Appendix 5.3.2C
Blackwater Gold Project Tatelkuz Lake IFN Withdrawal Model Letter

November 22, 2013

File No.:VA101-457/6-A.01
Cont. No.:VA13-02066

Mr. Ryan Todd
Manager, Environment
New Gold Inc.
Suite 1800, Two Bentall Centre
555 Burrard Street
Vancouver, British Columbia
Canada, V7X 1M9

Dear Ryan,

Re: Tatelkuz Lake IFN Withdrawal Model

Introduction

The Blackwater Gold Project is a prospective mining project located southwest of Vanderhoof, in central BC. The project design proposes a requirement for mill make-up water (during operations), as well as supplementary flows to Davison Creek downstream of the proposed TSF (during operations and closure). It is proposed that required flows be pumped from Tatelkuz Lake, located approximately 20 km northeast of the Project site.

AMEC performed a habitat assessment on Davidson Creek to determine the seasonal in stream flow needs (IFNs) that would be required to maintain fish habitat. Knight Piésold Ltd. (KP) was then retained by New Gold Inc. (New Gold) to develop a lake withdrawal model in order to estimate the impact of withdrawal on stage and discharge at the Tatelkuz Lake outlet. Two hydrometric monitoring station locations will be discussed in this letter, and will be referred to as the H2 node and the H5 node.

Model Objectives

The proposed Fresh Water Supply System, shown on Figure 1, implies that a reach of Chedakuz Creek, approximately 1 km long and located immediately downstream of the Tatelkuz Lake outlet, will likely be the area most impacted by the proposed system. Water required for the mill and IFN needs in Davidson Creek will be pumped from the lake to the H2 node on Davidson Creek during operations and closure. These flows will then return to Chedakuz Creek at the Davidson Creek confluence approximately 1 km downstream of Tatelkuz Lake outlet and 2.5 km upstream of the H5 node on Chedakuz Creek. The objective of the IFN withdrawal model was to assess the impact of water withdrawal on this 1 km reach of Chedakuz Creek based on the assessment of Tatelkuz Lake levels and outlet discharges.

Model Development

The primary input to the model was a 40 year synthetic discharge series for Chedakuz Creek at the H5 node. This series was prorated to the Tatelkuz Lake outlet and then analysed in conjunction with detailed outlet surveys and continuous but short-term measured lake level and outlet discharge data, in order to develop a 40 year long synthetic daily series of Tatelkuz Lake levels. The methodology is described in detail in KP letter VA13-01604 (KP, 2013).

The simplest approach to modelling the impact of withdrawal is to subtract the withdrawal rate from the continuous discharge series at the outlet of the lake. This approach, however, ignores the lake attenuating effects and assumes that alternating pumping rates have an immediate response at the lake outlet. Tatelkuz Lake has a surface area of over 8 km^2, which allows for temporary storage and attenuation. A better approach is to model the impacts of withdrawal by accounting for the attenuating effects of the lake by using a reservoir routing model.

The reservoir routing model balances the lake inflows and outflows through changes in lake storage. The following inputs were used in calculations:

- Depth-Area-Capacity (DAC) relationship for Tatelkuz Lake.
  - The depth area capacity (DAC) relationship was developed from a real-time bathymetric survey undertaken by AMEC on June 9, 2013. The DAC curve is shown on Figure 2.
- Hydraulic geometry of the outlet (rating curve).
  - Surveys of the Tatelkuz Lake outlet were used in conjunction with hydraulic theory to develop a reliable relationship between lake levels and lake outflows (i.e. a rating curve for the lake outlet). The rating curve development was described in KP letter VA13-01604 (KP, 2013). Measured discharge at the outlet suggests that the rating curve has a good fit to measured data, as shown on Figure 3.
- Inflow Hydrograph (daily resolution)
  - Daily inflow data are not available and hence the inflow hydrograph was developed using the reservoir routing model, which incorporated the 40 year long synthetic outlet discharge, the DAC relationship, and the rating curve for the lake outlet.
  - The modelled inflows were then verified by re-running the reservoir routing model and comparing the modelled lake outflows with the 40 year long synthetic Tatelkuz Lake outlet discharge series.

The inflow hydrograph developed for baseline conditions was used as an input for modelling Tatelkuz Lake levels and outflows for operational conditions. Operational withdrawal rates, consisting of two main components, were incorporated into the reservoir routing model as follows:

1. Mill makeup water supplied at a constant rate of 0.033 m3/s (33 L/s) annually, and
2. Supplementary flows, or IFN requirements, for Davidson Creek, which were determined through fish habitat studies performed by AMEC. The Davidson Creek IFNs are as follows (AMEC, 2013a):
   - Winter Stanza (December – March): 0.125 m3/s (125 L/s).
   - Freshet Stanza (May – June): 0.56 m3/s (560 L/s).
   - Rainbow Incubation Stanza (July – August): 0.15 m3/s (150 L/s).
   - Kokanee Incubation Stanza (September – November): 0.115 m3/s (115 L/s).

In conjunction with AMEC, KP determined that baseflow during the month of April would not be considered when developing IFNs due to the high variability in the synthetic series set resulting from variability in the timing of spring freshet between years. Consequently, Winter IFNs were assumed to apply in April as well. The withdrawal hydrograph is given on Figure 4, and shows the IFN and the mill requirements across the various stanzas.

Impact assessments of operational withdrawals are required for the Tatelkuz Lake outlet and the first kilometer of Chedakuz Creek. AMEC (2013 b) determined that fish habitat stanzas were different in Chedakuz Creek compared to Davidson Creek. The Chedakuz Creek stanzas are as follows:

- Winter (December – March).
- Freshet (May – June).
- Rainbow Incubation (July).
- Kokanee Spawning (August – September).
- Rainbow Rearing (October – November).

Figure 5 shows the baseline and operational hydrographs for the Tatelkuz Lake outlet developed for the 40 year long synthetic series, where both mill and IFN requirements were taken into consideration for operations. The operational lake outflow series was then converted to stage using the outlet rating curve to investigate the withdrawal impacts on stage. Stage and discharge are not linearly related and the reduction in both is important when considering impacts to fish habitat.

Model Results

The results of the analysis are summarized in Table 1. The average discharge and stage for each Chedakuz Creek stanza during baseline and operations were calculated for average conditions and for the 1 in 10 year low flow conditions. The lowest daily flow for each stanza in each year were calculated and then run through the statistical modeling software, LFA, to produce the 1 in 10 year daily low flows. The impact on the 1 km long Chedakuz Creek reach just downstream of the lake outlet, based on this analysis, is as follows:

- The average change in the average case is -15% for discharge and -7% for stage.
- The average change in the 1 in 10 year low flow case is -28% for discharge and -14% for stage.
- The largest change in flow occurs in the average case during freshet and equates to an approximate flow reduction of 0.51 m3/s (or -13%).
- The largest percent change in flow occurs in the 1 in 10 year low flow case during freshet and equates to a flow reduction of 0.48 m3/s (or -39%).
- The largest change in stage also corresponds to the largest percent change in stage, and occurs during the 1 in 10 year low flow case during freshet. The change equates to -10 cm (or -20%).

Figures 6 through 10 show the withdrawal impacts with regards to the expected change in stage for both the average and the 1 in 10 year low flow conditions. Each figure contains a surveyed control cross-section, as well as a lake outlet photograph that was taken during the particular stanza (no photo is available for the Rainbow rearing stanza). The figures also show the main channel is largely trapezoidal, with steep banks and well developed levees leading into the floodplain, which is several hundred meters in width. The average condition for each stanza indicates that flows do not breach the levee banks of the main channel. However, it should be noted that higher flows within the synthetic record for the freshet stanza in particular do breach the banks and inundate the floodplain, as shown on Figure 3. The attenuating impact of the lake is such that the overall drawdown due to lake withdrawal is low in many of the stanzas. The Freshet 1 in 10 year flow and stage are an exception to this general trend, where the impact of drawdown is more substantial than in other stanzas.

