Jul	98.515	4-Sep	97.955	4-Nov	
5-Jan		5-Mar		5-May		5-Jul	98.503	5-Sep	97.950	5-Nov	
6-Jan		6-Mar		6-May		6-Jul	98.481	6-Sep	97.948	6-Nov	
7-Jan		7-Mar		7-May		7-Jul	98.454	7-Sep	97.994	7-Nov	
8-Jan		8-Mar		8-May		8-Jul	98.426	8-Sep	98.037	8-Nov	
9-Jan		9-Mar		9-May		9-Jul	98.399	9-Sep	98.038	9-Nov	
10-Jan		10-Mar		10-May		10-Jul	98.376	10-Sep	98.055	10-Nov	
11-Jan		11-Mar		11-May		11-Jul	98.361	11-Sep	98.074	11-Nov	
12-Jan		12-Mar		12-May		12-Jul	98.340	12-Sep	98.073	12-Nov	
13-Jan		13-Mar		13-May		13-Jul	98.311	13-Sep	98.076	13-Nov	
14-Jan		14-Mar		14-May		14-Jul	98.294	14-Sep	98.076	14-Nov	
15-Jan		15-Mar		15-May		15-Jul	98.275	15-Sep	98.083	15-Nov	
16-Jan		16-Mar		16-May		16-Jul	98.259	16-Sep	98.080	16-Nov	
17-Jan		17-Mar		17-May		17-Jul	98.243	17-Sep	98.092	17-Nov	
18-Jan		18-Mar		18-May		18-Jul	98.218	18-Sep	98.106	18-Nov	
19-Jan		19-Mar		19-May		19-Jul	98.194	19-Sep	98.106	19-Nov	
20-Jan		20-Mar		20-May		20-Jul	98.184	20-Sep	98.112	20-Nov	
21-Jan		21-Mar		21-May		21-Jul	98.181	21-Sep	98.115	21-Nov	
22-Jan		22-Mar		22-May		22-Jul	98.174	22-Sep	98.122	22-Nov	
23-Jan		23-Mar		23-May		23-Jul	98.161	23-Sep		23-Nov	
24-Jan		24-Mar		24-May		24-Jul	98.150	24-Sep		24-Nov	
25-Jan		25-Mar		25-May		25-Jul	98.142	25-Sep		25-Nov	
26-Jan		26-Mar		26-May		26-Jul	98.151	26-Sep		26-Nov	
27-Jan		27-Mar		27-May		27-Jul	98.135	27-Sep		27-Nov	
28-Jan		28-Mar		28-May		28-Jul	98.119	28-Sep		28-Nov	
29-Jan		29-Mar		29-May		29-Jul	98.112	29-Sep		29-Nov	
30-Jan		30-Mar		30-May		30-Jul	98.099	30-Sep		30-Nov	
31-Jan		31-Mar		31-May		31-Jul	98.086	1-Oct		1-Dec	
1-Feb		1-Apr		1-Jun		1-Aug	98.070	2-Oct		2-Dec	
2-Feb		2-Apr		2-Jun		2-Aug	98.059	3-Oct		3-Dec	
3-Feb		3-Apr		3-Jun		3-Aug	98.052	4-Oct		4-Dec	
4-Feb		4-Apr		4-Jun		4-Aug	98.046	5-Oct		5-Dec	
5-Feb		5-Apr		5-Jun		5-Aug	98.040	6-Oct		6-Dec	
6-Feb		6-Apr		6-Jun		6-Aug	98.037	7-Oct		7-Dec	
7-Feb		7-Apr		7-Jun		7-Aug	98.027	8-Oct		8-Dec	
8-Feb		8-Apr		8-Jun		8-Aug	98.016	9-Oct		9-Dec	
9-Feb		9-Apr		9-Jun		9-Aug	98.007	10-Oct		10-Dec	
10-Feb		10-Apr		10-Jun		10-Aug	97.998	11-Oct		11-Dec	
11-Feb		11-Apr		11-Jun		11-Aug	97.993	12-Oct		12-Dec	
12-Feb		12-Apr		12-Jun		12-Aug	97.990	13-Oct		13-Dec	
13-Feb		13-Apr		13-Jun		13-Aug	97.986	14-Oct		14-Dec	
14-Feb		14-Apr		14-Jun		14-Aug	97.976	15-Oct		15-Dec	
15-Feb		15-Apr		15-Jun		15-Aug	97.957	16-Oct		16-Dec	
16-Feb		16-Apr		16-Jun		16-Aug	97.933	17-Oct		17-Dec	
17-Feb		17-Apr		17-Jun		17-Aug	97.917	18-Oct		18-Dec	
18-Feb		18-Apr		18-Jun		18-Aug	97.917	19-Oct		19-Dec	
19-Feb		19-Apr		19-Jun	*98.627*	19-Aug	97.934	20-Oct		20-Dec	
20-Feb		20-Apr		20-Jun	98.617	20-Aug	97.952	21-Oct		21-Dec	
21-Feb		21-Apr		21-Jun	98.612	21-Aug	97.947	22-Oct		22-Dec	
22-Feb		22-Apr		22-Jun	98.610	22-Aug	97.928	23-Oct		23-Dec	
23-Feb		23-Apr		23-Jun	98.577	23-Aug	97.916	24-Oct		24-Dec	
24-Feb		24-Apr		24-Jun	98.541	24-Aug	97.945	25-Oct		25-Dec	
25-Feb		25-Apr		25-Jun	98.511	25-Aug	97.960	26-Oct		26-Dec	
26-Feb		26-Apr		26-Jun	98.491	26-Aug	97.972	27-Oct		27-Dec	
27-Feb		27-Apr		27-Jun	98.470	27-Aug	97.976	28-Oct		28-Dec	
28-Feb		28-Apr		28-Jun	98.447	28-Aug	97.976	29-Oct		29-Dec	
		29-Apr		29-Jun	98.426	29-Aug	97.974	30-Oct		30-Dec	
		30-Apr		30-Jun	98.432	30-Aug	97.964	31-Oct		31-Dec	
						31-Aug	97.958				

Appendix A3

Rating Curves
Doris/Madrid Area

Left: Doris Outflow (TL-2) looking downstream (north). The hydrometric station is on the righ bank. The pressure transducer and data logger recorded water levels at 10 minute intervals. The data were then sent to a web portal via satellite link and were available on a real-time basis. Right: Photograph of the same location now facing upstream (south). Note on the left bank the flood terrace with overgrown grasses where the channel overflows during high flow conditions. This causes the differnce between the slopes of the rating relationship at low and high stage conditions. Photographs taken on July 24, 2011.



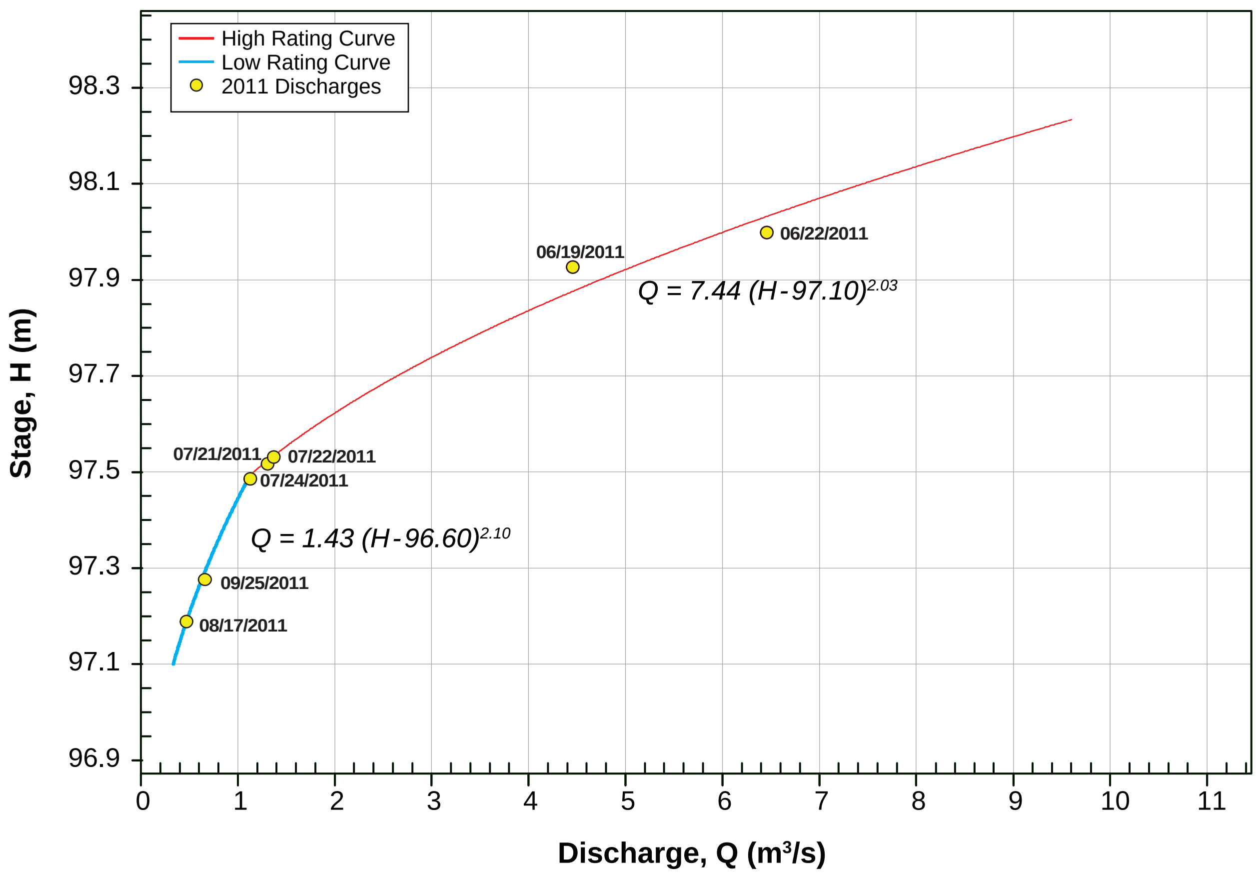
Note: pressure transducer stage readings are referenced to a site specific non-geodetic datum

NEWMONT NORTH AMERICA

Doris Outflow (TL-2) - Stage-Discharge Rating Curve
(Rating Period from 06/18/2009 to 10/18/2011)

Rescan Engineers & Scientists

Left: low angle view of Doris Creek Downstream (TL-3) facing south. At moderate to high flows, the channel overflows its banks. Photograph taken on July 22, 2011 during high to moderate flow conditions. Here the channel overflows the banks over flood terraces located on the left bank.
Right: Low angle view of the same location under lower flow conditions. Flows are well confined by the channel and water does not flow over the flood terraces. Photograph taken on September 25, 2011. In both prhotographs Doris Falls can be observed in the background. Note that the different rating relationships at low and high stages reflect the physical characterisics of this channel under varying flow conditions.



Note: pressure transducer stage readings are referenced to a site specific non-geodetic datum

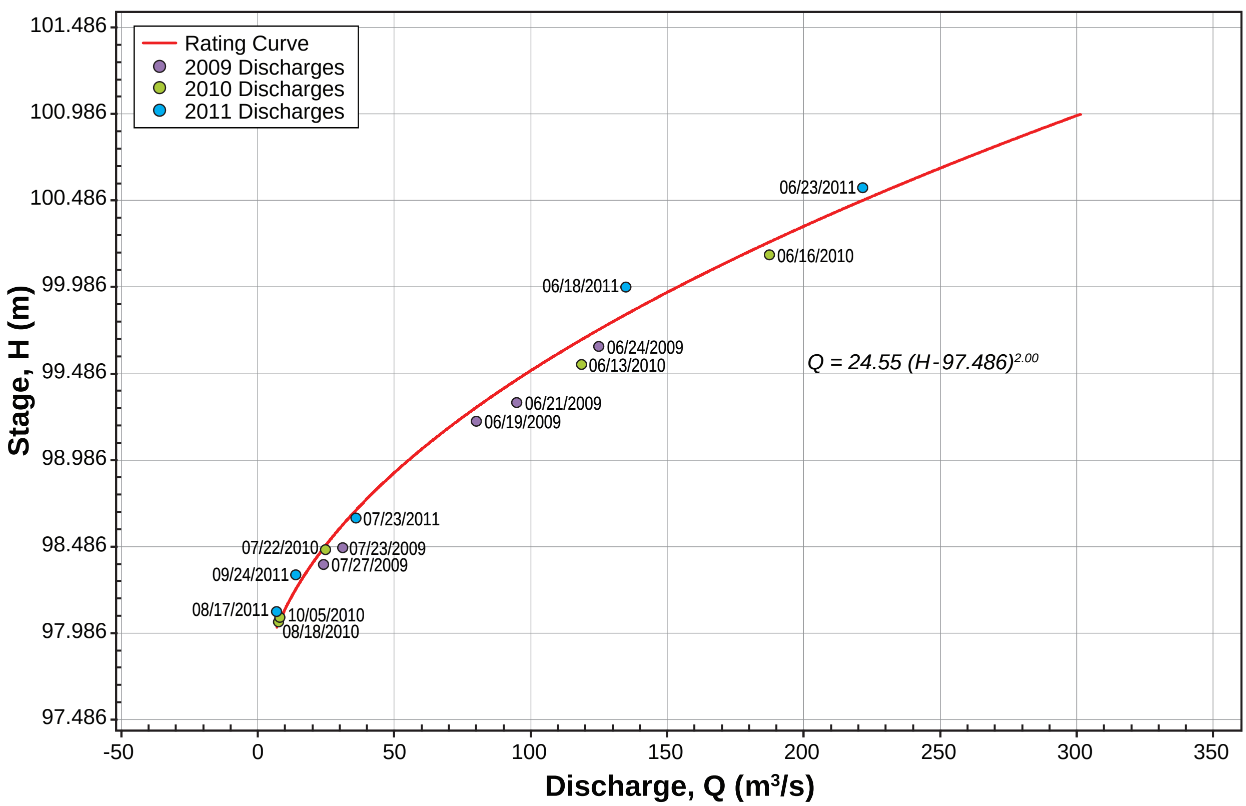
NEWMONT NORTH AMERICA

Doris Creek Downstream (TL-3) Stage-Discharge Rating Curve
(Rating Period from 07/21/2011 to 09/25/2011)

Appendix A3-2

Rescan Engineers & Scientists

Koignuk River facing upstream and southwest at the hydrometric station. The photo was taken during low flow conditions when the flow is well confined to the channel by the banks alongboth sides of the stream. Photograph taken on August 8, 2011.



