

Memorandum

To: Summit County Open Space and Trails

From: Lauren Duncan, Trout Unlimited Abandoned Mine Restoration Project Manager

Date: July 2nd, 2019

June 2019 Manila Lode Water Quality Results

Introduction and Site Information

On June 17th, 2019, staff members from Trout Unlimited (TU) collected water quality samples at nine water quality sites related to the Manila Lode in Montezuma, CO. These sites focused on the Manila Lode mine site, its surrounding wetlands and the Snake River, upstream and downstream of the mine's potential influence. Sampling at these sites, detailed in Table 1 and Figure 1, aimed to supplement soil quality results from 2018 and sought to provide a comprehensive overview of the potential risk associated with the Manila Lode.

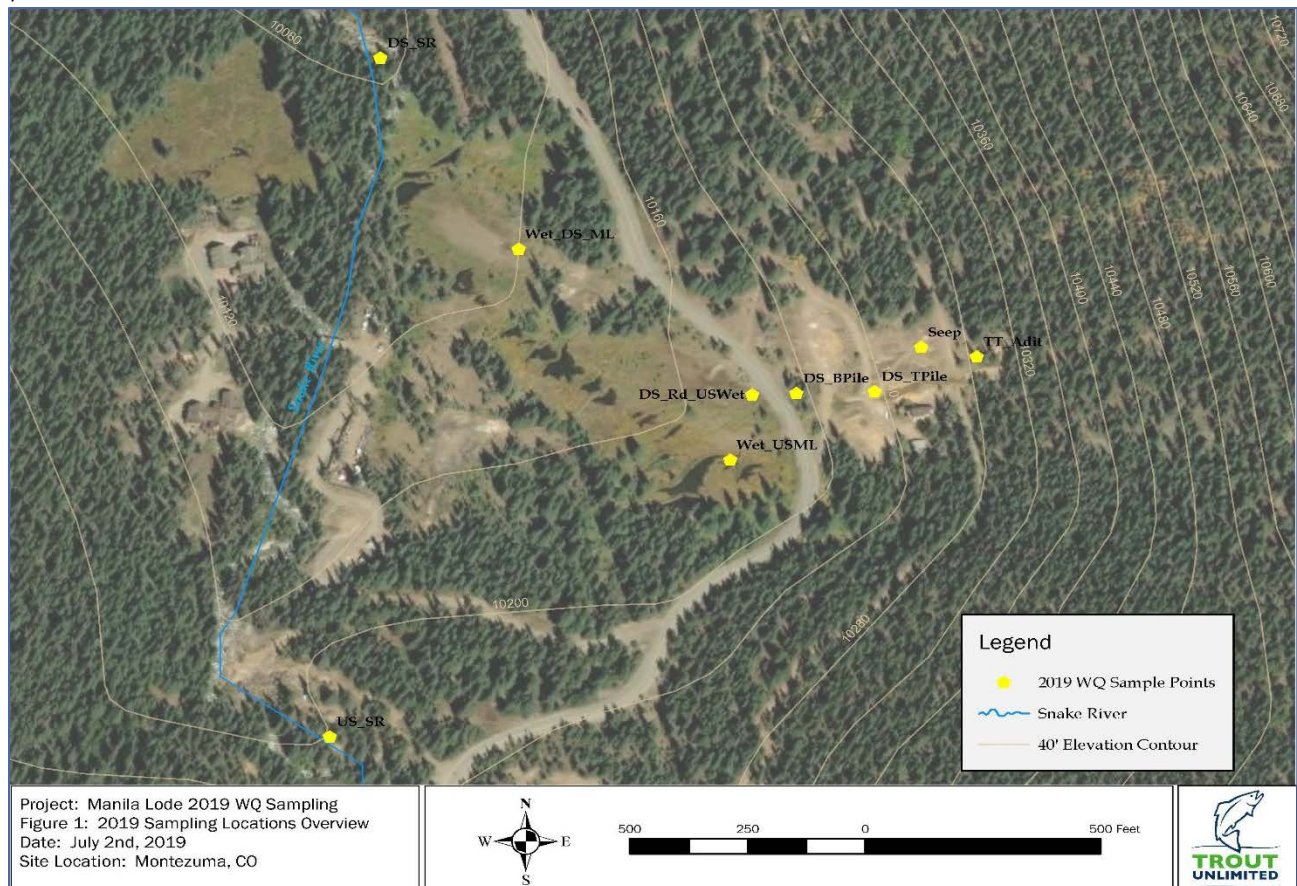


Figure 1. June 2019 Water Quality Sampling Locations.

Table 1. June 2019 Sample Site Descriptions and Locations.

Site Name	Site Description	Lat (WGS 84)	Long (WGS 84)
US_SR	Snake River, Upstream of Manila Lode	39.58413	-105.86958
Wet_US_ML	Wetland pond, Upstream of Manila Lode	39.58623	-105.86773
TT_Adit	Toledo Tunnel adit	39.58657	-105.86621
Seep	Seep at side of Bottom Pile	39.58692	-105.86646
DS_Tpile	Downgradient of Top Tailings Pile, above driveway culvert	39.58663	-105.86672
DS_Bpile	Downgradient of Bottom (Lower) Tailings Pile, above road culvert	39.58657	-105.86716
DS_Rd_US_Wet	Downstream of Montezuma Rd, Upstream of Wetlands	39.58668	-105.86743
Wet_DS_ML	Wetland pond, Downstream of Manila Lode	39.58686	-105.86847
DS_SR	Snake River, Downstream of Manila Lode	39.58859	-105.86941

Water Quality Results

TU staff collected field measurements of pH, conductivity and temperature (Table 2). Flow measurements were not possible as spring flush flows in the Snake River presented unsafe conditions. TU staff collected water quality samples at all nine identified sites related to the Manila Lode and its surrounding water resources. Once collected, water quality samples were placed on ice and sent to ALS Laboratory in Fort Collins, Colorado for analysis. All samples were tested for dissolved and total recoverable metals.

Table 2. June 2019 Field Measurement Results. Note that no field parameters were collected at the Seep site as the angle of the flow was too low to utilize field equipment.

Site Name	Field pH (SU)	Conductivity (us/cm)	Temperature (°C)
US_SR	6.05	84.8	3.7
Wet_US_ML	7.12	116.3	5.6
TT_Adit	7.82	155.4	6.6
Seep	--	--	--
DS_Tpile	8.07	225.4	8.7
DS_Bpile	6.7	340	6.3
DS_Rd_US_Wet	6.58	306	5.8
Wet_DS_ML	7.22	196.9	6.4

Trout Unlimited (TU) staff analyzed laboratory results against the corresponding segment-specific water quality standards for segment COUCBL06a, the Mainstem of the Snake River from the source to Dillon Reservoir, including Saint John Creek. Laboratory results are attached as an appendix to this memo.

Water quality results and standard exceedances varied by analyte and between the sampled sites. To provide clarity, the results described below are grouped by detectable metals included in the site's stream segment standards. Analytes that were analyzed as below laboratory detection limits or not specifically included in the site's stream segment are not included in this discussion.

All but two sampled sites exceeded the chronic, acute and acute trout standards for dissolved cadmium (Figure 2). Results from the Toledo Tunnel adit and downstream of the top tailings pile were below detection limits and did not exceed site standards. Dissolved cadmium results increased at the seep site at the side of the bottom pile and exceeded site standards, and increased rapidly below the bottom pile, rising from non-detectable levels below the top pile to 20 ug/L below the

bottom pile to 40 ug/L below Montezuma Rd, exceeding all standards. This increase indicates that the flows from the Toledo Tunnel are likely not the source of dissolved cadmium on site, rather an accumulation of leachate and overland flows from the site's tailings piles are likely contributing to these elevated results. Dissolved cadmium results remain above standards at all downstream sampling sites, but concentrations do decrease as they likely become diluted in the downstream wetlands and in the high flow of the downstream Snake River site.

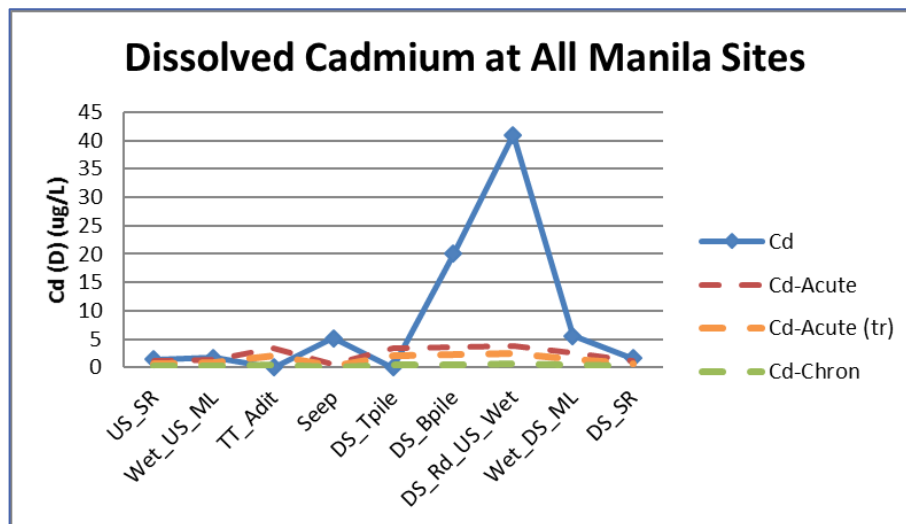


Figure 2. Dissolved cadmium results across all sampled sites. Sites are displayed in an upstream to downstream fashion.

Dissolved copper was only detectable at two sampled sites (Figure 3). Results from the seep at the side of the bottom pile far exceed all site standards at 26 ug/L, while results immediately downstream of Montezuma Road exceed the chronic dissolved copper standard at 17 ug/L. Again, these results indicate that the flows from the Toledo Tunnel are likely not the source of dissolved copper on site, rather dissolved copper is accumulated as these flows run over, and interact with, the tailings piles on site. Dissolved copper concentrations drop off rapidly through the downstream wetlands to non-detectable limits.

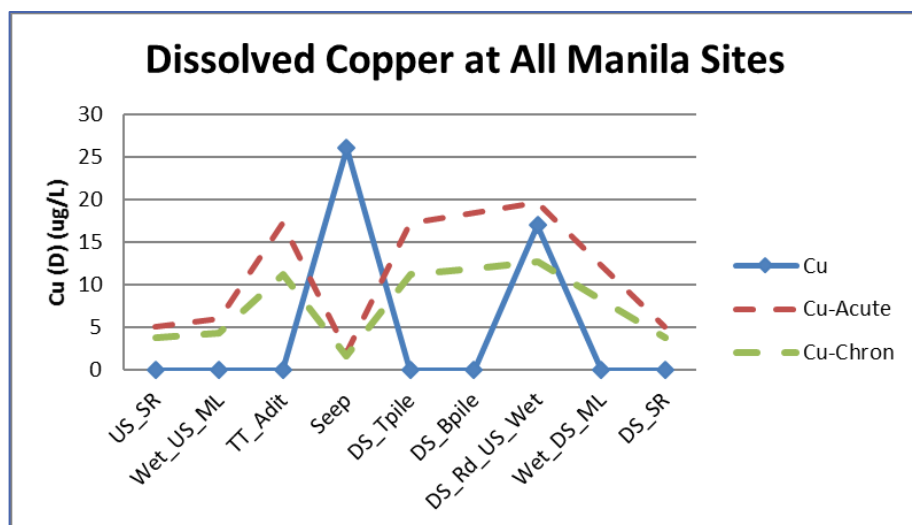


Figure 3. Dissolved copper concentrations across the Manila Lode sampling sites.

Dissolved iron concentrations were only detectable in the Snake River sampling sites (Figure 4). These concentrations, measured at 130 ug/L upstream and 140 ug/L downstream were below the segment's chronic standard of 300 ug/L for dissolved iron and indicate an upstream source of the metal and some contribution from the adjacent wetlands, rather than a direct input from the Manila Lode site.

