Appendix 5.1.2.1C
Baseline Tatelkuz Lake Levels

July 22, 2013

File No.:VA101-457/6-A.01
Cont. No.:VA13-01604

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: Revised Baseline Tatelkuz Lake Levels

INTRODUCTION

Knight Piesold LTD. (KPL) has completed an analysis of the lake level changes at Tatelkuz Lake during Baseline conditions in the Project Area and presented it in a KPL letter VA13-01528 issued on July 11, 2013. In that letter, the stage measurements in the lake and the lake bathymetry were presented in two different coordinate systems, where the lake levels were presented in a local coordinate system, while the bathymetry was presented in the absolute coordinate system relative to sea level. In this revised letter, the same information is presented again, but with all the data shown in the same coordinate system equivalent to absolute elevations in meters above sea level (masl).

The estimated lake levels are based on measured lake levels and estimated discharges at the outlet to Chedakuz Creek. The following outlines the methodology and the results of the analysis.

METHODOLGY

Baseline outflows from Tatelkuz Lake are based on a long term synthetic discharge series developed at the hydrology station H5 on Chedakuz Creek (KPL, 101-457/4-1, Rev 1 issued Feb. 2013). The values at H5 were then pro-rated by catchment area to the outlet of the lake. The synthetic discharge series is 40 years long. A short period of stage record also exists for Tatelkuz Lake at Station L1, which was installed by Avison Management Services (AMS) and KPL on October 16, 2012. The station was removed on December 10, 2012 for the winter and then re-installed on May 6, 2013.

An empirical and a theoretical method were used in order to develop a relationship between discharge and lake levels. The empirical method involved relating the discharge estimated at the lake outlet to the measured lake stage at L1. The theoretical method involved using Manning's equation and an assumed channel geometry to relate lake levels to the outlet channel hydraulics and discharge.

Method 1

A stage/discharge relationship was developed using the daily average stage measured at L1 and the daily average discharge estimated at the outlet. The results of this analysis are shown on Figure 1, where the scatter in the measured lake levels is due to lake storage and attenuation effects. The resulting best fit equation is of the form:

$$\boldsymbol{Q = C(Stage - a)^n}$$

Where:
Q is the discharge (m^3/s);
C is a constant describing the channel geometry equal to 5.6;
a is a point of zero flow (PZF) equal to 926.483 m; and
n is an exponent describing the channel roughness equal to 2.19.

Method 2

Manning's equation was used to estimate the flow depth in the outlet channel based on the estimated outlet discharge. The flow depth in the channel was then used to calculate the long term lake levels. Manning's equation is typically presented in the following form:

$$\boldsymbol{Q = \left(\frac{1}{n}\right) A (R_h)^{\frac{2}{3}} (S_0)^{\frac{1}{2}}}$$

Where:
Q is the channel discharge (m^3/s);
n is the Manning's roughness coefficient equivalent to 0.045 for the Chedakuz Creek downstream of the lake outlet;
A is the channel area (m^2);
R_h is the hydraulic radius (m); and
S_o is the channel slope.

The channel geometry was based on a measured cross-section at the lake outlet that was surveyed on October 16, 2012 by Avison Management Services (AMS) and KPL and is shown on Figure 2 and a point of zero flow (PZF) was established to be equivalent to 926.483 masl. The measured cross-section was simplified in our numerical model and represented by a trapezoidal cross-section. A relationship was developed between the discharge at the outlet and the lake stage that was calculated based on the flow depth in the channel downstream of the lake outlet.

The developed relationship using Manning's equation is also shown on Figure 1. As expected, the estimated lake level is somewhat lower for the Manning's equation approach compared to the empirical approach that is based on measured lake levels (Figure 1), where the difference increases with increasing flow. This is due to the fact that no storage or attenuation is considered in this theoretical analysis and the changes in the channel are assumed to occur concurrently with the changes in the lake, which would not be the case.

<u>RESULTS</u>

Both the empirical and the numerical methods resulted in a similar relationship between the lake level and the outlet discharge (as shown on Figure 1). The two methods were used to develop a long term synthetic lake level series based on the 40 year long synthetic discharge series and provided reasonable estimates of the lake level fluctuations (Figure 3). The empirical method, however, is based on measured data and inherently incorporates lake storage and attenuation effects. Consequently, the estimated lake levels are somewhat higher based on this method resulting in larger annual fluctuations, and will be therefore used as a basis for further analysis. For the 40 year period, the estimated average annual lake level fluctuation was determined to be 0.8 m with the maximum fluctuation between the historic minimum and maximum levels of 2.0 m.