Model Limitations

While the lake withdrawal model is designed to quantify the impacts at the outlet of Tatelkuz Lake, there are several assumptions and limitations relevant for its application:

- The primary discharge series is based on node H5 on Chedakuz Creek, pro-rated to the lake outlet. H5 is located approximately 3.5 km downstream of the outlet. While the catchment proration of these data is considered reasonable, there are inherent uncertainties when scaling a discharge series by drainage area, such as the assumption of proportionality of inflows from tributaries which flow into Chedakuz Creek between the lake outlet and node H5. No gauges exist along this reach of Chedakuz Creek, and consequently, assumptions of hydrologic behaviour were necessary.
- The bathymetric survey was completed during a peak flow period. However, it is still limited to the maximum water depth on that particular day, while higher water levels had to be extrapolated.
- The model is not deterministic and is not designed to state whether the impacts are acceptable or not from the perspective of fish and fish habitat.
- The model is not designed to be used for operations. It is possible to convert this model to one capable of functioning during operations; however, it does not have that capacity and was not intended for that purpose. The model may be used to assist in informing operations about the types of real-time data inputs that would be required to develop an operational model.
- Comparisons to channel cross-sections given on Figures 6 through 10 are provided as examples of channel sections, but may not necessarily represent the entire impacted reach of Chedakuz Creek.

Closing Remarks

The results of this analysis indicate that using Tatelkuz Lake as a fresh water source, for the purpose of supplementing mill and IFN requirements during mining operations, will result in reduced flow and stage along the 1 km reach downstream of Tatelkuz Lake and upstream of the Chedakuz/Davidson confluence. As shown in Table 1:

- The average reduction to flows is predicted to be approximately 15%.
- The average reduction to stage is estimated to be 7%.
- The average reduction in 1:10 daily low flows is predicted to be approximately 28%.
- The average reduction in 1:10 daily low stage is estimated to be 14%.

Yours truly,

KNIGHT PIÉSOLD LTD.

Signed:
Brendan Worrall, E.I.T.
Staff Engineer

Reviewed:
Cameron McCarthy, P.Eng., PGeo.
Senior Engineer

Violeta Martin

Reviewed:
Violeta Martin, Ph.D., P.Eng.
Senior Hydrotechnical Engineer

Approved:
Ken Brouwer, P.Eng.
President

Attachments:

Table 1	Rev 0	Model Results
Figure 1	Rev 0	Fresh Water Supply Pipeline Layout
Figure 2	Rev 0	Tatelkuz Lake Depth Area Capacity Curve
Figure 3	Rev 0	Tatelkuz Lake Outlet Rating Curve and Cross Section
Figure 4	Rev 0	Withdrawal Hydrograph
Figure 5	Rev 0	Outflow Discharge Series
Figure 6	Rev 0	Winter Stage Impact
Figure 7	Rev 0	Freshet Stage Impact
Figure 8	Rev 0	Rainbow Incubation Stage Impact
Figure 9	Rev 0	Kokanee Spawning Stage Impact
Figure 10	Rev 0	Rainbow Rearing Stage Impact

References:

AMEC 2013 a — Recommended Flushing Flows, transitional Flows, and Ramping Rates for Davidson Creek., AMEC file ref. VA52277.4430, October 2013

AMEC 2013 b — Instream Flow – Chedakuz Switching Evaluation. AMEC File Ref. VE52277. September , 2013, issued in draft

KP 2013 — Revised Baseline Tatelkuz Lake Levels, KP Cont. Number VA13-01604. July 2013

/bw

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TABLE 1

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TATELKUZ IFN MODEL
BASELINE VS. OPERATIONS

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Average Case						
Stanza	Baseline		Operations		Change	
	Discharge (m^3/s)	Stage (m)	Discharge (m^3/s)	Stage (m)	Discharge (%)	Stage (%)
Winter	1.14	0.48	0.97	0.45	-15%	-7%
Freshet	3.87	0.84	3.36	0.79	-13%	-6%
Rainbow Incubation	1.87	0.61	1.60	0.56	-14%	-7%
Kokanee Spawning	1.01	0.46	0.85	0.42	-16%	-8%
Rainbow Rearing	1.09	0.47	0.93	0.44	-15%	-7%
Average	1.80	0.57	1.54	0.53	-15%	-7%
1:10 Daily Low Flow Case						
Stanza	Baseline		Operations		Change	
	Discharge (m^3/s)	Stage (m)	Discharge (m^3/s)	Stage (m)	Discharge (%)	Stage (%)
Winter	0.72	0.39	0.58	0.35	-20%	-10%
Freshet	1.23	0.50	0.75	0.40	-39%	-20%
Rainbow Incubation	0.75	0.40	0.54	0.34	-28%	-14%
Kokanee Spawning	0.60	0.36	0.44	0.31	-26%	-13%
Rainbow Rearing	0.65	0.37	0.49	0.33	-24%	-12%
Average	0.79	0.41	0.56	0.35	-28%	-14%

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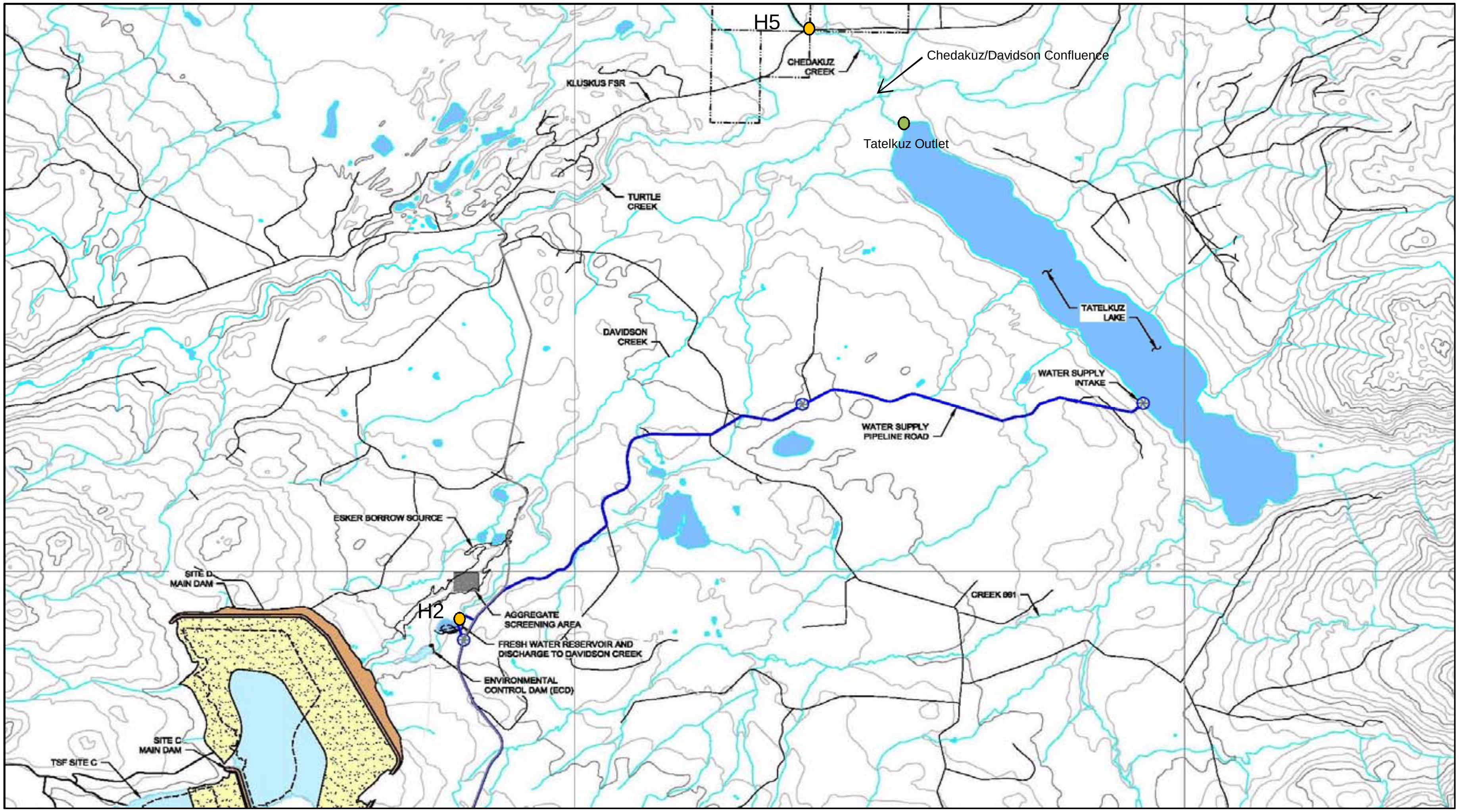

