TECHNICAL MEMORANDUM

Utah Coal Regulatory Program

January 10th, 2019

TO: The Utah Board of Oil, Gas, and Mining

THRU: Dana Dean, Associate Director

FROM: Steve Christensen, Hydrologist

RE: Crandall Canyon Mine Discharge Water Board Update, Docket No. 2010-026, Cause No. C/015/0032

SUMMARY:

Attached please find the Division of Oil, Gas and Mining's six month update report on the total iron concentrations in the mine discharge water at the Crandall Canyon Mine. This report is submitted in compliance with the January 28, 2013 Board Order.

Crandall Canyon Mine Hydrologic Evaluation Update
January 10th, 2019

Background

The Division of Oil, Gas and Mining (the Division) completed a Hydrologic Evaluation of the Crandall Canyon Mine Water Discharge in June 2010. Since that time, numerous reports have been prepared by the Division and Genwal Resources, Inc. (Genwal) that examine the mine discharge water at Crandall Canyon.

In compliance with the January 28, 2013, Board of Oil, Gas and Mining (the Board) Order[1], the following report presents an update on the data collected from May through December of 2018. The previous Board Update focused on data collected from December 2017 through April of 2018. The following sections of this updated report include: the data collected from the aforementioned time period, plots which have been prepared to examine the data, and a recent data evaluation.

The Utah Division of Water Quality (DWQ) renewed Genwal's Utah Pollutant Discharge Elimination System (UPDES) permit on May 1st, 2016. The DWQ effluent limit for total iron concentration at Genwal continues to be 1.24 mg/L.

Genwal continues to perform monthly sampling and analysis of the mine discharge water in accordance with the Crandall Canyon Mining and Reclamation Plan (MRP). The sampling is conducted to evaluate the need for continued treatment of the mine discharge water in order to meet the 1.24 mg/L maximum daily effluent limitation (MDEL) for total iron in accordance with their Utah Pollutant Discharge Elimination System (UPDES) permit. In addition, treatment is required for compliance with the narrative standard of Section I.C of the UPDES permit.

The sampling data in this report focuses primarily on the raw mine water discharge entering the treatment system. The raw mine water discharge sampling takes place at a continuous flow sampling port. The original port, used from October 2012 to March 2013, was destroyed by a highwall rock fall event. In March 2013, a new port was installed and has been used since for all sampling of the raw mine water discharge.

Results of UPDES Monitoring Activities

Total iron concentrations of the untreated mine water discharge (Pre-002) through December 2018 are presented in Table 1 with the corresponding sampler (i.e. Genwal or DOGM) identified. Split sampling of the mine water discharge is conducted with Genwal and DOGM representatives collecting separate samples during the same sampling event. The samples are sent to different labs in order to provide more verifiable results and increased confidence in the data.

A plot of total iron concentrations (with Genwal and DOGM samples identified) is presented in Exhibit 1. A plot of the total iron concentration average for each month is presented in Exhibit 2. The plot in

Exhibit 3 shows the monthly median total iron concentrations obtained from the mine water discharge sampled from the continuous flow sampling port from October 2012 to December 2018.

A plot of the average mine discharge flow rates is provided in Exhibit 4. It should be noted that the July mine discharge value depicted in Exhibit 4 is based on one discrete reading obtained that month as opposed to an average flow value obtained from daily measurements obtained via a continuous flow meter. The reason for this is that power to the entire mine site was shut off from June 22nd through August 15th due to the Trail Mountain wildfire. Local fire authorities directed Genwal to turn the power off during the resulting fire suppression effort.

As a result, the continuous flow meter was inoperable during the aforementioned period. The flow values depicted in Exhibit 4 are through October 2018. Per Division guidelines, Genwal has until the end of 1st quarter 2019 to provide the requisite monitoring data for 4th quarter 2018. The Division had not received the mine water discharge values for November and December at the time this report was prepared.

