COLORADO
Division of Reclamation, Mining and Safety
Department of Natural Resources

1313 Sherman Street, Room 215
Denver, CO 80203

M-2018-065
Governor Basin Restoration

Date: December 13, 2018

RE: Need for State Reclamation Permit: "Is It Mining?"

Name: UnCompahgre Watershed Partnership, Anthony Ramsey, President
Mailing Address: P.O. Box 392 City: Ridgway State: CO Zip Code: 81432
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Email: uwpcommunications@gmail.com

Enclosed are pertinent sections of the Colorado Mined Land Reclamation Board (Board) Rules governing activities that do not require a reclamation permit. To determine if you need a permit for you proposed activity, first check Rule 1.2 which describes activities the Board has determined do not require state reclamation permits. If you find a match, you can proceed based on your interpretation of the rule, but at your own risk. If you are uncertain how the Rule may apply to your activity, you should answer the list of questions below with as much detail as possible. Please feel free to use additional paper, maps, and attachments to explain your project.

Please include in your determination request answers to the following questions:

1. Please provide the legal location of the proposed project and submit a site map that clearly delineates the location of the proposed extraction site and the location of the nearest city, town, and county location name.
   Section 20 ;Township 43N;Range 8W ;PM NM County Ouray
   Or NAD27 GPS X UTM 256364. Y UTM 4205591
   Direction and miles to nearest town/city 7 miles west of Ouray, CO
2. Is the site of material extraction on public or privately owned property? 97% private, 3% public
3. What type(s) of material or metal is/are proposed to be extracted and describe the physical nature of the site i.e., river terrace, rocky knob, in-stream gravel deposit, etc.? No extraction of materials. Moving existing waste rock from legacy hard rock mining operation, San Juan tuff material.
4. What processing or extraction method(s) will be used on site? Include any equipment or chemical(s) that will be used in the processing and extraction of the materials. Bulldozer and excavator, no chemicals
5. Will the extracted material be hauled offsite or used on the same parcel of property where the material is extracted? used on same parcel, no off site hauling
6. How will the extracted material be used on site? The upper waste rock material will be used to cap lower acid generating waste rock to provide buffering and armoring and reduce runoff of acid generating materials
7. If the material is hauled offsite, where will it be hauled to and what it the intended use? no offsite use

8. What is the approximate areal extent of the proposed extraction in acres? 7.5 acres

9. To what approximate depth will the extraction extend? no extraction of materials

10. In cubic yards, approximately how much material will be removed? estimated 400 cubic yards moved on-site

11. Will material extraction involve the use of explosives? no

12. Will site of extraction result in the exposure of tributary ground water? no

13. Will either the landowner or the mine site operator receive any type of compensation, i.e., monetary, in-kind, haulage fees, etc., from the proposed material extraction? no

14. Please supply a copy of any documents that will ensure that the area of extraction will be reclaimed to some beneficial land use once extraction activities have been completed. see attached Governor Basin Project Proposal

15. Do you have permits for this activity from any other governmental agencies such as building, construction, or grading permits, and if so, what are they? no, working with Forest Service for needed permits

16. Are there state/federal/local agency participants in terms of funding (yes)-(no), design (yes)-(no). What are the percentages? funding - yes 80% design - yes 80%

17. What *post mining* uses will be made of the site of extraction and why? (This question helps us determine the intent of the activity) post mining will attempt to return the area to more natural state and potential to support vegetation and reduce water quality impacts

18. What types and sizes of equipment will be used in the extraction? Caterpillar D-8 Bulldozer, Caterpillar 315 excavator

Please send the completed questionnaire to the Division at the address above for review. The Board has directed the Division to make a decision based on the information you have supplied. We trust that the activities will be performed as represented. If we receive a complaint, we are required by law to conduct an inspection of the site. Which could result in a violation, a cease and desist order, and other corrective actions including submittal of a permit application.