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FRESH WATER SUPPLY SYSTEM
GENERAL ARRANGEMENT

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P/A NO. VA101-457/6

REF. NO. VA13-02066

FIGURE 1

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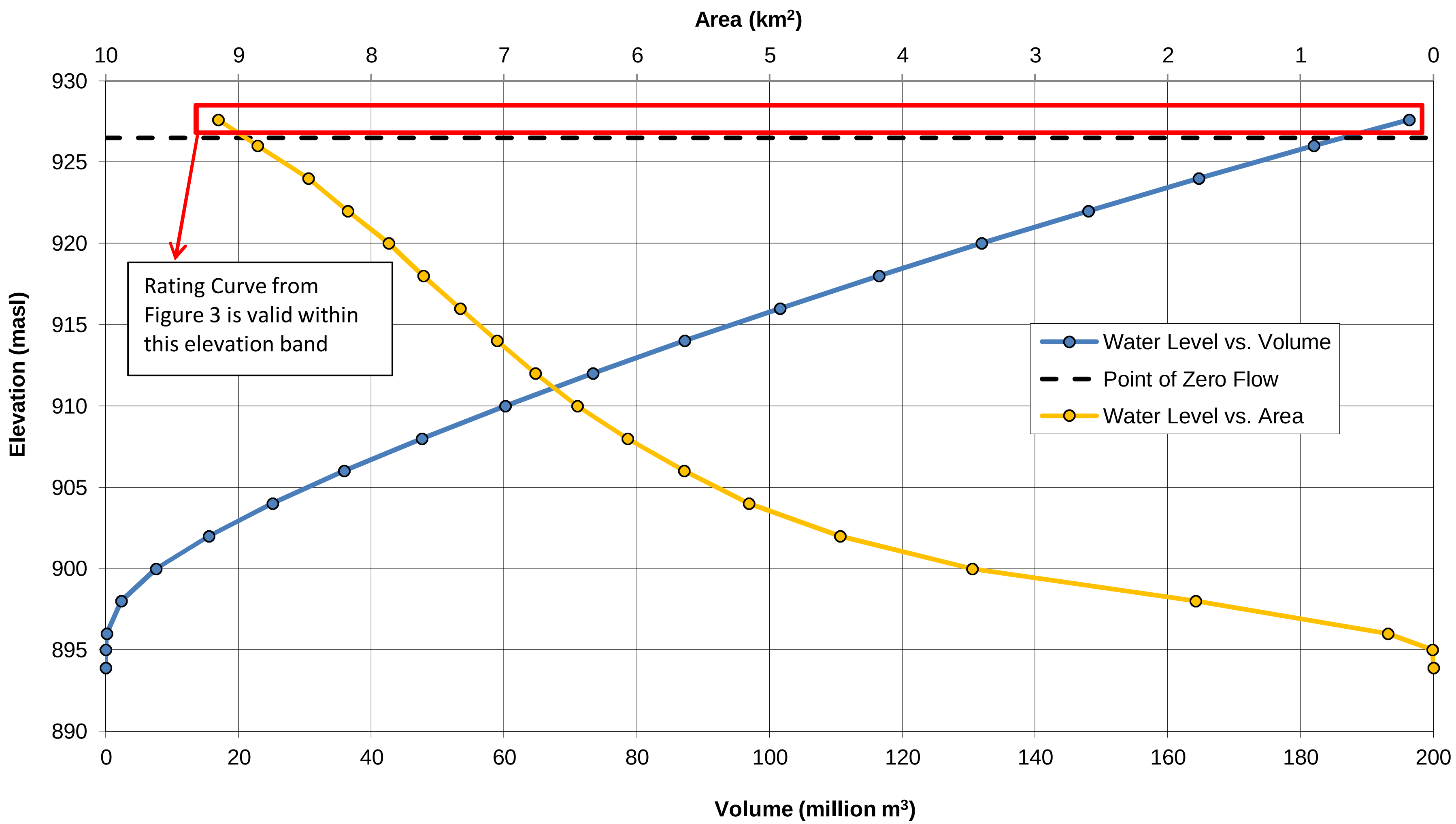

NOTES:

1. DAC CURVE IS BASED ON BATHYMETRIC SURVEY PERFORMED BY AMEC ON JUNE 9, 2013.
2. WATER SURFACE ELEVATION AT THE TIME OF SURVEY WAS 927.6 m.
3. VOLUME IS CUMMULATIVE VOLUME.
4. AREA IS NOT CUMMULATIVE (i.e. AREA AT 910 m IS THE AREA OF THAT CONTOUR).

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TATELKUZ LAKE DEPTH AREA CAPACITY CURVE

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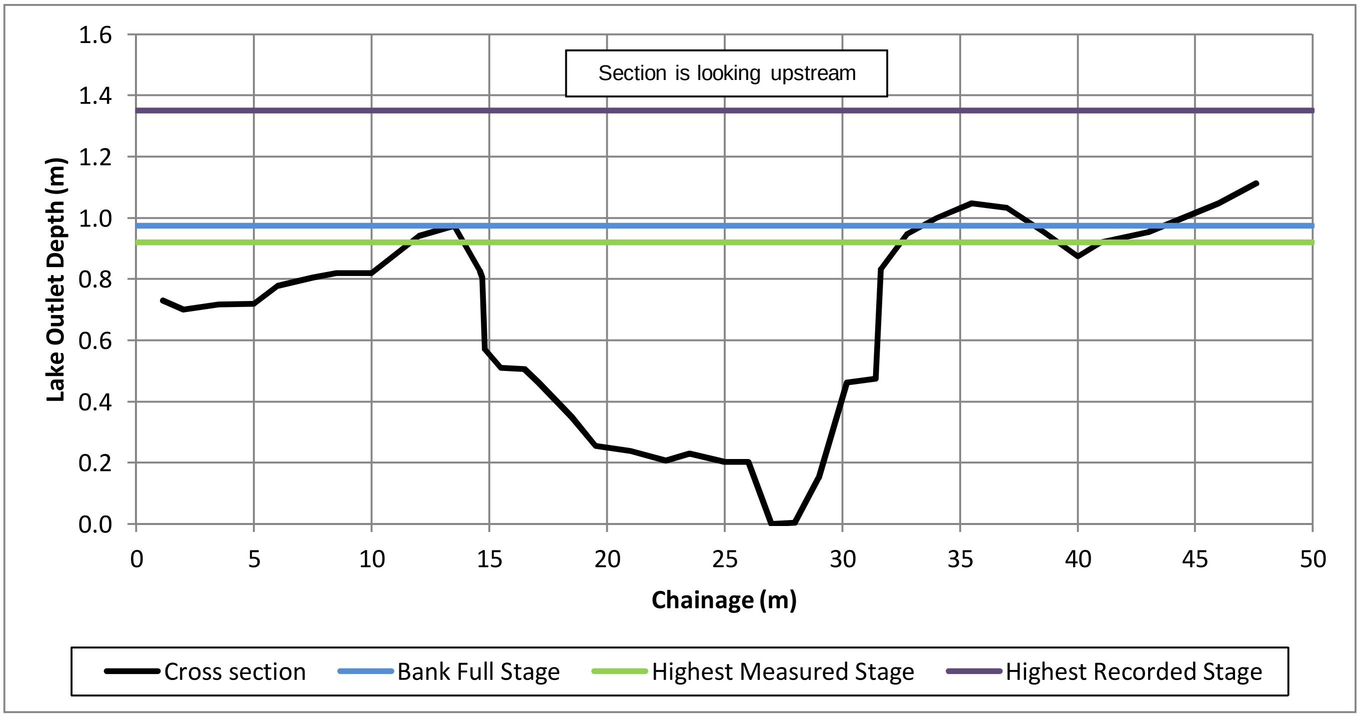
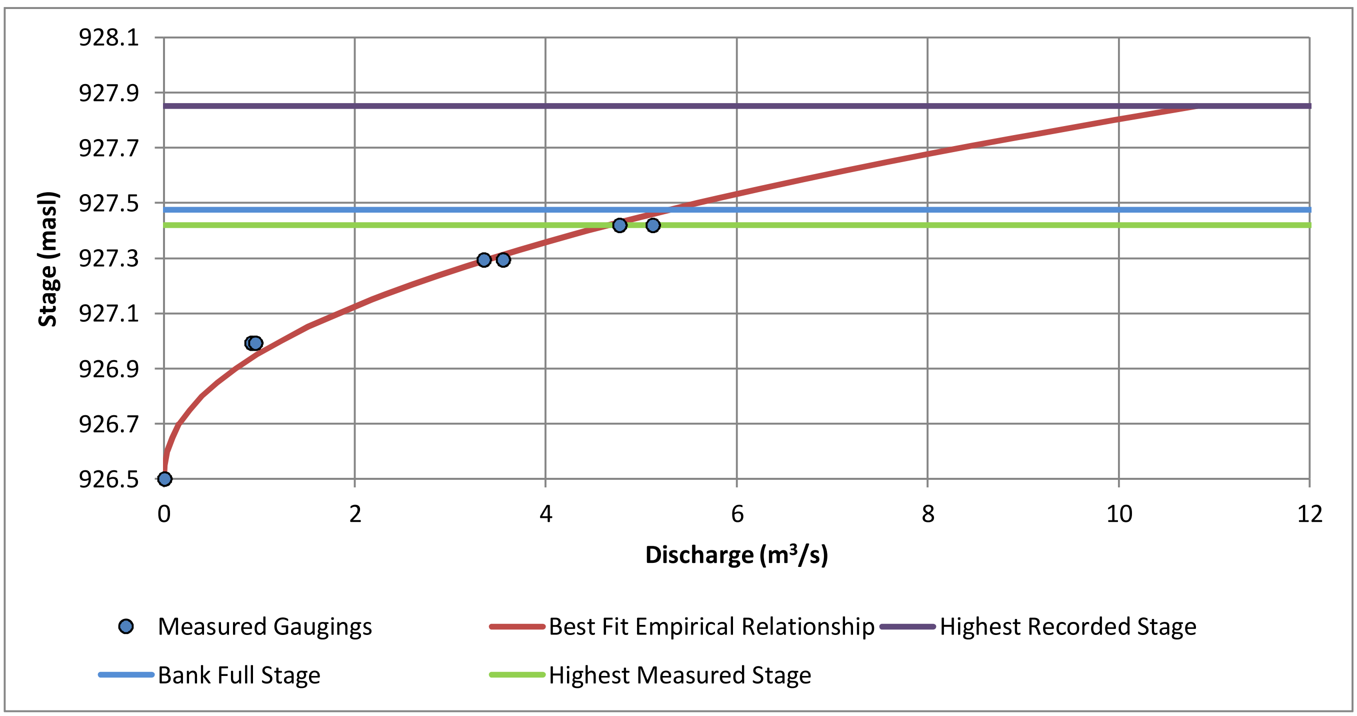
FIGURE 2 REV 0