Observed Total Iron Concentration Trends

Upon receipt of the December total iron concentrations from the Genwal and Division sampling event in December, 2018 is the first complete calendar year in which all 12 months have consecutively produced total iron concentrations below the UPDES limit of 1.24 mg/L. All 24 samples collected by both Genwal and the Division for 2018 were compliant. The last sample that produced a non-compliant total iron concentration was in December 19th, 2017. The total iron concentrations from May to December 2018 have fluctuated as low as 0.88 mg/L to as high as 1.07 mg/L.

The average total iron concentration of all samples collected in 2018 was 1.01 mg/L. In 2016 and 2017, the average total iron concentration was 1.10 mg/L and 1.18 mg/L respectively. The standard deviation of samples collected for 2016, 2017 and 2018 are 0.18, 0.18 and 0.08 respectively. The reduction in standard deviation provides some evidence that suggests the total iron concentration appears to be stabilizing below the effluent limitation of 1.24 mg/L.

It's notable that out of the last 47 samples collected in the last two years (since January 2017); there have been only 8 recorded sampling events where the UPDES limit of 1.24 mg/L was exceeded. With the exception of the July 26, 2017 Genwal sample (1.68 mg/L), the remaining seven non-compliant samples recorded total iron concentrations that were very low (less than 0.3 mg/L from the 1.24 mg/L compliance concentration).

Upon review of the average monthly total iron concentrations (See Exhibit 2, Crandall Mine- Untreated Mine Water- Total Iron Monthly Average) and the mine-water discharge rates (See Exhibit 4, Mine Discharge), there is a notable correlation. As the monthly average and 6-month average mine discharge rates have notably decreased with time, so has the total raw iron concentration in the mine-water discharge. If this trend continues, the iron concentration should continue to decrease along with the mine water discharge rate.

Mine Water Treatment System

All of the reported total iron concentrations discharging from the mine-water treatment system retention pond were below the 1.24 mg/L limit every month of 2018. This is noteworthy given that the mine-water treatment system (as with the continuous flow meter discussed earlier) was not operable during the period in which the Trail Mountain Fire was burning and the electrical system was ordered disabled by local fire authorities. During that time-frame (June 22nd thru August 15th), the raw mine-water was not being treated prior to discharging into Crandall Creek.

Additionally, based on information provided by Genwal representatives, the mine water treatment system has not been in operation since October 17th, 2018. However; as stated previously, the mine-water discharge reporting to Crandall Creek remained in compliance for all of 2018. Based on the data provided by Genwal, the average total iron concentration for the discharge reporting to Crandall Creek was 0.51 mg/L for 2018 (well below the UPDES limit of 1.24 mg/L).

Conclusion

For the entire year of 2018, all total iron concentrations obtained from Genwal and the Division were below the UPDES limit of 1.24 mg/L. The total iron concentration of the untreated mine water discharge continues to show signs of steady decline and has produced evidence that suggests it's beginning to stabilize below the compliant limit.

The Division feels that it is prudent to continue collecting data to support accurate evaluations of total iron trends. The Division recommends continued sampling of total raw iron concentrations with an evaluation of newly available data to be conducted every six months. The next mine-water discharge evaluation will be distributed to the Board in July of 2019.

References

1. Board of Oil, Gas and Mining., Findings of Fact, Conclusions of Law and Order, Docket No. 2010-026, Cause No. C/0150032, January 28, 2013.