Note: pressure transducer stage readings are referenced to datum

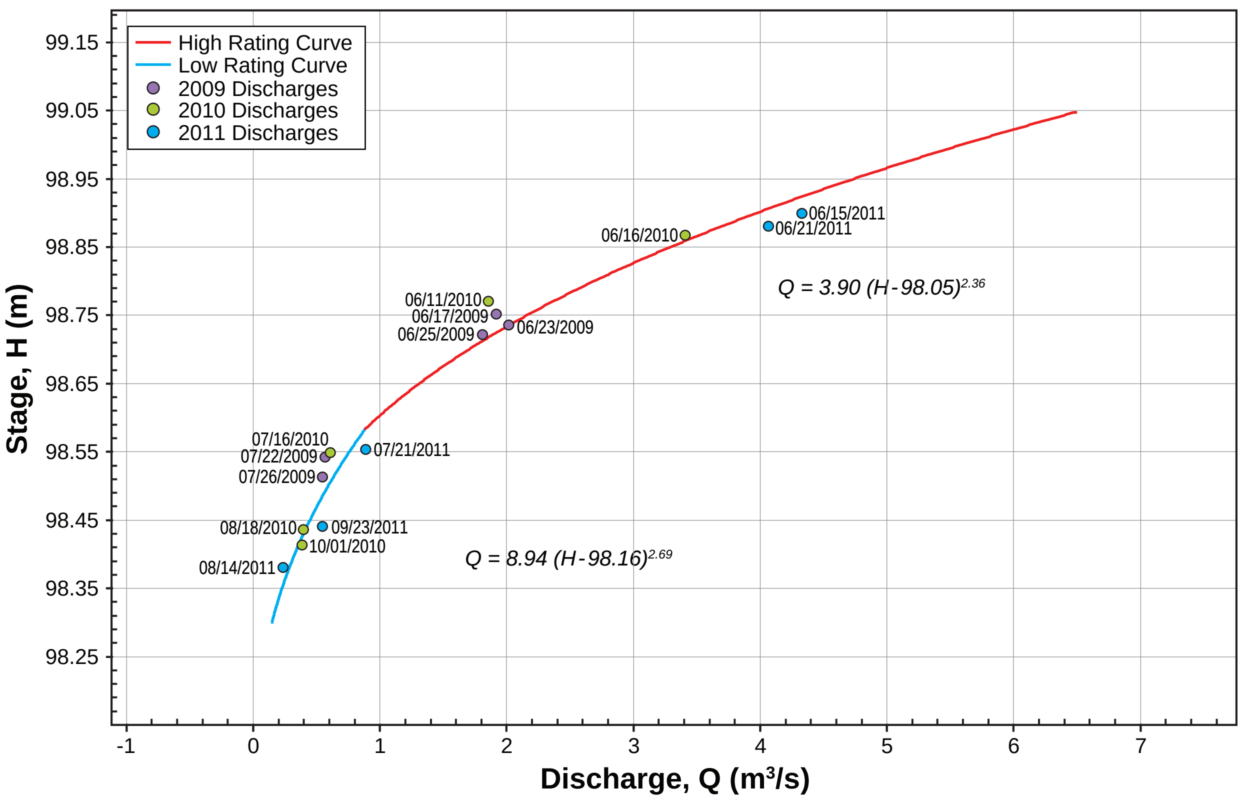
Appendix A3-3

NEWMONT NORTH AMERICA

Koignuk Hydro - Stage-Discharge Rating Curve
(Rating Period from 06/18/2009 to 09/24/2011)

Rescan Engineers & Scientists

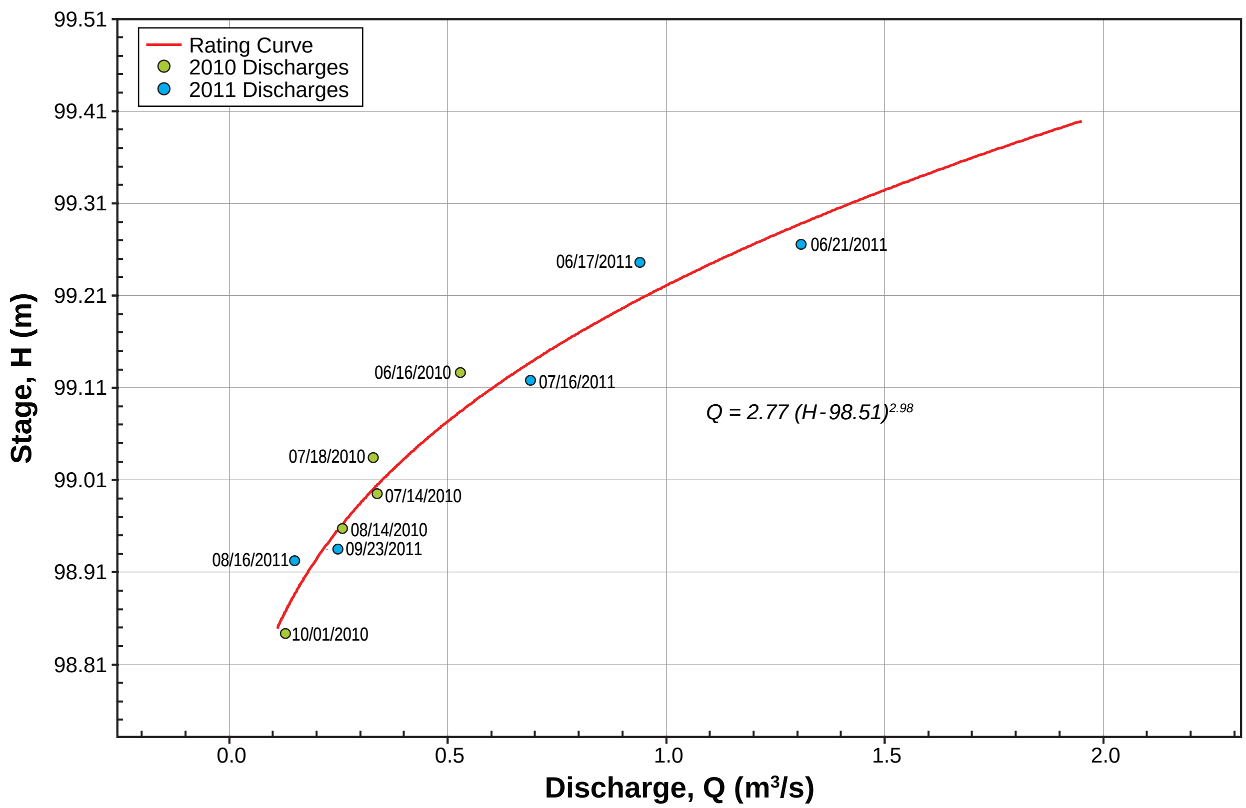
Ogama outflow facing upstream and south towards Ogama Lake at the hydrometric station. Note the bedrock outcrop along the left bank that confines flow in the main channel. During high flow conditions the channel overflows onto the flood terrace located along the right bank. Photograph taken on July 21, 2011.



Note: pressure transducer stage readings are referenced to datum

Ogama Hydro - Stage-Discharge Rating Curve
(Rating Period from 06/16/2009 to 09/23/2011)

Patch Lake outflow channel, facing upstream and west towards the hydrometric station. The flow is confined by the channel at low and medium flow conditions. During high flow conditions the channel overflows a flood terrace overgown with vegetation located along the left bank. Photograph taken on July 16, 2011.



Note: pressure transducer stage readings are referenced to datum

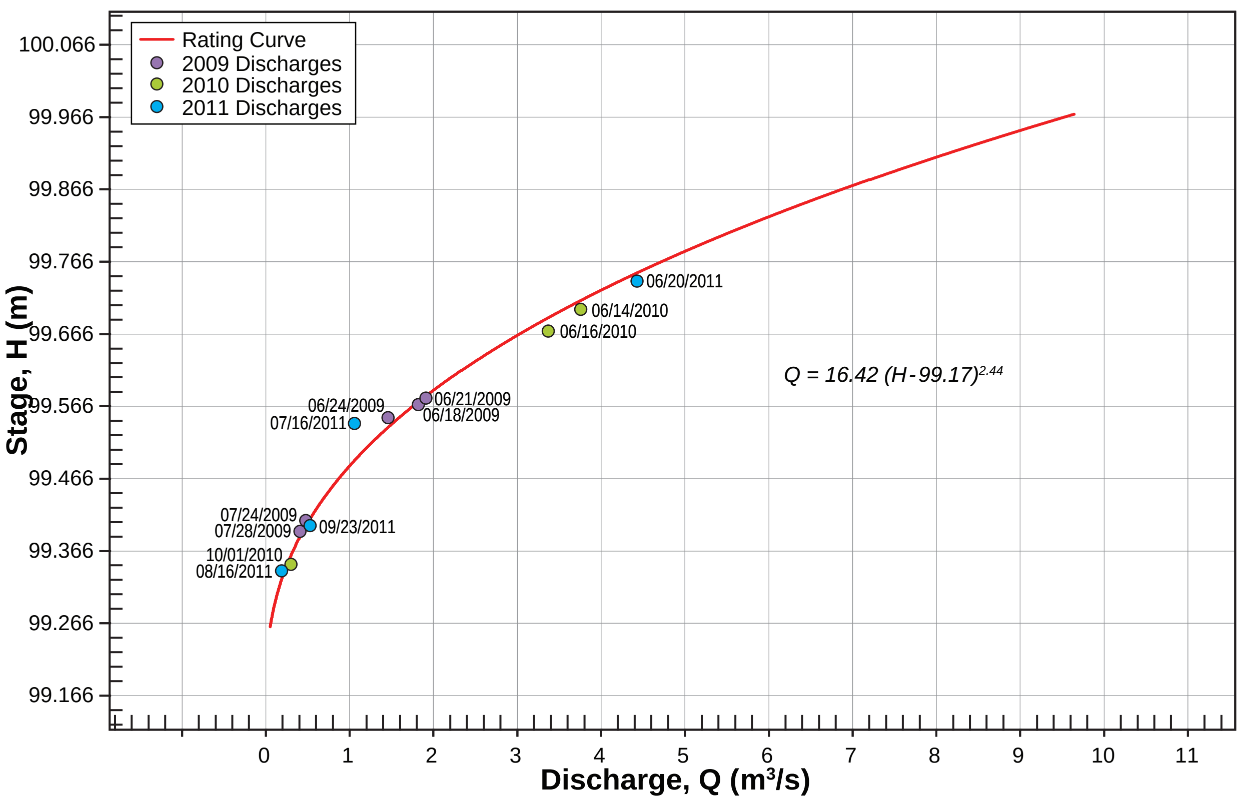
Appendix A3-5

NEWMONT NORTH AMERICA

Patch Hydro - Stage-Discharge Rating Curve
(Rating Period from 06/16/2010 to 09/24/2011)

Rescan Engineers & Scientists

PO Lake outflow channel facing downstream and north towards the hydrometric station. Note how the flow is well confined by the main channel during low and medium flow conditions. During high flow conditions the channel overflows on the terraces overgrown with grasses located along both banks. Photograph taken on September 23, 2011.



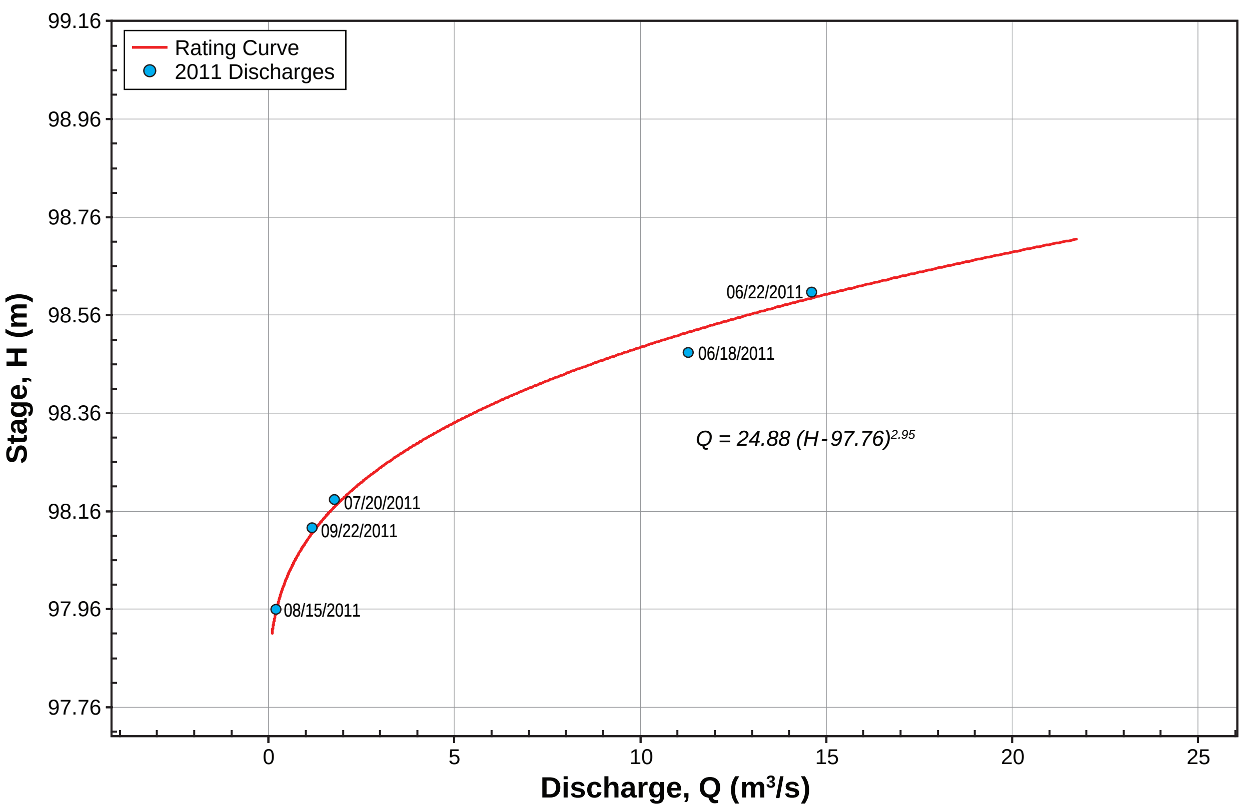
Note: pressure transducer stage readings are referenced to datum

NEWMONT NORTH AMERICA

PO Hydro - Stage-Discharge Rating Curve
(Rating Period from 06/20/2009 to 09/23/2011)

Rescan Engineers & Scientists

Reference B outflow facing downstream and west at the hydrometric station. The flow is well confined by the channel during low and high flow conditions. Photograph taken on July 20, 2011.