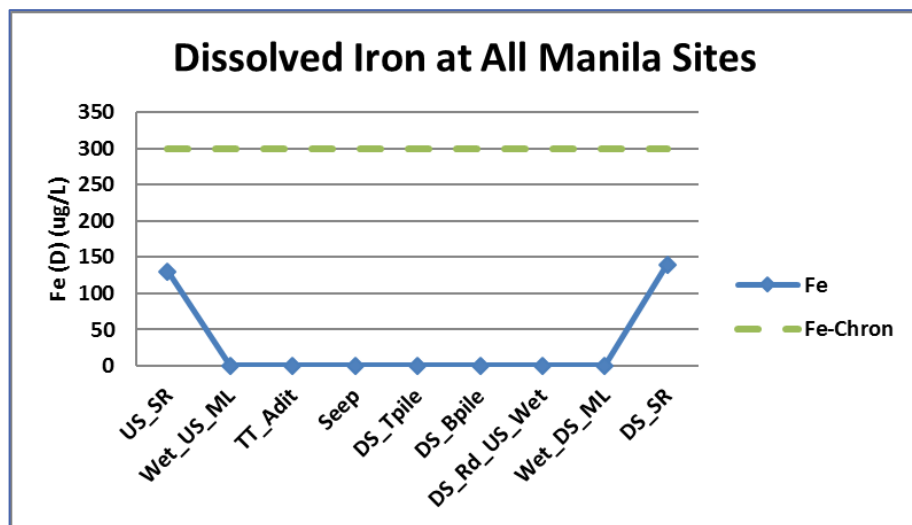


Figure 4. Dissolved iron across the Manila Lode sampling sites.

Results for total iron across the Manila Lode sites varied across sampled sites (Figure 5). Results from the Toledo Tunnel adit, measured at 2000 ug/L, exceeded the site standard of 1000 ug/L for total iron. Downstream of the top pile, results were measured at 1,000 ug/L, meeting the chronic

standard for the site. Results drop rapidly to non-detectable limits below the bottom pile and below Montezuma Rd. This pattern of results does indicate that the Toledo Tunnel flows are the source of total iron concentrations on site. Total iron results within the Snake River sites decline from 680 ug/L at the upstream site to 560 ug/L at the downstream site, while total iron concentrations increase through the wetlands from 110 upstream of the Manila Lode to 120 ug/L below the Manila Lode, suggesting that the wetlands are partially accumulating concentrations of total iron.

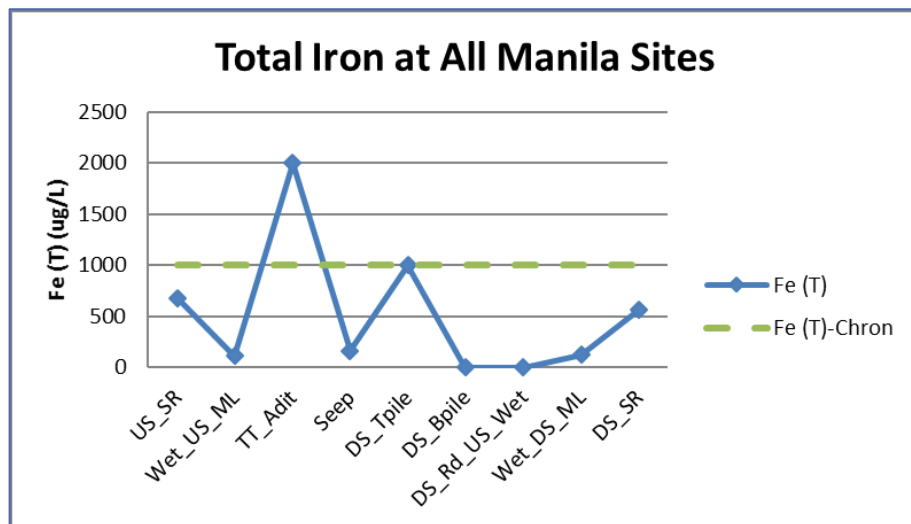


Figure 5. Total iron results across the Manila Lode sites.

Dissolved manganese results exceed water supply standard of 50 ug/L at all sampled sites (Figure 6). While this is likely not a relevant use of these water supplies, this standard exceedance should be noted. Results from the Toledo Tunnel of 2300 ug/L exceed the hardness-based calculated chronic standard of approximately 1,800 ug/L. Results remain just below standards below the on-site tailings piles, but exceed all standards below Montezuma Rd at 4,700 ug/L. The relatively high results from the Toledo Tunnel flows, coupled with increasing concentrations as surface waters combine interact with tailings materials on site, likely result in the high concentrations found at the DS-Rd_US_Wet site.

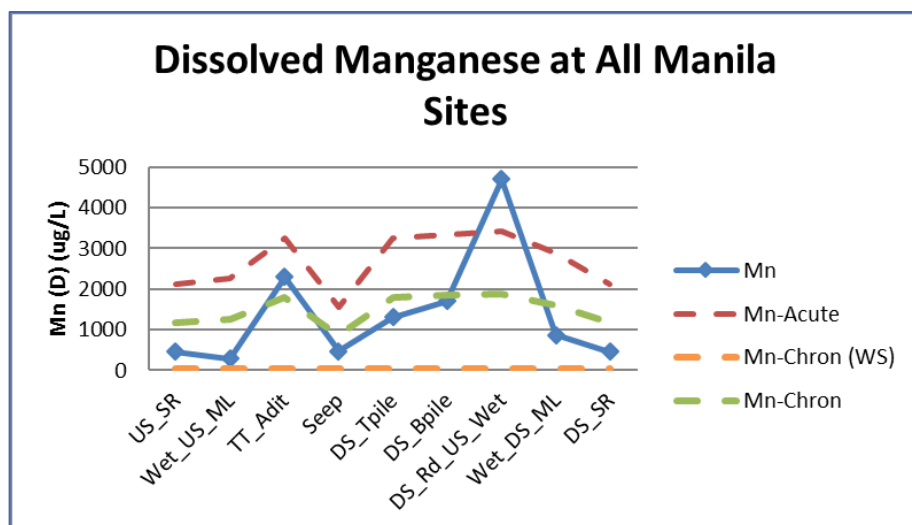


Figure 6. Dissolved manganese results across all Manila Lode sites.

Lab measured pH was recorded at, or below pH standards of 6.5-9 SU at multiple sites across the Manila Lode site. The sampled wetland pond upstream of the Manila Lode and the results from below Montezuma Rd met the low pH standard at 6.5 and 6.53 SU respectively, while the pH results from the seep at the side of the bottom pile (6.3 SU), the wetland pond downstream of Manila (6.22 SU) and the downstream Snake River site (5.67 SU) were below standard. When TU staff sampled the pH of the on-site tailings piles in October 2018, both piles had pH values below 4 SU (Trout Unlimited, 2018). The steady decrease of pH values downgradient of the Manila Lode site, ranging from 7.57 SU at the Toledo Tunnel adit to 5.67 SU at the most downstream sampled site, as well as the decrease in Snake River pH values from 6.77 SU upstream to 5.67 SU downstream may be attributable to the relatively acidic nature of the tailings materials found on site.

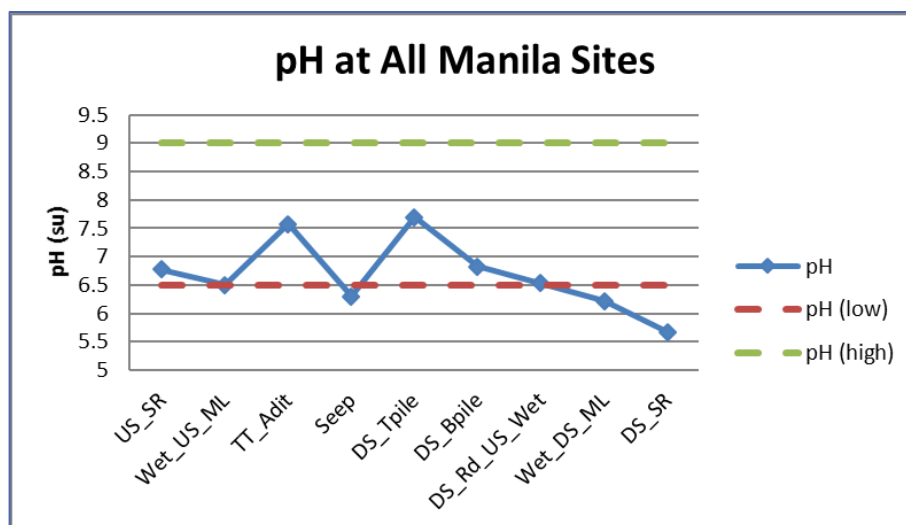


Figure 7. pH results across all Manila Lode sites.

Dissolved lead concentrations were below site standards at all sites except the seep at the side of the bottom pile and immediately downstream of Montezuma Rd. Concentrations at the seep site of 30 ug/L exceed both the hardness-based acute and chronic dissolved lead standards for the site. Because concentrations at all other sites are lower than the results from this site, the elevated results here are likely due to slow-moving groundwater interacting with the tailings at the bottom pile. In order to fully understand the source(s), interaction potential and complexity of this seep, it is imperative to understand whether this seep is a surface expression of an elevated water table, a seasonal accumulation of shallow groundwater or if this seep is connected with buried mine workings not immediately apparent at the site.

Dissolved lead concentrations of 11 ug/L immediately below Montezuma Rd exceeded the chronic standard of approximately 3.9 ug/L. Elevated lead concentrations in site leachate measured in October 2018 may explain this standard-exceeding result (Trout Unlimited, 2018), and the culvert material at the Montezuma Rd site may be contributing to these elevated results. If this culvert is constructed from, or contains, lead, these elevated results may also be attributable to this pipe's materials.

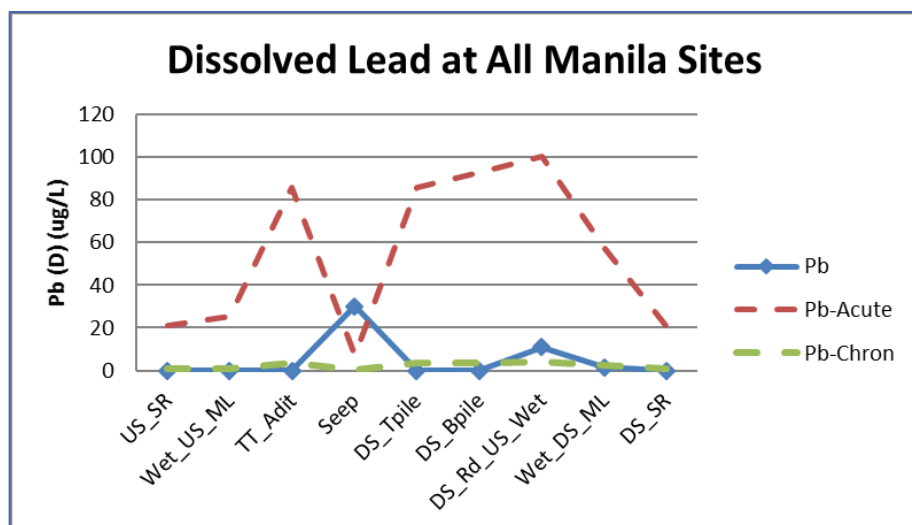


Figure 8. Dissolved lead concentrations across all sampled Manila Lode sites.

Sulfate concentrations did not exceed the chronic sulfate standard of 250 mg/L at any of the sampled sites (Figure 9), however a visible increase in sulfate concentrations can be noted from below the top pile (46 mg/L) to immediately below Montezuma Rd (140 mg/L) indicating sulfate accumulation across the Manila Lode site.

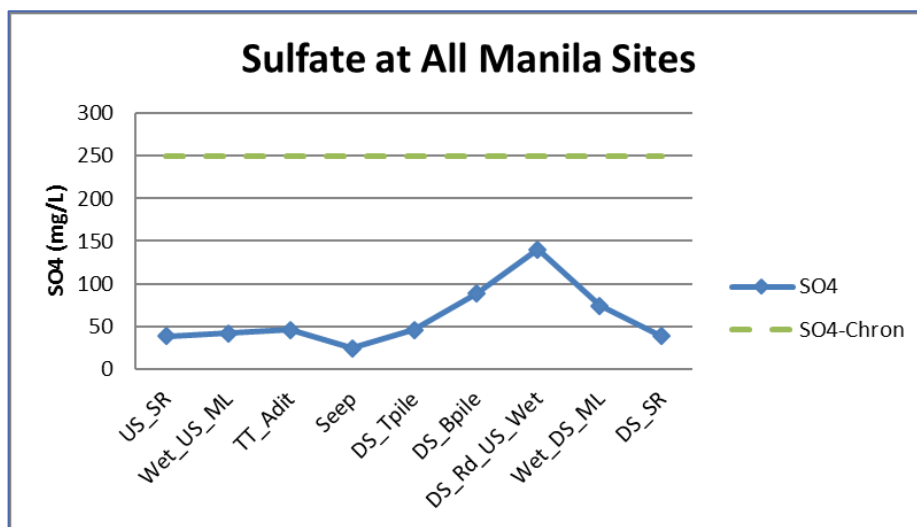


Figure 9. Sulfate concentrations at all sampled Manila Lode sites.