EXHIBIT 1: Crandall Mine - Untreated Mine Water - Total Iron

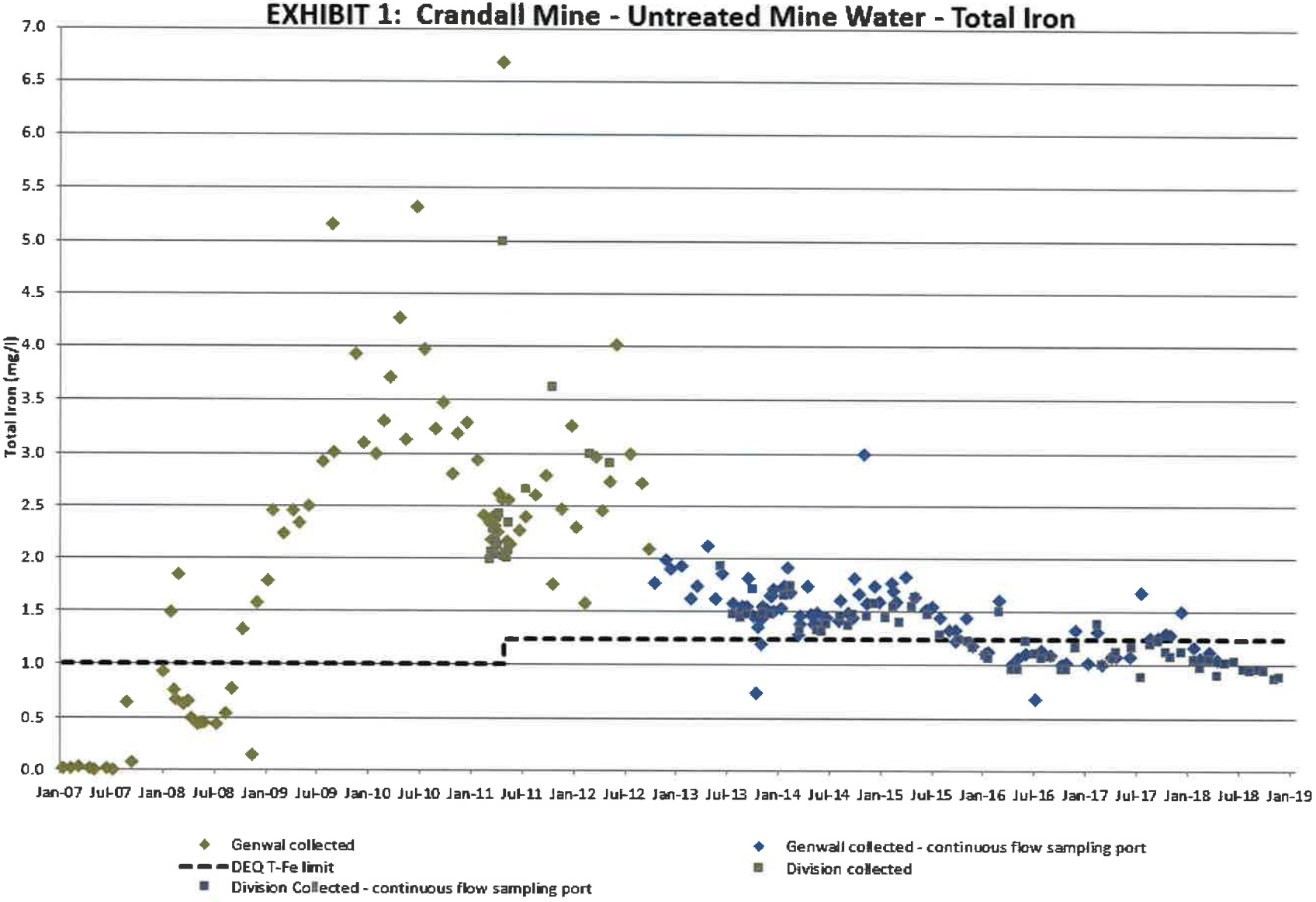

EXHIBIT 2: Crandall Mine - Untreated Mine Water - Total Iron Monthly Average

