



MEMORANDUM

TO: Neil Soltis, Administrator, City of Scandia

FROM: Erik Anderson, Water Resource Specialist

DATE: November 28, 2016

RE: **Zavoral Mining and Reclamation Project – Annual Surface Water Monitoring Report and Closeout**

As per the contract (16-01) between the Washington Conservation District (WCD) and the City of Scandia, WCD staff performed surface water monitoring tasks pertaining to Technical Service 1 of Exhibit B. This memorandum serves as a summary and project closeout of those activities.



The Washington Conservation District installed stream monitoring equipment at two locations on Zavoral Creek in 2013 – 2016 and at one location on Middle Creek in 2014 – 2016. Of the sites on Zavoral Creek, one is located at the monitoring point that was installed for the Environmental Impact Statement pump test near the creek mouth (referred to simply as Zavoral Creek), the other site is located upstream of all groundwater inputs to the creek (Crystal Springs) and is dry during periods of no precipitation. This paired monitoring setup can be used to help determine sources of impacts to Zavoral Creek by potentially either

eliminating or supporting the mine as a source. The Middle Creek site was added in 2014 because groundwater elevation data collected by Leggette, Brashears, and Graham, Inc. (LBG) in 2013 suggests groundwater is potentially flowing in a southeast direction towards Middle Creek. The monitoring site is located near the creek mouth. Continuous turbidity, dissolved oxygen (D.O.), temperature, specific conductivity, stage, velocity, and discharge data were collected at all three locations. Water quality samples were collected during base and storm flow at Zavoral Creek and analyzed for total & volatile suspended sediments. No samples were collected at Crystal Springs or Middle Creek. Equipment at Zavoral Creek and Crystal Springs was installed on June 12, 2013 with the intention of gathering baseline data previous to the commencement of mining activities. Due to harsh winter weather, equipment at all three locations were removed for the season and reinstalled the follow year. Macroinvertebrate samples were collected at Zavoral Creek in June and September in 2013 – 2015 and in June 2016, and results were forwarded to the Carnelian-Marine-St. Croix Watershed District.

All surface water monitoring equipment was removed from Crystal Springs and Middle Creek on July 21, 2016, and from Zavoral Creek on August 2, 2016 due to project completion, and all surface water monitoring activities ended. Periods of record for each site are in the table below.

Measurement Period of Record by Location

Location	Turbidity, Temperature, D.O., Specific Conductivity	Stage, Velocity, Discharge	Macroinvertebrates
Zavoral Creek	6/12/13 – 8/2/16	7/1/13 – 11/14/13 5/7/14 – 11/3/14 5/7/15 – 10/27/15 4/4/16 – 8/2/16	6/20/13, 9/17/13 6/11/14, 9/18/14 6/19/15, 9/16/15 6/22/16
Crystal Springs	6/12/13 – 10/27/13 5/6/14 – 11/3/14 6/16/15 – 10/14/15 4/22/16 – 7/21/16	6/12/13 – 10/31/13 5/6/14 – 11/3/14 5/7/15 – 10/14/15 4/22/16 – 7/21/16	
Middle Creek		5/6/14 – 11/3/14 5/7/15 – 10/14/15 4/22/16 – 7/21/16	

Results and Conclusions

Surface water data collected at Zavoral Creek, Crystal Springs, and Middle Creek from June 12, 2013 to August 2, 2016 were analyzed by the WCD for this summary. Groundwater data collected by LBG was compared to the surface water data to determine if a correlation exists between the two datasets. Rainfall data collected from a monitoring station at Bone Lake in Scandia was used for comparison because of its close proximity to the project location. It should be noted that quick unsustained spikes in turbidity have been recorded at all monitoring locations, independent of each other, previous to or outside of any mining activities occurring, and in the absence of recorded rainfall. Possible explanations for these anomalies include logger error, sediment adhering to the sensor, animal activity in the stream, or some other activity not related to mining operations. These data have been included in the final dataset to show that very short fluctuations in stream turbidity have been recorded outside of mining activities. Median values, rather than averages, were used to characterize turbidity during baseflow in order to better account for anomalous data. **Data results and onsite observations do not indicate any impacts to the streams caused by the mining operations.** Hydrographs showing data collected at all sites can be found in previous annual surface water monitoring reports for 2013, 2014, and 2015. A summary table for all monitored sites is found at the end of this report.

This ends the summary report of the WCD’s surface water monitoring activities for the Zavoral Mining and Reclamation Project. Please call me with any questions at 651-330-8220 x32.

	Zavoral Creek				Crystal Springs				Middle Creek		
	2013	2014	2015	2016	2013	2014	2015	2016	2014	2015	2016
Average Baseflow Discharge (cfs)	0.27	0.24	0.27	0.21	No baseflow				0.14 ^c	0.13 ^c	0.26 ^c
Peak Discharge (cfs)	0.69 ^a	26.08 ^b	27.47	14.28	1.66 ^c	13.96 ^c	22.73 ^c	0.076 ^c	1.81 ^c	3.22 ^c	2.59 ^c
Median Baseflow Turbidity (NTU)	0	0	0	0	No baseflow				0.5	0.1	2.7
Peak Turbidity (NTU)	854	2923	3000	3000	2268	2985	3000	0	3000	3000	3000
^a Discharge was not collected at Zavoral Creek during the Crystal Springs peak discharge event (2013). ^b Peak discharge was calculated using the 2015 rating curve (2014). ^c Raw discharge values were calculated by the flow logger using channel shape and size, not a rating curve. cfs: cubic feet per second NTU: Nephelometric Turbidity Units											