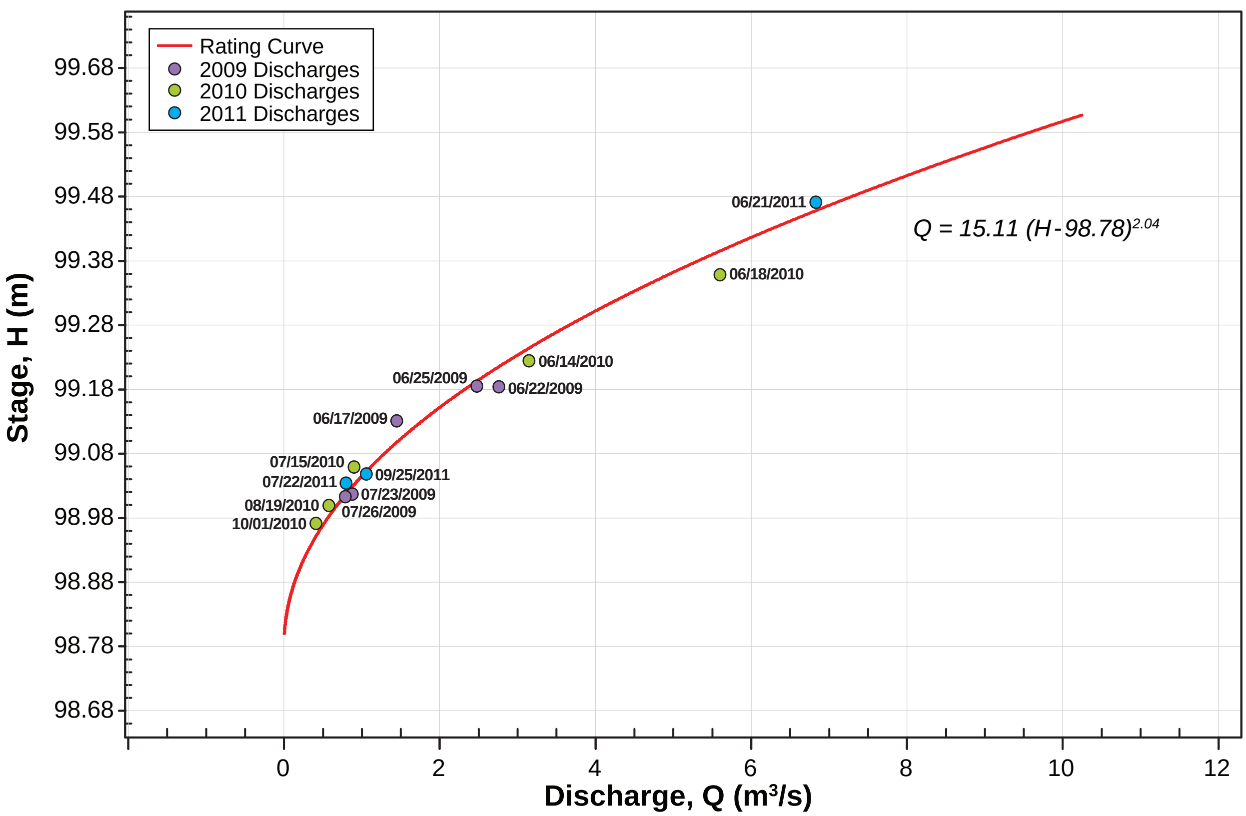
Note: pressure transducer stage readings are referenced to datum

NEWMONT NORTH AMERICA

Reference B Hydro - Stage-Discharge Rating Curve
(Rating Period from 06/10/2011 to 09/26/2011)

Rescan Engineers & Scientists

Left: Roberts Lake outflow looking downstream (northwest). The hydrometric station is on the foreground and was reestablished on June 21, 2011. The pressure transducer recorded water levels at 10 min intervals. The yellow circle indicates a riffle section in the channel that controls the rate of water flowing from the lake. Right: Close up view of the the control section (riffle). Farther downstream, on the background of the photograph, a fish fence can be observed. Photographs taken on July 22, 2011.



Note: pressure transducer stage readings are referenced to a site specific non-geodetic datum

Roberts Hydro- Stage-Discharge Rating Curve
(Rating Period from 06/17/2009 to 09/26/2011)

Appendix A4

Summary of Survey Information Doris/Madrid Area

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Appendix A4. Summary of Survey Control Points Used at the Hydrometric Stations

Station ID	Survey Point	Elevation (m)	Date	Notes
TL-2 Doris Hydro	Benchamrk 59	100.000	18-Aug-11	arbitrary elevation
	Benchmark 58	100.601		
	Benchmark 57	100.157		
	Pressure transducer	98.116		
TL-3 Doris Hydro	Benchmark 87	100.000	23-Sep-11	arbitrary elevation
	Benchmark 88	99.944		
	Benchmark 89	100.323		
	Pressure transducer	96.496		
Roberts Hydro	Benchmark 12	100.000	23-Sep-11	arbitrary elevation
	Benchmark 49	99.943		
	Benchmark 50	100.005		
	Benchmark 64	99.733		
	Pressure transducer	98.219		
Koignuk-Hydro	Benchmark 66	100.000	24-Sep-11	arbitrary elevation
	Benchmark 68	100.098		
	Benchmark 55	100.458		
	Benchmark 56	100.329		
	Pressure transducer	97.778		
Ogama-Hydro	Benchamrk 41	100.000	23-Sep-11	arbitrary elevation
	Benchmark 42	100.103		
	Benchmark 11	100.669		
	Pressure transducer	97.994		
Patch-Hydro	Benchmark 53	100.000	23-Sep-11	arbitrary elevation
	Benchmark 52	99.587		
	Benchmark 54	99.250		
	Benchmark 25	102.327		
	Pressure transducer	99.248		
PO-Hydro	Benchmark 40	100.000	23-Sep-11	arbitrary elevation
	Benchmark 39	100.240		
	Benchmark 38	99.809		
	Pressure transducer	98.522		
Reference B-Hydro	Benchmark 86	100.000	22-Sep-11	arbitrary elevation
	Benchmark 85	99.644		
	Benchmark 84	98.879		
	Pressure transducer	97.480		
Wolverine-Hydro	Benchmark 61	100.000	16-Jul-11	arbitrary elevation
	Benchmark 60	99.418		
	Pressure transducer	97.919		

Appendix A5

Hydrographs
Doris/Madrid Area

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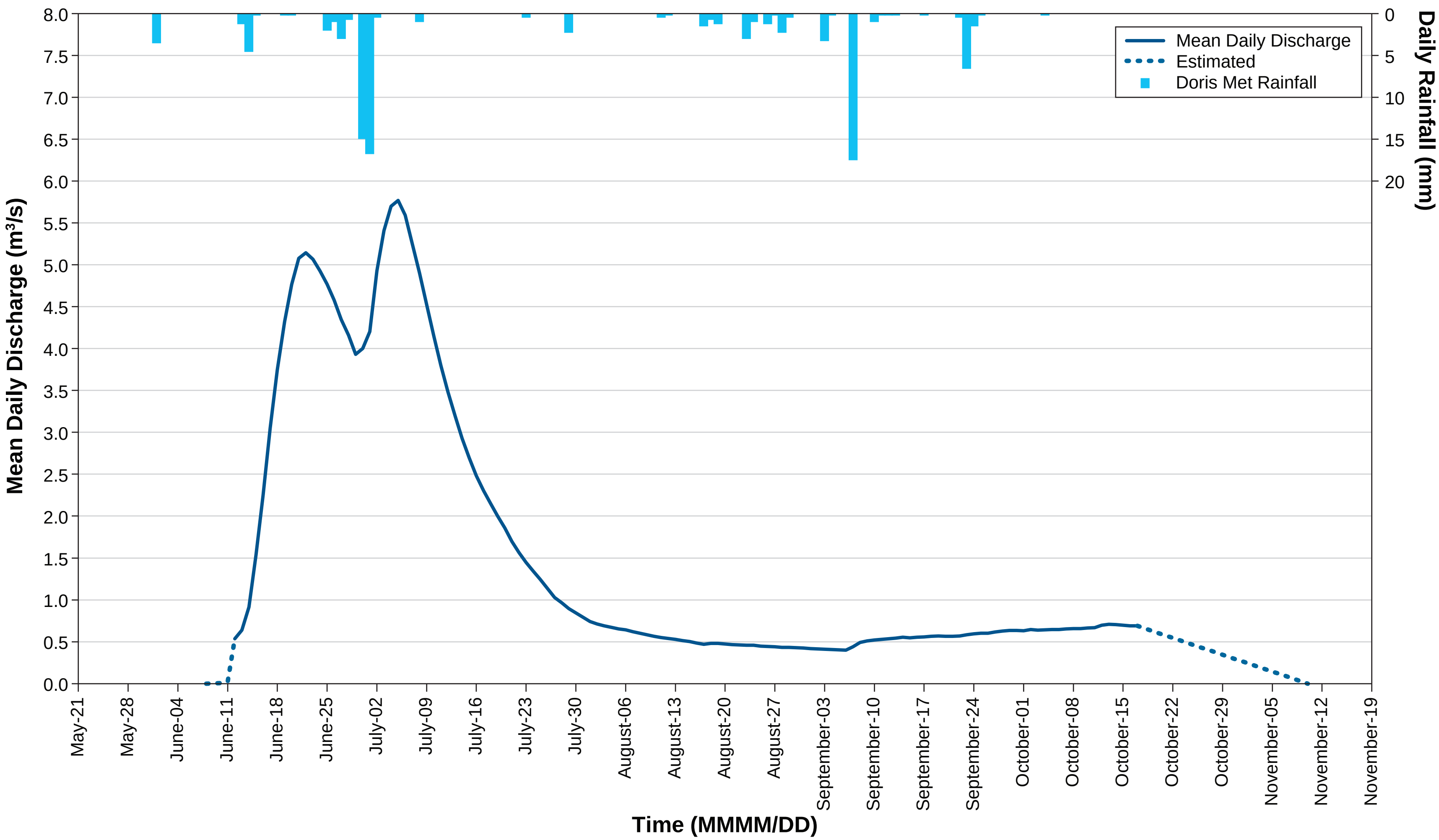
Appendix A5-1. Summary of Daily Mean Discharge [Q] at Doris-Hydro TL-2 in 2011

Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)
1-Jan		1-Mar		1-May		1-Jul	4.20	1-Sep	0.42	1-Nov	
2-Jan		2-Mar		2-May		2-Jul	4.93	2-Sep	0.41	2-Nov	
3-Jan		3-Mar		3-May		3-Jul	5.41	3-Sep	0.41	3-Nov	
4-Jan		4-Mar		4-May		4-Jul	5.70	4-Sep	0.41	4-Nov	
5-Jan		5-Mar		5-May		5-Jul	5.77	5-Sep	0.40	5-Nov	
6-Jan		6-Mar		6-May		6-Jul	5.59	6-Sep	0.40	6-Nov	
7-Jan		7-Mar		7-May		7-Jul	5.25	7-Sep	0.44	7-Nov	
8-Jan		8-Mar		8-May		8-Jul	4.90	8-Sep	0.49	8-Nov	
9-Jan		9-Mar		9-May		9-Jul	4.52	9-Sep	0.51	9-Nov	
10-Jan		10-Mar		10-May		10-Jul	4.15	10-Sep	0.52	10-Nov	
11-Jan		11-Mar		11-May		11-Jul	3.80	11-Sep	0.53	11-Nov	
12-Jan		12-Mar		12-May		12-Jul	3.48	12-Sep	0.53	12-Nov	
13-Jan		13-Mar		13-May		13-Jul	3.20	13-Sep	0.54	13-Nov	
14-Jan		14-Mar		14-May		14-Jul	2.93	14-Sep	0.55	14-Nov	
15-Jan		15-Mar		15-May		15-Jul	2.70	15-Sep	0.55	15-Nov	
16-Jan		16-Mar		16-May		16-Jul	2.48	16-Sep	0.56	16-Nov	
17-Jan		17-Mar		17-May		17-Jul	2.30	17-Sep	0.56	17-Nov	
18-Jan		18-Mar		18-May		18-Jul	2.15	18-Sep	0.57	18-Nov	
19-Jan		19-Mar		19-May		19-Jul	2.00	19-Sep	0.57	19-Nov	
20-Jan		20-Mar		20-May		20-Jul	1.86	20-Sep	0.57	20-Nov	
21-Jan		21-Mar		21-May		21-Jul	1.70	21-Sep	0.57	21-Nov	
22-Jan		22-Mar		22-May		22-Jul	1.57	22-Sep	0.57	22-Nov	
23-Jan		23-Mar		23-May		23-Jul	1.45	23-Sep	0.58	23-Nov	
24-Jan		24-Mar		24-May		24-Jul	1.34	24-Sep	0.59	24-Nov	
25-Jan		25-Mar		25-May		25-Jul	1.25	25-Sep	0.60	25-Nov	
26-Jan		26-Mar		26-May		26-Jul	1.14	26-Sep	0.60	26-Nov	
27-Jan		27-Mar		27-May		27-Jul	1.03	27-Sep	0.62	27-Nov	
28-Jan		28-Mar		28-May		28-Jul	0.96	28-Sep	0.63	28-Nov	
29-Jan		29-Mar		29-May		29-Jul	0.90	29-Sep	0.64	29-Nov	
30-Jan		30-Mar		30-May		30-Jul	0.84	30-Sep	0.64	30-Nov	
31-Jan		31-Mar		31-May		31-Jul	0.79	1-Oct	0.63	1-Dec	
1-Feb		1-Apr		1-Jun		1-Aug	0.74	2-Oct	0.65	2-Dec	
2-Feb		2-Apr		2-Jun		2-Aug	0.71	3-Oct	0.64	3-Dec	
3-Feb		3-Apr		3-Jun		3-Aug	0.69	4-Oct	0.64	4-Dec	
4-Feb		4-Apr		4-Jun		4-Aug	0.67	5-Oct	0.65	5-Dec	
5-Feb		5-Apr		5-Jun		5-Aug	0.65	6-Oct	0.65	6-Dec	
6-Feb		6-Apr		6-Jun		6-Aug	0.64	7-Oct	0.65	7-Dec	
7-Feb		7-Apr		7-Jun		7-Aug	0.62	8-Oct	0.66	8-Dec	
8-Feb		8-Apr		8-Jun		8-Aug	0.60	9-Oct	0.66	9-Dec	
9-Feb		9-Apr		9-Jun		9-Aug	0.58	10-Oct	0.66	10-Dec	
10-Feb		10-Apr		10-Jun		10-Aug	0.57	11-Oct	0.67	11-Dec	
11-Feb		11-Apr		11-Jun		11-Aug	0.55	12-Oct	0.70	12-Dec	
12-Feb		12-Apr		12-Jun	0.54	12-Aug	0.54	13-Oct	0.71	13-Dec	
13-Feb		13-Apr		13-Jun	0.64	13-Aug	0.53	14-Oct	0.71	14-Dec	
14-Feb		14-Apr		14-Jun	0.92	14-Aug	0.51	15-Oct	0.70	15-Dec	
15-Feb		15-Apr		15-Jun	1.54	15-Aug	0.50	16-Oct	0.69	16-Dec	
16-Feb		16-Apr		16-Jun	2.25	16-Aug	0.48	17-Oct	0.69	17-Dec	
17-Feb		17-Apr		17-Jun	3.05	17-Aug	0.47	18-Oct		18-Dec	
18-Feb		18-Apr		18-Jun	3.74	18-Aug	0.48	19-Oct		19-Dec	
19-Feb		19-Apr		19-Jun	4.32	19-Aug	0.48	20-Oct		20-Dec	
20-Feb		20-Apr		20-Jun	4.76	20-Aug	0.47	21-Oct		21-Dec	
21-Feb		21-Apr		21-Jun	5.08	21-Aug	0.47	22-Oct		22-Dec	
22-Feb		22-Apr		22-Jun	5.15	22-Aug	0.46	23-Oct		23-Dec	
23-Feb		23-Apr		23-Jun	5.07	23-Aug	0.46	24-Oct		24-Dec	
24-Feb		24-Apr		24-Jun	4.93	24-Aug	0.46	25-Oct		25-Dec	
25-Feb		25-Apr		25-Jun	4.77	25-Aug	0.45	26-Oct		26-Dec	
26-Feb		26-Apr		26-Jun	4.58	26-Aug	0.44	27-Oct		27-Dec	
27-Feb		27-Apr		27-Jun	4.34	27-Aug	0.44	28-Oct		28-Dec	
28-Feb		28-Apr		28-Jun	4.16	28-Aug	0.43	29-Oct		29-Dec	
29-Feb		29-Apr		29-Jun	3.93	29-Aug	0.43	30-Oct		30-Dec	
		30-Apr		30-Jun	4.00	30-Aug	0.43	31-Oct		31-Dec	
						31-Aug	0.42				

Note: Estimated values are italicized.