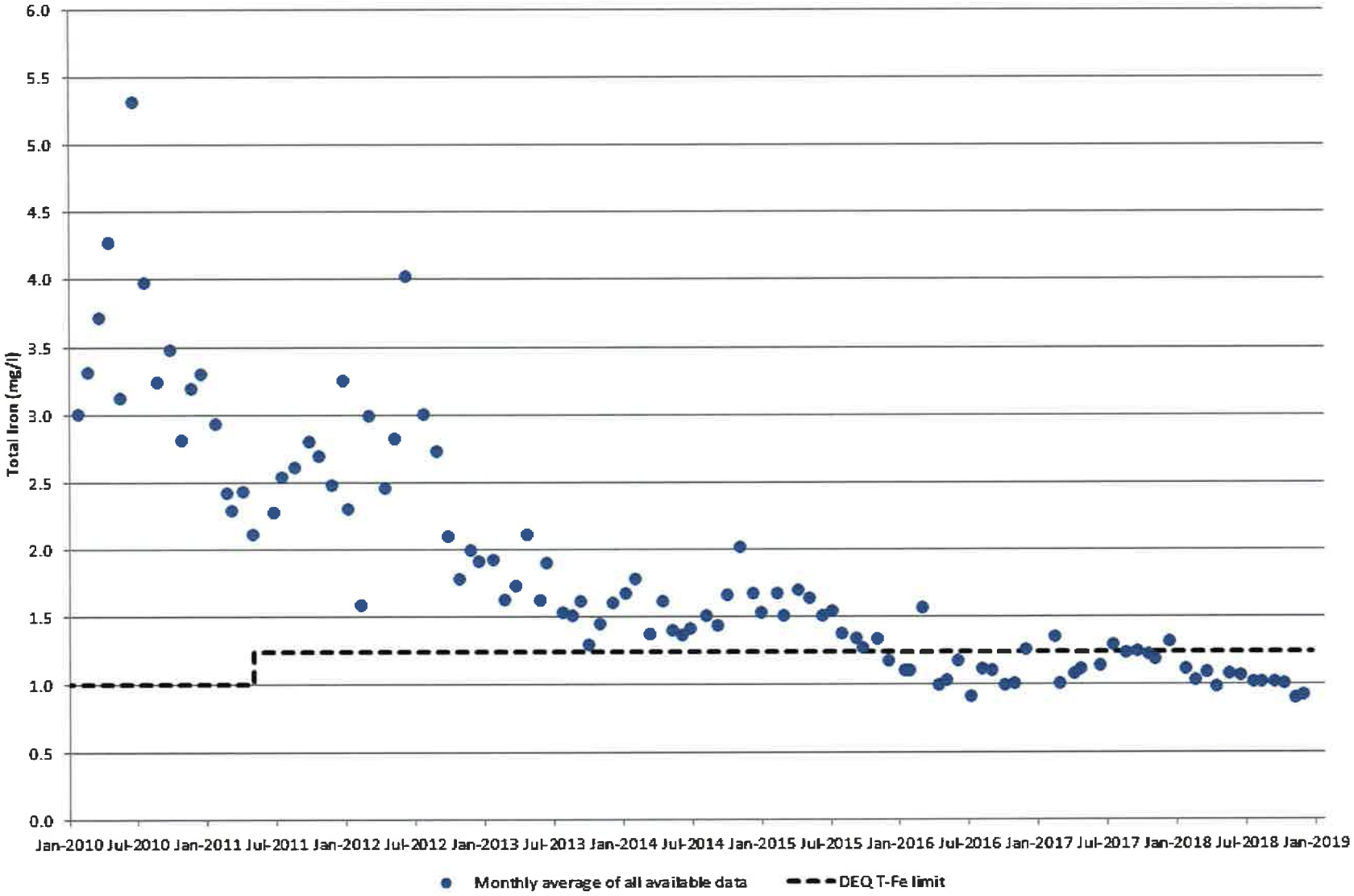

EXHIBIT 3: Crandall Mine - Untreated Mine Water
Monthly Median - Continuous Flow Sampling Port