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TATELKUZ LAKE OUTLET
RATING CURVE AND CROSS SECTION

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FIGURE 3 | REV 0

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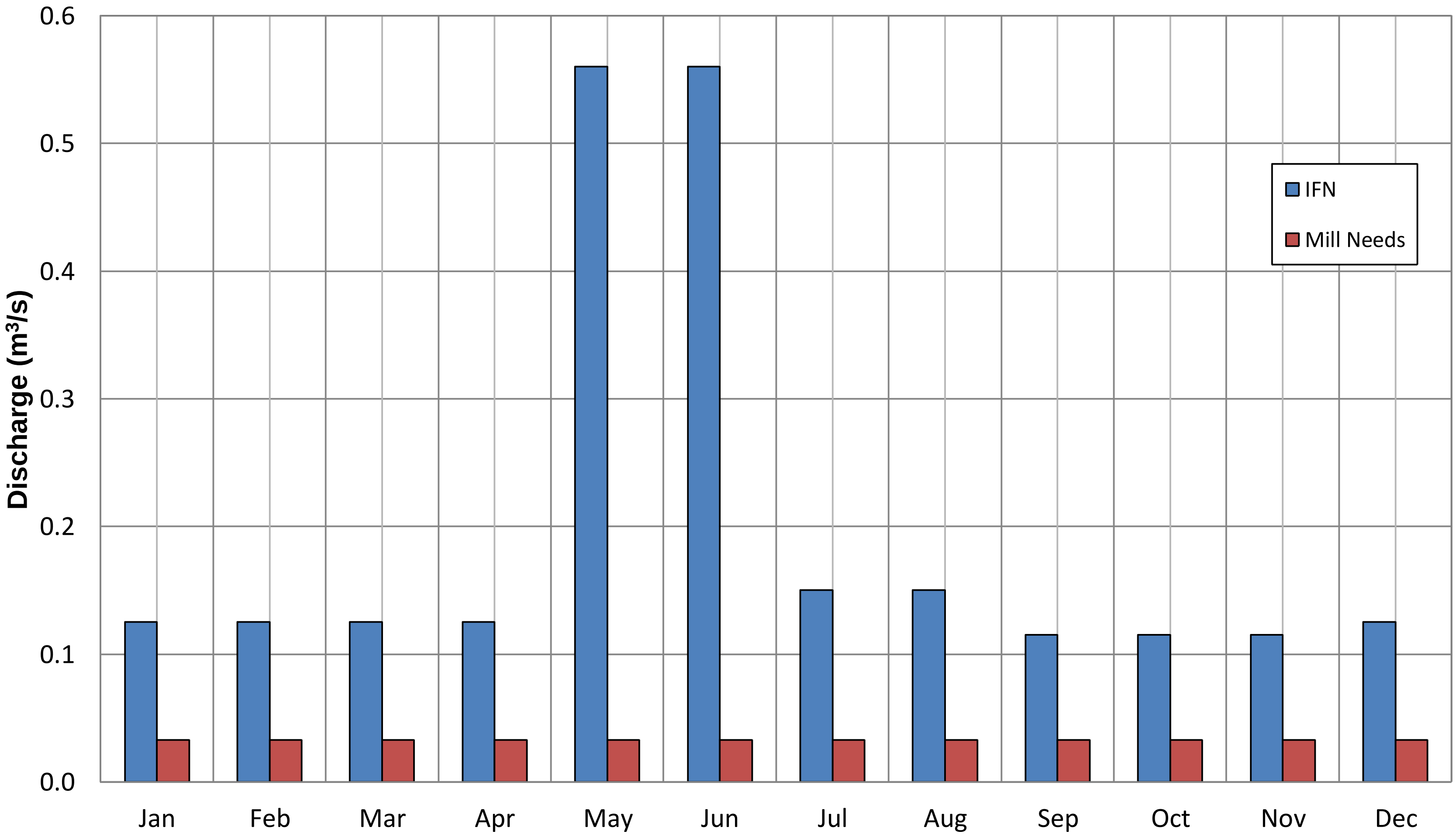

NOTES:

1. MILL WATER SUPPLY IS CONSTANT AT 0.033 m^3/s.
2. IFN WATER REQUIREMENTS ARE BASED ON FISH HABITAT STUDIES (AMEC 2013a).