Dissolved zinc concentrations were above site chronic and acute standards at all sites except below the top tailings pile (Figure 10). Dissolved zinc concentrations are elevated to 8,300 ug/L below the bottom pile at the base of the site and reach their highest concentrations of 14,000 ug/L below Montezuma Rd.

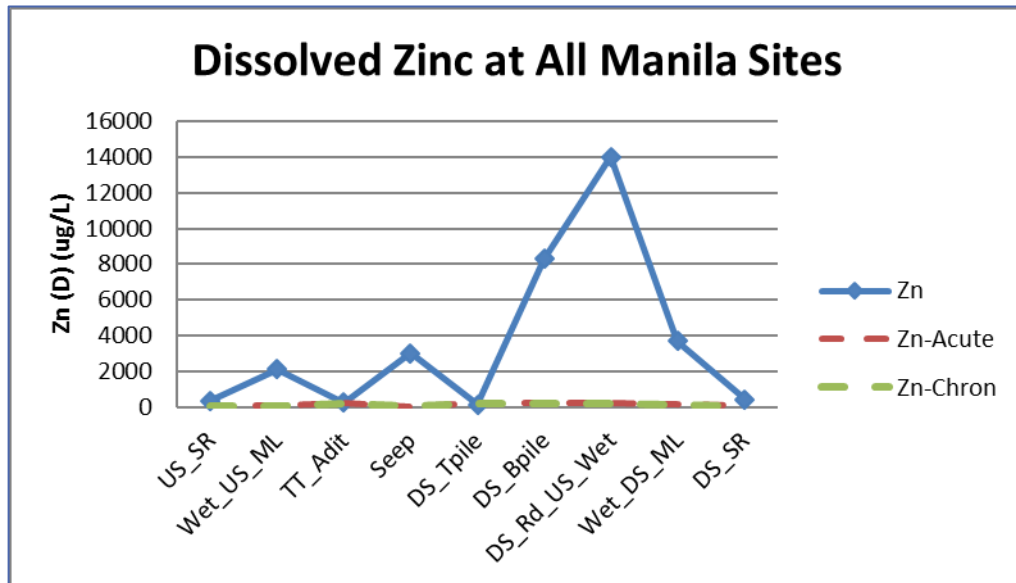


Figure 10. Dissolved zinc concentrations at all Manila Lode sites.

Flows below Montezuma Rd appear mineralized as a result of these elevated metals concentrations (Figure 11). The elevated dissolved zinc concentrations can be attributed to surface waters interacting with the on-site tailings materials at the Manila Lode site and could potentially have severe impacts on the aquatic community of the downstream wetlands.



Figure 11. Mineralized outflows exiting the culvert below Montezuma Rd entering downstream wetlands. Photo taken 6/17/19.

Water Quality Conclusions

June 2019 sampling at the Manila Lode, its adjacent wetlands, and the Snake River provided additional information regarding the impacts of the Manila Lode on its surrounding environment. The water quality results generated as part of this sampling effort complement the soil testing results generated in October of 2018 to provide a more complete site characterization.

Elevated metals results can be attributed to the Toledo Tunnel outflows (specifically total iron, dissolved manganese) and the interaction between surface flows and on-site tailings materials. Results below the bottom pile and below Montezuma Rd highlight this interaction potential. While these two sites include some of the site's highest concentrations, multiple standards were also exceeded at the seep on the side of the bottom pile.

This seep has been noted in previous site assessments (Summit Geology & Consulting, LLC, 2018), and could be a surface expression of a localized high water table, a seasonal accumulation of shallow groundwater precipitated by snowmelt or tied to underground mine workings; adding a layer of complexity to its analysis. While collecting water quality samples, TU staff noted an open shaft above the Manila Lode site directly above the location of this seep (Figure 12). This opening may indicate that this seep is a shallow surface expression of flooded workings. A dye-tracer test or an analysis of this seep's chemistry in comparison to its surrounding site features may provide additional information on its source(s) and its management. Due to the multiple features found on site and surrounding the site, any future site planning should look to historical mine maps to understand the complete workings of the Manila Lode and its surrounding features.



Figure 12. Flooded opening above the Manila Lode site in line with the seep location. Workings are flooded, and timbers are visible within this opening. The entrance of this feature is approximately 3 feet by 4 feet. Photo taken 6/17/19.

Numerous elevated metals at the Manila Lode and its surrounding environment indicate that the Manila Lode site is impacting water quality downstream. These impacts are of particular concern to the aquatic community of the downstream wetlands and the recreational and residential users immediately surrounding the Manila Lode site. Opportunities for restoration at this site range from removal of impactful tailings materials to drainage and sediment controls to re-routing adit flows into lined drainage channels away from tailings materials. Should Summit County Open Space and Trails decide to pursue this property, TU will provide a full evaluation and designs for site alternatives that will provide a comprehensive restoration plan for the Manila Lode.

References

Summit Geology & Consulting, LLC. (2018). *Manila Lode Claim Phase 1 ESA*.

Trout Unlimited. (2018). *Manila Lode Characterization: October 2018 Soil Quality Report*.

Client: Trout Unlimited

Date: 01-Jul-19

Project: Manila Lode

Work Order: 1906370

Sample ID: DS-SR

Lab ID: 1906370-1

Legal Location:

Matrix: WATER

Collection Date: 6/17/2019 08:50

Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Alkalinity as Calcium Carbonate			EPA310.1		Prep Date: 6/28/2019	PrepBy: AEJ
TOTAL ALKALINITY As CaCO3	ND		5	MG/L	1	6/28/2019
Ion Chromatography			EPA300.0		Prep Date: 6/19/2019	PrepBy: AEJ
SULFATE	38		1	MG/L	1	6/19/2019 20:54
Mercury			EPA245.1		Prep Date: 6/24/2019	PrepBy: KJM
MERCURY	ND		0.0002	MG/L	1	6/25/2019 10:54
Total Recoverable Metals by 200.7			EPA200.7		Prep Date: 6/24/2019	PrepBy: JML
ALUMINUM	1.5		0.2	MG/L	1	6/28/2019 12:50
CALCIUM	9.7		1	MG/L	1	6/28/2019 12:50
CHROMIUM	ND		0.01	MG/L	1	6/28/2019 12:50
COPPER	ND		0.01	MG/L	1	6/28/2019 12:50
IRON	0.56		0.1	MG/L	1	6/28/2019 12:50
HARDNESS (AS CaCO3)	36		1	MG/L	1	6/28/2019 12:50
MAGNESIUM	2.9		1	MG/L	1	6/28/2019 12:50
NICKEL	ND		0.02	MG/L	1	6/28/2019 12:50
ZINC	0.43		0.02	MG/L	1	6/28/2019 12:50
Total Recoverable Metals by 200.8			EPA200.8		Prep Date: 6/24/2019	PrepBy: JML
SILVER	ND		0.0001	MG/L	10	6/25/2019 19:17
ARSENIC	ND		0.002	MG/L	10	6/25/2019 19:17
CADMIUM	0.0015		0.0003	MG/L	10	6/25/2019 19:17
MANGANESE	0.48		0.002	MG/L	10	6/25/2019 19:17
MOLYBDENUM	ND		0.001	MG/L	10	6/25/2019 19:17
LEAD	0.0097		0.0005	MG/L	10	6/25/2019 19:17
SELENIUM	ND		0.001	MG/L	10	6/25/2019 19:17
URANIUM	0.00061		0.0001	MG/L	10	6/25/2019 19:17
pH			SW9040		Prep Date: 6/28/2019	PrepBy: AEJ
PH	5.67		0.1	pH	1	6/28/2019

Client: Trout Unlimited

Date: 01-Jul-19

Project: Manila Lode

Work Order: 1906370

Sample ID: Wet-DS-ML

Lab ID: 1906370-2

Legal Location:

Matrix: WATER

Collection Date: 6/17/2019 09:30

Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Alkalinity as Calcium Carbonate		EPA310.1			Prep Date: 6/28/2019	PrepBy: AEJ
TOTAL ALKALINITY As CaCO3	16		5	MG/L	1	6/28/2019
Ion Chromatography		EPA300.0			Prep Date: 6/19/2019	PrepBy: AEJ
SULFATE	74		1	MG/L	1	6/19/2019 21:18
Mercury		EPA245.1			Prep Date: 6/24/2019	PrepBy: KJM
MERCURY	ND		0.0002	MG/L	1	6/25/2019 10:56
Total Recoverable Metals by 200.7		EPA200.7			Prep Date: 6/24/2019	PrepBy: JML
ALUMINUM	ND		0.2	MG/L	1	6/28/2019 12:55
CALCIUM	29		1	MG/L	1	6/28/2019 12:55
CHROMIUM	ND		0.01	MG/L	1	6/28/2019 12:55
COPPER	ND		0.01	MG/L	1	6/28/2019 12:55
IRON	0.12		0.1	MG/L	1	6/28/2019 12:55
HARDNESS (AS CaCO3)	90		1	MG/L	1	6/28/2019 12:55
MAGNESIUM	4.1		1	MG/L	1	6/28/2019 12:55
NICKEL	ND		0.02	MG/L	1	6/28/2019 12:55
ZINC	3.8		0.02	MG/L	1	6/28/2019 12:55
Total Recoverable Metals by 200.8		EPA200.8			Prep Date: 6/24/2019	PrepBy: JML
SILVER	ND		0.0001	MG/L	10	6/25/2019 19:20
ARSENIC	ND		0.002	MG/L	10	6/25/2019 19:20
CADMIUM	0.0057		0.0003	MG/L	10	6/25/2019 19:20
MANGANESE	0.83		0.002	MG/L	10	6/25/2019 19:20
MOLYBDENUM	ND		0.001	MG/L	10	6/25/2019 19:20
LEAD	0.004		0.0005	MG/L	10	6/25/2019 19:20
SELENIUM	ND		0.001	MG/L	10	6/25/2019 19:20
URANIUM	0.00024		0.0001	MG/L	10	6/25/2019 19:20
pH		SW9040			Prep Date: 6/28/2019	PrepBy: AEJ
PH	6.22		0.1	pH	1	6/28/2019

ALS -- Fort Collins

SAMPLE SUMMARY REPORT

Client: Trout Unlimited
 Project: Manila Lode
 Sample ID: DS Rd - OS Wet
 Legal Location:
 Collection Date: 6/17/2019 09:42

Date: 01-Jul-19
 Work Order: 1906370
 Lab ID: 1906370-3
 Matrix: WATER
 Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Alkalinity as Calcium Carbonate			EPA310.1		Prep Date: 6/28/2019	PrepBy: AEJ
TOTAL ALKALINITY As CaCO3	46		5	MG/L	1	6/28/2019
Mercury			EPA245.1		Prep Date: 6/24/2019	PrepBy: KJM
MERCURY	ND		0.0002	MG/L	1	6/25/2019 10:58
Total Recoverable Metals by 200.7			EPA200.7		Prep Date: 6/24/2019	PrepBy: JML
ALUMINUM	2.3		0.2	MG/L	1	6/28/2019 13:01
CALCIUM	51		1	MG/L	1	6/28/2019 13:01
CHROMIUM	ND		0.01	MG/L	1	6/28/2019 13:01
COPPER	0.041		0.01	MG/L	1	6/28/2019 13:01
IRON	ND		0.1	MG/L	1	6/28/2019 13:01
HARDNESS (AS CaCO3)	150		1	MG/L	1	6/28/2019 13:25
MAGNESIUM	6.1		1	MG/L	1	6/28/2019 13:01
NICKEL	ND		0.02	MG/L	1	6/28/2019 13:01
ZINC	14		0.2	MG/L	10	6/28/2019 13:25
Total Recoverable Metals by 200.8			EPA200.8		Prep Date: 6/24/2019	PrepBy: JML
SILVER	0.00011		0.0001	MG/L	10	6/25/2019 19:23
ARSENIC	ND		0.002	MG/L	10	6/25/2019 19:23
CADMIUM	0.042		0.0003	MG/L	10	6/25/2019 19:23
MANGANESE	4.6		0.002	MG/L	10	6/25/2019 19:23
MOLYBDENUM	ND		0.001	MG/L	10	6/25/2019 19:23
LEAD	0.057		0.0005	MG/L	10	6/25/2019 19:23
SELENIUM	0.001		0.001	MG/L	10	6/25/2019 19:23
URANIUM	0.012		0.0001	MG/L	10	6/25/2019 19:23
pH			SW9040		Prep Date: 6/28/2019	PrepBy: AEJ
PH	6.53		0.1	pH	1	6/28/2019