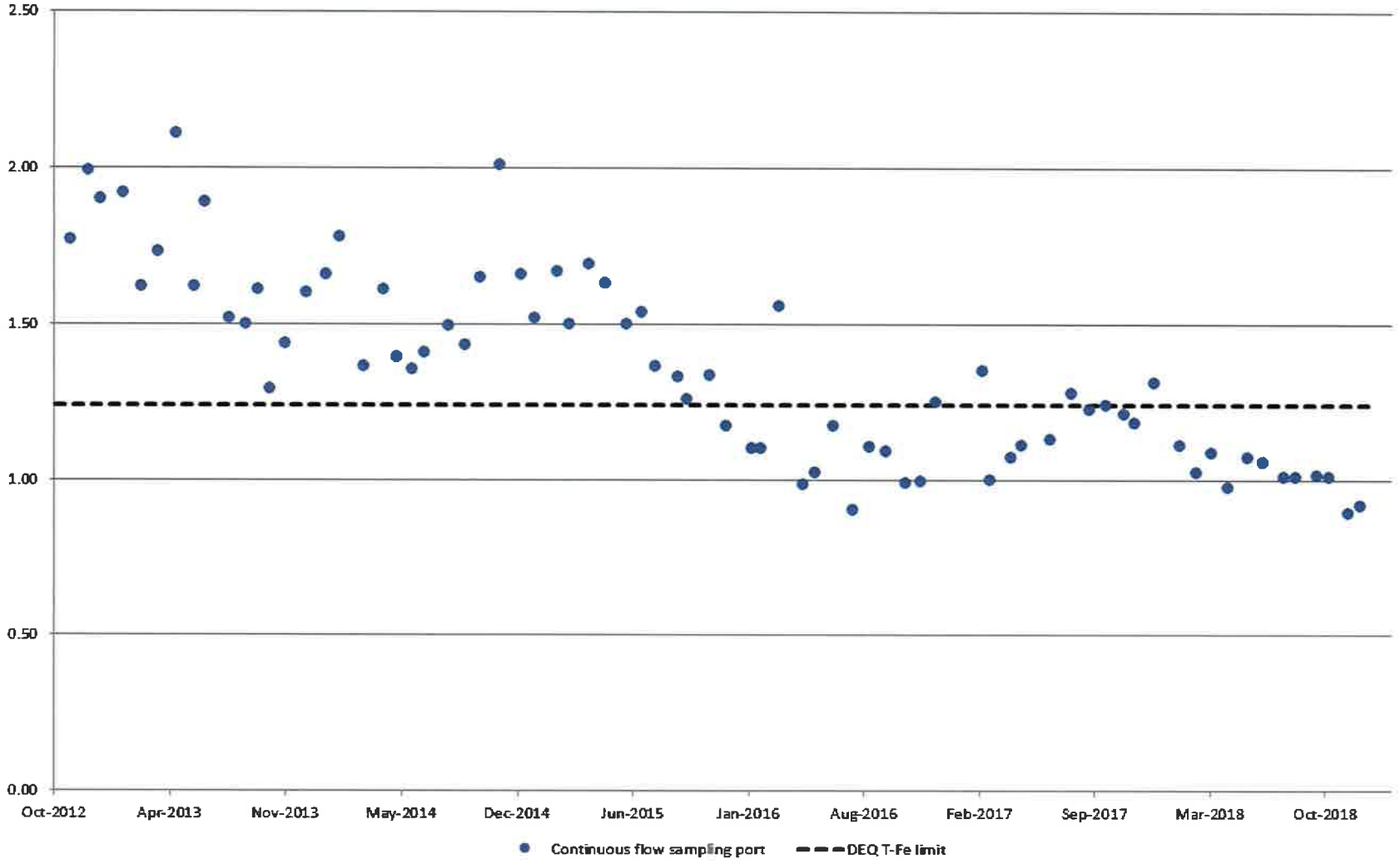

EXHIBIT 4: Mine Discharge

Table 1: Raw data of Genwal and Division Total Iron Concentrations, Monthly Average of Split Samples, and Monthly Average Flow ***UPDES Exceedances in Red, >1.24 mg/L T-Fe**