Figure 4 presents the long term synthetic stage series as a scatter plot of daily lake levels in order to better illustrate how the average stage relates to both peak and low events. On average, the lake levels are at their lowest elevations between August and April. The highest lake levels are experienced during the freshet period between April and August, with occasional high levels in the summer or fall that are driven by rainfall events.

A frequency duration curve for the lake levels was also developed to better understand the frequency and magnitude of lake elevations as shown on Figure 5. As can be seen, for the majority of the time the changes to the natural lake levels are small. For example, 80% of the time, the lake level elevations are within 0.3 m and they exceed 1.0 m only about 3% of the time.

LAKE BATHYMETRY

A bathymetric survey was performed on Tatelkuz Lake by AMEC on June 9, 2013, at which time the lake level was at elevation 927.6 masl. The results of this survey yielded a Depth Area Capacity (DAC) curve as shown on Figure 6. The survey was undertaken during a period of typically high water surface elevations (Figure 4) that occurs approximately 2% of the time (Figure 5), and for the majority of the time the lake elevation would fluctuate below the water surface observed at the time of the survey. Based on the estimated PZF of 926.483 masl, the water depth at the lake outlet was approximately 1.12 m and the outflow to Chedakuz Creek was about 7.13 m^3/s. The difference between the lake level at the time of the bathymetric survey and the PZF is equivalent to nearly 11 million m^3 of water (5.6% of the total lake volume) and the lake surface area for this is equivalent to 0.24 km^2 (2.6% of the total lake surface area), as shown on Figure 6.

Linear relationships were developed from the DAC curves for the lake surface area and volume based on the lake elevations above 920 masl.

The lake surface area can be calculated using the following equation:

$$\boldsymbol{A = \frac{y - y_0}{m} + A_0 = \frac{y - 920}{5.94} + 7.87}$$

Where:
A is the lake surface area (km^2);
y is the lake elevation (m);
m is the slope of the depth to area relationship equivalent to 5.94;
y_0 is the lake elevation at A_0 equivalent to 920 masl; and
A_0 is the lake surface area at elevation y_0 equivalent to 7.87 km^2.

The lake volume can be calculated using the following equation:

$$\boldsymbol{V = \frac{y - y_0}{m_1} + V_0 = \frac{y - 920}{0.118} + 131.99}$$

Where:
V is the lake volume (million m^3);
y is the lake elevation (m);
m_1 is the slope of the depth to volume relationship equivalent to 0.118;
y_0 is the lake elevation at V_0 equivalent to 920 masl; and
V_0 is the lake volume at elevation y_0 equivalent to 131.99 million m^3.

CONCLUSIONS

A stage/discharge relationship was developed for the Tatelkuz Lake that was based on measured lake elevations and estimated outlet discharges. This relationship was used to develop a long term synthetic stage series for the period January 1973 to May 2013, which represents our estimate of historic lake surface elevations. The results of this analysis indicate that the maximum lake level fluctuation was on the order of 2 m during this period, while on average the lake level fluctuates within 0.8 m annually. The lake levels are the highest during the freshet period from April to August, while they vary within a relatively narrow margin during the rest of the year.

We trust that the information provided in this letter is sufficient for you needs at this time. If you have any questions or comments please contact the undersigned.

Yours truly,
KNIGHT PIESOLD LTD.