ALS -- Fort Collins

SAMPLE SUMMARY REPORT

Client: Trout Unlimited

Date: 01-Jul-19

Project: Manila Lode

Work Order: 1906370

Sample ID: DS-B Pile

Lab ID: 1906370-4

Legal Location:

Matrix: WATER

Collection Date: 6/17/2019 09:55

Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Alkalinity as Calcium Carbonate			EPA310.1		Prep Date: 6/28/2019	PrepBy: AEJ
TOTAL ALKALINITY As CaCO3	72		20	MG/L	1	6/28/2019
Ion Chromatography			EPA300.0		Prep Date: 6/19/2019	PrepBy: AEJ
SULFATE	88		1	MG/L	1	6/19/2019 22:10
Mercury			EPA245.1		Prep Date: 6/24/2019	PrepBy: KJM
MERCURY	ND		0.0002	MG/L	1	6/25/2019 11:00
Total Recoverable Metals by 200.7			EPA200.7		Prep Date: 6/24/2019	PrepBy: JML
ALUMINUM	0.55		0.2	MG/L	1	6/28/2019 13:02
CALCIUM	48		1	MG/L	1	6/28/2019 13:02
CHROMIUM	ND		0.01	MG/L	1	6/28/2019 13:02
COPPER	ND		0.01	MG/L	1	6/28/2019 13:02
IRON	ND		0.1	MG/L	1	6/28/2019 13:02
HARDNESS (AS CaCO3)	140		1	MG/L	1	6/28/2019 13:02
MAGNESIUM	5.3		1	MG/L	1	6/28/2019 13:02
NICKEL	ND		0.02	MG/L	1	6/28/2019 13:02
ZINC	8.9		0.02	MG/L	1	6/28/2019 13:02
Total Recoverable Metals by 200.8			EPA200.8		Prep Date: 6/24/2019	PrepBy: JML
SILVER	ND		0.0001	MG/L	10	6/25/2019 19:49
ARSENIC	ND		0.002	MG/L	10	6/25/2019 19:49
CADMIUM	0.022		0.0003	MG/L	10	6/25/2019 19:49
MANGANESE	1.8		0.002	MG/L	10	6/25/2019 19:49
MOLYBDENUM	ND		0.001	MG/L	10	6/25/2019 19:49
LEAD	0.0029		0.0005	MG/L	10	6/25/2019 19:49
SELENIUM	ND		0.001	MG/L	10	6/25/2019 19:49
URANIUM	0.0087		0.0001	MG/L	10	6/25/2019 19:49
pH			SW9040		Prep Date: 6/28/2019	PrepBy: AEJ
PH	6.83		0.1	pH	1	6/28/2019

ALS -- Fort Collins

SAMPLE SUMMARY REPORT

Client: Trout Unlimited

Date: 01-Jul-19

Project: Manila Lode

Work Order: 1906370

Sample ID: DS-T Pile

Lab ID: 1906370-5

Legal Location:

Matrix: WATER

Collection Date: 6/17/2019 10:10

Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Alkalinity as Calcium Carbonate			EPA310.1		Prep Date: 6/28/2019	PrepBy: AEJ
TOTAL ALKALINITY As CaCO3	110		20	MG/L	1	6/28/2019
Ion Chromatography			EPA300.0		Prep Date: 6/19/2019	PrepBy: AEJ
SULFATE	46		1	MG/L	1	6/19/2019 22:22
Mercury			EPA245.1		Prep Date: 6/24/2019	PrepBy: KJM
MERCURY	ND		0.0002	MG/L	1	6/25/2019 11:02
Total Recoverable Metals by 200.7			EPA200.7		Prep Date: 6/24/2019	PrepBy: JML
ALUMINUM	ND		0.2	MG/L	1	6/28/2019 13:03
CALCIUM	45		1	MG/L	1	6/28/2019 13:03
CHROMIUM	ND		0.01	MG/L	1	6/28/2019 13:03
COPPER	ND		0.01	MG/L	1	6/28/2019 13:03
IRON	1		0.1	MG/L	1	6/28/2019 13:03
HARDNESS (AS CaCO3)	130		1	MG/L	1	6/28/2019 13:03
MAGNESIUM	4.2		1	MG/L	1	6/28/2019 13:03
NICKEL	ND		0.02	MG/L	1	6/28/2019 13:03
ZINC	0.22		0.02	MG/L	1	6/28/2019 13:03
Total Recoverable Metals by 200.8			EPA200.8		Prep Date: 6/24/2019	PrepBy: JML
SILVER	ND		0.0001	MG/L	10	6/25/2019 20:07
ARSENIC	ND		0.002	MG/L	10	6/25/2019 20:07
CADMIUM	ND		0.0003	MG/L	10	6/25/2019 20:07
MANGANESE	1.6		0.002	MG/L	10	6/25/2019 20:07
MOLYBDENUM	ND		0.001	MG/L	10	6/25/2019 20:07
LEAD	0.017		0.0005	MG/L	10	6/25/2019 20:07
SELENIUM	ND		0.001	MG/L	10	6/25/2019 20:07
URANIUM	0.011		0.0001	MG/L	10	6/25/2019 20:07
pH			SW9040		Prep Date: 6/28/2019	PrepBy: AEJ
PH	7.7		0.1	pH	1	6/28/2019

ALS -- Fort Collins

SAMPLE SUMMARY REPORT

Client: Trout Unlimited

Date: 01-Jul-19

Project: Manila Lode

Work Order: 1906370

Sample ID: TT-Adit

Lab ID: 1906370-6

Legal Location:

Matrix: WATER

Collection Date: 6/17/2019 10:35

Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Alkalinity as Calcium Carbonate			EPA310.1		Prep Date: 6/28/2019	PrepBy: AEJ
TOTAL ALKALINITY As CaCO3	110		20	MG/L	1	6/28/2019
Ion Chromatography			EPA300.0		Prep Date: 6/19/2019	PrepBy: AEJ
SULFATE	46		1	MG/L	1	6/19/2019 22:34
Mercury			EPA245.1		Prep Date: 6/24/2019	PrepBy: KJM
MERCURY	ND		0.0002	MG/L	1	6/25/2019 11:15
Total Recoverable Metals by 200.7			EPA200.7		Prep Date: 6/24/2019	PrepBy: JML
ALUMINUM	ND		0.2	MG/L	1	6/28/2019 13:04
CALCIUM	45		1	MG/L	1	6/28/2019 13:04
CHROMIUM	ND		0.01	MG/L	1	6/28/2019 13:04
COPPER	ND		0.01	MG/L	1	6/28/2019 13:04
IRON	2		0.1	MG/L	1	6/28/2019 13:04
HARDNESS (AS CaCO3)	130		1	MG/L	1	6/28/2019 13:04
MAGNESIUM	4.2		1	MG/L	1	6/28/2019 13:04
NICKEL	ND		0.02	MG/L	1	6/28/2019 13:04
ZINC	0.29		0.02	MG/L	1	6/28/2019 13:04
Total Recoverable Metals by 200.8			EPA200.8		Prep Date: 6/24/2019	PrepBy: JML
SILVER	ND		0.0001	MG/L	10	6/25/2019 20:10
ARSENIC	ND		0.002	MG/L	10	6/25/2019 20:10
CADMIUM	ND		0.0003	MG/L	10	6/25/2019 20:10
MANGANESE	2.3		0.002	MG/L	10	6/25/2019 20:10
MOLYBDENUM	ND		0.001	MG/L	10	6/25/2019 20:10
LEAD	0.0025		0.0005	MG/L	10	6/25/2019 20:10
SELENIUM	ND		0.001	MG/L	10	6/25/2019 20:10
URANIUM	0.011		0.0001	MG/L	10	6/25/2019 20:10
pH			SW9040		Prep Date: 6/28/2019	PrepBy: AEJ
PH	7.57		0.1	pH	1	6/28/2019

ALS -- Fort Collins

SAMPLE SUMMARY REPORT

Client: Trout Unlimited

Date: 01-Jul-19

Project: Manila Lode

Work Order: 1906370

Sample ID: Wet-OS ML

Lab ID: 1906370-7

Legal Location:

Matrix: WATER

Collection Date: 6/17/2019 09:50

Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Alkalinity as Calcium Carbonate			EPA310.1		Prep Date: 6/28/2019	PrepBy: AEJ
TOTAL ALKALINITY As CaCO3	28		20	MG/L	1	6/28/2019
Ion Chromatography			EPA300.0		Prep Date: 6/19/2019	PrepBy: AEJ
SULFATE	42		1	MG/L	1	6/19/2019 22:47
Mercury			EPA245.1		Prep Date: 6/24/2019	PrepBy: KJM
MERCURY	ND		0.0002	MG/L	1	6/25/2019 11:24
Total Recoverable Metals by 200.7			EPA200.7		Prep Date: 6/24/2019	PrepBy: JML
ALUMINUM	ND		0.2	MG/L	1	6/28/2019 13:05
CALCIUM	13		1	MG/L	1	6/28/2019 13:05
CHROMIUM	ND		0.01	MG/L	1	6/28/2019 13:05
COPPER	ND		0.01	MG/L	1	6/28/2019 13:05
IRON	0.11		0.1	MG/L	1	6/28/2019 13:05
HARDNESS (AS CaCO3)	43		1	MG/L	1	6/28/2019 13:05
MAGNESIUM	2.6		1	MG/L	1	6/28/2019 13:05
NICKEL	ND		0.02	MG/L	1	6/28/2019 13:05
ZINC	2.1		0.02	MG/L	1	6/28/2019 13:05
Total Recoverable Metals by 200.8			EPA200.8		Prep Date: 6/24/2019	PrepBy: JML
SILVER	ND		0.0001	MG/L	10	6/25/2019 20:13
ARSENIC	ND		0.002	MG/L	10	6/25/2019 20:13
CADMIUM	0.0019		0.0003	MG/L	10	6/25/2019 20:13
MANGANESE	0.3		0.002	MG/L	10	6/25/2019 20:13
MOLYBDENUM	ND		0.001	MG/L	10	6/25/2019 20:13
LEAD	0.0036		0.0005	MG/L	10	6/25/2019 20:13
SELENIUM	ND		0.001	MG/L	10	6/25/2019 20:13
URANIUM	ND		0.0001	MG/L	10	6/25/2019 20:13
pH			SW9040		Prep Date: 6/28/2019	PrepBy: AEJ
PH	6.5		0.1	pH	1	6/28/2019

Client: Trout Unlimited

Date: 01-Jul-19

Project: Manila Lode

Work Order: 1906370

Sample ID: OS-SR

Lab ID: 1906370-8

Legal Location:

Matrix: WATER

Collection Date: 6/17/2019 11:10

Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Alkalinity as Calcium Carbonate			EPA310.1		Prep Date: 6/28/2019	PrepBy: AEJ
TOTAL ALKALINITY As CaCO3	ND		5	MG/L	1	6/28/2019
Ion Chromatography			EPA300.0		Prep Date: 6/19/2019	PrepBy: AEJ
SULFATE	38		1	MG/L	1	6/19/2019 22:59
Mercury			EPA245.1		Prep Date: 6/24/2019	PrepBy: KJM
MERCURY	ND		0.0002	MG/L	1	6/25/2019 11:26
Total Recoverable Metals by 200.7			EPA200.7		Prep Date: 6/24/2019	PrepBy: JML
ALUMINUM	1.6		0.2	MG/L	1	6/28/2019 13:06
CALCIUM	9.7		1	MG/L	1	6/28/2019 13:06
CHROMIUM	ND		0.01	MG/L	1	6/28/2019 13:06
COPPER	ND		0.01	MG/L	1	6/28/2019 13:06
IRON	0.68		0.1	MG/L	1	6/28/2019 13:06
HARDNESS (AS CaCO3)	36		1	MG/L	1	6/28/2019 13:06
MAGNESIUM	2.9		1	MG/L	1	6/28/2019 13:06
NICKEL	ND		0.02	MG/L	1	6/28/2019 13:06
ZINC	0.38		0.02	MG/L	1	6/28/2019 13:06
Total Recoverable Metals by 200.8			EPA200.8		Prep Date: 6/24/2019	PrepBy: JML
SILVER	ND		0.0001	MG/L	10	6/25/2019 20:16
ARSENIC	ND		0.002	MG/L	10	6/25/2019 20:16
CADMIUM	0.0015		0.0003	MG/L	10	6/25/2019 20:16
MANGANESE	0.48		0.002	MG/L	10	6/25/2019 20:16
MOLYBDENUM	ND		0.001	MG/L	10	6/25/2019 20:16
LEAD	0.0054		0.0005	MG/L	10	6/25/2019 20:16
SELENIUM	ND		0.001	MG/L	10	6/25/2019 20:16
URANIUM	0.00063		0.0001	MG/L	10	6/25/2019 20:16
pH			SW9040		Prep Date: 6/28/2019	PrepBy: AEJ
PH	6.77		0.1	pH	1	6/28/2019