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REQUIRED WITHDRAWAL FROM TATELKUZ LAKE

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FIGURE 4 REV 0

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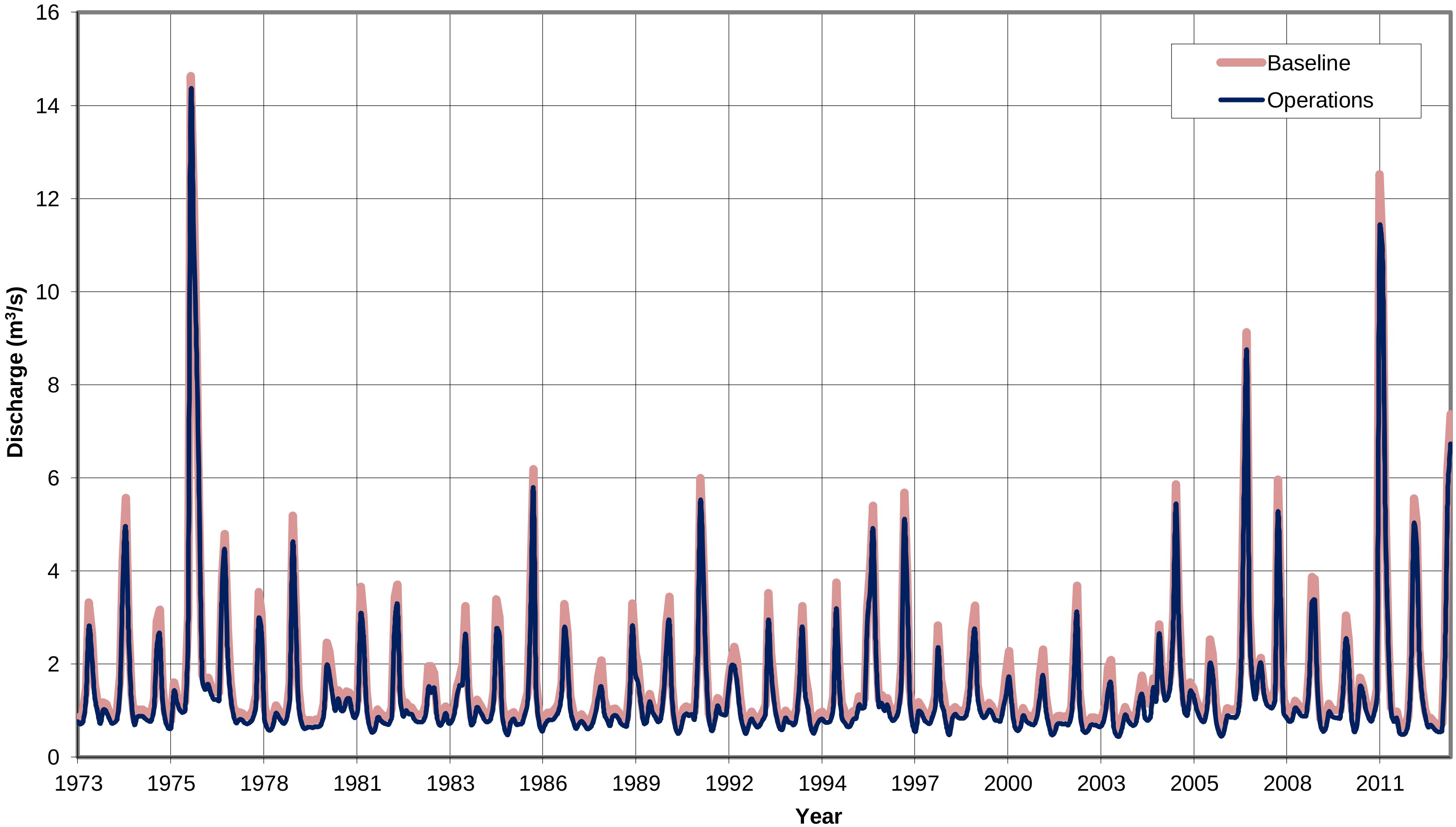

NOTES:
1. MILL WATER SUPPLY IS CONSTANT AT 0.033 m^3/s.
2. IFN WATER REQUIREMENTS ARE BASED ON FISH HABITAT STUDIES (AMEC 2013a).

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MODELLED TATELKUZ LAKE OUTFLOW BASELINE AND OPERATIONS

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REF. NO. VA13-02066

FIGURE 5

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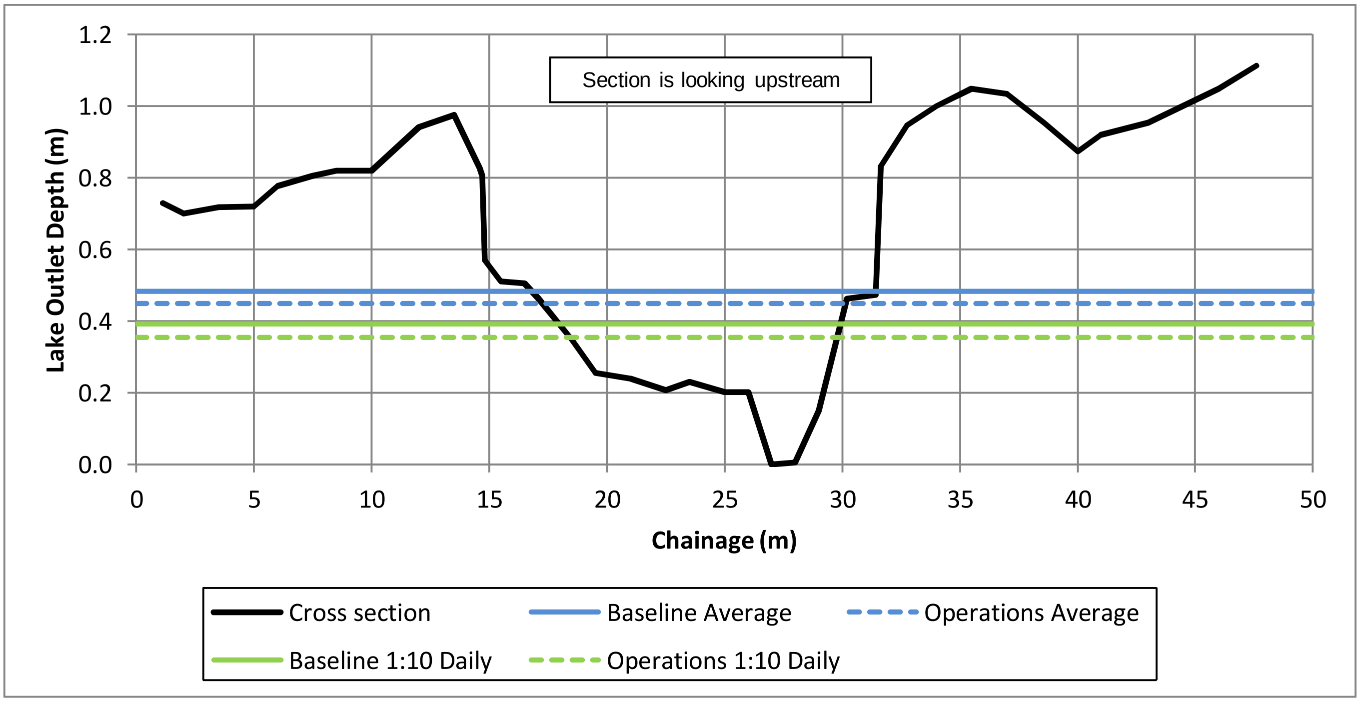