PROJECT # 1009-008-04 ILLUSTRATION # a34394w December 20, 2011



Appendix A5-1

NEWMONT NORTH AMERICA

Annual Discharge Hydrograph at Doris Outflow (TL-2)

Appendix A5-1

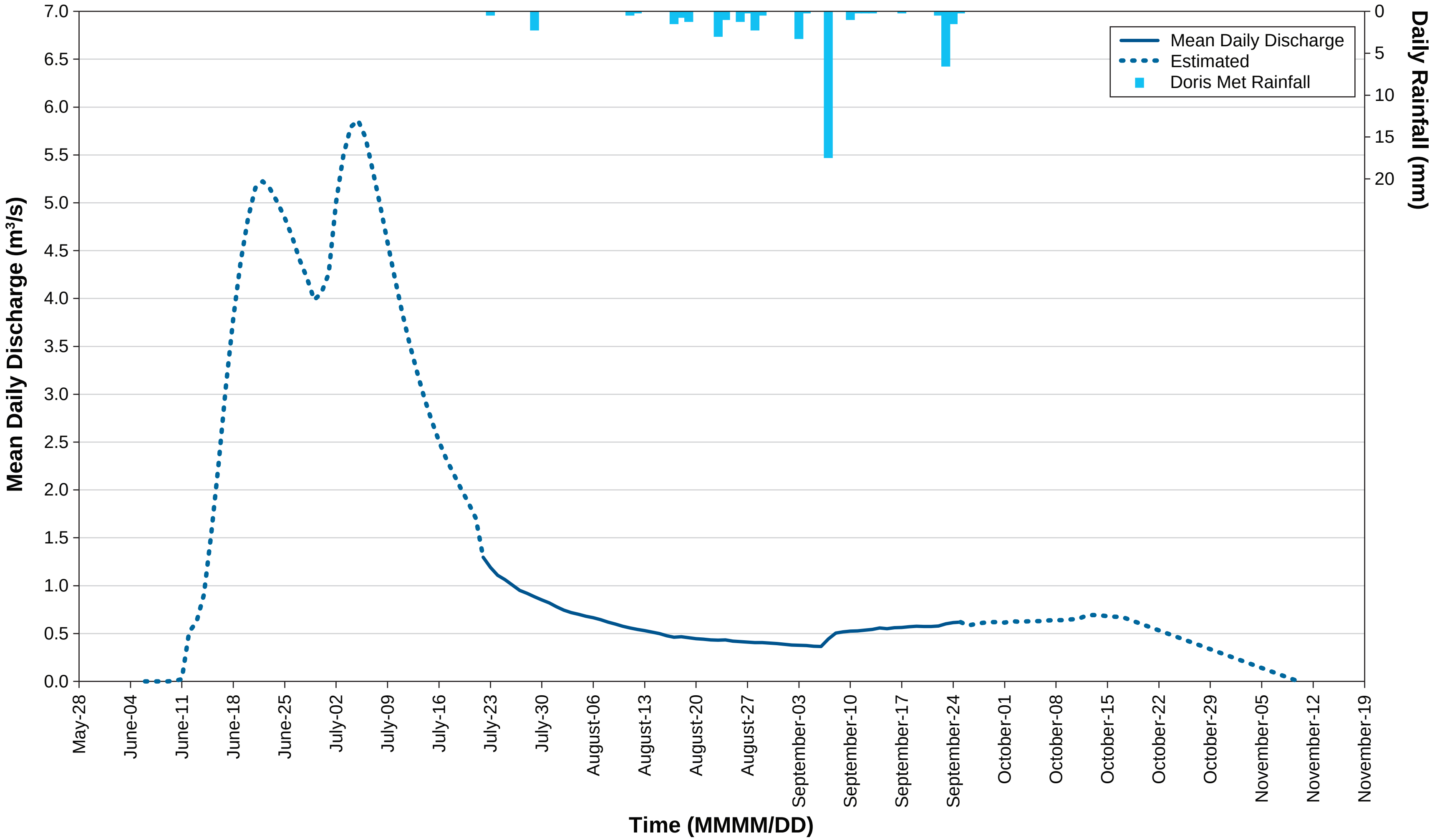
Rescan Engineers & Scientists

Appendix A5-2. Summary of Daily Mean Discharge [Q] at Doris-Hydro TL-3 in 2011

Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)
1-Jan		1-Mar		1-May		1-Jul	*4.26*	1-Sep	0.39	1-Nov	
2-Jan		2-Mar		2-May		2-Jul	*5.00*	2-Sep	0.38	2-Nov	
3-Jan		3-Mar		3-May		3-Jul	*5.50*	3-Sep	0.38	3-Nov	
4-Jan		4-Mar		4-May		4-Jul	*5.79*	4-Sep	0.37	4-Nov	
5-Jan		5-Mar		5-May		5-Jul	*5.86*	5-Sep	0.37	5-Nov	
6-Jan		6-Mar		6-May		6-Jul	*5.68*	6-Sep	0.37	6-Nov	
7-Jan		7-Mar		7-May		7-Jul	*5.33*	7-Sep	0.44	7-Nov	
8-Jan		8-Mar		8-May		8-Jul	*4.97*	8-Sep	0.50	8-Nov	
9-Jan		9-Mar		9-May		9-Jul	*4.59*	9-Sep	0.52	9-Nov	
10-Jan		10-Mar		10-May		10-Jul	*4.21*	10-Sep	0.53	10-Nov	
11-Jan		11-Mar		11-May		11-Jul	*3.85*	11-Sep	0.53	11-Nov	
12-Jan		12-Mar		12-May		12-Jul	*3.53*	12-Sep	0.54	12-Nov	
13-Jan		13-Mar		13-May		13-Jul	*3.24*	13-Sep	0.54	13-Nov	
14-Jan		14-Mar		14-May		14-Jul	*2.96*	14-Sep	0.56	14-Nov	
15-Jan		15-Mar		15-May		15-Jul	*2.73*	15-Sep	0.55	15-Nov	
16-Jan		16-Mar		16-May		16-Jul	*2.51*	16-Sep	0.56	16-Nov	
17-Jan		17-Mar		17-May		17-Jul	*2.32*	17-Sep	0.56	17-Nov	
18-Jan		18-Mar		18-May		18-Jul	*2.17*	18-Sep	0.57	18-Nov	
19-Jan		19-Mar		19-May		19-Jul	*2.01*	19-Sep	0.58	19-Nov	
20-Jan		20-Mar		20-May		20-Jul	*1.87*	20-Sep	0.57	20-Nov	
21-Jan		21-Mar		21-May		21-Jul	*1.70*	21-Sep	0.57	21-Nov	
22-Jan		22-Mar		22-May		22-Jul	1.30	22-Sep	0.58	22-Nov	
23-Jan		23-Mar		23-May		23-Jul	1.19	23-Sep	0.60	23-Nov	
24-Jan		24-Mar		24-May		24-Jul	1.11	24-Sep	0.62	24-Nov	
25-Jan		25-Mar		25-May		25-Jul	1.06	25-Sep	0.62	25-Nov	
26-Jan		26-Mar		26-May		26-Jul	1.01	26-Sep	*0.58*	26-Nov	
27-Jan		27-Mar		27-May		27-Jul	0.95	27-Sep	*0.60*	27-Nov	
28-Jan		28-Mar		28-May		28-Jul	0.92	28-Sep	*0.61*	28-Nov	
29-Jan		29-Mar		29-May		29-Jul	0.88	29-Sep	*0.62*	29-Nov	
30-Jan		30-Mar		30-May		30-Jul	0.85	30-Sep	*0.62*	30-Nov	
31-Jan		31-Mar		31-May		31-Jul	0.82	1-Oct	*0.61*	1-Dec	
1-Feb		1-Apr		1-Jun		1-Aug	0.78	2-Oct	*0.63*	2-Dec	
2-Feb		2-Apr		2-Jun		2-Aug	0.74	3-Oct	*0.62*	3-Dec	
3-Feb		3-Apr		3-Jun		3-Aug	0.72	4-Oct	*0.63*	4-Dec	
4-Feb		4-Apr		4-Jun		4-Aug	0.70	5-Oct	*0.63*	5-Dec	
5-Feb		5-Apr		5-Jun		5-Aug	0.68	6-Oct	*0.63*	6-Dec	
6-Feb		6-Apr		6-Jun		6-Aug	0.67	7-Oct	*0.64*	7-Dec	
7-Feb		7-Apr		7-Jun		7-Aug	0.64	8-Oct	*0.64*	8-Dec	
8-Feb		8-Apr		8-Jun		8-Aug	0.62	9-Oct	*0.64*	9-Dec	
9-Feb		9-Apr		9-Jun		9-Aug	0.60	10-Oct	*0.65*	10-Dec	
10-Feb		10-Apr		10-Jun		10-Aug	0.58	11-Oct	*0.65*	11-Dec	
11-Feb		11-Apr		11-Jun		11-Aug	0.56	12-Oct	*0.68*	12-Dec	
12-Feb		12-Apr		12-Jun	*0.52*	12-Aug	0.54	13-Oct	*0.69*	13-Dec	
13-Feb		13-Apr		13-Jun	*0.62*	13-Aug	0.53	14-Oct	*0.69*	14-Dec	
14-Feb		14-Apr		14-Jun	*0.91*	14-Aug	0.52	15-Oct	*0.68*	15-Dec	
15-Feb		15-Apr		15-Jun	*1.54*	15-Aug	0.50	16-Oct	*0.68*	16-Dec	
16-Feb		16-Apr		16-Jun	*2.27*	16-Aug	0.48	17-Oct	*0.67*	17-Dec	
17-Feb		17-Apr		17-Jun	*3.09*	17-Aug	0.46	18-Oct		18-Dec	
18-Feb		18-Apr		18-Jun	*3.79*	18-Aug	0.47	19-Oct		19-Dec	
19-Feb		19-Apr		19-Jun	*4.38*	19-Aug	0.46	20-Oct		20-Dec	
20-Feb		20-Apr		20-Jun	*4.84*	20-Aug	0.45	21-Oct		21-Dec	
21-Feb		21-Apr		21-Jun	*5.16*	21-Aug	0.44	22-Oct		22-Dec	
22-Feb		22-Apr		22-Jun	*5.23*	22-Aug	0.43	23-Oct		23-Dec	
23-Feb		23-Apr		23-Jun	*5.14*	23-Aug	0.43	24-Oct		24-Dec	
24-Feb		24-Apr		24-Jun	*5.00*	24-Aug	0.43	25-Oct		25-Dec	
25-Feb		25-Apr		25-Jun	*4.84*	25-Aug	0.42	26-Oct		26-Dec	
26-Feb		26-Apr		26-Jun	*4.64*	26-Aug	0.42	27-Oct		27-Dec	
27-Feb		27-Apr		27-Jun	*4.41*	27-Aug	0.41	28-Oct		28-Dec	
28-Feb		28-Apr		28-Jun	*4.22*	28-Aug	0.40	29-Oct		29-Dec	
29-Feb		29-Apr		29-Jun	*3.98*	29-Aug	0.41	30-Oct		30-Dec	
		30-Apr		30-Jun	*4.06*	30-Aug	0.40	31-Oct		31-Dec	
						31-Aug	0.39				

Note: Estimated values are italicized.

PROJECT # 1009-008-04 ILLUSTRATION # a34395w December 20, 2011



Appendix A5-2

NEWMONT NORTH AMERICA

Annual Discharge Hydrograph at Doris Outflow (TL-3)