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

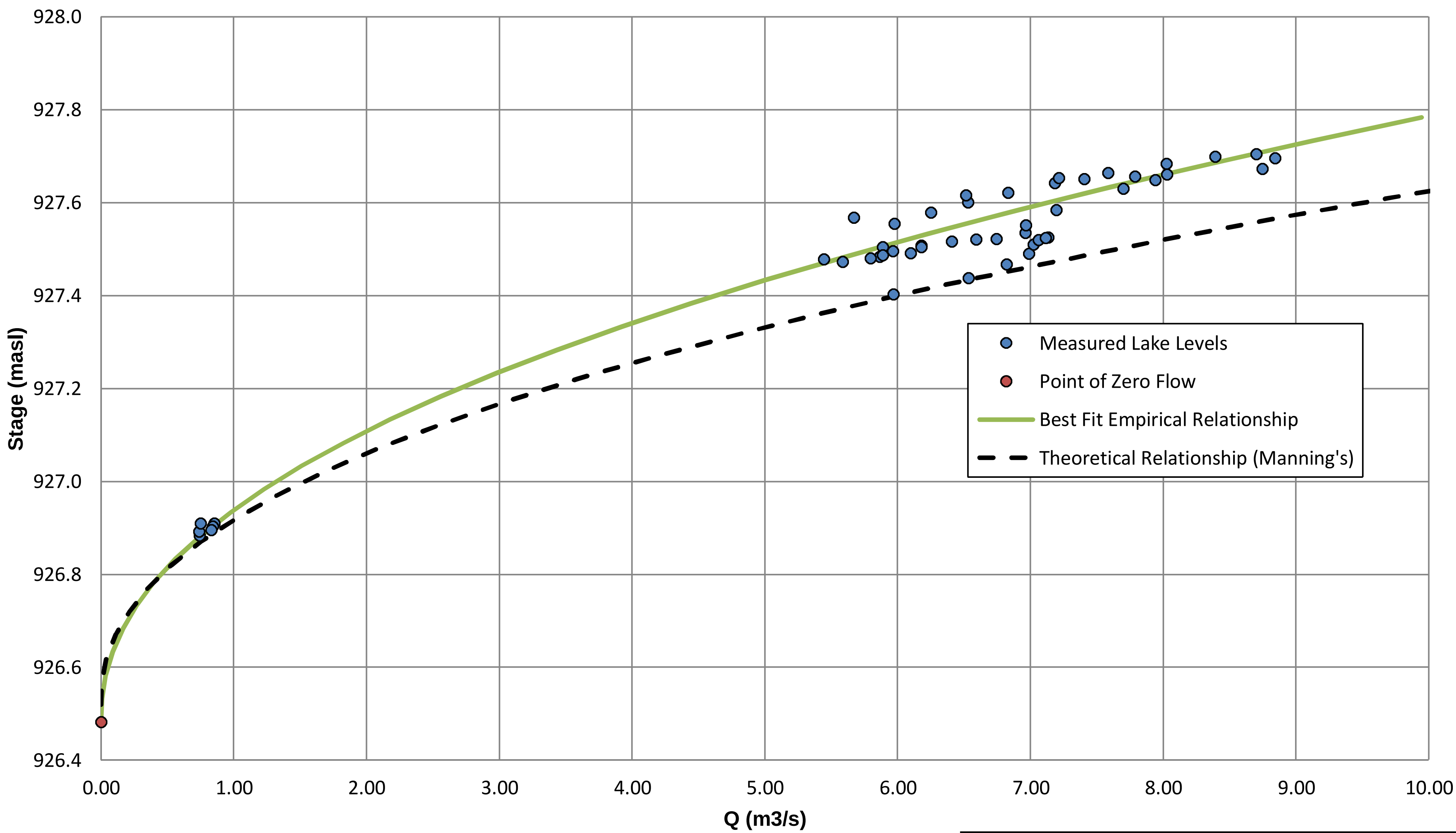
Reviewed:
Violeta Martin, Ph.D., P.Eng.
Senior Hydrotechnical Engineer

Approved:
Ken Brouwer, P.Eng.
President

Attachments:

Figure 1 Rev 0	Tatelkuz Lake Level vs. Discharge Relationship
Figure 2 Rev 0	Tatelkuz Lake Outlet Channel Geometry
Figure 3 Rev 0	Tatelkuz Lake Long Term Synthetic Stage Series
Figure 4 Rev 0	Tatelkuz Lake Synthetic Stage Series Scatter Plot
Figure 5 Rev 0	Tatelkuz Lake Level Frequency Duration Curve
Figure 6 Rev 0	Tatelkuz Lake Depth Area Capacity Curve

/vm



NEW GOLD INC.