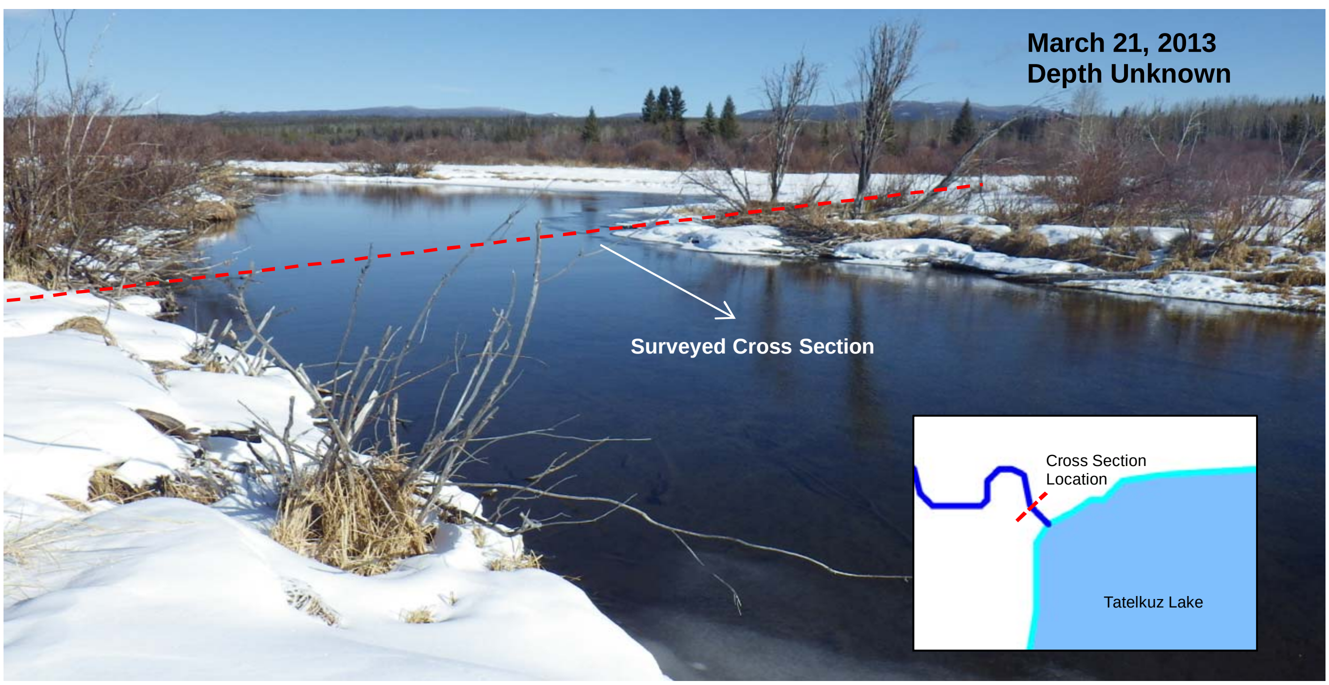

NOTES:

1. WINTER STANZA IS FROM DECEMBER TO APRIL.
2. "AVERAGE" IS THE AVERAGE DEPTH OF WATER AT THE LAKE OUTLET THAT OCCURS WITHIN THE GIVEN STANZA, ACROSS THE ENTIRE PERIOD OF RECORD.
3 "1:10 DAILY LOW" IS THE 1:10 DAILY LOW FLOW CONVERTED TO DEPTH AT THE LAKE OUTLET THAT OCCURS WITHIN THE GIVEN STANZA, ACROSS THE ENTIRE PERIOD OF RECORD.

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TATELKUZ LAKE OUTLET
IMPACT OF PROJECT ON STAGE
WINTER STANZA

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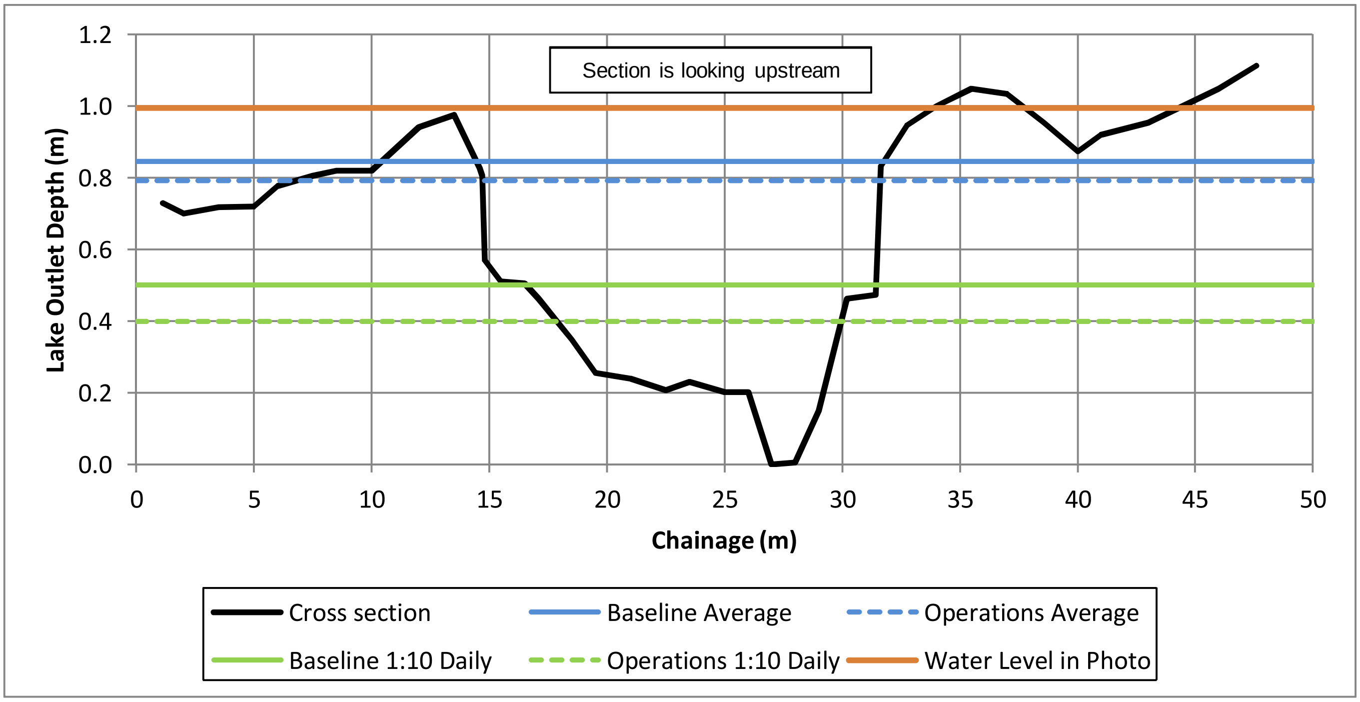
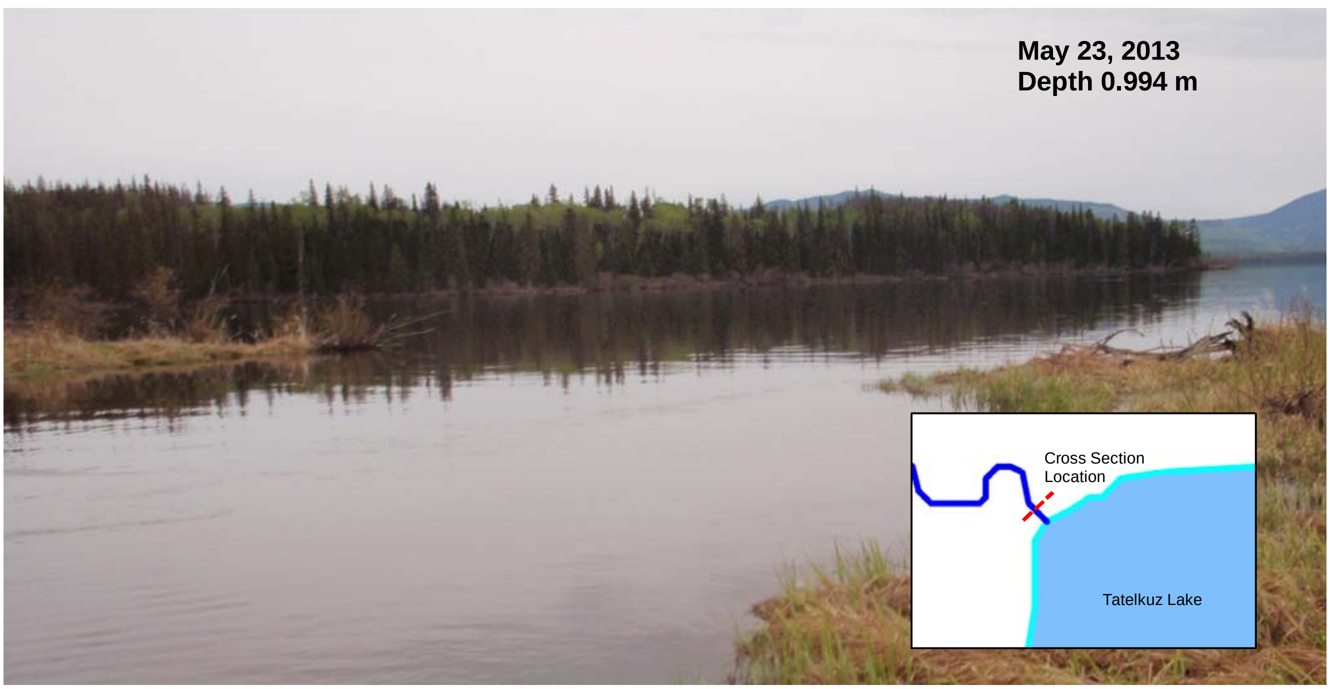
FIGURE 6 REV 0





NOTES:

1. FRESHET STANZA IS FROM MAY TO JUNE.
2. "AVERAGE" IS THE AVERAGE DEPTH OF WATER AT THE LAKE OUTLET THAT OCCURS WITHIN THE GIVEN STANZA, ACROSS THE ENTIRE PERIOD OF RECORD.
3 "1:10 DAILY LOW" IS THE 1:10 DAILY LOW FLOW CONVERTED TO DEPTH AT THE LAKE OUTLET THAT OCCURS WITHIN THE GIVEN STANZA, ACROSS THE ENTIRE PERIOD OF RECORD.