ALS -- Fort Collins

SAMPLE SUMMARY REPORT

Client: Trout Unlimited

Date: 01-Jul-19

Project: Manila Lode

Work Order: 1906370

Sample ID: Opp-Seep

Lab ID: 1906370-10

Legal Location:

Matrix: WATER

Collection Date: 6/17/2019 10:20

Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Alkalinity as Calcium Carbonate			EPA310.1		Prep Date: 6/28/2019	PrepBy: AEJ
TOTAL ALKALINITY As CaCO3	5.3		5	MG/L	1	6/28/2019
Ion Chromatography			EPA300.0		Prep Date: 6/19/2019	PrepBy: AEJ
SULFATE	24		1	MG/L	1	6/19/2019 23:23
Mercury			EPA245.1		Prep Date: 6/24/2019	PrepBy: KJM
MERCURY	ND		0.0002	MG/L	1	6/25/2019 11:30
Total Recoverable Metals by 200.7			EPA200.7		Prep Date: 6/24/2019	PrepBy: JML
ALUMINUM	ND		0.2	MG/L	1	6/28/2019 13:09
CALCIUM	5.6		1	MG/L	1	6/28/2019 13:09
CHROMIUM	ND		0.01	MG/L	1	6/28/2019 13:09
COPPER	0.025		0.01	MG/L	1	6/28/2019 13:09
IRON	0.16		0.1	MG/L	1	6/28/2019 13:09
HARDNESS (AS CaCO3)	14		1	MG/L	1	6/28/2019 13:09
MAGNESIUM	ND		1	MG/L	1	6/28/2019 13:09
NICKEL	ND		0.02	MG/L	1	6/28/2019 13:09
ZINC	3		0.02	MG/L	1	6/28/2019 13:09
Total Recoverable Metals by 200.8			EPA200.8		Prep Date: 6/24/2019	PrepBy: JML
SILVER	ND		0.0001	MG/L	10	6/25/2019 20:34
ARSENIC	ND		0.002	MG/L	10	6/25/2019 20:34
CADMIUM	0.0051		0.0003	MG/L	10	6/25/2019 20:34
MANGANESE	0.47		0.002	MG/L	10	6/25/2019 20:34
MOLYBDENUM	ND		0.001	MG/L	10	6/25/2019 20:34
LEAD	0.037		0.0005	MG/L	10	6/25/2019 20:34
SELENIUM	ND		0.001	MG/L	10	6/25/2019 20:34
URANIUM	0.0013		0.0001	MG/L	10	6/25/2019 20:34
pH			SW9040		Prep Date: 6/28/2019	PrepBy: AEJ
PH	6.3		0.1	pH	1	6/28/2019

Client: Trout Unlimited

Date: 01-Jul-19

Project: Manila Lode

Work Order: 1906370

Sample ID: DS-SR

Lab ID: 1906370-11

Legal Location:

Matrix: WATER

Collection Date: 6/17/2019 08:50

Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Dissolved Mercury			EPA245.1		Prep Date: 6/24/2019	PrepBy: KJM
MERCURY	ND		0.0002	MG/L	1	6/25/2019 11:32
Dissolved Metals by 200.7			EPA200.7		Prep Date: 6/24/2019	PrepBy: JML
ALUMINUM	ND		0.2	MG/L	1	6/28/2019 13:10
CALCIUM	9.7		1	MG/L	1	6/28/2019 13:10
CHROMIUM	ND		0.01	MG/L	1	6/28/2019 13:10
COPPER	ND		0.01	MG/L	1	6/28/2019 13:10
IRON	0.14		0.1	MG/L	1	6/28/2019 13:10
MAGNESIUM	2.8		1	MG/L	1	6/28/2019 13:10
NICKEL	ND		0.02	MG/L	1	6/28/2019 13:10
ZINC	0.42		0.02	MG/L	1	6/28/2019 13:10
Dissolved Metals by 200.8			EPA200.8		Prep Date: 6/24/2019	PrepBy: JML
SILVER	ND		0.0001	MG/L	10	6/25/2019 20:37
ARSENIC	ND		0.002	MG/L	10	6/25/2019 20:37
CADMIUM	0.0016		0.0003	MG/L	10	6/25/2019 20:37
MANGANESE	0.46		0.002	MG/L	10	6/25/2019 20:37
MOLYBDENUM	ND		0.001	MG/L	10	6/25/2019 20:37
LEAD	ND		0.0005	MG/L	10	6/25/2019 20:37
SELENIUM	ND		0.001	MG/L	10	6/25/2019 20:37
URANIUM	0.00013		0.0001	MG/L	10	6/25/2019 20:37

Client: Trout Unlimited

Date: 01-Jul-19

Project: Manila Lode

Work Order: 1906370

Sample ID: Wet-DS-ML

Lab ID: 1906370-12

Legal Location:

Matrix: WATER

Collection Date: 6/17/2019 09:30

Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Dissolved Mercury			EPA245.1		Prep Date: 6/24/2019	PrepBy: KJM
MERCURY	ND		0.0002	MG/L	1	6/25/2019 11:35
Dissolved Metals by 200.7			EPA200.7		Prep Date: 6/24/2019	PrepBy: JML
ALUMINUM	ND		0.2	MG/L	1	6/28/2019 13:13
CALCIUM	25		1	MG/L	1	6/28/2019 13:13
CHROMIUM	ND		0.01	MG/L	1	6/28/2019 13:13
COPPER	ND		0.01	MG/L	1	6/28/2019 13:13
IRON	ND		0.1	MG/L	1	6/28/2019 13:13
MAGNESIUM	3.7		1	MG/L	1	6/28/2019 13:13
NICKEL	ND		0.02	MG/L	1	6/28/2019 13:13
ZINC	3.7		0.02	MG/L	1	6/28/2019 13:13
Dissolved Metals by 200.8			EPA200.8		Prep Date: 6/24/2019	PrepBy: JML
SILVER	ND		0.0001	MG/L	10	6/25/2019 20:40
ARSENIC	ND		0.002	MG/L	10	6/25/2019 20:40
CADMIUM	0.0056		0.0003	MG/L	10	6/25/2019 20:40
MANGANESE	0.86		0.002	MG/L	10	6/25/2019 20:40
MOLYBDENUM	ND		0.001	MG/L	10	6/25/2019 20:40
LEAD	0.0014		0.0005	MG/L	10	6/25/2019 20:40
SELENIUM	ND		0.001	MG/L	10	6/25/2019 20:40
URANIUM	0.0002		0.0001	MG/L	10	6/25/2019 20:40

Client: Trout Unlimited
Project: Manila Lode
Sample ID: DS Rd-OS Wet
Legal Location:
Collection Date: 6/17/2019 09:42

Date: 01-Jul-19
Work Order: 1906370
Lab ID: 1906370-13
Matrix: WATER
Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Dissolved Mercury			EPA245.1		Prep Date: 6/24/2019	PrepBy: KJM
MERCURY	ND		0.0002	MG/L	1	6/25/2019 11:41
Dissolved Metals by 200.7			EPA200.7		Prep Date: 6/24/2019	PrepBy: JML
ALUMINUM	ND		0.2	MG/L	1	6/28/2019 13:14
CALCIUM	51		1	MG/L	1	6/28/2019 13:14
CHROMIUM	ND		0.01	MG/L	1	6/28/2019 13:14
COPPER	0.017		0.01	MG/L	1	6/28/2019 13:14
IRON	ND		0.1	MG/L	1	6/28/2019 13:14
MAGNESIUM	6.1		1	MG/L	1	6/28/2019 13:14
NICKEL	ND		0.02	MG/L	1	6/28/2019 13:14
ZINC	14		0.2	MG/L	10	6/28/2019 13:29
Dissolved Metals by 200.8			EPA200.8		Prep Date: 6/24/2019	PrepBy: JML
SILVER	ND		0.0001	MG/L	10	6/25/2019 20:43
ARSENIC	ND		0.002	MG/L	10	6/25/2019 20:43
CADMIUM	0.041		0.0003	MG/L	10	6/25/2019 20:43
MANGANESE	4.7		0.002	MG/L	10	6/25/2019 20:43
MOLYBDENUM	ND		0.001	MG/L	10	6/25/2019 20:43
LEAD	0.011		0.0005	MG/L	10	6/25/2019 20:43
SELENIUM	ND		0.001	MG/L	10	6/25/2019 20:43
URANIUM	0.0045		0.0001	MG/L	10	6/25/2019 20:43

Client: Trout Unlimited

Date: 01-Jul-19

Project: Manila Lode

Work Order: 1906370

Sample ID: DS-B Pile

Lab ID: 1906370-14

Legal Location:

Matrix: WATER

Collection Date: 6/17/2019 09:55

Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Dissolved Mercury			EPA245.1		Prep Date: 6/24/2019	PrepBy: KJM
MERCURY	ND		0.0002	MG/L	1	6/25/2019 11:43
Dissolved Metals by 200.7			EPA200.7		Prep Date: 6/24/2019	PrepBy: JML
ALUMINUM	ND		0.2	MG/L	1	6/28/2019 13:16
CALCIUM	47		1	MG/L	1	6/28/2019 13:16
CHROMIUM	ND		0.01	MG/L	1	6/28/2019 13:16
COPPER	ND		0.01	MG/L	1	6/28/2019 13:16
IRON	ND		0.1	MG/L	1	6/28/2019 13:16
MAGNESIUM	5.2		1	MG/L	1	6/28/2019 13:16
NICKEL	ND		0.02	MG/L	1	6/28/2019 13:16
ZINC	8.3		0.02	MG/L	1	6/28/2019 13:16
Dissolved Metals by 200.8			EPA200.8		Prep Date: 6/24/2019	PrepBy: JML
SILVER	ND		0.0001	MG/L	10	6/25/2019 20:46
ARSENIC	ND		0.002	MG/L	10	6/25/2019 20:46
CADMIUM	0.02		0.0003	MG/L	10	6/25/2019 20:46
MANGANESE	1.7		0.002	MG/L	10	6/25/2019 20:46
MOLYBDENUM	ND		0.001	MG/L	10	6/25/2019 20:46
LEAD	ND		0.0005	MG/L	10	6/25/2019 20:46
SELENIUM	ND		0.001	MG/L	10	6/25/2019 20:46
URANIUM	0.0084		0.0001	MG/L	10	6/25/2019 20:46

Client: Trout Unlimited

Date: 01-Jul-19

Project: Manila Lode

Work Order: 1906370

Sample ID: DS-T Pile

Lab ID: 1906370-15

Legal Location:

Matrix: WATER

Collection Date: 6/17/2019 10:10

Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Dissolved Mercury			EPA245.1		Prep Date: 6/24/2019	PrepBy: KJM
MERCURY	ND		0.0002	MG/L	1	6/25/2019 11:45
Dissolved Metals by 200.7			EPA200.7		Prep Date: 6/24/2019	PrepBy: JML
ALUMINUM	ND		0.2	MG/L	1	6/28/2019 13:17
CALCIUM	45		1	MG/L	1	6/28/2019 13:17
CHROMIUM	ND		0.01	MG/L	1	6/28/2019 13:17
COPPER	ND		0.01	MG/L	1	6/28/2019 13:17
IRON	ND		0.1	MG/L	1	6/28/2019 13:17
MAGNESIUM	4.2		1	MG/L	1	6/28/2019 13:17
NICKEL	ND		0.02	MG/L	1	6/28/2019 13:17
ZINC	0.11		0.02	MG/L	1	6/28/2019 13:17
Dissolved Metals by 200.8			EPA200.8		Prep Date: 6/24/2019	PrepBy: JML
SILVER	ND		0.0001	MG/L	10	6/25/2019 20:49
ARSENIC	ND		0.002	MG/L	10	6/25/2019 20:49
CADMIUM	ND		0.0003	MG/L	10	6/25/2019 20:49
MANGANESE	1.3		0.002	MG/L	10	6/25/2019 20:49
MOLYBDENUM	ND		0.001	MG/L	10	6/25/2019 20:49
LEAD	ND		0.0005	MG/L	10	6/25/2019 20:49
SELENIUM	ND		0.001	MG/L	10	6/25/2019 20:49
URANIUM	0.011		0.0001	MG/L	10	6/25/2019 20:49