If you have any question, please contact Wally Erickson for Eastern Colorado sites at (303)866-3567, ext. 8176, or Russ Means for Western Colorado sites at (303)866-3567, ext. 8185. If you are unsure which area your project lies please feel free to contact either for further guidance and assistance. Please feel free to visit our web site at: www.mining.state.co.us for further access to the full Act and Rules governing extraction of metals, non-metals, and construction materials in the State of Colorado.

Sincerely,

Division of Reclamation, Mining and Safety Staff

Enclosure: Rule 1.2.1 for both Hard Rock Metal Mines and Construction Materials

1.2 SCOPE OF RULES AND ACTIVITIES THAT DO NOT REQUIRE A RECLAMATION PERMIT

1.2.1 Specified by Rule

The Board has determined that certain types of activities do not need reclamation permits either because the excavated substance is not a mineral as defined in Section 34-32-103(7), Colorado Revised Statutes 1984, as amended or because the activity is not a mining operation as defined by Section 34-32-103(8), C.R.S. 1984, as amended. Such activities include the following:

(a) the exploration and extraction of natural petroleum in a liquid or gaseous state by means of wells or pipe;

(b) the development or extraction of coal (refer to the Colorado Surface Coal Mining Reclamation Act Section 34-33-101, et seq., C.R.S. 1984, as amended);

(c) smelting, refining, cleaning, preparation, transportation, and other off site operations not conducted on affected land;

(d)

(e) a custom mill.

1.2 ACTIVITIES THAT DO NOT REQUIRE A RECLAMATION PERMIT

103(3) and (13)

1.2.1 Specified by Rule

The Board has determined that certain types of activities do not need reclamation permits either because the excavated substance is not a construction material as defined in Section 34-32.5-103(3), Colorado Revised Statutes 1984, as amended or because the activity is not a mining operation as defined by Section 34-32.5-103(13), C.R.S. 1984, as amended. Such activities include the following:

(a) the exploration and extraction of natural petroleum in a liquid or gaseous state by means of wells or pipe;

(b) the development or extraction of coal (refer to the Colorado Surface Coal Mining Reclamation Act Section 34-33-101, et seq., C.R.S. 1984, as amended);

(c) cleaning, preparation, transportation, and other off-site operations not conducted on permitted land; and

(d) the extraction of geothermal or groundwater resources.

1.2.2 Reserved

1.2.3 Reserved

1.2.4 Extraction or Exploration on Federal Lands

Any person who intends to extract or explore for construction materials on federal lands shall apply for a Mined Land Reclamation Board permit or submit a Notice of Intent to conduct exploration operations unless specifically exempted by the Board according to the provisions of this Subsection 1.2.

NATURAL RESOURCE DAMAGES FUND PROJECT PROPOSAL: GOVERNOR BASIN RESTORATION PROJECT IN OURAY COUNTY, COLORADO

PREPARED BY THE UNCOMPAHGRE WATERSHED PARTNERSHIP

CONTENTS

Cover photo: View from the Terrible #3 Adit drainage. The foreground and middle ground of the photo characterize resource damage common throughout the Terrible mine dumps. The background of the photo characterizes alpine tundra characteristic of the San Juan Mountains. Photo credit: Jeff Litteral, Colorado Division of Reclamation, Mining and Safety.

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1.0 INTRODUCTION

The Uncompahgre Watershed Partnership (UWP) is pleased to submit this Natural Resource Damages (NRD) Funds proposal for the Governor Basin Restoration Project. Since 2015, UWP, the Colorado Division of Reclamation, Mining, and Safety (DRMS), Ouray Silver Mines, Inc. (OSMI), Trout Unlimited (TU), and the United States Forest Service (USFS) have evaluated water quality and environmental conditions, conceptual project designs, and potential funding sources to plan a restoration project in Governor Basin.

Governor Basin is impacted by waste rock and tailings from the Terrible and Virginius mines which leach metals that impair water quality, downgradient aquatic and terrestrial habitat, and watershed health. The goal of this project is to restore alpine, riparian, and aquatic habitat and improve water quality in Governor Creek, Sneffels Creek, and Canyon Creek.