Sample Date	Continuous Flow Sampling Port	Genwal (G) or Division (D) Sample	Monthly Median	Monthly Average Flow
	total iron (mg/L)			**(gpm)**
1/8/2007	0.012	G		
2/6/2007	0.015	G		
3/7/2007	0.033	G		
4/18/2007	0.013	G		
5/1/2007	< .005	G		
6/13/2007	0.012	G		
7/16/2007	< .01	G		
8/30/2007	0.64	G		
9/11/2007	0.073	G		
10/15/2007	no flow	G		
11/15/2007	no flow	G		
12/15/2007	no flow	G		
1/10/2008	0.937	G		
1/28/2008	1.491	G		
2/11/2008	0.765	G		
2/18/2008	0.668	G		
3/3/2008	1.846	G		
3/17/2008	0.626	G		
4/1/2008	0.653	G		
4/15/2008	0.491	G		
5/5/2008	0.433	G		
5/14/2008	0.457	G		
6/1/2008	0.448	G		
7/16/2008	0.434	G		
8/14/2008	0.546	G		
9/9/2008	0.775	G		
10/10/2008	1.335	G		
11/15/2008	0.141	G		
12/9/2008	1.569	G		
1/7/2009	1.78	G		
2/3/2009	2.45	G		
3/4/2009	2.23	G		
4/6/2009	2.455	G		

Sample Date	Continuous Flow Sampling Port	Genwal (G) or Division (D) Sample	Monthly Median	Monthly Average Flow
total iron (mg/L)				(gpm)
5/6/2009	2.33	G		
6/3/2009	2.50	G		
7/29/2009	2.92	G		
8/24/2009	5.151	G	5.15	
9/3/2009	3.01	G	3.01	
10/28/2009	8.03	G	8.03	
11/18/2009	3.927	G	3.93	
12/16/2009	3.102	G	3.10	
1/28/2010	3.00	G	3.00	
2/23/2010	3.30	G	3.30	
3/26/2010	3.709	G	3.71	
4/21/2010	4.268	G	4.27	
5/18/2010	3.119	G	3.12	
6/23/2010	5.312	G	5.31	
7/21/2010	3.97	G	3.97	
8/27/2010	3.23	G	3.23	
9/29/2010	3.47	G	3.47	
10/29/2010	2.81	G	2.81	
11/22/2010	3.19	G	3.19	
12/17/2010	3.29	G	3.29	
1/24/2011	2.93	G	2.93	
2/23/2011	2.41	G	2.41	
3/10/2011	2.34	G		
3/10/2011	1.98	D		
3/17/2011	2.18	G		
3/17/2011	2.06	D		
3/24/2011	2.39	G	2.28	
3/24/2011	2.28	D		
3/28/2011	2.31	G		
3/30/2011	2.36	G		
3/30/2011	2.04	D		

Sample Date	Continuous Flow Sampling Port	Genwal (G) or Division (D) Sample	Monthly Median	Monthly Average Flow
total iron (mg/L)				(gpm)
4/7/2011	2.39	G	2.43	
4/7/2011	2.15	D		
4/14/2011	2.25	G		
4/14/2011	2.11	D		
4/19/2011	2.62	G		
4/19/2011	2.43	D		
4/26/2011	2.55	G		
4/27/2011	6.68	G		
4/27/2011	5.00	D		
5/3/2011	2.05	G	2.10	
5/3/2011	2.02	D		
5/12/2011	2.16	G		
5/12/2011	2.00	D		
5/17/2011	2.56	G		
5/17/2011	2.33	D		
5/25/2011	2.07	D		
5/31/2011	2.13	G		
6/27/2011	2.27	G	2.27	
7/21/2011	2.66	D	2.53	561
7/25/2011	2.40	G		
8/22/2011	2.60	G	2.60	563
9/30/2011	2.79	G	2.79	558
10/24/2011	1.75	G	2.69	511
10/25/2011	3.62	D		
11/28/2011	2.47	G	2.47	483
12/28/2011	3.25	G	3.25	434
1/12/2012	2.29	G	2.29	429
2/15/2012	1.58	G	1.58	430
3/7/2012	3.00	D	2.98	395
3/23/2012	2.96	G		
4/17/2012	2.45	G	2.45	389