BLACKWATER GOLD PROJECT

TATELKUZ LAKE LEVEL VS. DISCHARGE RELATIONSHIP

Knight Piésold CONSULTING

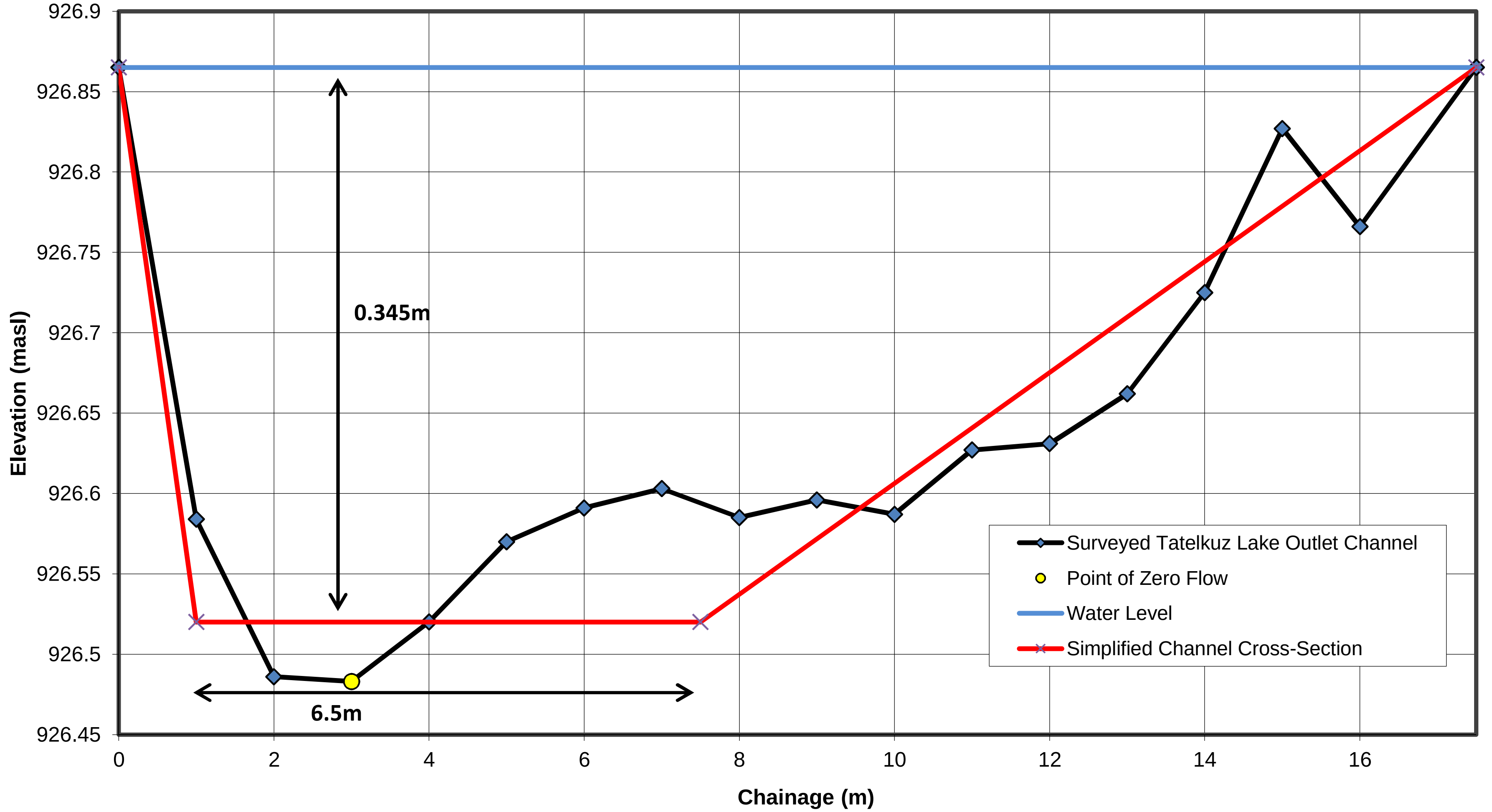
P/A NO. VA101-457/6

REF. NO. VA13-01604

FIGURE 1

REV 0

0	19JUL'13	ISSUED WITH LETTER	BW	VM	SRM
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D



NOTES:
1. CROSS SECTION SURVEYED BY KPL AND AMS ON OCTOBER 16, 2012.

0	19JUL'13	ISSUED WITH LETTER	BW	VM	SRM
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

NEW GOLD LTD.