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BLACKWATER GOLD PROJECT

TATELKUZ LAKE OUTLET
IMPACT OF PROJECT ON STAGE
FRESHET STANZA

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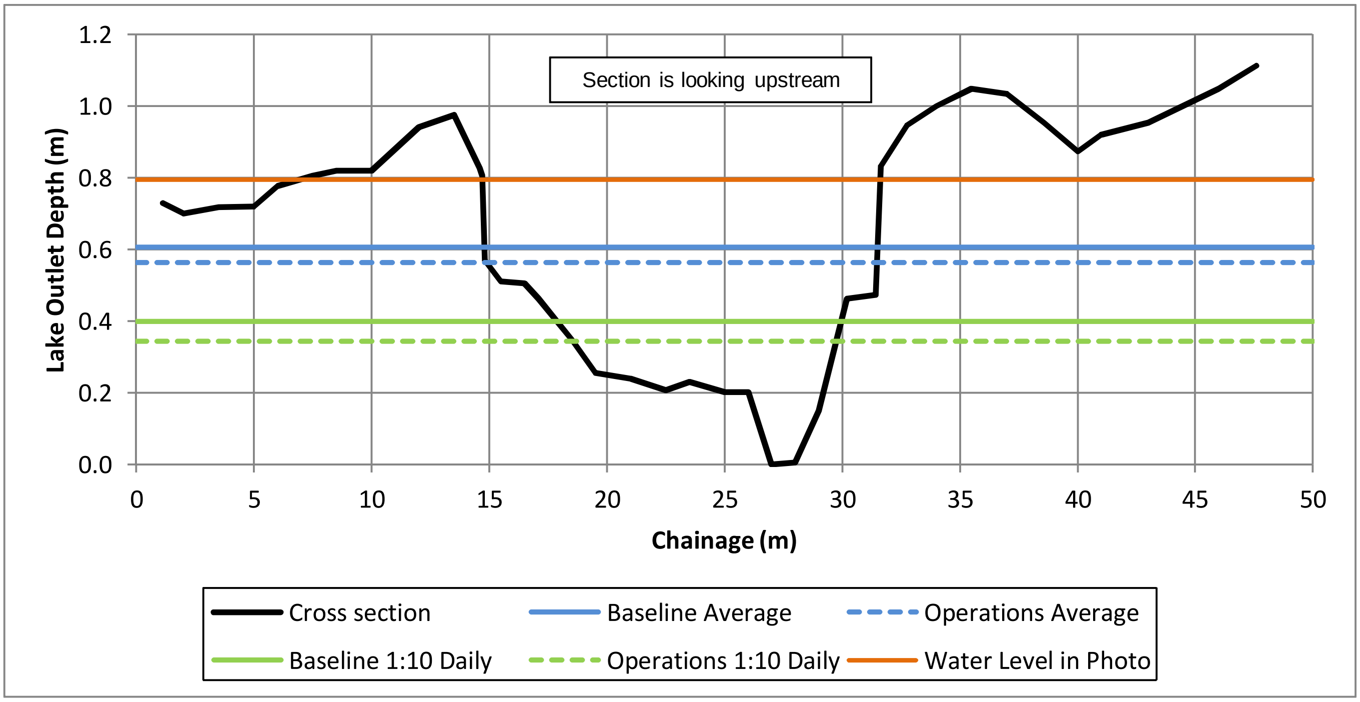
FIGURE 7		REV 0



NOTES:

1. RAINBOW INCUBATION STANZA IS JULY.
2. "AVERAGE" IS THE AVERAGE DEPTH OF WATER AT THE LAKE OUTLET THAT OCCURS WITHIN THE GIVEN STANZA, ACROSS THE ENTIRE PERIOD OF RECORD.
3 "1:10 DAILY LOW" IS THE 1:10 DAILY LOW FLOW CONVERTED TO DEPTH AT THE LAKE OUTLET THAT OCCURS WITHIN THE GIVEN STANZA, ACROSS THE ENTIRE PERIOD OF RECORD.

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TATELKUZ LAKE OUTLET
IMPACT OF PROJECT ON STAGE
RAINBOW INCUBATION STANZA

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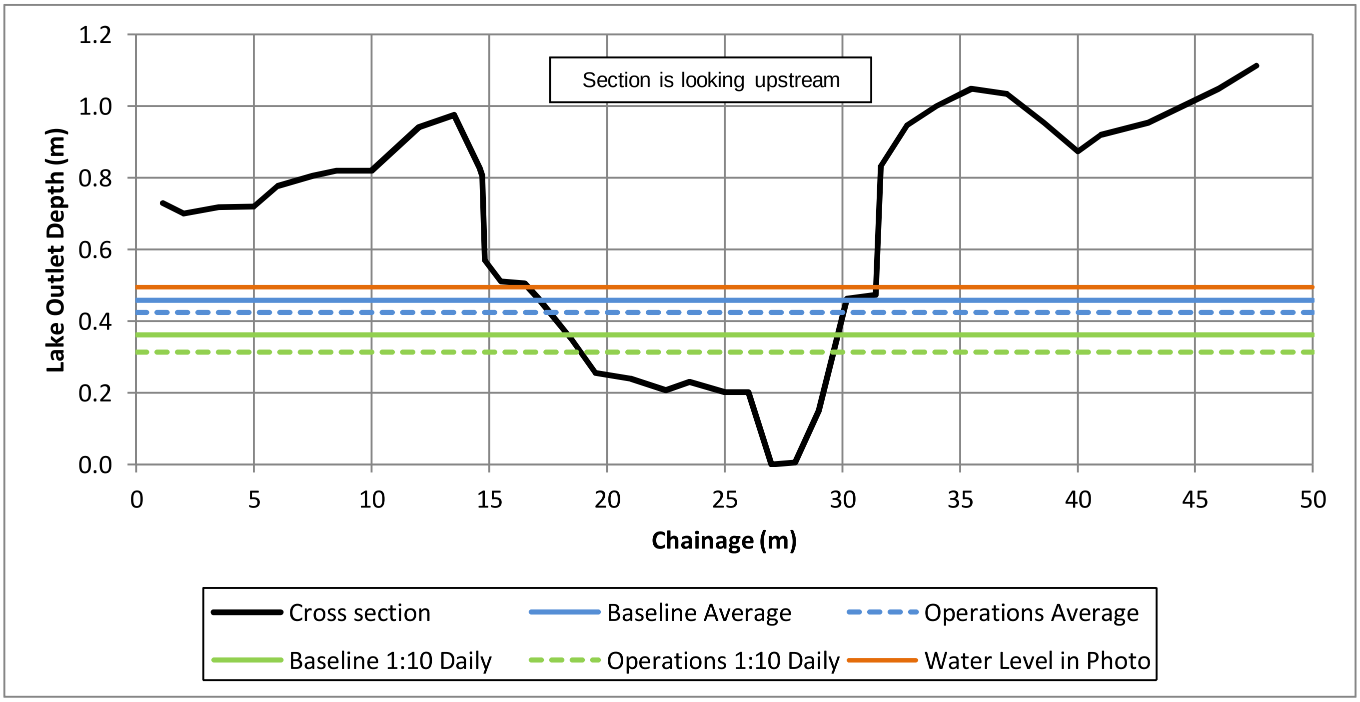
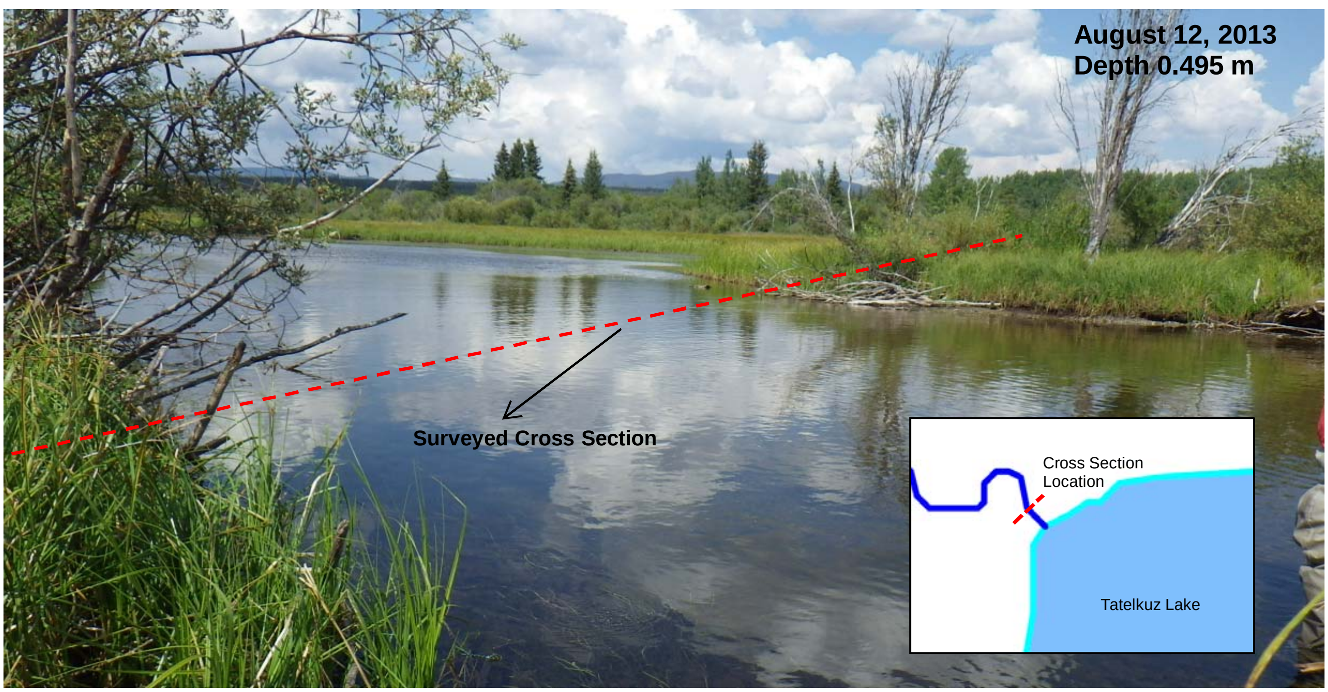
FIGURE 8 REV 0