Sample Date	Continuous Flow Sampling Port	Genwal (G) or Division (D) Sample	Monthly Median	Monthly Average Flow
total iron (mg/L)				**(gpm)**
5/15/2012	2.73	G	2.82	412
5/15/2012	2.90	D		
6/12/2012	4.02	G	4.02	399
7/30/2012	2.99	G	2.99	393
8/31/2012	2.72	G	2.72	400
9/30/2012	2.09	G	2.09	400
10/30/2012	1.77	G	1.77	446
11/30/2012	1.99	G	1.99	411
12/20/2012	1.90	G	1.90	448
1/29/2013	1.92	G	1.92	389
2/28/2013	1.62	G	1.62	425
3/28/2013	1.73	G	1.73	384
4/30/2013	2.11	G	2.11	390
5/30/2013	1.65	G	1.62	379
6/19/2013	1.93	D	1.89	376
6/24/2013	1.85	G		
7/30/2013	1.47	D	1.52	361
7/30/2013	1.57	G		
8/27/2013	1.44	D	1.49	358
8/28/2013	1.54	G		
8/29/2013	1.52	G		
9/17/2013	1.48	D	1.51	366
9/17/2013	1.54	G		
9/26/2013	1.81	G		
10/9/2013	1.71	D	1.59	334
10/9/2013	1.46	G		
10/17/2013	0.74	G		
10/24/2013	1.35	G		

Sample Date	Continuous Flow Sampling Port	Genwal (G) or Division (D) Sample	Monthly Median	Monthly Average Flow
total iron (mg/L)				**(gpm)**
11/4/2013	1.19	G	1.31	326
11/8/2013	1.43	G		
11/14/2013	1.46	G		
11/19/2013	1.49	D		
11/19/2013	1.54	G		
11/26/2013	1.52	G		
12/10/2013	1.65	G	1.60	315
12/10/2013	1.48	D		
12/12/2013	1.65	G		
12/17/2013	1.51	G		
12/26/2013	1.71	G		
1/14/2014	1.53	G	1.66	307
1/22/2014	1.72	G		
1/28/2014	1.74	G		
1/28/2014	1.65	D		
2/7/2014	1.91	G	1.78	322
2/26/2014	1.68	G		
2/26/2014	1.74	D		
3/20/2014	1.29	G	1.37	291
3/25/2014	1.46	G		
3/25/2014	1.33	D		
3/31/2014	1.38	G		
4/23/2014	1.74	G	1.61	328
4/30/2014	1.48	G		
5/16/2014	1.38	G	1.39	337
5/23/2014	1.37	G		
5/28/2014	1.33	D		
5/29/2014	1.49	G		
6/10/2014	1.39	G	1.36	353
6/10/2014	1.32	D		

Sample Date	Continuous Flow Sampling Port	Genwal (G) or Division (D) Sample	Monthly Median	Monthly Average Flow
total iron (mg/L)				(gpm)
7/1/2014	1.44	G	1.41	342
7/1/2014	1.38	D		
8/13/2014	1.42	G	1.5	374
8/19/2014	1.61	G		
8/19/2014	1.46	D		
9/12/2014	1.49	G	1.43	356
9/15/2014	1.37	D		
9/29/2014	1.44	G		
10/7/2014	1.48	D	1.65	330
10/9/2014	1.81	G		
10/20/2014	1.66	G		
11/10/2014	2.99	G	2.01	329
11/24/2014	1.58	G		
11/25/2014	1.46	D		
12/16/2014	1.58	D	1.66	326
12/16/2014	1.74	G		
1/8/2015	1.59	G	1.52	272
1/27/2015	1.45	D		
2/17/2015	1.77	G	1.67	312
2/23/2015	1.55	D		
2/23/2015	1.70	G		
3/9/2015	1.59	G	1.50	278
3/17/2015	1.40	D		
4/14/2015	1.82	G	1.69	301
4/30/2015	1.55	D		
5/13/2015	1.63	D	1.63	287
5/13/2015	1.63	G		
6/17/2015	1.52	G	1.50	297
6/22/2015	1.47	D		
6/29/2015	1.52	G		