Client: Trout Unlimited

Date: 01-Jul-19

Project: Manila Lode

Work Order: 1906370

Sample ID: TT-Adit

Lab ID: 1906370-16

Legal Location:

Matrix: WATER

Collection Date: 6/17/2019 10:35

Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Dissolved Mercury			EPA245.1		Prep Date: 6/24/2019	PrepBy: KJM
MERCURY	ND		0.0002	MG/L	1	6/25/2019 11:47
Dissolved Metals by 200.7			EPA200.7		Prep Date: 6/24/2019	PrepBy: JML
ALUMINUM	ND		0.2	MG/L	1	6/28/2019 13:18
CALCIUM	44		1	MG/L	1	6/28/2019 13:18
CHROMIUM	ND		0.01	MG/L	1	6/28/2019 13:18
COPPER	ND		0.01	MG/L	1	6/28/2019 13:18
IRON	ND		0.1	MG/L	1	6/28/2019 13:18
MAGNESIUM	4.2		1	MG/L	1	6/28/2019 13:18
NICKEL	ND		0.02	MG/L	1	6/28/2019 13:18
ZINC	0.22		0.02	MG/L	1	6/28/2019 13:18
Dissolved Metals by 200.8			EPA200.8		Prep Date: 6/24/2019	PrepBy: JML
SILVER	ND		0.0001	MG/L	10	6/25/2019 20:52
ARSENIC	ND		0.002	MG/L	10	6/25/2019 20:52
CADMIUM	ND		0.0003	MG/L	10	6/25/2019 20:52
MANGANESE	2.3		0.002	MG/L	10	6/25/2019 20:52
MOLYBDENUM	ND		0.001	MG/L	10	6/25/2019 20:52
LEAD	ND		0.0005	MG/L	10	6/25/2019 20:52
SELENIUM	ND		0.001	MG/L	10	6/25/2019 20:52
URANIUM	0.012		0.0001	MG/L	10	6/25/2019 20:52

Client: Trout Unlimited

Date: 01-Jul-19

Project: Manila Lode

Work Order: 1906370

Sample ID: Wet-OS ML

Lab ID: 1906370-17

Legal Location:

Matrix: WATER

Collection Date: 6/17/2019 09:50

Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Dissolved Mercury			EPA245.1		Prep Date: 6/24/2019	PrepBy: KJM
MERCURY	ND		0.0002	MG/L	1	6/25/2019 11:50
Dissolved Metals by 200.7			EPA200.7		Prep Date: 6/24/2019	PrepBy: JML
ALUMINUM	ND		0.2	MG/L	1	6/28/2019 13:19
CALCIUM	13		1	MG/L	1	6/28/2019 13:19
CHROMIUM	ND		0.01	MG/L	1	6/28/2019 13:19
COPPER	ND		0.01	MG/L	1	6/28/2019 13:19
IRON	ND		0.1	MG/L	1	6/28/2019 13:19
MAGNESIUM	2.5		1	MG/L	1	6/28/2019 13:19
NICKEL	ND		0.02	MG/L	1	6/28/2019 13:19
ZINC	2.1		0.02	MG/L	1	6/28/2019 13:19
Dissolved Metals by 200.8			EPA200.8		Prep Date: 6/24/2019	PrepBy: JML
SILVER	ND		0.0001	MG/L	10	6/25/2019 20:55
ARSENIC	ND		0.002	MG/L	10	6/25/2019 20:55
CADMIUM	0.0017		0.0003	MG/L	10	6/25/2019 20:55
MANGANESE	0.28		0.002	MG/L	10	6/25/2019 20:55
MOLYBDENUM	ND		0.001	MG/L	10	6/25/2019 20:55
LEAD	ND		0.0005	MG/L	10	6/25/2019 20:55
SELENIUM	ND		0.001	MG/L	10	6/25/2019 20:55
URANIUM	ND		0.0001	MG/L	10	6/25/2019 20:55

Client: Trout Unlimited

Date: 01-Jul-19

Project: Manila Lode

Work Order: 1906370

Sample ID: OS-SR

Lab ID: 1906370-18

Legal Location:

Matrix: WATER

Collection Date: 6/17/2019 11:10

Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Dissolved Mercury			EPA245.1		Prep Date: 6/24/2019	PrepBy: KJM
MERCURY	ND		0.0002	MG/L	1	6/25/2019 11:52
Dissolved Metals by 200.7			EPA200.7		Prep Date: 6/24/2019	PrepBy: JML
ALUMINUM	ND		0.2	MG/L	1	6/28/2019 13:20
CALCIUM	9.6		1	MG/L	1	6/28/2019 13:20
CHROMIUM	ND		0.01	MG/L	1	6/28/2019 13:20
COPPER	ND		0.01	MG/L	1	6/28/2019 13:20
IRON	0.13		0.1	MG/L	1	6/28/2019 13:20
MAGNESIUM	2.9		1	MG/L	1	6/28/2019 13:20
NICKEL	ND		0.02	MG/L	1	6/28/2019 13:20
ZINC	0.36		0.02	MG/L	1	6/28/2019 13:20
Dissolved Metals by 200.8			EPA200.8		Prep Date: 6/24/2019	PrepBy: JML
SILVER	ND		0.0001	MG/L	10	6/25/2019 20:58
ARSENIC	ND		0.002	MG/L	10	6/25/2019 20:58
CADMIUM	0.0014		0.0003	MG/L	10	6/25/2019 20:58
MANGANESE	0.46		0.002	MG/L	10	6/25/2019 20:58
MOLYBDENUM	ND		0.001	MG/L	10	6/25/2019 20:58
LEAD	ND		0.0005	MG/L	10	6/25/2019 20:58
SELENIUM	ND		0.001	MG/L	10	6/25/2019 20:58
URANIUM	0.00013		0.0001	MG/L	10	6/25/2019 20:58

Client: Trout Unlimited

Date: 01-Jul-19

Project: Manila Lode

Work Order: 1906370

Sample ID: Opp-Seep

Lab ID: 1906370-20

Legal Location:

Matrix: WATER

Collection Date: 6/17/2019 10:20

Percent Moisture:

Analyses	Result	Qual	Report Limit	Units	Dilution Factor	Date Analyzed
Dissolved Mercury			EPA245.1		Prep Date: 6/24/2019	PrepBy: KJM
MERCURY	ND		0.0002	MG/L	1	6/25/2019 11:56
Dissolved Metals by 200.7			EPA200.7		Prep Date: 6/24/2019	PrepBy: JML
ALUMINUM	ND		0.2	MG/L	1	6/28/2019 13:22
CALCIUM	5.6		1	MG/L	1	6/28/2019 13:22
CHROMIUM	ND		0.01	MG/L	1	6/28/2019 13:22
COPPER	0.026		0.01	MG/L	1	6/28/2019 13:22
IRON	ND		0.1	MG/L	1	6/28/2019 13:22
MAGNESIUM	ND		1	MG/L	1	6/28/2019 13:22
NICKEL	ND		0.02	MG/L	1	6/28/2019 13:22
ZINC	3		0.02	MG/L	1	6/28/2019 13:22
Dissolved Metals by 200.8			EPA200.8		Prep Date: 6/24/2019	PrepBy: JML
SILVER	ND		0.0001	MG/L	10	6/25/2019 21:19
ARSENIC	ND		0.002	MG/L	10	6/25/2019 21:19
CADMIUM	0.0052		0.0003	MG/L	10	6/25/2019 21:19
MANGANESE	0.47		0.002	MG/L	10	6/25/2019 21:19
MOLYBDENUM	ND		0.001	MG/L	10	6/25/2019 21:19
LEAD	0.03		0.0005	MG/L	10	6/25/2019 21:19
SELENIUM	ND		0.001	MG/L	10	6/25/2019 21:19
URANIUM	0.00093		0.0001	MG/L	10	6/25/2019 21:19



Manila Lode Characterization

October 2018 Soil Quality Report

Report to Summit County Open Space and Trails

Submitted: March 29, 2019

Trout Unlimited, Inc.
Lauren Duncan, Abandoned Mine Restoration Project Manager
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Overview

On October 31st, 2018, Trout Unlimited (TU) staff conducted a soil sampling event at the Manila Lode site in Summit County, Colorado. The Manila Lode site sits on a parcel of approximately 5 acres known as the Manila Lode Claim; MS #16359. The physical address of this parcel is 5503 Montezuma Road, in Section 26, T5S, R76W, of the 6th PM. The site is located in the Snake River valley, immediately north of the town of Montezuma and immediately up-gradient of a wetlands system that runs adjacent to the Snake River (Figure 1).

The Manila Lode site contains mine tailings and waste rock associated with the historic Toledo Tunnel and Toledo Mill complex. The collapsed adit of the Toledo Tunnel, is located on the western portion of the property. This adit continuously drains year-round and water from this adit runs over, and through, the on-site tailings. The wagon road from Montezuma to Chihuahua ran below the tunnel, and the Toledo Mill was located on the opposite side of the wagon road on the Manila Lode site. This historic wagon road now serves as a recreational trail for hikers and bikers.

The Toledo Tunnel was a 3,150-foot-long tunnel that carried ore from mine sites in adjacent Peru Gulch, particularly the Jumbo Mine. These transported ores, and some ore from the Toledo Tunnel itself, were processed at the Toledo Mill (Lovering, 1935). Although the mine and the mill ceased operation in 1915, fine-grained sediments generated by this milling operation can still be found on the parcel.

Soil Quality Monitoring Sampling Procedures:

TU staff collected soil samples at the “Upper Pile” and “Lower Pile” (Figure 2). Each tailings/waste pile soil sample was collected as a 30-point composite sample. These sites should be as evenly spaced as possible to give the best coverage of the pile as possible. Cell dimensions were site-specific and determined in the field by qualified personnel, based on the size and shape of the sample site. Once the 30 sites were established, TU staff collected a composite sample from each site using pre-cleaned stainless scoop. The first inch of soil of each site was scraped prior to sampling to remove organics, vegetation, or any litter that was present. Once the inch had been removed, TU staff focused on collecting soil from the 0-6 inch soil profile. These sub-samples at each site were appropriately sized to achieve a total composite sample of a gallon Ziploc bag. After collection, the composite sample was thoroughly mixed, labeled, and then bagged again for sample security.

Once collected, samples were properly labeled and packaged with complete Chain of Custody forms. Samples were stored at room temperature in a dry environment, then taken to the closest Post Office for shipping to ALS Labs of Fort Collins, CO. Samples were analyzed for total metals, TCLP metals and pH.

Soil Quality Assessment

To provide the most applicable comparison of parameters and reporting limits, TU staff have referenced the Draft Terrestrial Screening-Level Ecological Risk Assessment (SLERA) of the Bonita Peak Mining District (BPMD) during data consolidation. Ecological Soil Screening Levels (Eco SSLs) for Aluminum and Iron were also referenced for comparison, as well as Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants. With Bonita Peak being the most recent Superfund site, TU staff felt it pertinent to compare study results to baseline parameters of the SLERA to provide a relative perspective. This process involved identifying 12 soil contaminants of potential ecological concern (COPECs) and ranking the highest analyte concentrations from each site. These values were then used to develop Hazard Quotients (HQ) for each of the four receptor categories; terrestrial plants, soil invertebrates, birds, and mammals. In addition to this investigation, which is discussed below, TU also evaluated maximum, average, and concentration ranges of high ranking COPECs. Due to the relatively high recreational usage of the site area, TU staff also compared average and maximum soil concentrations to BLM Recreational Human Health screening levels (SLs). This was done to account for the various recreational groups that might use the area for hiking, biking or fishing.

Metals Assessment and Results Comparison:

Metal concentrations varied between sites and parameters with the Upper Pile having 76% of the maximum soil concentrations. All units were in mg/kg (unless otherwise indicated) and analyzed on a total metals basis. Table 1 displays the soil concentrations, and site averages, for soil analytes across the Manila Lode site. Site maximum values are displayed in bold text.

Table 1. Soil Analysis Results at the Manila Lode Site.