NOTES:

1. KOKANEE SPAWNING STANZA IS FROM AUGUST TO SEPTEMBER.
2. "AVERAGE" IS THE AVERAGE DEPTH OF WATER AT THE LAKE OUTLET THAT OCCURS WITHIN THE GIVEN STANZA, ACROSS THE ENTIRE PERIOD OF RECORD.
3 "1:10 DAILY LOW" IS THE 1:10 DAILY LOW FLOW CONVERTED TO DEPTH AT THE LAKE OUTLET THAT OCCURS WITHIN THE GIVEN STANZA, ACROSS THE ENTIRE PERIOD OF RECORD.

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TATELKUZ LAKE OUTLET
IMPACT OF PROJECT ON STAGE
KOKANEE SPAWNING STANZA

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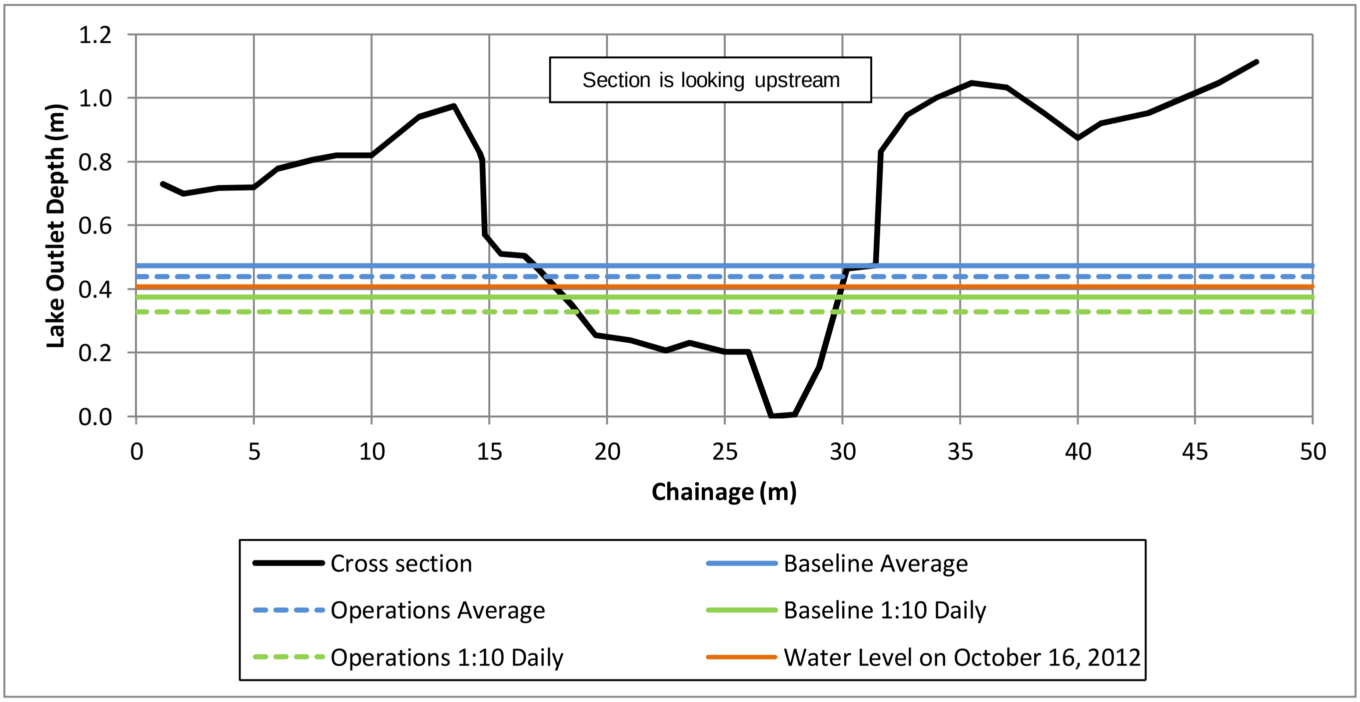
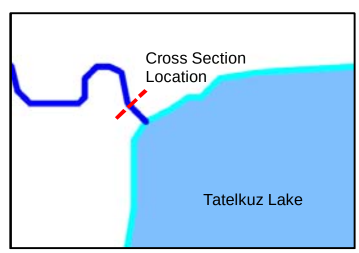
FIGURE 9 REV 0



October 16, 2012
Depth 0.408 m

Cross Sectional Photo Not Available



NOTES:

1. RAINBOW REARING STANZA IS FROM OCTOBER TO NOVEMBER.
2. "AVERAGE" IS THE AVERAGE DEPTH OF WATER AT THE LAKE OUTLET THAT OCCURS WITHIN THE GIVEN STANZA, ACROSS THE ENTIRE PERIOD OF RECORD.
3 "1:10 DAILY LOW" IS THE 1:10 DAILY LOW FLOW CONVERTED TO DEPTH AT THE LAKE OUTLET THAT OCCURS WITHIN THE GIVEN STANZA, ACROSS THE ENTIRE PERIOD OF RECORD.

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BLACKWATER GOLD PROJECT

TATELKUZ LAKE OUTLET
IMPACT OF PROJECT ON STAGE
RAINBOW REARING STANZA

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FIGURE 10 REV 0