Sample Date	Continuous Flow Sampling Port	Genwal (G) or Division (D) Sample	Monthly Median	Monthly Average Flow
total iron (mg/L)				**(gpm)**
7/14/2015	1.54	G	1.54	322
8/6/2015	1.29	D	1.37	305
8/7/2015	1.44	G		
9/14/2015	1.33	G	1.33	311
10/1/2015	1.22	G	1.26	307
10/5/2015	1.33	G		
10/20/2015	1.24	D		
11/9/2015	1.45	G	1.34	311
11/16/2015	1.22	D		
12/8/2015	1.18	G	1.17	297
12/8/2015	1.16	D		
1/20/2016	1.11	G	1.10	255
1/20/2016	1.09	D		
2/4/2016	1.13	G	1.10	258
2/4/2016	1.07	D		
3/7/2016	1.60	G	1.56	296
3/7/2016	1.51	D		
4/18/2016	1.01	G	0.99	256
4/18/2016	0.96	D		
5/10/2016	1.07	G	1.02	269
5/10/2016	0.96	D		
6/15/2016	1.11	G	1.17	266
6/15/2016	1.23	D		
7/13/2016	0.69	G	0.90	294
7/13/2016	1.11	D		
8/11/2016	1.14	G	1.105	287
8/11/2016	1.07	D		
9/8/2016	1.10	G	1.09	285
9/8/2016	1.08	D		
10/13/2016	1.01	G	0.99	278
10/13/2016	0.97	D		
11/7/2016	1.02	G	0.995	288
11/7/2016	0.97	D		

Sample Date	Continuous Flow Sampling Port	Genwal (G) or Division (D) Sample	Monthly Median	Monthly Average Flow
	total iron (mg/L)			**(gpm)**
12/5/2016	1.33	G	1.25	268
12/5/2016	1.17	D		
1/19/2017	1.02	G	1.02	252
2/22/2017	1.32	G	1.35	250
2/22/2017	1.38	D		
3/7/2017	1.00	G	1.00	248
3/7/2017	1.00	D		
4/13/2017	1.08	G	1.07	271
4/17/2017	1.06	D		
5/1/2017	1.08	G	1.11	305
5/1/2017	1.13	D		
6/20/2017	1.08	G	1.13	327
6/28/2017	1.17	D		
7/26/2017	1.68	G	1.28	343
7/26/2017	0.883	D		
8/28/2017	1.25	G	1.225	360
8/28/2017	1.20	D		
9/26/2017	1.26	G	1.24	373
9/26/2017	1.22	D		
10/26/2017	1.30	G	1.21	323
10/26/2017	1.12	D		
11/14/2017	1.28	G	1.18	332
11/14/2017	1.08	D		
12/19/2017	1.5	G	1.31	331
12/19/2017	1.12	D		
01/30/2018	1.170	G	1.11	313
01/30/2018	1.050	D		
02/28/2018	1.070	G	1.024	342
02/28/2018	0.978	D		
03/28/2018	1.120	G	1.085	267
03/28/2018	1.050	D		
04/25/2018	1.050	G	0.9755	269
04/25/2018	0.901	D		

Sample Date	Continuous Flow Sampling Port	Genwal (G) or Division (D) Sample	Monthly Median	Monthly Average Flow
total iron (mg/L)				**(gpm)**
5/29/2018	1.12	G	1.07	274
5/29/2018	1.02	D		
6/25/2018	1.07	G	1.06	284
6/25/2018	1.04	D		
7/31/2018	1.06	G	1.01	275*
7/31/2018	0.957	D		
8/21/2018	1.07	G	1.01	285
8/21/2018	0.946	D		
9/25/2018	1.06	G	1.01	267
9/25/2018	0.966	D		
10/17/2018	1.06	G	1.01	276
10/17/2018	0.951	D		
11/19/2018	0.9	G	0.89	**
11/19/2018	0.88	D		
12/11/2018	0.94	G	0.92	**
12/11/2018	0.893	D		

**Due to the Trail Mountain Fire, power was lost at the mine-site. As a result, the continuous flow meter was not operable. The July flow reading is based on one, discrete flow meter reading (i.e. not an average)*

***November and December flow data was not received by DOGM in time for this report. The data is not required for submission to DOGM until the end of 1st quarter 2019.*