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TATELKUZ LAKE OUTLET CHANNEL GEOMETRY

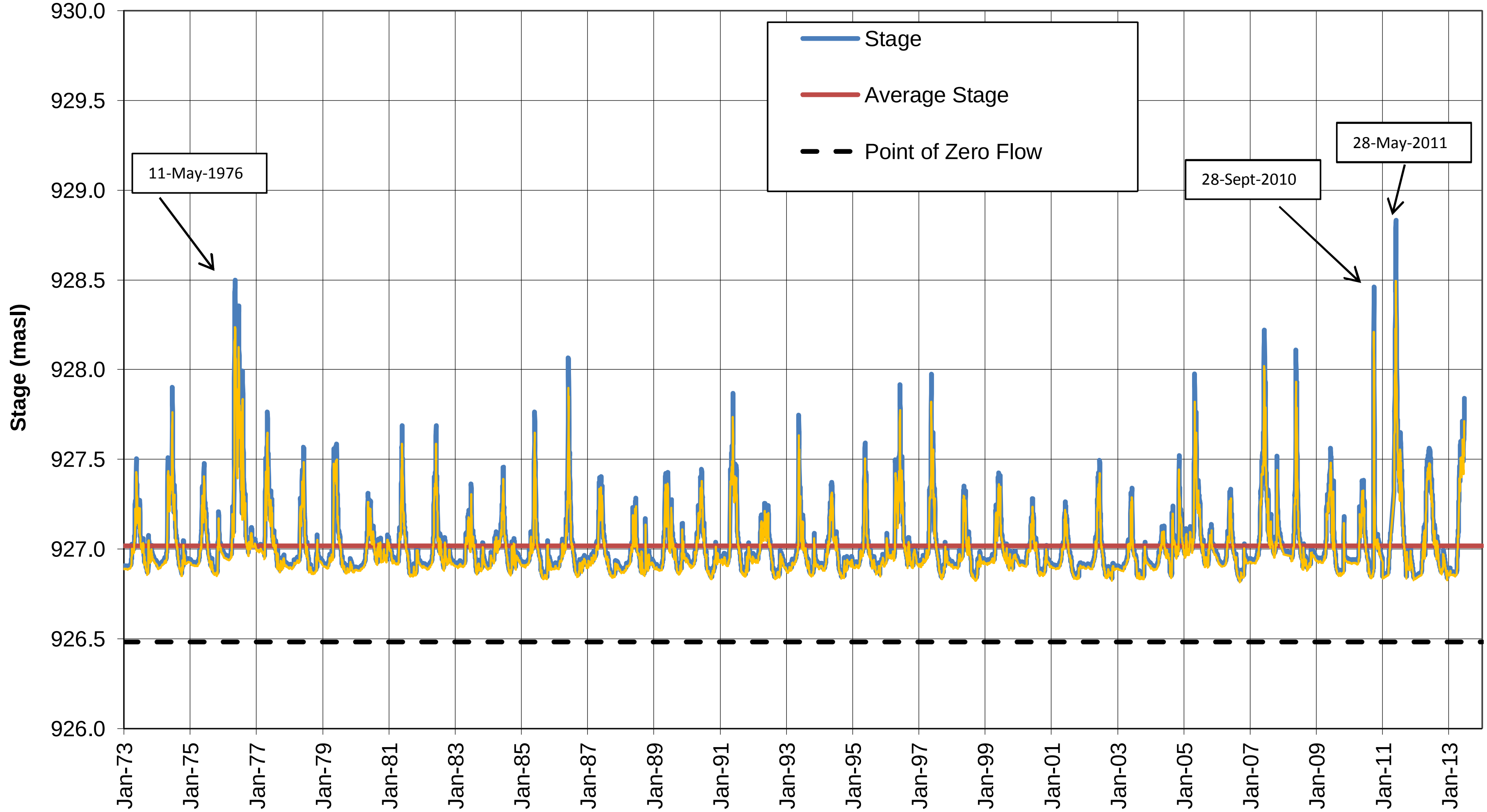
Knight Piésold CONSULTING

P/A NO. VA101-457/6

REF. NO. VA13-01604

FIGURE 2

REV 0



NOTES:
1. LONG TERM SYNTHETIC STAGE SERIES IS BASED ON THE COMBINED LONG TERM SYNTHETIC AND MEASURED DISCHARGE SERIES DEVELOPED FOR THE LAKE OUTLET FOR THE PERIOD JAN 1973 - MAY 2013.
2. AVERAGE STAGE IS THE AVERAGE DAILY STAGE OVER THE ENTIRE PERIOD OF RECORD.

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REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

NEW GOLD INC.