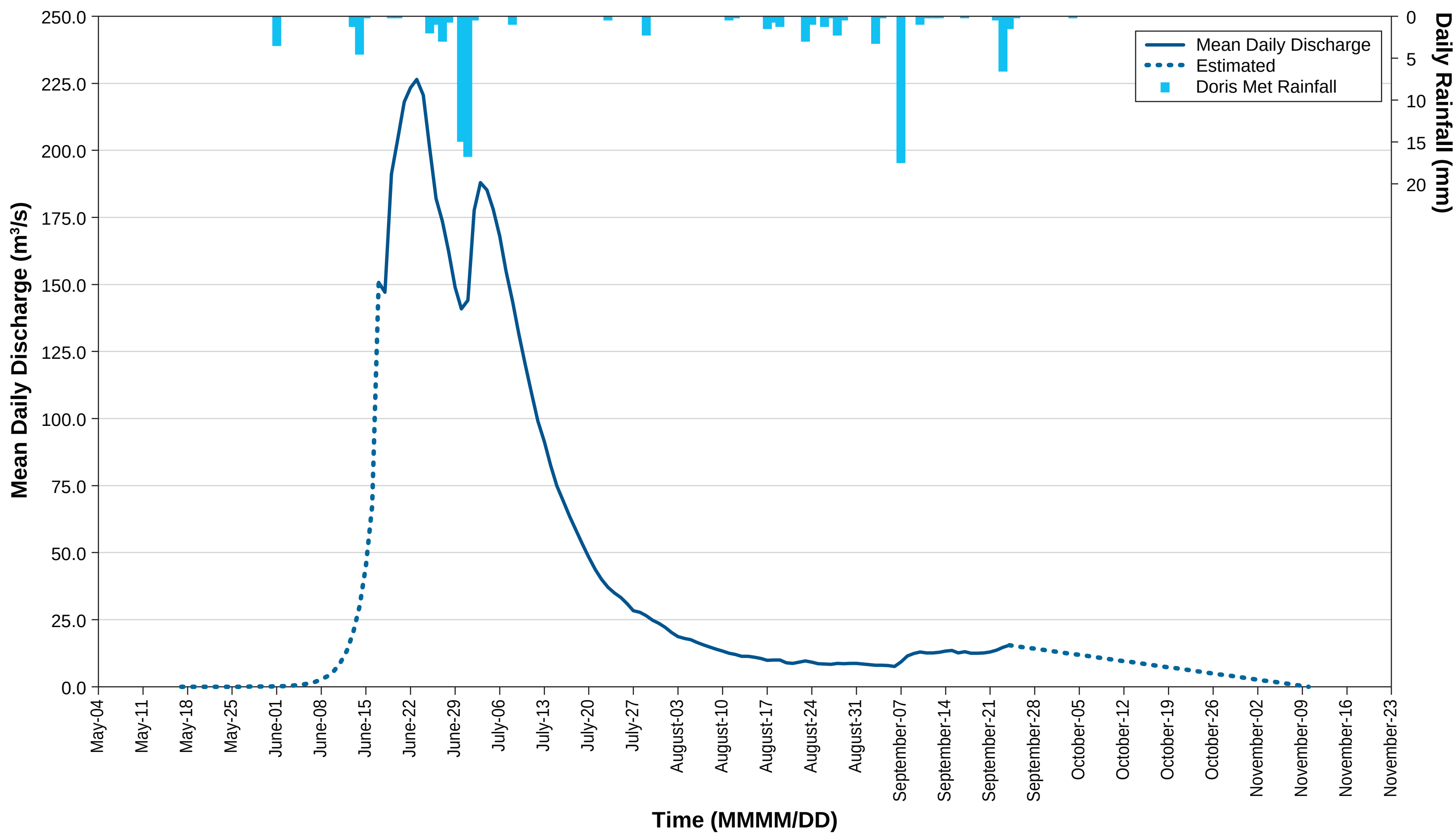
Appendix A5-2

Rescan Engineers & Scientists

Appendix A5-3. Summary of Daily Mean Discharge [Q] at Koignuk Hydro in 2011

Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)
1-Jan		1-Mar		1-May		1-Jul	144.12	1-Sep	8.46	1-Nov	*6.83*
2-Jan		2-Mar		2-May		2-Jul	177.61	2-Sep	8.19	2-Nov	*6.60*
3-Jan		3-Mar		3-May		3-Jul	187.96	3-Sep	8.05	3-Nov	*6.37*
4-Jan		4-Mar		4-May		4-Jul	185.18	4-Sep	8.04	4-Nov	*6.15*
5-Jan		5-Mar		5-May		5-Jul	177.96	5-Sep	7.86	5-Nov	*5.92*
6-Jan		6-Mar		6-May		6-Jul	167.98	6-Sep	7.58	6-Nov	*5.69*
7-Jan		7-Mar		7-May		7-Jul	155.03	7-Sep	9.26	7-Nov	*5.46*
8-Jan		8-Mar		8-May		8-Jul	143.73	8-Sep	11.44	8-Nov	*5.24*
9-Jan		9-Mar		9-May		9-Jul	131.56	9-Sep	12.38	9-Nov	*5.01*
10-Jan		10-Mar		10-May		10-Jul	120.48	10-Sep	12.91	10-Nov	*4.78*
11-Jan		11-Mar		11-May		11-Jul	109.37	11-Sep	12.56	11-Nov	*4.55*
12-Jan		12-Mar		12-May		12-Jul	99.11	12-Sep	12.63	12-Nov	*4.32*
13-Jan		13-Mar		13-May		13-Jul	91.35	13-Sep	12.81	13-Nov	*4.10*
14-Jan		14-Mar		14-May		14-Jul	82.56	14-Sep	13.24	14-Nov	*3.87*
15-Jan		15-Mar		15-May		15-Jul	74.89	15-Sep	13.51	15-Nov	*3.64*
16-Jan		16-Mar		16-May		16-Jul	69.05	16-Sep	12.61	16-Nov	*3.41*
17-Jan		17-Mar		17-May		17-Jul	63.50	17-Sep	13.05	17-Nov	*3.19*
18-Jan		18-Mar		18-May		18-Jul	58.19	18-Sep	12.43	18-Nov	*2.96*
19-Jan		19-Mar		19-May		19-Jul	53.12	19-Sep	12.50	19-Nov	*2.73*
20-Jan		20-Mar		20-May		20-Jul	48.27	20-Sep	12.60	20-Nov	*2.50*
21-Jan		21-Mar		21-May		21-Jul	43.70	21-Sep	12.99	21-Nov	*2.28*
22-Jan		22-Mar		22-May		22-Jul	40.01	22-Sep	13.64	22-Nov	*2.05*
23-Jan		23-Mar		23-May		23-Jul	37.01	23-Sep	14.62	23-Nov	*1.82*
24-Jan		24-Mar		24-May		24-Jul	35.02	24-Sep	15.48	24-Nov	*1.59*
25-Jan		25-Mar		25-May		25-Jul	33.31	25-Sep	*15.15*	25-Nov	*1.37*
26-Jan		26-Mar		26-May		26-Jul	31.00	26-Sep	*14.82*	26-Nov	*1.14*
27-Jan		27-Mar		27-May		27-Jul	28.30	27-Sep	*14.49*	27-Nov	*0.91*
28-Jan		28-Mar		28-May		28-Jul	27.72	28-Sep	*14.16*	28-Nov	*0.68*
29-Jan		29-Mar		29-May		29-Jul	26.47	29-Sep	*13.83*	29-Nov	*0.46*
30-Jan		30-Mar		30-May		30-Jul	24.82	30-Sep	*13.50*	30-Nov	*0.23*
31-Jan		31-Mar		31-May	*0.11*	31-Jul	23.63	1-Oct	*13.17*	1-Dec	*0.00*
1-Feb		1-Apr		1-Jun	*0.16*	1-Aug	22.08	2-Oct	*12.84*	2-Dec	
2-Feb		2-Apr		2-Jun	*0.24*	2-Aug	20.18	3-Oct	*12.51*	3-Dec	
3-Feb		3-Apr		3-Jun	*0.36*	3-Aug	18.72	4-Oct	*12.19*	4-Dec	
4-Feb		4-Apr		4-Jun	*0.53*	4-Aug	17.99	5-Oct	*11.86*	5-Dec	
5-Feb		5-Apr		5-Jun	*0.80*	5-Aug	17.48	6-Oct	*11.53*	6-Dec	
6-Feb		6-Apr		6-Jun	*1.20*	6-Aug	16.46	7-Oct	*11.20*	7-Dec	
7-Feb		7-Apr		7-Jun	*1.79*	7-Aug	15.59	8-Oct	*10.87*	8-Dec	
8-Feb		8-Apr		8-Jun	*2.68*	8-Aug	14.73	9-Oct	*10.54*	9-Dec	
9-Feb		9-Apr		9-Jun	*4.01*	9-Aug	13.92	10-Oct	*10.21*	10-Dec	
10-Feb		10-Apr		10-Jun	*5.99*	10-Aug	13.27	11-Oct	*9.88*	11-Dec	
11-Feb		11-Apr		11-Jun	*8.97*	11-Aug	12.51	12-Oct	*9.55*	12-Dec	
12-Feb		12-Apr		12-Jun	*13.42*	12-Aug	12.00	13-Oct	*9.22*	13-Dec	
13-Feb		13-Apr		13-Jun	*20.09*	13-Aug	11.37	14-Oct	*8.89*	14-Dec	
14-Feb		14-Apr		14-Jun	*30.07*	14-Aug	11.35	15-Oct	*8.56*	15-Dec	
15-Feb		15-Apr		15-Jun	*44.99*	15-Aug	10.94	16-Oct	*8.23*	16-Dec	
16-Feb		16-Apr		16-Jun	*67.33*	16-Aug	10.55	17-Oct	*7.90*	17-Dec	
17-Feb		17-Apr		17-Jun	150.80	17-Aug	9.82	18-Oct	*7.57*	18-Dec	
18-Feb		18-Apr		18-Jun	147.11	18-Aug	9.97	19-Oct	*7.25*	19-Dec	
19-Feb		19-Apr		19-Jun	191.18	19-Aug	9.96	20-Oct	*6.92*	20-Dec	
20-Feb		20-Apr		20-Jun	204.16	20-Aug	8.96	21-Oct	*6.59*	21-Dec	
21-Feb		21-Apr		21-Jun	218.04	21-Aug	8.67	22-Oct	*6.26*	22-Dec	
22-Feb		22-Apr		22-Jun	223.29	22-Aug	9.11	23-Oct	*5.93*	23-Dec	
23-Feb		23-Apr		23-Jun	226.44	23-Aug	9.66	24-Oct	*5.60*	24-Dec	
24-Feb		24-Apr		24-Jun	220.54	24-Aug	9.13	25-Oct	*5.27*	25-Dec	
25-Feb		25-Apr		25-Jun	201.15	25-Aug	8.61	26-Oct	*4.94*	26-Dec	
26-Feb		26-Apr		26-Jun	182.03	26-Aug	8.44	27-Oct	*4.61*	27-Dec	
27-Feb		27-Apr		27-Jun	173.60	27-Aug	8.36	28-Oct	*4.28*	28-Dec	
28-Feb		28-Apr		28-Jun	162.31	28-Aug	8.67	29-Oct	*3.95*	29-Dec	
29-Feb		29-Apr		29-Jun	148.93	29-Aug	8.53	30-Oct	*3.62*	30-Dec	
		30-Apr		30-Jun	140.91	30-Aug	8.64	31-Oct	*3.29*	31-Dec	
						31-Aug	8.66				

Note: Estimated values are italicized.



Appendix A5-3

NEWMONT NORTH AMERICA

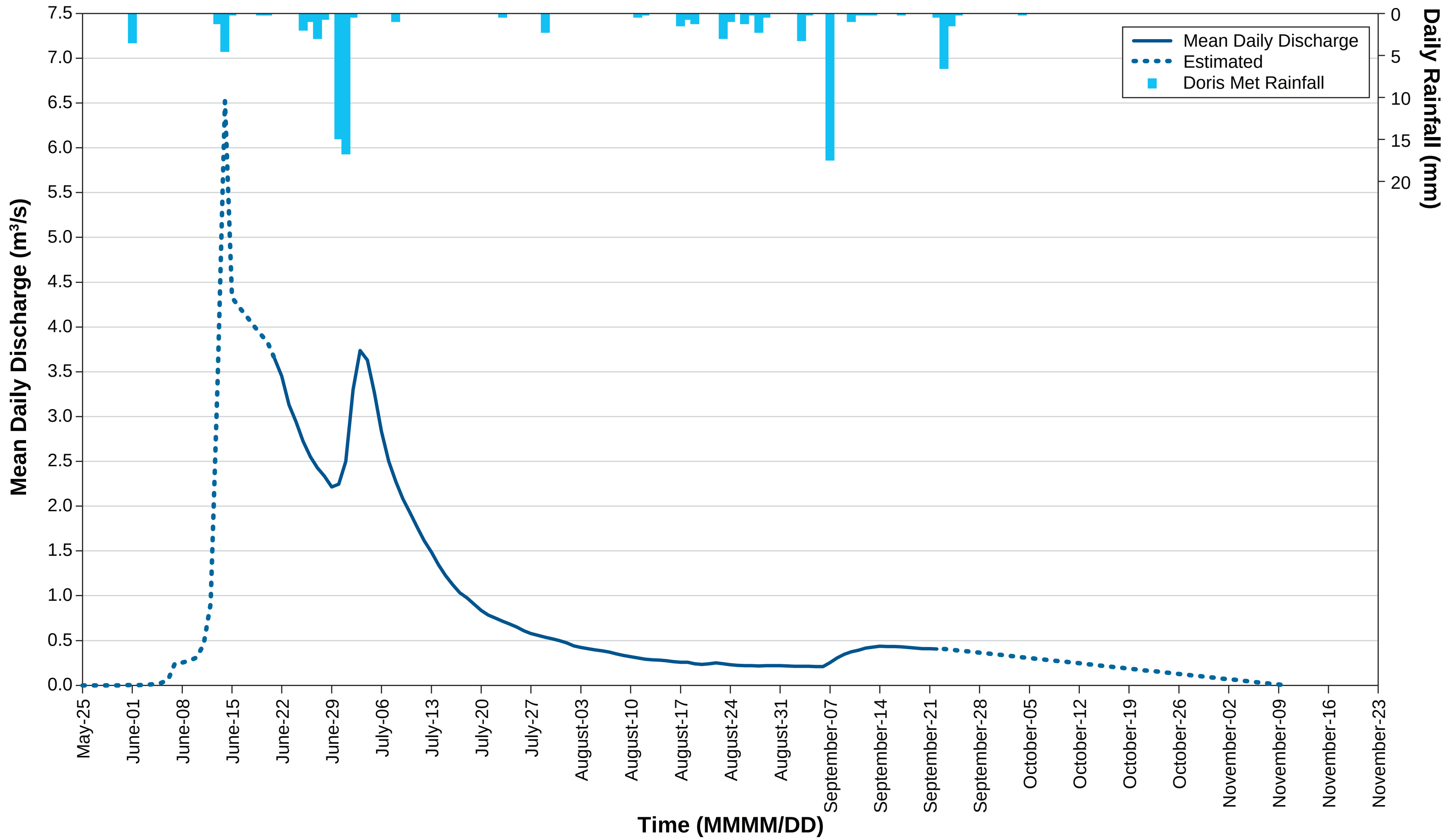
Annual Discharge Hydrograph at Koignuk Hydro

