Memorandum

To: Patricia Randell, Dustin Rainey, Carrie Gillis – Assessment and Abandoned Mines

CC: Eric Domingue, DST Consulting Engineers Inc.

From: Bill Slater

Date: July 13, 2017

Re: Faro Water Treatment Capacity

This memo is an update to a memo prepared in December 2016 on the subject of "Faro Water Management and Water Treatment." That memo addressed both water treatment capacity and overall water management planning for the Faro Mine site. To support current Technical Review Committee discussions about water treatment capacity for the X13/CVS2 area, this memo provides an updated version of the section related to water treatment capacity, including some revisions to a preliminary annual water balance to incorporate new information about flows in the X13/CVS2 area, and the incorporation of CVP treatment.

The primary purpose of the original memo was to highlight the need for the Faro Project to begin immediately planning for establishment of additional water treatment capacity, recognizing that other sources of contaminated water were likely to need treatment within the next few years. As a result, the memo and the water balance considered several sources in addition to the X13/CVS2 source.

Over the past few months I have raised concern through the TRC about the adequacy of water treatment capacity to address water quality risks at the site over the next few years. My main concern relates to the lead time required to plan and implement additional water treatment capacity should it be required. I have completed a simple comparison of existing and potential treatment volumes with the current treatment capacity to evaluate the issue.

I believe that the IWTS operation in 2016 demonstrated that the current treatment capacity is sufficient to address current treatment needs, but I am concerned that new sources and flows will lead to capacity shortfalls before additional treatment capacity is available. There are several sources that will or may require additional treatment capacity in the foreseeable future, including:

- Contaminated water from the NRFC valley once the NFRC Project is complete. This water WILL have to be treated, hopefully within the next three years.
- X-13 seepage flows that currently do not meet all effluent quality standards, and that show a long-term deteriorating trend. Treatment is needed immediately and will likely continue until a complete seepage interception system is constructed in the Rose Creek Valley.
- Cross-Valley Pond water. Treatment of CVP water began in the spring of 2017 and is likely to continue for the foreseeable future, until implementation of the final

closure plan. Recent analysis by Robertson GeoConsultants suggests that there will be an ongoing source for contaminants in this pond.
- CVD Seepage Interception System. Timing for implementation of this system remains uncertain, but will be a very large volume when it is needed.
- Other currently undefined sources, for example in the upper NFRC or in Guardhouse Creek.

In order to understand what potential treatment requirements present the greatest risks, I have compared existing and possible annual treatment volumes to the capacity of the IWTS. Table 1 describes potential contaminated water inputs that do or may require treatment.

Table 1: Existing and Potential Annual Water Treatment Volumes

Source[1]	**Volume (m^3/yr)**	**Notes**
Faro Pit, Intermediate Pond, ETA[2]	3,100,000 Average 4,160,000 Maximum	Based on CH2M HILL analysis to support treatment plant planning, 2013. Developed based on historic treatment volumes. Includes pumping from S-Wells and Zone 2 Pit.
NFRD Collection	52,000	Based on 5 l/s from November 1 to March 31. Assume this source is no longer collected once NFRC Project is complete.
NFRC Contaminated Water Circuit	356,000 1:2-year 561,000 1:50-year	Based on CH2M HILL January 2016 information from planning meetings.
X-13	630,000	Based on 20 l/s average flow year-round. Assume this source is no longer collected once CVD-SIS is operational.
CVP	1,260,000	Based on 40 l/s average inflows year-round.
CVD-SIS	5,300,000	Based on CH2M HILL analysis from 2013. 1114 USGPM year-round.
Note 1: Pumping from PW14-06 is not included as potential source – calculations assume that water pumped from PW14-06 will result in reduced flows from S-Wells and/or NFRD. Note 2: Historic treatment volumes included seasonal inputs from the ETA (open water season only). Current planning for year-round routing of the ETA flows to the IP will add additional treatment volume. This is not included in any of the estimates.		