SAMPLE SITE	ANALYTE	RESULT (mg/kg)	AVERAGE (mg/kg)
Lower Pile	Aluminum	3,900	3,100
Upper Pile	Aluminum	2,300	
Lower Pile	Antimony	4.8	11.9
Upper Pile	Antimony	19	
Lower Pile	Arsenic	20	33.5
Upper Pile	Arsenic	47	
Lower Pile	Barium	680	570
Upper Pile	Barium	460	
Lower Pile	Beryllium	0.47	0.49
Upper Pile	Beryllium	0.51	
Lower Pile	Cadmium	3.9	10.95
Upper Pile	Cadmium	18	

Lower Pile	Calcium	1,400	870
Upper Pile	Calcium	340	
Lower Pile	Chromium	9.4	29.2
Upper Pile	Chromium	49	
Lower Pile	Cobalt	3.8	13.4
Upper Pile	Cobalt	23	
Lower Pile	Copper	66	98
Upper Pile	Copper	130	
Lower Pile	Iron	17,000	32,000
Upper Pile	Iron	47,000	
Lower Pile	Lead	2,000	11,000
Upper Pile	Lead	20,000	
Lower Pile	Magnesium	1,400	1,055
Upper Pile	Magnesium	710	
Lower Pile	Manganese	2,000	14,000
Upper Pile	Manganese	26,000	
Lower Pile	Mercury	0.48	0.405
Upper Pile	Mercury	0.33	
Lower Pile	Molybdenum	1.3	1.45
Upper Pile	Molybdenum	1.6	
Lower Pile	Nickel	4.8	4.35
Upper Pile	Nickel	3.9	
Lower Pile	pH	3.94 (SU)	3.7 (SU)
Upper Pile	pH	3.46 (SU)	
Lower Pile	Potassium	1,100	1,300
Upper Pile	Potassium	1,500	
Lower Pile	Selenium	4.7	14.35
Upper Pile	Selenium	24	
Lower Pile	Silver	6.1	16.05
Upper Pile	Silver	26	
Lower Pile	Sodium	94	102
Upper Pile	Sodium	110	
Lower Pile	Thallium	9.4	29.2
Upper Pile	Thallium	49	
Lower Pile	Uranium	190	580
Upper Pile	Uranium	970	
Lower Pile	Vanadium	12	30.5
Upper Pile	Vanadium	49	
Lower Pile	Zinc	1,100	1,800
Upper Pile	Zinc	2,500	

All results for the analyzed metals were above the minimum detection limits established by ALS Labs. The Lower Pile had the maximum soil values of Aluminum (3,900 mg/Kg), Barium (680 mg/Kg), Calcium (1,400 mg/Kg), Magnesium (1,400 mg/Kg), Mercury (0.24 mg/Kg) and Nickel (4.8 mg/Kg). The Upper Pile site included the maximum values for all other analytes as indicated in Table 1. The Upper Pile site also had the lowest pH value of 3.46 as compared to the Lower Pile's pH result of 3.94.

The variability of sample concentrations speaks to the high level of heterogeneity within each sample site. This is consistent with the multiple uses of this site and waste rock and tailings material typically found at historic mining sites.

Human Health Screening Levels (SLs) Discussion:

TU staff compared site average and maximum soil concentrations with established BLM human health screening levels (SLs) (Table 2). The BLM Recreational SLs assume an exposure duration of 14 days per year over 26 years (BLM Technical Memorandum – Screening Assessment Approaches for Metals in Soil at BLM HazMat/AML Sites, 2017). The BLM SLs are representative of conditions in the site area due to the relatively remote setting and intended recreational use, however the EPA Residential SLs (which assume an exposure duration of 350 days per year over 26 years), should also be considered at this site due to the proximity of a full-time dwelling adjacent to this site and the potential future residential use of this site.

Table 2. BLM SLs Compared to Manila Lode Soil Results. Highlighted cells indicate SL exceedances.

Chemical	BLM Recreational SL	EPA Residential SL	EPA Industrial SL	Manila Max Value (mg/Kg)	Max Sample Site	Exceedance(s)?	SL(s) Exceeded
Aluminum	>1,000,000	77,000	>1,000,000	3,900.0	Lower Pile	no	--
Antimony	782	31	470	19.0	Upper Pile	no	--
Arsenic	30.6	0.68	3	47.0	Upper Pile	yes	All
Barium	390,000	15,000	220,000	680.0	Lower Pile	no	--
Beryllium	3,910	160	2,300	0.51	Upper Pile	no	--
Cadmium	1,780	71	980	18.0	Upper Pile	no	--
Chromium (III)	>1,000,000	120,000	>1,000,000	49.0	Upper Pile	no	--
Cobalt	586	23	350	23.0	Upper Pile	no	--
Copper	78,200	3,100	47,000	130.0	Upper Pile	no	--
Iron	>1,000,000	55,000	820,000	47,000.0	Upper Pile	no	--
Lead	800	400	800	20,000.0	Upper Pile	yes	All

Manganese	46,700	1,800	26,000	26,000.0	Upper Pile	yes	Residential and Industrial
Mercury	271	11	46	0.48	Lower Pile	no	--
Molybdenum	9,780	390	5,800	1.60	Upper Pile	no	--
Nickel	39,000	1,500	22,000	4.80	Lower Pile	no	--
Selenium	9,780	390	5,800	24.0	Upper Pile	no	--
Silver	9,780	390	5,800	26.0	Upper Pile	no	--
Thallium	19.6	0.78	12	49.0	Upper Pile	yes	All
Uranium	391	16	230	970.0	Upper Pile	yes	All
Vanadium	9,850	390	5,800	49.0	Upper Pile	no	--
Zinc	587,000	23,000	350,000	2,500.0	Upper Pile	no	--
Primary Exposure Assumptions	14 days/year, 26 years, adult/child	350 days/year, 26 years, adult/child	225 days/year, 25 years, adult	--			

Concentrations of arsenic, lead, manganese, thallium, and uranium exceedances some, or all, of the BLM and EPA's Screening Levels. Manganese concentrations exceeded the EPA's Residential SL and met the EPA's maximum for Industrial SL, while concentrations of arsenic, lead, thallium, and uranium exceeded all of the relevant BLM and EPA SLs. All of these SL exceedances occurred at the Upper Pile site.

TCLP Discussion:

To measure toxicity of the Manila Lode tailings, ALS Labs performed the Toxicity Characterization Leaching Procedure (TCLP) on collected samples from the Lower and Upper Piles. The TCLP test is designed to identify wastes that are likely to leach specified concentrations of chemicals into groundwater as it broadly simulates the leaching a waste will undergo if disposed of in a sanitary landfill. Extracts from the TCLP test are analyzed to determine if any of the results exceed thresholds established for the 40 Toxicity Characteristic (TC) constituents. If the TCLP extract contains any one of the TC constituents in an amount equal to or exceeding the concentrations specified in 40 CFR 261.24, the waste possesses the characteristic of toxicity and is a hazardous waste (EPA, 2004).

Manila Lode samples were evaluated against eight relevant TCs including: arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver. Results of this comparison are displayed in Table 3. TCLP results from the Upper Pile significantly exceeded the EPA Regulatory Level for lead. The established regulatory level for lead is 5 mg/L; results from the Upper Pile indicate a concentration of 70 mg/L in the soils leachate.

Table 3. Manila Lode TCLP Results Compared to EPA Regulatory Levels. Red text indicates exceedance of EPA Regulatory Level.

Contaminant	EPA Regulatory Level (mg/L)	Manila Max TCLP Result (mg/L)	Exceedance?	Site of Exceedance
Arsenic	5.0	0.1	no	N/A
Barium	100.0	1	no	N/A
Cadmium	1.0	0.067	no	N/A
Chromium	5.0	0.1	no	N/A
Lead	5.0	70	yes	Upper Pile
Mercury	0.2	0.002	no	N/A
Selenium	1.0	0.06	no	N/A
Silver	5.0	0.1	no	N/A

Because the TCLP leachate results at the Upper Pile exceeded the EPA regulatory level for lead, waste at the Manila Lode site possesses the characteristic of toxicity and could be considered hazardous. These elevated lead results have serious human health implications as lead can affect almost every organ and system in the body. The main target for lead toxicity is the nervous system, both in adults and children (Agency for Toxic Substances and Disease Registry, 2016).

COPEC and HQ Discussion:

The four primary terrestrial receptor groups used in development of ecological risk evaluations are terrestrial plants, soil invertebrates, birds, and mammals. Plants and invertebrates represent community-level organisms that are assumed to be exposed to mining impacted soils through direct contact. Birds and mammals would forage in the vicinity of habitats surrounding the Site. These receptor groups help break down data for comparison of published ecological screening values (ESVs) within each group. This report goes on to use commonly used Contaminants of Potential Ecological Concern (COPEC) to calculate Hazard Quotient (HQ) values for each parameter. These COPECs corresponded to maximum Exposure Point Concentrations (EPCs) for each analyte that were used to calculate HQ values by dividing max EPC by the most conservative, or “no-effect” ESV ($HQ = \text{max EPC} / \text{ESV}$). Analytes with an HQ greater than 1 were designated in excess and warranted further evaluation. The soil no-effect ESVs for this study have been generated from several standard sources, and are commonly used for remedial decisions at Superfund, and other hazardous waste sites. These data sources are listed in the References section of this document.

The most conservative (lowest) ESV is chosen for each analyte from the four receptor groups. This varies between analyte and receptor group. For example, arsenic is most detrimental to invertebrates as concentration increases so it is assigned the lowest ESV of the four receptor groups. Because of its low score, it is prioritized as the driving COPEC ESV throughout the study. Also, aluminum and iron do have ESVs, but they are not discussed as part of this study because they are highly dependent on soil pH. Birds and plants are systematically the most at risk of the four terrestrial receptor groups, followed by invertebrates and mammals. Soil No-Effect Ecological Screening Values are listed in Table 4.

Table 4. Listed Soil No-effect Ecological Screening Values (mg/Kg).

Soil No-effect Ecological Screening Values (mg/kg)					Soil COPEC
<u>Analyte</u>	<u>Plants</u>	<u>Invertebrates</u>	<u>Birds</u>	<u>Mammals</u>	
Aluminum	--	--	--	--	--
Arsenic	18	6.8	43	46	6.8
Cadmium	32	140	0.77	0.36	0.36
Chromium	--	0.4	26	34	0.4
Copper	70	80	28	49	28
Iron	--		--	--	--
Lead	120	1700	11	56	11
Manganese	220	450	4300	4000	220
Nickel	38	280	210	130	38
Selenium	0.52	4.1	1.2	0.63	0.52
Silver	560	--	4.2	14	4.2
Zinc	160	120	46	79	46

The EPA SLERA utilized a process that begins with identifying the maximum analyte concentrations at each site in relation to the no-effect ESV of each analyte. The max detected concentration of each analyte was divided by the corresponding minimum soil ESV (Table 5). Any resulting HQ > 1 was then considered a COPEC as Y (yes) or N (no).

Table 5. COPEC Evaluation for the Manila Lode Site.

Terrestrial Screening Value Comparison for the Manila Lode Site					
<u>Analyte</u>	<u>Max Detected (mg/kg)</u>	<u>Station ID</u>	<u>Soil ESV mg/kg</u>	<u>HQ</u>	<u>Soil COPEC?</u>
Aluminum	3,900.0	Lower Pile	--	NA	NA
Arsenic	47.0	Upper Pile	6.8	6.9	Y
Cadmium	18.0	Upper Pile	0.36	50.0	Y
Chromium	49.0	Lower Pile	0.4	122.5	Y
Copper	130.0	Upper Pile	28	4.6	Y
Iron	47,000.0	Upper Pile	--	NA	NA
Lead	20,000.0	Upper Pile	11	1,818.2	Y
Manganese	26,000.0	Upper Pile	220	118.2	Y
Nickel	4.8	Lower Pile	38	0.1	N
Selenium	24.0	Upper Pile	0.52	46.2	Y
Silver	26.0	Upper Pile	4.2	6.2	Y
Zinc	2,500.0	Upper Pile	46	54.3	Y

Every parameter with a soil ESV qualified as a soil COPEC besides nickel for the Manila dataset. The Lower Pile sampling location yielded one (chromium) of the soil COPECs, while the Upper Pile location yielded the other nine COPECs. HQ evaluations of lead, chromium and manganese generated the highest hazard quotient results of 1,818.2, 112.5 and 118.2, respectively.

A further breakdown of maximum HQs per terrestrial receptor group validated that lead was the main risk driver with a HQ sum of 2,353.8, which corresponds to 78.3% of the total risk between the ten evaluated analytes (Table 6).

Table 6. Breakdown of MAXIMUM HQ values within each terrestrial receptor group, as well as a sum of each parameter to show priority.