Rescan Engineers & Scientists

Appendix A5-4. Summary of Daily Mean Discharge [Q] at Ogama Hydro in 2011

Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)
1-Jan		1-Mar		1-May		1-Jul	2.50	1-Sep	0.22	1-Nov	*0.08*
2-Jan		2-Mar		2-May		2-Jul	3.30	2-Sep	0.21	2-Nov	*0.07*
3-Jan		3-Mar		3-May		3-Jul	3.74	3-Sep	0.21	3-Nov	*0.06*
4-Jan		4-Mar		4-May		4-Jul	3.63	4-Sep	0.21	4-Nov	*0.05*
5-Jan		5-Mar		5-May		5-Jul	3.27	5-Sep	0.21	5-Nov	*0.04*
6-Jan		6-Mar		6-May		6-Jul	2.84	6-Sep	0.21	6-Nov	*0.03*
7-Jan		7-Mar		7-May		7-Jul	2.50	7-Sep	0.25	7-Nov	*0.03*
8-Jan		8-Mar		8-May		8-Jul	2.28	8-Sep	0.31	8-Nov	*0.02*
9-Jan		9-Mar		9-May		9-Jul	2.08	9-Sep	0.35	9-Nov	*0.01*
10-Jan		10-Mar		10-May		10-Jul	1.92	10-Sep	0.37	10-Nov	
11-Jan		11-Mar		11-May		11-Jul	1.77	11-Sep	0.39	11-Nov	
12-Jan		12-Mar		12-May		12-Jul	1.62	12-Sep	0.41	12-Nov	
13-Jan		13-Mar		13-May		13-Jul	1.49	13-Sep	0.43	13-Nov	
14-Jan		14-Mar		14-May		14-Jul	1.35	14-Sep	0.44	14-Nov	
15-Jan		15-Mar		15-May		15-Jul	1.23	15-Sep	0.43	15-Nov	
16-Jan		16-Mar		16-May		16-Jul	1.12	16-Sep	0.43	16-Nov	
17-Jan		17-Mar		17-May		17-Jul	1.03	17-Sep	0.43	17-Nov	
18-Jan		18-Mar		18-May		18-Jul	0.98	18-Sep	0.42	18-Nov	
19-Jan		19-Mar		19-May		19-Jul	0.90	19-Sep	0.42	19-Nov	
20-Jan		20-Mar		20-May		20-Jul	0.84	20-Sep	0.41	20-Nov	
21-Jan		21-Mar		21-May		21-Jul	0.79	21-Sep	0.41	21-Nov	
22-Jan		22-Mar		22-May		22-Jul	0.75	22-Sep	0.41	22-Nov	
23-Jan		23-Mar		23-May		23-Jul	0.72	23-Sep	0.41	23-Nov	
24-Jan		24-Mar		24-May		24-Jul	0.68	24-Sep	*0.40*	24-Nov	
25-Jan		25-Mar		25-May		25-Jul	0.65	25-Sep	*0.39*	25-Nov	
26-Jan		26-Mar		26-May		26-Jul	0.61	26-Sep	*0.38*	26-Nov	
27-Jan		27-Mar		27-May		27-Jul	0.58	27-Sep	*0.37*	27-Nov	
28-Jan		28-Mar		28-May		28-Jul	0.56	28-Sep	*0.36*	28-Nov	
29-Jan		29-Mar		29-May		29-Jul	0.54	29-Sep	*0.36*	29-Nov	
30-Jan		30-Mar		30-May		30-Jul	0.52	30-Sep	*0.35*	30-Nov	
31-Jan		31-Mar		31-May		31-Jul	0.50	1-Oct	*0.34*	1-Dec	
1-Feb		1-Apr		1-Jun		1-Aug	0.47	2-Oct	*0.33*	2-Dec	
2-Feb		2-Apr		2-Jun		2-Aug	0.44	3-Oct	*0.32*	3-Dec	
3-Feb		3-Apr		3-Jun		3-Aug	0.42	4-Oct	*0.31*	4-Dec	
4-Feb		4-Apr		4-Jun		4-Aug	0.41	5-Oct	*0.31*	5-Dec	
5-Feb		5-Apr		5-Jun		5-Aug	0.39	6-Oct	*0.30*	6-Dec	
6-Feb		6-Apr		6-Jun		6-Aug	0.39	7-Oct	*0.29*	7-Dec	
7-Feb		7-Apr		7-Jun	*0.26*	7-Aug	0.37	8-Oct	*0.28*	8-Dec	
8-Feb		8-Apr		8-Jun	*0.27*	8-Aug	0.35	9-Oct	*0.27*	9-Dec	
9-Feb		9-Apr		9-Jun	*0.29*	9-Aug	0.33	10-Oct	*0.26*	10-Dec	
10-Feb		10-Apr		10-Jun	*0.31*	10-Aug	0.32	11-Oct	*0.25*	11-Dec	
11-Feb		11-Apr		11-Jun	*0.43*	11-Aug	0.31	12-Oct	*0.25*	12-Dec	
12-Feb		12-Apr		12-Jun	*0.73*	12-Aug	0.29	13-Oct	*0.24*	13-Dec	
13-Feb		13-Apr		13-Jun	*2.24*	13-Aug	0.28	14-Oct	*0.23*	14-Dec	
14-Feb		14-Apr		14-Jun	*6.66*	14-Aug	0.28	15-Oct	*0.22*	15-Dec	
15-Feb		15-Apr		15-Jun	*4.33*	15-Aug	0.28	16-Oct	*0.21*	16-Dec	
16-Feb		16-Apr		16-Jun	*4.22*	16-Aug	0.26	17-Oct	*0.20*	17-Dec	
17-Feb		17-Apr		17-Jun	*4.12*	17-Aug	0.26	18-Oct	*0.19*	18-Dec	
18-Feb		18-Apr		18-Jun	*4.02*	18-Aug	0.26	19-Oct	*0.19*	19-Dec	
19-Feb		19-Apr		19-Jun	*3.92*	19-Aug	0.24	20-Oct	*0.18*	20-Dec	
20-Feb		20-Apr		20-Jun	*3.83*	20-Aug	0.23	21-Oct	*0.17*	21-Dec	
21-Feb		21-Apr		21-Jun	3.64	21-Aug	0.24	22-Oct	*0.16*	22-Dec	
22-Feb		22-Apr		22-Jun	3.45	22-Aug	0.25	23-Oct	*0.15*	23-Dec	
23-Feb		23-Apr		23-Jun	3.13	23-Aug	0.24	24-Oct	*0.14*	24-Dec	
24-Feb		24-Apr		24-Jun	2.94	24-Aug	0.23	25-Oct	*0.14*	25-Dec	
25-Feb		25-Apr		25-Jun	2.73	25-Aug	0.22	26-Oct	*0.13*	26-Dec	
26-Feb		26-Apr		26-Jun	2.55	26-Aug	0.22	27-Oct	*0.12*	27-Dec	
27-Feb		27-Apr		27-Jun	2.43	27-Aug	0.22	28-Oct	*0.11*	28-Dec	
28-Feb		28-Apr		28-Jun	2.33	28-Aug	0.22	29-Oct	*0.10*	29-Dec	
29-Feb		29-Apr		29-Jun	2.21	29-Aug	0.22	30-Oct	*0.09*	30-Dec	
		30-Apr		30-Jun	2.25	30-Aug	0.22	31-Oct	*0.08*	31-Dec	
						31-Aug	0.22				

Note: Estimated values are italicized.



NEWMONT NORTH AMERICA

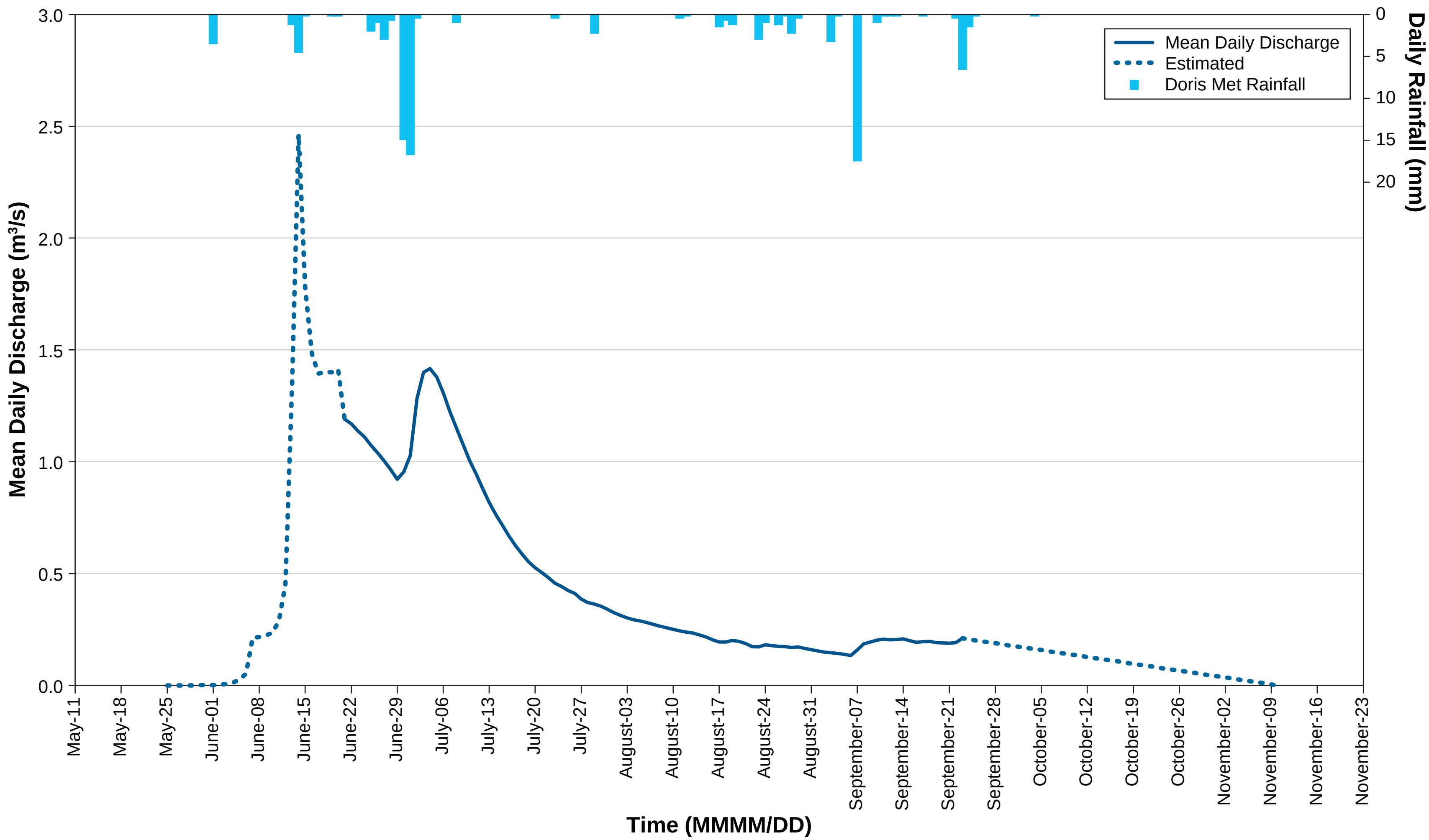
Annual Discharge Hydrograph at Ogama Hydro

Rescan Engineers & Scientists

Appendix A5-5. Summary of Daily Mean Discharge [Q] at Patch Hydro in 2011

Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)
1-Jan		1-Mar		1-May		1-Jul	1.03	1-Sep	0.15	1-Nov	*0.04*
2-Jan		2-Mar		2-May		2-Jul	1.28	2-Sep	0.15	2-Nov	*0.04*
3-Jan		3-Mar		3-May		3-Jul	1.40	3-Sep	0.15	3-Nov	*0.03*
4-Jan		4-Mar		4-May		4-Jul	1.42	4-Sep	0.14	4-Nov	*0.03*
5-Jan		5-Mar		5-May		5-Jul	1.38	5-Sep	0.14	5-Nov	*0.02*
6-Jan		6-Mar		6-May		6-Jul	1.31	6-Sep	0.13	6-Nov	*0.02*
7-Jan		7-Mar		7-May		7-Jul	1.23	7-Sep	0.16	7-Nov	*0.01*
8-Jan		8-Mar		8-May		8-Jul	1.15	8-Sep	0.19	8-Nov	*0.01*
9-Jan		9-Mar		9-May		9-Jul	1.08	9-Sep	0.19	9-Nov	
10-Jan		10-Mar		10-May		10-Jul	1.01	10-Sep	0.20	10-Nov	
11-Jan		11-Mar		11-May		11-Jul	0.95	11-Sep	0.21	11-Nov	
12-Jan		12-Mar		12-May		12-Jul	0.88	12-Sep	0.20	12-Nov	
13-Jan		13-Mar		13-May		13-Jul	0.82	13-Sep	0.21	13-Nov	
14-Jan		14-Mar		14-May		14-Jul	0.76	14-Sep	0.21	14-Nov	
15-Jan		15-Mar		15-May		15-Jul	0.72	15-Sep	0.20	15-Nov	
16-Jan		16-Mar		16-May		16-Jul	0.67	16-Sep	0.19	16-Nov	
17-Jan		17-Mar		17-May		17-Jul	0.62	17-Sep	0.20	17-Nov	
18-Jan		18-Mar		18-May		18-Jul	0.59	18-Sep	0.20	18-Nov	
19-Jan		19-Mar		19-May		19-Jul	0.55	19-Sep	0.19	19-Nov	
20-Jan		20-Mar		20-May		20-Jul	0.53	20-Sep	0.19	20-Nov	
21-Jan		21-Mar		21-May		21-Jul	0.50	21-Sep	0.19	21-Nov	
22-Jan		22-Mar		22-May		22-Jul	0.48	22-Sep	0.19	22-Nov	
23-Jan		23-Mar		23-May		23-Jul	0.46	23-Sep	0.21	23-Nov	
24-Jan		24-Mar		24-May		24-Jul	0.44	24-Sep	*0.21*	24-Nov	
25-Jan		25-Mar		25-May		25-Jul	0.42	25-Sep	*0.20*	25-Nov	
26-Jan		26-Mar		26-May		26-Jul	0.41	26-Sep	*0.20*	26-Nov	
27-Jan		27-Mar		27-May		27-Jul	0.38	27-Sep	*0.19*	27-Nov	
28-Jan		28-Mar		28-May		28-Jul	0.37	28-Sep	*0.19*	28-Nov	
29-Jan		29-Mar		29-May		29-Jul	0.36	29-Sep	*0.18*	29-Nov	
30-Jan		30-Mar		30-May		30-Jul	0.35	30-Sep	*0.18*	30-Nov	
31-Jan		31-Mar		31-May		31-Jul	0.34	1-Oct	*0.18*	1-Dec	
1-Feb		1-Apr		1-Jun		1-Aug	0.32	2-Oct	*0.17*	2-Dec	
2-Feb		2-Apr		2-Jun		2-Aug	0.31	3-Oct	*0.17*	3-Dec	
3-Feb		3-Apr		3-Jun		3-Aug	0.30	4-Oct	*0.16*	4-Dec	
4-Feb		4-Apr		4-Jun		4-Aug	0.29	5-Oct	*0.16*	5-Dec	
5-Feb		5-Apr		5-Jun		5-Aug	0.29	6-Oct	*0.15*	6-Dec	
6-Feb		6-Apr		6-Jun		6-Aug	0.28	7-Oct	*0.15*	7-Dec	
7-Feb		7-Apr		7-Jun	*0.22*	7-Aug	0.27	8-Oct	*0.14*	8-Dec	
8-Feb		8-Apr		8-Jun	*0.22*	8-Aug	0.26	9-Oct	*0.14*	9-Dec	
9-Feb		9-Apr		9-Jun	*0.23*	9-Aug	0.26	10-Oct	*0.14*	10-Dec	
10-Feb		10-Apr		10-Jun	*0.24*	10-Aug	0.25	11-Oct	*0.13*	11-Dec	
11-Feb		11-Apr		11-Jun	*0.28*	11-Aug	0.24	12-Oct	*0.13*	12-Dec	
12-Feb		12-Apr		12-Jun	*0.39*	12-Aug	0.24	13-Oct	*0.12*	13-Dec	
13-Feb		13-Apr		13-Jun	*0.93*	13-Aug	0.23	14-Oct	*0.12*	14-Dec	
14-Feb		14-Apr		14-Jun	*2.51*	14-Aug	0.23	15-Oct	*0.11*	15-Dec	
15-Feb		15-Apr		15-Jun	*1.75*	15-Aug	0.22	16-Oct	*0.11*	16-Dec	
16-Feb		16-Apr		16-Jun	*1.47*	16-Aug	0.20	17-Oct	*0.11*	17-Dec	
17-Feb		17-Apr		17-Jun	*1.39*	17-Aug	0.19	18-Oct	*0.10*	18-Dec	
18-Feb		18-Apr		18-Jun	*1.40*	18-Aug	0.19	19-Oct	*0.10*	19-Dec	
19-Feb		19-Apr		19-Jun	*1.40*	19-Aug	0.20	20-Oct	*0.09*	20-Dec	
20-Feb		20-Apr		20-Jun	*1.42*	20-Aug	0.20	21-Oct	*0.09*	21-Dec	
21-Feb		21-Apr		21-Jun	1.19	21-Aug	0.19	22-Oct	*0.08*	22-Dec	
22-Feb		22-Apr		22-Jun	1.17	22-Aug	0.17	23-Oct	*0.08*	23-Dec	
23-Feb		23-Apr		23-Jun	1.14	23-Aug	0.17	24-Oct	*0.07*	24-Dec	
24-Feb		24-Apr		24-Jun	1.11	24-Aug	0.18	25-Oct	*0.07*	25-Dec	
25-Feb		25-Apr		25-Jun	1.08	25-Aug	0.18	26-Oct	*0.07*	26-Dec	
26-Feb		26-Apr		26-Jun	1.04	26-Aug	0.18	27-Oct	*0.06*	27-Dec	
27-Feb		27-Apr		27-Jun	1.00	27-Aug	0.17	28-Oct	*0.06*	28-Dec	
28-Feb		28-Apr		28-Jun	0.97	28-Aug	0.17	29-Oct	*0.05*	29-Dec	
29-Feb		29-Apr		29-Jun	0.92	29-Aug	0.17	30-Oct	*0.05*	30-Dec	
		30-Apr		30-Jun	0.95	30-Aug	0.16	31-Oct	*0.04*	31-Dec	
						31-Aug	0.16				

Note: Estimated values are italicized.