Nominal treatment capacity for the IWTS is 6000 USGPM. Assuming 85% availability (assuming some downtime for repair and other issues), this provides 322 l/s of capacity. For a treatment season of 184 days (May 1 to October 31) the IWTS can process 5,119,027 m^3 per year. For a treatment season of 214 days (April 15 to November 15) the IWTS can process 5,953,651 m^3 per year.

Table 2 provides water treatment volumes for various input combinations. Cells highlighted in red identify combinations that lead to exceedance of IWTS treatment capacity with a 214-day treatment season. Cells highlighted in orange identify combinations that lead to exceedance of IWTS treatment capacity with a 184-day treatment season. Cells highlighted in yellow identify combinations that require more than 80% of the assumed capacity for a 184-day treatment season.

Table 2: Annual Treatment Volumes Required for Various Source Combinations

Source Combination[1]	FP,IP,ETA Historical Average (3,100,000 m³)	FP,IP,ETA Historical Maximum (4,160,000 m³)
+ NFRD	3152000	4212000
+ NFRC 1:2-year	3456000	4516000
+ NFRC 1:50-year	3661000	4721000
+ X-13/CVS2	5300000	6360000
+ CVP	4360000	5420000
+ X-13 and CVP	6560000	7620000
+ NFRD and X-13/CVS2	5352000	6412000
+ NFRD and X-13/CVS2 and CVP	6612000	7672000
+ CVD-SIS	8400000	9460000
+ CVD-SIS and NFRC 1:2-year	8756000	9816000
+ CVD-SIS and NFRC 1:50-year	8961000	10021000

Note 1: All combinations include flows from Faro Pit, Intermediate Pond, ETA – based on Historical Average (Column 2) or Historical Maximum (Column 3).

The calculations of treatment volumes have significant uncertainty, and the comparison with treatment capacity does not consider the current excess water that has accumulated in the Faro Pit. However, the results indicate the following:

- Not surprisingly, the IWTS would not be capable of treating water from a fully implemented CVD-SIS. Water from this source would quickly overwhelm existing treatment and storage capacities.
- Treatment of water from X-13/CVS2 would exceed the capacity of the IWTS on an annual basis for a 6 month treatment season, even when considering the historical

average FP/IP/ETA treatment needs. Higher than average requirements for FP/IP/ETA treatment would further exceed the IWTS capacity.

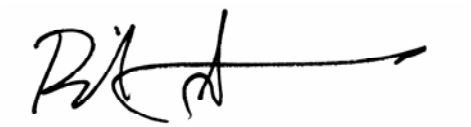
- Any requirement to treat water from the CVP would require almost all of the available capacity for the IWTS.
- For conditions identified in 2013 by CH2M HILL as Historical Maximum conditions for existing treatment, any additional sources would require most of the capacity of the IWTS.
- Consistent with CH2M HILL analysis in early 2016, the addition of expected water from the NFRC Project would not overwhelm the IWTS on its own. I believe there is significant uncertainty with the CH2M HILL estimate of collection volumes from this system.
- In most cases, addition of more than one of the future sources would require most or all of the remaining capacity of the IWTS.

The conclusion in the December 2016 memo was stated as follows:

> Past experience indicates that interim water treatment capacity can be planned and implemented within approximately 2 years, provided it can be implemented without regulatory hurdles. Permanent water treatment capacity would likely have a much longer lead time – probably in the range of at least 4-6 years, depending on the approach to regulatory requirements. Unless there is strong rationale to conclude that significant additional water treatment capacity will not be required within the next 6 years, it appears that planning for implementing permanent water treatment should be initiated very soon.

With respect to the current discussions about X13/CVS2, the preliminary water balance appears to confirm that treating water from this source would consume all of the available excess capacity of the IWTS during average flow conditions for the FP/IP/ETA. If this is the case, any conditions with above average flows could exceed the IWTS capacity and lead to net accumulation of water on site. There appears to be no excess IWTS capacity that could be used to continue reducing levels in the Faro Pit, or for any unexpected water sources.

Regards,



Bill Slater