BLACKWATER GOLD PROJECT

TATELKUZ LAKE
LONG TERM SYNTHETIC STAGE SERIES

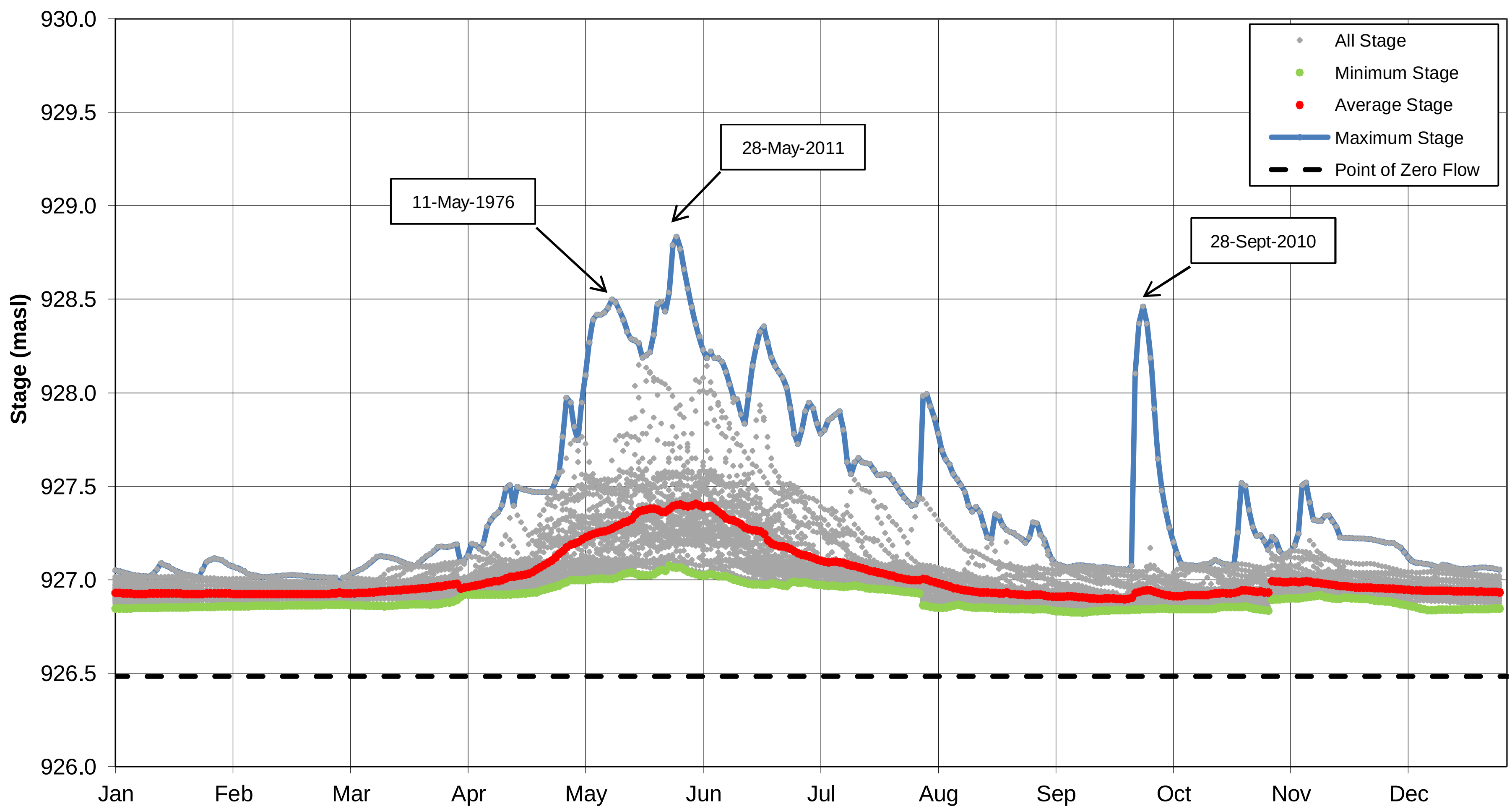
Knight Piésold CONSULTING

P/A NO. VA101-457/6

REF. NO. VA13-01604

FIGURE 3

REV 0



NOTES:

1. SYNTHETIC STAGE SERIES IS BASED ON THE COMBINED MEASURED AND SYNTHETIC DISCHARGE SERIES FOR THE LAKE OUTLET DEVELOPED FOR THE PERIOD JAN 1973 - MAY 2013.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
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NEW GOLD INC.