NEWMONT NORTH AMERICA

Annual Discharge Hydrograph at Patch Hydro

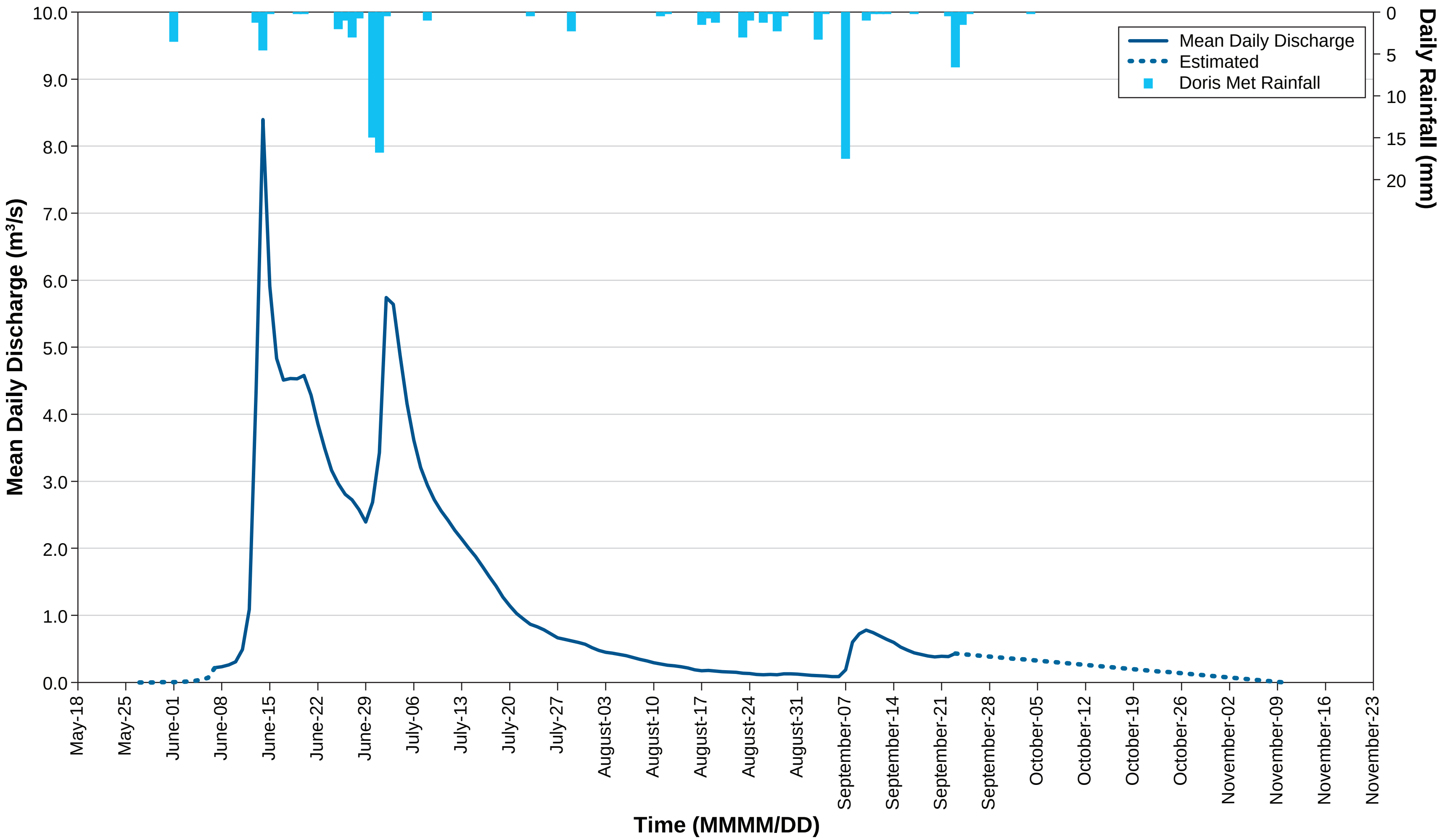
Appendix A5-5

Rescan Engineers & Scientists

Appendix A5-6. Summary of Daily Mean Discharge [Q] at PO Hydro in 2011

Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)
1-Jan		1-Mar		1-May		1-Jul	3.42	1-Sep	0.11	1-Nov	*0.08*
2-Jan		2-Mar		2-May		2-Jul	5.74	2-Sep	0.11	2-Nov	*0.07*
3-Jan		3-Mar		3-May		3-Jul	5.64	3-Sep	0.10	3-Nov	*0.06*
4-Jan		4-Mar		4-May		4-Jul	4.87	4-Sep	0.10	4-Nov	*0.05*
5-Jan		5-Mar		5-May		5-Jul	4.16	5-Sep	0.09	5-Nov	*0.04*
6-Jan		6-Mar		6-May		6-Jul	3.61	6-Sep	0.08	6-Nov	*0.04*
7-Jan		7-Mar		7-May		7-Jul	3.21	7-Sep	0.19	7-Nov	*0.03*
8-Jan		8-Mar		8-May		8-Jul	2.94	8-Sep	0.60	8-Nov	*0.02*
9-Jan		9-Mar		9-May		9-Jul	2.72	9-Sep	0.72	9-Nov	*0.01*
10-Jan		10-Mar		10-May		10-Jul	2.56	10-Sep	0.78	10-Nov	*0.00*
11-Jan		11-Mar		11-May		11-Jul	2.42	11-Sep	0.74	11-Nov	
12-Jan		12-Mar		12-May		12-Jul	2.27	12-Sep	0.69	12-Nov	
13-Jan		13-Mar		13-May		13-Jul	2.14	13-Sep	0.64	13-Nov	
14-Jan		14-Mar		14-May		14-Jul	2.01	14-Sep	0.59	14-Nov	
15-Jan		15-Mar		15-May		15-Jul	1.88	15-Sep	0.52	15-Nov	
16-Jan		16-Mar		16-May		16-Jul	1.73	16-Sep	0.48	16-Nov	
17-Jan		17-Mar		17-May		17-Jul	1.58	17-Sep	0.44	17-Nov	
18-Jan		18-Mar		18-May		18-Jul	1.44	18-Sep	0.42	18-Nov	
19-Jan		19-Mar		19-May		19-Jul	1.27	19-Sep	0.39	19-Nov	
20-Jan		20-Mar		20-May		20-Jul	1.14	20-Sep	0.38	20-Nov	
21-Jan		21-Mar		21-May		21-Jul	1.03	21-Sep	0.39	21-Nov	
22-Jan		22-Mar		22-May	*<0.01*	22-Jul	0.95	22-Sep	0.39	22-Nov	
23-Jan		23-Mar		23-May	*<0.01*	23-Jul	0.87	23-Sep	0.43	23-Nov	
24-Jan		24-Mar		24-May	*<0.01*	24-Jul	0.83	24-Sep	*0.42*	24-Nov	
25-Jan		25-Mar		25-May	*<0.01*	25-Jul	0.78	25-Sep	*0.41*	25-Nov	
26-Jan		26-Mar		26-May	*<0.01*	26-Jul	0.73	26-Sep	*0.40*	26-Nov	
27-Jan		27-Mar		27-May	*<0.01*	27-Jul	0.66	27-Sep	*0.39*	27-Nov	
28-Jan		28-Mar		28-May	*<0.01*	28-Jul	0.64	28-Sep	*0.39*	28-Nov	
29-Jan		29-Mar		29-May	*<0.01*	29-Jul	0.62	29-Sep	*0.38*	29-Nov	
30-Jan		30-Mar		30-May	*<0.01*	30-Jul	0.60	30-Sep	*0.37*	30-Nov	
31-Jan		31-Mar		31-May	*<0.01*	31-Jul	0.57	1-Oct	*0.36*	1-Dec	
1-Feb		1-Apr		1-Jun	*<0.01*	1-Aug	0.52	2-Oct	*0.35*	2-Dec	
2-Feb		2-Apr		2-Jun	*0.01*	2-Aug	0.48	3-Oct	*0.34*	3-Dec	
3-Feb		3-Apr		3-Jun	*0.01*	3-Aug	0.45	4-Oct	*0.33*	4-Dec	
4-Feb		4-Apr		4-Jun	*0.02*	4-Aug	0.43	5-Oct	*0.32*	5-Dec	
5-Feb		5-Apr		5-Jun	*0.04*	5-Aug	0.42	6-Oct	*0.31*	6-Dec	
6-Feb		6-Apr		6-Jun	*0.07*	6-Aug	0.40	7-Oct	*0.30*	7-Dec	
7-Feb		7-Apr		7-Jun	0.22	7-Aug	0.37	8-Oct	*0.30*	8-Dec	
8-Feb		8-Apr		8-Jun	0.23	8-Aug	0.34	9-Oct	*0.29*	9-Dec	
9-Feb		9-Apr		9-Jun	0.26	9-Aug	0.32	10-Oct	*0.28*	10-Dec	
10-Feb		10-Apr		10-Jun	0.30	10-Aug	0.29	11-Oct	*0.27*	11-Dec	
11-Feb		11-Apr		11-Jun	0.49	11-Aug	0.27	12-Oct	*0.26*	12-Dec	
12-Feb		12-Apr		12-Jun	1.09	12-Aug	0.26	13-Oct	*0.25*	13-Dec	
13-Feb		13-Apr		13-Jun	4.36	13-Aug	0.25	14-Oct	*0.24*	14-Dec	
14-Feb		14-Apr		14-Jun	8.40	14-Aug	0.23	15-Oct	*0.23*	15-Dec	
15-Feb		15-Apr		15-Jun	5.91	15-Aug	0.22	16-Oct	*0.22*	16-Dec	
16-Feb		16-Apr		16-Jun	4.83	16-Aug	0.19	17-Oct	*0.22*	17-Dec	
17-Feb		17-Apr		17-Jun	4.51	17-Aug	0.17	18-Oct	*0.21*	18-Dec	
18-Feb		18-Apr		18-Jun	4.53	18-Aug	0.18	19-Oct	*0.20*	19-Dec	
19-Feb		19-Apr		19-Jun	4.53	19-Aug	0.17	20-Oct	*0.19*	20-Dec	
20-Feb		20-Apr		20-Jun	4.58	20-Aug	0.16	21-Oct	*0.18*	21-Dec	
21-Feb		21-Apr		21-Jun	4.28	21-Aug	0.16	22-Oct	*0.17*	22-Dec	
22-Feb		22-Apr		22-Jun	3.86	22-Aug	0.15	23-Oct	*0.16*	23-Dec	
23-Feb		23-Apr		23-Jun	3.49	23-Aug	0.14	24-Oct	*0.15*	24-Dec	
24-Feb		24-Apr		24-Jun	3.16	24-Aug	0.13	25-Oct	*0.14*	25-Dec	
25-Feb		25-Apr		25-Jun	2.96	25-Aug	0.12	26-Oct	*0.13*	26-Dec	
26-Feb		26-Apr		26-Jun	2.80	26-Aug	0.12	27-Oct	*0.13*	27-Dec	
27-Feb		27-Apr		27-Jun	2.72	27-Aug	0.12	28-Oct	*0.12*	28-Dec	
28-Feb		28-Apr		28-Jun	2.58	28-Aug	0.11	29-Oct	*0.11*	29-Dec	
29-Feb		29-Apr		29-Jun	2.39	29-Aug	0.13	30-Oct	*0.10*	30-Dec	
		30-Apr		30-Jun	2.68	30-Aug	0.13	31-Oct	*0.09*	31-Dec	
						31-Aug	0.12				

Note: Estimated values are italicized.