<u>Analyte</u>	<u>Max Detected (mg/kg)</u>	<u>Manila Maximum HQs</u>				<u>COEPC</u>	<u>% total Risk</u>
		<u>Plants</u>	<u>Invertebrates</u>	<u>Birds</u>	<u>Mammals</u>	<u>HQ sum</u>	
Aluminum	3,900	NA	NA	NA	NA	--	--
Arsenic	47	2.6	6.9	1.1	1.0	11.6	0.387%
Cadmium	18	0.6	0.1	23.4	50.0	74.1	2.464%
Chromium	49	NA	122.5	1.9	1.4	125.8	4.187%
Copper	130	1.9	1.6	4.6	2.7	10.8	0.359%
Iron	47,000	NA	NA	NA	NA	--	--
Lead	20,000	166.7	11.8	1,818.2	357.1	2,353.8	78.317%
Manganese	26,000	118.2	57.8	6.0	6.5	188.5	6.272%
Nickel	4.8	0.1	0.0	0.0	0.0	0.2	0.007%
Selenium	24	46.2	5.9	20.0	38.1	110.1	3.663%
Silver	26	0.0	NA	6.2	1.9	8.1	0.269%
Zinc	2,500	15.6	20.8	54.3	31.6	122.5	4.074%
<u>Total Risk</u>						3,005.4	100.0%

Of the four receptor groups, the bird community has the largest potential to be negatively affected by high lead concentrations. These high lead values correlate to past historic reports from the area stating that two veins of lead-silver ore were discovered while mining in the Toledo Tunnel (Lovering, 1935). The next highest HQs were attributed to manganese, chromium and zinc with total HQs of 188.5, 125.8 and 122.5, respectively. Manganese concentrations correlated to 6.3% of the total site risk, while chromium concentrations correlated to 4.2% and zinc 4.1% of the total site risk. This analysis exhibited a large disparity between the main risk driver, lead, and the remaining suite of analytes. The HQ sum for lead is greater than 12 times the HQ sum of the next highest analyte, making it the target metal for risk reduction.

For comparison purposes, average detected concentrations of all sites were also evaluated and compared to ESVs for the four receptor groups (Table 7). All analytes saw reductions in hazard quotients between maximum and average values. However, a similar trend of lead dominating the total risk percentage was maintained in the average HQ evaluation. Manganese was again the second risk driver at 6.0% of the total risk.

Table 7. Breakdown of AVERAGE HQ values within each terrestrial receptor group, as well as a sum of each parameter to show priority.

<u>Analyte</u>	<u>Avg Detected (mg/kg)</u>	<u>Manila Average HQs</u>				<u>COEPC</u>	<u>% total Risk</u>
		<u>Plants</u>	<u>Invertebrates</u>	<u>Birds</u>	<u>Mammals</u>	<u>HQ sum</u>	
Aluminum	3,100	NA	NA	NA	NA	--	--
Arsenic	33.5	1.9	4.9	0.8	0.7	8.3	0.490%
Cadmium	10.95	0.3	0.1	14.2	30.4	45.1	2.663%
Chromium	29.2	NA	73.0	1.1	0.9	75.0	4.432%
Copper	98	1.4	1.2	3.5	2.0	8.1	0.480%
Iron	32,000	NA	NA	NA	NA	--	--
Lead	11,000	91.7	6.5	1,000.0	196.4	1,294.6	76.524%
Manganese	14,000	63.6	31.1	3.3	3.5	101.5	6.000%
Nickel	4.35	0.1	0.0	0.0	0.0	0.2	0.011%
Selenium	14.35	27.6	3.5	12.0	22.8	65.8	3.891%
Silver	16.05	0.0	NA	3.8	1.1	5.0	0.295%
Zinc	1,800	11.3	15.0	39.1	22.8	88.2	5.212%
					<u>Total Risk</u>	1,625.9	100%

Conclusions and Recommendations

TU staff will conduct water quality sampling in June of 2019 to further characterize the Manila Lode site and to provide data that will allow for a complete recommendation for site restoration. The conclusion and recommendations in this report only pertain to cleanup and restoration of on-site soils.

Soil Quality Conclusions:

Of the two locations sampled, the Upper Pile contained the results with the highest and lowest metals concentrations. Concentrations ranged from 0.33 mg/Kg of mercury to 47,000 mg/Kg of iron at this location. Although not analyzed for acid generating potential, these high iron results, and relatively low pH values, could indicate the appropriate conditions for acid rock drainage from this site. Low pH values at both the Upper and Lower Pile sites also indicate the appropriate conditions for increased solubility of metals if water is allowed to pass through or over the tailings at these sites.

Metal concentrations found in the soils at the Upper Pile of the Manila Lode site exceed some, or all, of the BLM and EPA's human health Screening Levels. Concentrations of arsenic, lead, thallium, and uranium exceedances all of the BLM and EPA's Screening Levels. These results indicate a high potential threat to human health for recreational, residential and industrial site users that may interact with the tailings material found on site.

Results from TCLP analysis at this site also indicate that lead concentrations in the TCLP extract at the Upper Pile can be classified as toxic and could be considered hazardous. These TCLP results indicate a

high potential threat to groundwater and/or surface waters that comes into contact with the Upper Pile. Limiting the potential for water to interact with this material will be key to reducing potential impacts to downstream/downgradient water resources.

Elevated levels of lead are present at the Upper Pile site, as well as high HQs for all receptor groups. A no-risk condition would have a HQ less than one but lead receptor groups range from 11.8 for invertebrates up to 1,818.2 for birds. These HQ values provide concern for local communities of receptors, especially mammals and birds, that are primarily exposed through ingestion. While lead is the standout constituent in the HQ analysis, it should be noted that all analyzed metals, except for Nickel, had calculated hazard quotients above the no-risk condition. These results have potential implications for the ecosystem surrounding the Manila Lode site and provide concern for local communities of receptors, especially mammals and birds, that are primarily exposed through ingestion.

Potential Restoration Alternatives:

The results discussed above indicate that the soils on the Manila Lode site, particularly at the Upper Pile Site, can pose a threat to environmental and human health. Based on results from this analysis, recommendations for site clean-up would depend on priorities from future site users, but each alternative should focus on reducing physical exposure to the tailings and waste rock on site and reducing the opportunity for water to interact with (and leach through) these piles.

A combination of restoration alternatives at this site will help to limit physical and environmental exposure and protect groundwater and surface water resources. Initially, reduction of physical interaction for human and environmental receptors should be prioritized. Grading and capping the tailings material with clean fill would ensure that rainwater, snowmelt or adit water will no longer interact with the mobile, exposed tailings at the site. Prior to capping the piles, soil pH could be raised by incorporating crushed limestone (or carbonate equivalent) into the tailings material so that the underlying material will not encourage metal solubility to the same degree as it currently does. Limestone application rates will be calculated based on tailings chemistry, volume, and/or overall acreage restored.

Once applied, the clean fill can be amended to encourage plant growth. The success of plant communities on site will improve site stabilization and further reduce exposure factors. Similar to the limestone application rates, the amendment volumes and types will be calculated based on soil chemistry, volume, and/or overall acreage. Amendments will be mixed throughout the clean fill and include compost for organic supply, a 7-2-1 or 3-6-3 NPK fertilizer equivalent, native seed, and a wood straw/ag straw mix. After mixing, the ground surface is usually roughed or hummocked to minimize sheet flow and erosion of freshly graded surface. Fertilizer and a native seed mix would then be mixed into the top two inches of soil followed by straw application.

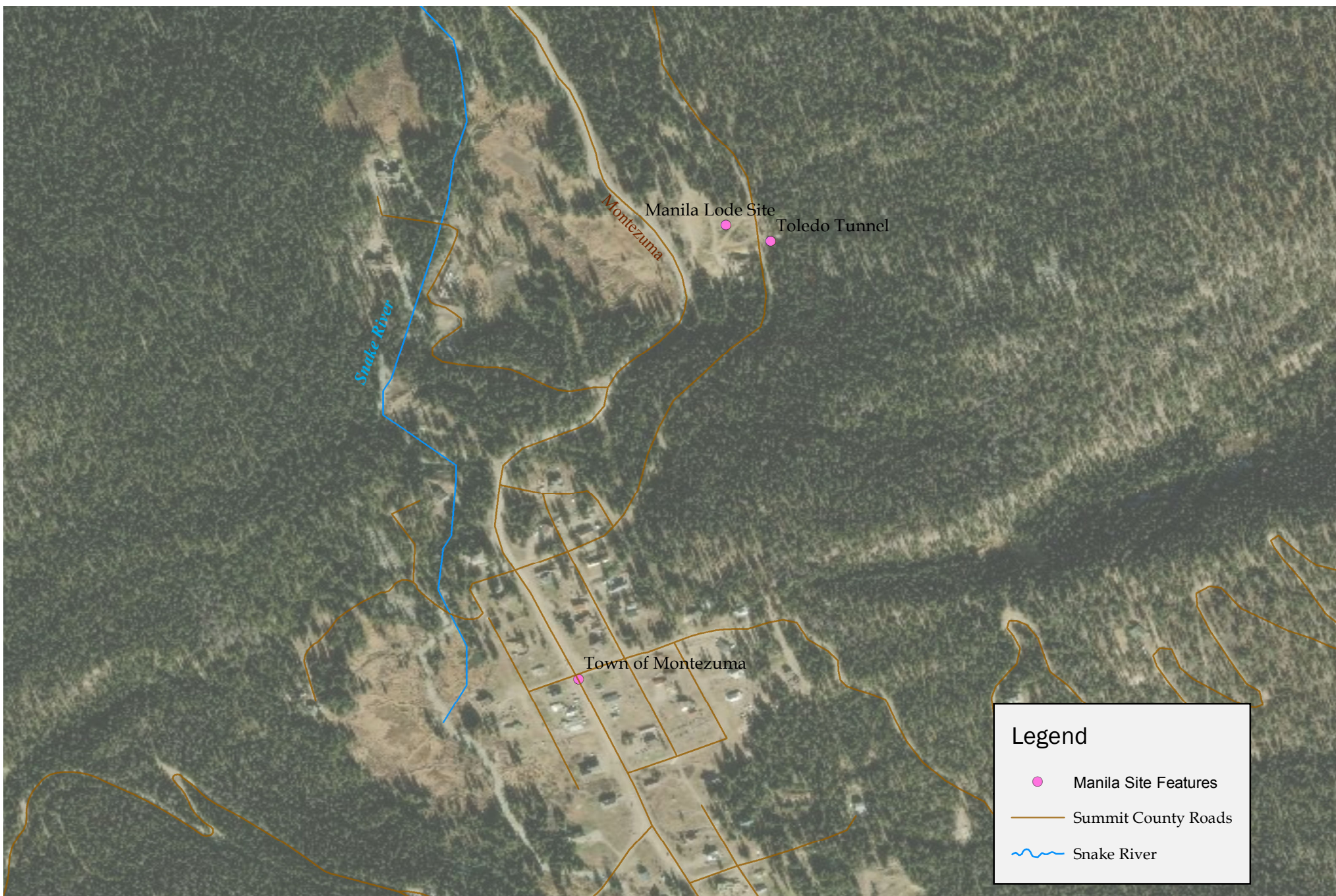
Because the lead concentrations from leachate generated at this site pose a specific threat to human and environmental health, water controls will be integral to the overall site restoration plan. TU plans to

sample water quality at the Manila Lode site in June of 2019 to gain a complete understanding of water quality on site, but initially, surface and groundwater controls appear necessary to reduce interaction potential with Manila tailings. Routing the Toledo Tunnel adit flow away from the Manila tailings will remove the consistent, year-round opportunity that this adit water has to interact with mine tailings on site. The water quality of the Toledo Tunnel outflow will influence the design and channel needs of this diversion.

Finally, groundwater controls installed at on-site slope-breaks eliminate the opportunity for shallow groundwater that has interacted with Manila tailings to exit the site and potentially impact the wetlands downstream/downgradient of the site. Groundwater could be captured in shallow channels at these breaks and be routed into the constructed Toledo Tunnel adit channel. Presence of, quality of, and flow rates of groundwater will guide the design of these controls.

References

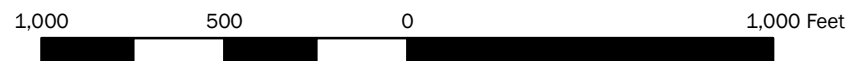
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Legend

- Manila Site Features
- Summit County Roads
- ~ Snake River

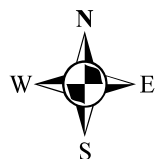
Project: Manila Lode 2018 Soils Report
Figure 1: Manila Lode Overview
Date: April 5th, 2019
Site Location: Montezuma, CO



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Project: Manila Lode 2018 Soils Report
Figure 2: Soil Sampling Locations
Date: April 5th, 2019
Site Location: Montezuma, CO



150 75 0 150 Feet