BLACKWATER GOLD PROJECT

TATELKUZ LAKE
SYNTHETIC STAGE SERIES SCATTER PLOT

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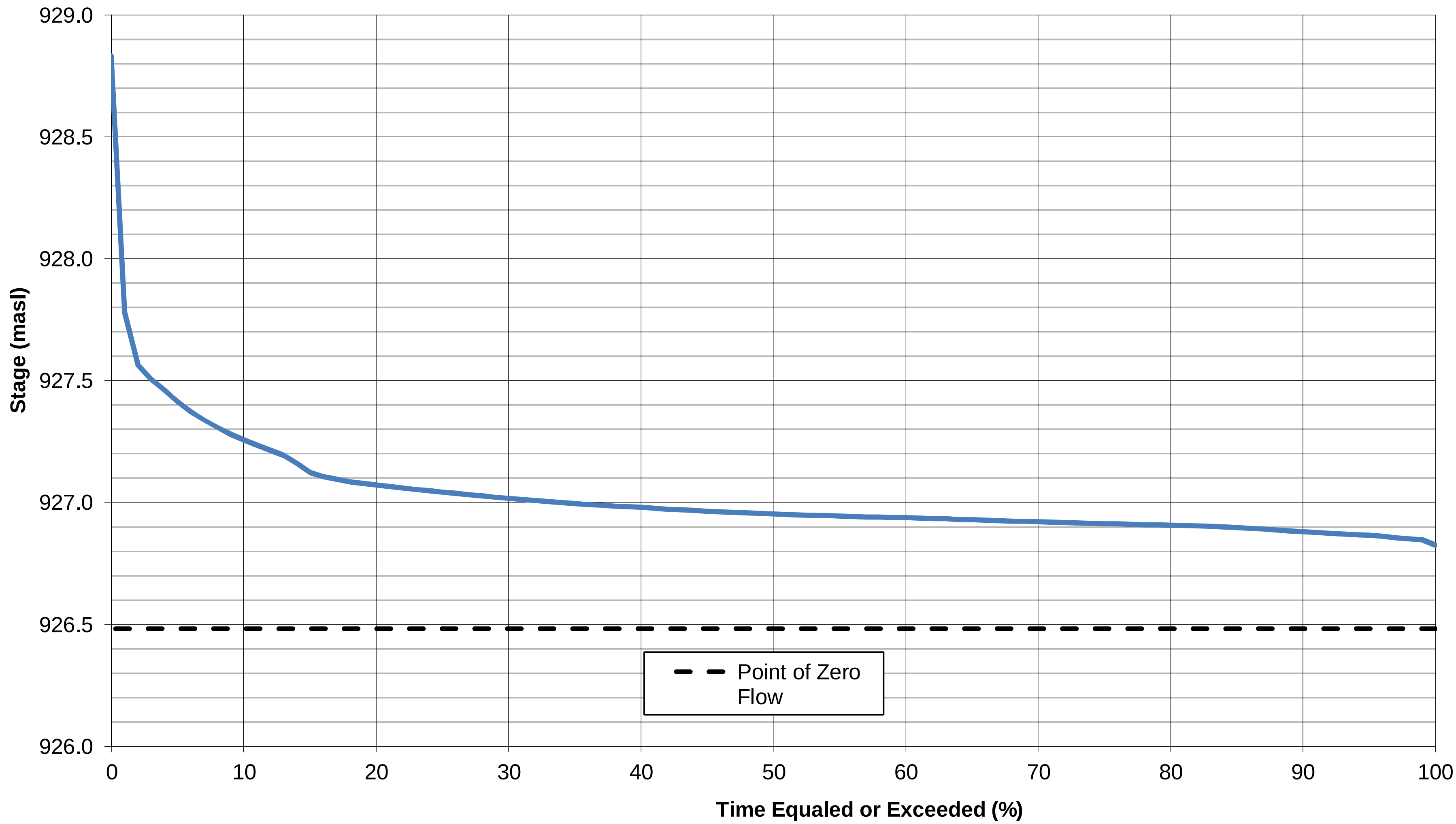
P/A NO. VA101-457/6

REF. NO. VA13-01604

FIGURE 4

REV 0



NOTES:

1. FREQUENCY DURATION CURVE IS BASED ON THE LONG TERM SYNTHETIC STAGE SERIES DEVELOPED FROM JAN 1973 - MAY 2013.

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BLACKWATER GOLD PROJECT

TATELKUZ LAKE LEVEL
FREQUENCY DURATION CURVE

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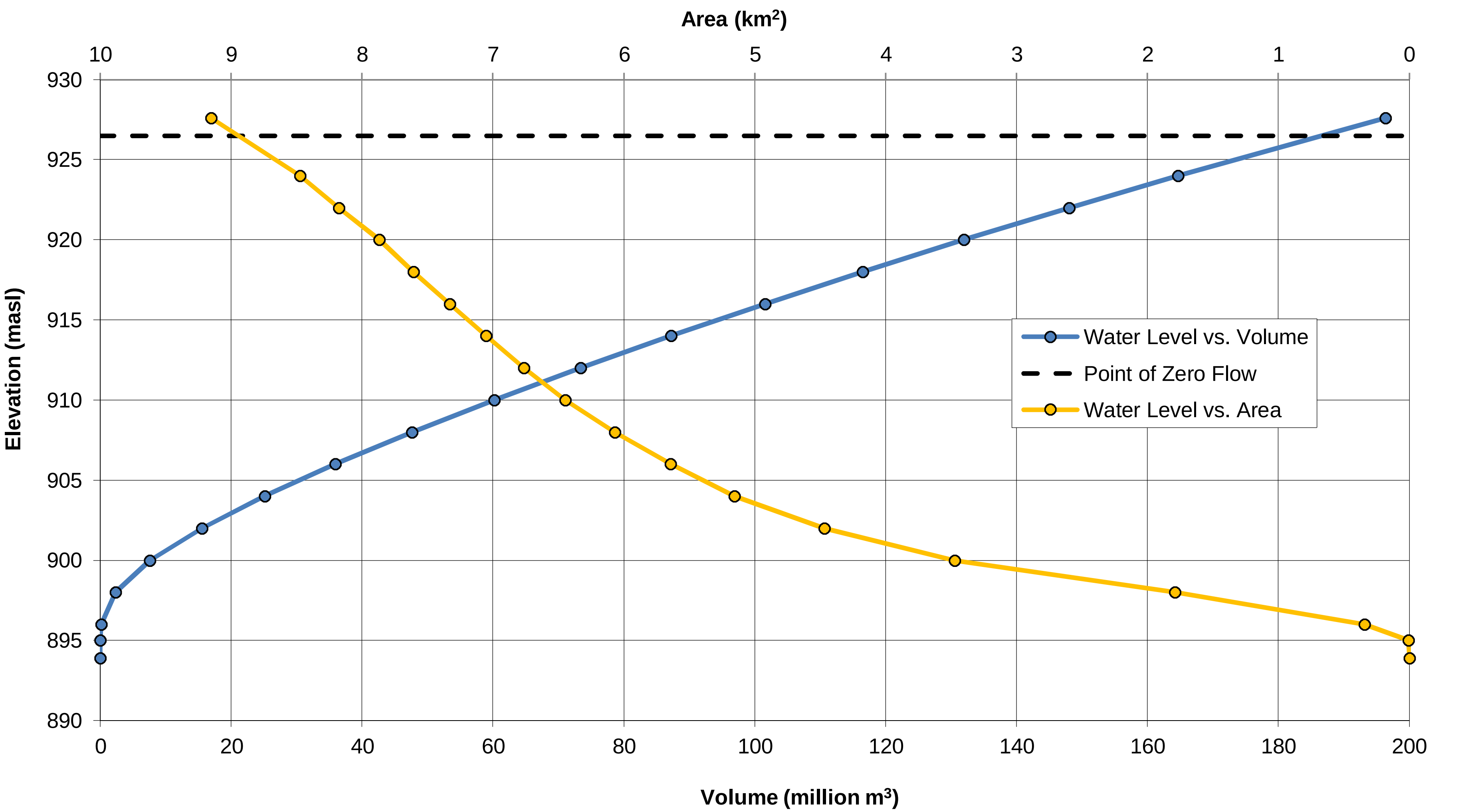
P/A NO. VA101-457/6

REF. NO. VA13-01604

FIGURE 5

REV 0



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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BLACKWATER GOLD PROJECT

TATELKUZ LAKE DEPTH AREA CAPACITY CURVE

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P/A NO. VA101-457/6

REF. NO. VA13-01604

FIGURE 6

REV 0