Appendix A5-6

NEWMONT NORTH AMERICA

Annual Discharge Hydrograph at PO Hydro

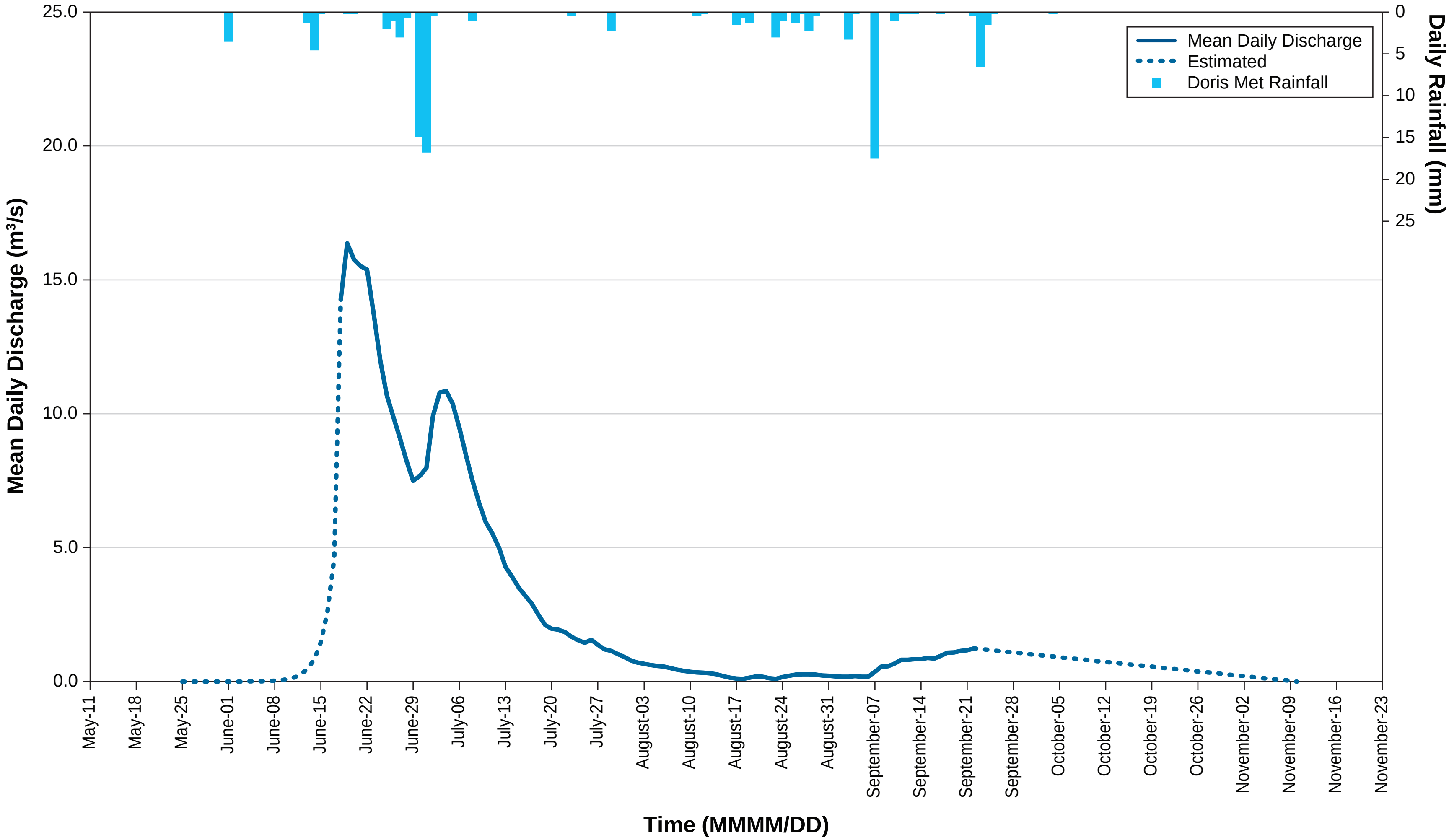
Rescan Engineers & Scientists

Appendix A5-7. Summary of Daily Mean Discharge [Q] at Reference B Hydro in 2011

Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)
1-Jan		1-Mar		1-May		1-Jul	7.97	1-Sep	0.19	1-Nov	*0.23*
2-Jan		2-Mar		2-May		2-Jul	9.91	2-Sep	0.18	2-Nov	*0.20*
3-Jan		3-Mar		3-May		3-Jul	10.79	3-Sep	0.18	3-Nov	*0.18*
4-Jan		4-Mar		4-May		4-Jul	10.85	4-Sep	0.20	4-Nov	*0.15*
5-Jan		5-Mar		5-May		5-Jul	10.37	5-Sep	0.18	5-Nov	*0.13*
6-Jan		6-Mar		6-May		6-Jul	9.46	6-Sep	0.18	6-Nov	*0.10*
7-Jan		7-Mar		7-May		7-Jul	8.45	7-Sep	0.37	7-Nov	*0.08*
8-Jan		8-Mar		8-May		8-Jul	7.50	8-Sep	0.56	8-Nov	*0.05*
9-Jan		9-Mar		9-May		9-Jul	6.64	9-Sep	0.57	9-Nov	*0.03*
10-Jan		10-Mar		10-May		10-Jul	5.95	10-Sep	0.68	10-Nov	
11-Jan		11-Mar		11-May		11-Jul	5.53	11-Sep	0.82	11-Nov	
12-Jan		12-Mar		12-May		12-Jul	4.99	12-Sep	0.81	12-Nov	
13-Jan		13-Mar		13-May		13-Jul	4.28	13-Sep	0.83	13-Nov	
14-Jan		14-Mar		14-May		14-Jul	3.92	14-Sep	0.83	14-Nov	
15-Jan		15-Mar		15-May		15-Jul	3.50	15-Sep	0.88	15-Nov	
16-Jan		16-Mar		16-May		16-Jul	3.20	16-Sep	0.86	16-Nov	
17-Jan		17-Mar		17-May		17-Jul	2.90	17-Sep	0.96	17-Nov	
18-Jan		18-Mar		18-May		18-Jul	2.49	18-Sep	1.08	18-Nov	
19-Jan		19-Mar		19-May		19-Jul	2.11	19-Sep	1.08	19-Nov	
20-Jan		20-Mar		20-May		20-Jul	1.97	20-Sep	1.14	20-Nov	
21-Jan		21-Mar		21-May		21-Jul	1.94	21-Sep	1.17	21-Nov	
22-Jan		22-Mar		22-May		22-Jul	1.85	22-Sep	1.24	22-Nov	
23-Jan		23-Mar		23-May		23-Jul	1.68	23-Sep	*1.21*	23-Nov	
24-Jan		24-Mar		24-May		24-Jul	1.55	24-Sep	*1.19*	24-Nov	
25-Jan		25-Mar		25-May		25-Jul	1.45	25-Sep	*1.16*	25-Nov	
26-Jan		26-Mar		26-May		26-Jul	1.56	26-Sep	*1.14*	26-Nov	
27-Jan		27-Mar		27-May		27-Jul	1.38	27-Sep	*1.11*	27-Nov	
28-Jan		28-Mar		28-May		28-Jul	1.20	28-Sep	*1.09*	28-Nov	
29-Jan		29-Mar		29-May		29-Jul	1.14	29-Sep	*1.06*	29-Nov	
30-Jan		30-Mar		30-May		30-Jul	1.03	30-Sep	*1.03*	30-Nov	
31-Jan		31-Mar		31-May		31-Jul	0.91	1-Oct	*1.01*	1-Dec	
1-Feb		1-Apr		1-Jun		1-Aug	0.79	2-Oct	*0.98*	2-Dec	
2-Feb		2-Apr		2-Jun		2-Aug	0.70	3-Oct	*0.96*	3-Dec	
3-Feb		3-Apr		3-Jun		3-Aug	0.66	4-Oct	*0.93*	4-Dec	
4-Feb		4-Apr		4-Jun		4-Aug	0.62	5-Oct	*0.91*	5-Dec	
5-Feb		5-Apr		5-Jun		5-Aug	0.58	6-Oct	*0.88*	6-Dec	
6-Feb		6-Apr		6-Jun		6-Aug	0.56	7-Oct	*0.86*	7-Dec	
7-Feb		7-Apr		7-Jun	*0.02*	7-Aug	0.51	8-Oct	*0.83*	8-Dec	
8-Feb		8-Apr		8-Jun	*0.03*	8-Aug	0.44	9-Oct	*0.81*	9-Dec	
9-Feb		9-Apr		9-Jun	*0.05*	9-Aug	0.40	10-Oct	*0.78*	10-Dec	
10-Feb		10-Apr		10-Jun	*0.09*	10-Aug	0.36	11-Oct	*0.76*	11-Dec	
11-Feb		11-Apr		11-Jun	*0.15*	11-Aug	0.34	12-Oct	*0.73*	12-Dec	
12-Feb		12-Apr		12-Jun	*0.27*	12-Aug	0.32	13-Oct	*0.71*	13-Dec	
13-Feb		13-Apr		13-Jun	*0.48*	13-Aug	0.31	14-Oct	*0.68*	14-Dec	
14-Feb		14-Apr		14-Jun	*0.84*	14-Aug	0.27	15-Oct	*0.66*	15-Dec	
15-Feb		15-Apr		15-Jun	*1.48*	15-Aug	0.21	16-Oct	*0.63*	16-Dec	
16-Feb		16-Apr		16-Jun	*2.60*	16-Aug	0.14	17-Oct	*0.61*	17-Dec	
17-Feb		17-Apr		17-Jun	*4.59*	17-Aug	0.11	18-Oct	*0.58*	18-Dec	
18-Feb		18-Apr		18-Jun	14.26	18-Aug	0.10	19-Oct	*0.56*	19-Dec	
19-Feb		19-Apr		19-Jun	16.36	19-Aug	0.14	20-Oct	*0.53*	20-Dec	
20-Feb		20-Apr		20-Jun	15.75	20-Aug	0.19	21-Oct	*0.50*	21-Dec	
21-Feb		21-Apr		21-Jun	15.52	21-Aug	0.18	22-Oct	*0.48*	22-Dec	
22-Feb		22-Apr		22-Jun	15.39	22-Aug	0.13	23-Oct	*0.45*	23-Dec	
23-Feb		23-Apr		23-Jun	13.71	23-Aug	0.10	24-Oct	*0.43*	24-Dec	
24-Feb		24-Apr		24-Jun	11.99	24-Aug	0.17	25-Oct	*0.40*	25-Dec	
25-Feb		25-Apr		25-Jun	10.69	25-Aug	0.22	26-Oct	*0.38*	26-Dec	
26-Feb		26-Apr		26-Jun	9.88	26-Aug	0.26	27-Oct	*0.35*	27-Dec	
27-Feb		27-Apr		27-Jun	9.07	27-Aug	0.27	28-Oct	*0.33*	28-Dec	
28-Feb		28-Apr		28-Jun	8.23	28-Aug	0.27	29-Oct	*0.30*	29-Dec	
29-Feb		29-Apr		29-Jun	7.50	29-Aug	0.26	30-Oct	*0.28*	30-Dec	
		30-Apr		30-Jun	7.68	30-Aug	0.23	31-Oct	*0.25*	31-Dec	
						31-Aug	0.21				

Note: Estimated values are italicized.

PROJECT # 1009-008-04 ILLUSTRATION # a34282w December 15, 2011



Appendix A5-7

NEWMONT NORTH AMERICA

Annual Discharge Hydrograph at Reference B Hydro

Appendix A5-7

Rescan Engineers & Scientists

Appendix A5-8. Summary of Daily Mean Discharge [Q] at Roberts Hydro in 2011

Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)	Date	Q (m^3/s)
1-Jan		1-Mar		1-May		1-Jul	5.00	1-Sep	0.13	1-Nov	
2-Jan		2-Mar		2-May		2-Jul	6.20	2-Sep	0.12	2-Nov	
3-Jan		3-Mar		3-May		3-Jul	6.55	3-Sep	0.12	3-Nov	
4-Jan		4-Mar		4-May		4-Jul	6.28	4-Sep	0.12	4-Nov	
5-Jan		5-Mar		5-May		5-Jul	5.80	5-Sep	0.11	5-Nov	
6-Jan		6-Mar		6-May		6-Jul	5.22	6-Sep	0.11	6-Nov	
7-Jan		7-Mar		7-May		7-Jul	4.65	7-Sep	0.17	7-Nov	
8-Jan		8-Mar		8-May		8-Jul	4.15	8-Sep	0.25	8-Nov	
9-Jan		9-Mar		9-May		9-Jul	3.71	9-Sep	0.31	9-Nov	
10-Jan		10-Mar		10-May		10-Jul	3.31	10-Sep	0.36	10-Nov	
11-Jan		11-Mar		11-May		11-Jul	2.94	11-Sep	0.40	11-Nov	
12-Jan		12-Mar		12-May		12-Jul	2.64	12-Sep	0.44	12-Nov	
13-Jan		13-Mar		13-May		13-Jul	2.35	13-Sep	0.46	13-Nov	
14-Jan		14-Mar		14-May		14-Jul	2.10	14-Sep	0.49	14-Nov	
15-Jan		15-Mar		15-May		15-Jul	1.87	15-Sep	0.50	15-Nov	
16-Jan		16-Mar		16-May		16-Jul	1.67	16-Sep	0.51	16-Nov	
17-Jan		17-Mar		17-May		17-Jul	1.49	17-Sep	0.51	17-Nov	
18-Jan		18-Mar		18-May		18-Jul	1.37	18-Sep	0.51	18-Nov	
19-Jan		19-Mar		19-May		19-Jul	1.23	19-Sep	0.51	19-Nov	
20-Jan		20-Mar		20-May		20-Jul	1.08	20-Sep	0.50	20-Nov	
21-Jan		21-Mar		21-May		21-Jul	0.96	21-Sep	0.50	21-Nov	
22-Jan		22-Mar		22-May		22-Jul	0.86	22-Sep	0.51	22-Nov	
23-Jan		23-Mar		23-May		23-Jul	0.83	23-Sep	0.53	23-Nov	
24-Jan		24-Mar		24-May		24-Jul	0.78	24-Sep	0.55	24-Nov	
25-Jan		25-Mar		25-May		25-Jul	0.73	25-Sep	0.56	25-Nov	
26-Jan		26-Mar		26-May		26-Jul	0.67	26-Sep		26-Nov	
27-Jan		27-Mar		27-May		27-Jul	0.64	27-Sep		27-Nov	
28-Jan		28-Mar		28-May		28-Jul	0.61	28-Sep		28-Nov	
29-Jan		29-Mar		29-May		29-Jul	0.59	29-Sep		29-Nov	
30-Jan		30-Mar		30-May		30-Jul	0.56	30-Sep		30-Nov	
31-Jan		31-Mar		31-May		31-Jul	0.54	1-Oct		1-Dec	
1-Feb		1-Apr		1-Jun		1-Aug	0.51	2-Oct		2-Dec	
2-Feb		2-Apr		2-Jun		2-Aug	0.46	3-Oct		3-Dec	
3-Feb		3-Apr		3-Jun		3-Aug	0.43	4-Oct		4-Dec	
4-Feb		4-Apr		4-Jun		4-Aug	0.41	5-Oct		5-Dec	
5-Feb		5-Apr		5-Jun		5-Aug	0.39	6-Oct		6-Dec	
6-Feb		6-Apr		6-Jun		6-Aug	0.38	7-Oct		7-Dec	
7-Feb		7-Apr		7-Jun		7-Aug	0.36	8-Oct		8-Dec	
8-Feb		8-Apr		8-Jun		8-Aug	0.33	9-Oct		9-Dec	
9-Feb		9-Apr		9-Jun		9-Aug	0.31	10-Oct		10-Dec	
10-Feb		10-Apr		10-Jun		10-Aug	0.28	11-Oct		11-Dec	
11-Feb		11-Apr		11-Jun		11-Aug	0.27	12-Oct		12-Dec	
12-Feb		12-Apr		12-Jun		12-Aug	0.25	13-Oct		13-Dec	
13-Feb		13-Apr		13-Jun		13-Aug	0.24	14-Oct		14-Dec	
14-Feb		14-Apr		14-Jun		14-Aug	0.23	15-Oct		15-Dec	
15-Feb		15-Apr		15-Jun		15-Aug	0.22	16-Oct		16-Dec	
16-Feb		16-Apr		16-Jun		16-Aug	0.20	17-Oct		17-Dec	
17-Feb		17-Apr		17-Jun		17-Aug	0.20	18-Oct		18-Dec	
18-Feb		18-Apr		18-Jun		18-Aug	0.19	19-Oct		19-Dec	
19-Feb		19-Apr		19-Jun		19-Aug	0.17	20-Oct		20-Dec	
20-Feb		20-Apr		20-Jun		20-Aug	0.17	21-Oct		21-Dec	
21-Feb		21-Apr		21-Jun	7.53	21-Aug	0.17	22-Oct		22-Dec	
22-Feb		22-Apr		22-Jun	7.30	22-Aug	0.19	23-Oct		23-Dec	
23-Feb		23-Apr		23-Jun	6.87	23-Aug	0.16	24-Oct		24-Dec	
24-Feb		24-Apr		24-Jun	6.44	24-Aug	0.15	25-Oct		25-Dec	
25-Feb		25-Apr		25-Jun	6.04	25-Aug	0.15	26-Oct		26-Dec	
26-Feb		26-Apr		26-Jun	5.64	26-Aug	0.14	27-Oct		27-Dec	
27-Feb		27-Apr		27-Jun	5.26	27-Aug	0.14	28-Oct		28-Dec	
28-Feb		28-Apr		28-Jun	4.92	28-Aug	0.14	29-Oct		29-Dec	
29-Feb		29-Apr		29-Jun	4.56	29-Aug	0.14	30-Oct		30-Dec	
		30-Apr		30-Jun	4.60	30-Aug	0.14	31-Oct		31-Dec	
						31-Aug	0.14				

Note: Estimated values are italicized.