During the restoration project, waste rock and tailings will be capped and covered. Soil amendments and a custom high alpine seed mix will be used to revegetate the restoration area. Drainage channels will be constructed to capture and divert flow away from mine waste and tailings. The Governor Basin restoration project will restore natural resources equivalent to those damaged at the Idarado site.

Photo 1. View from the Terrible #3 Adit drainage channel. The foreground of the photo characterizes resource damage common throughout the project area. Left of center, drainage from the Terrible Mine flows into Governor Creek. The background of the photo includes alpine tundra characteristic of the San Juan Mountains. Photo credit: Jeff Litteral, DRMS

The project area is approximately 97% private land owned by OSMI (94%) and Caldera Resources (3%), and the remaining 3% is owned by the USFS. The restoration plan includes environmental covenants for privately owned lands to permanently protect restored areas.

UWP is requesting $67,215.75 from the NRD Fund to implement the Governor Basin Restoration Project. The total project budget is $165,965.75 and includes $81,750.00 in cash and in-kind contributions from UWP, DRMS, and OSMI; and funding requests to the Colorado Water Conservation Board (CWCB) and the Gunnison Basin Round Table (GBRT) grant programs.

2.0 SITE DESCRIPTION

Upper Governor Basin is in the headwaters of the Canyon Creek watershed approximately seven miles west-southwest of Ouray, in southwest Colorado (Figure 1). Upper Governor Basin is an alpine basin that ranges in elevation from 11,880 feet near the basin's outlet to 13,267 feet near the summit of Greenback mountain. Portions of the upper basin support alpine tundra with a wide variety of wildflowers, grasses, sedges, cushion plants, and lichens during the short, alpine growing season. Other areas in the basin lack vegetation due to limited soil development, talus and rock outcrops or the presence of mine waste generated from historic abandoned mines.

Several seeps, springs, and small perennial streams converge near the lower portion of the upper basin to form Governor Creek, a local name for the unnamed tributary that drains Governor Basin. Governor Creek flows through the lower basin and into Sneffels Creek, which flows east-southeast to Canyon Creek. Canyon Creek flows into the Uncompahgre River in Ouray.

Mining in Governor Basin began sometime between 1883 and 1885. The Virginius Mine is located on the upper slopes of Governor Basin. The Terrible Mine is located downslope from the Virginius Mine. Ore from both mines was predominantly hand sorted. High grade ore was shipped directly to smelters throughout Colorado. Low grade ore and overburden was left in mine waste dumps. Only a small portion of the ore was milled in Governor Basin; the tailings are near Governor Basin Road (Ouray County Road 26A). Historic mining operations generated all of the mine waste in upper Governor Basin.

The Virginius Mine was developed on the Virginius vein in the San Juan Tuff. The Virginius workings are extensive and extend 2000 feet down to the Revenue Tunnel. The Revenue Tunnel portal is down valley from Governor Basin near the historic townsite of Sneffels. The San Juan Tuff is alkaline with modest buffering capacity and limited metal solubility. The Virginius Mine waste rock dump is approximately 3.2 acres, with an estimated 57,000 tons of waste rock material (Figure 2, blue polygon). Operations at the Virginius Mine ceased in 1895. All subsequent mining was conducted from the Revenue Tunnel and accessed from the portal near Sneffels.

The Terrible Mine was developed on the Terrible vein. The Terrible Mine has three adits; the adits are numbered from upgradient to downgradient (Figure 2). Waste rock associated with the Terrible Vein tends to be fine-grained and very acidic with high metal solubility. Waste rock from the Terrible Mine accumulated downgradient of each adit (Figure 2). The Terrible #1 and #2 adits are collapsed. The waste rock dump below the Terrible #1 adit is approximately 1.0 acre. The Terrible #2 waste rock dump is approximately 1.7 acres. The Terrible #3 adit is a draining adit; flow from the adit varies and there is limited information about drainage patterns. Flow from the Terrible #3 adit traverses mine waste and tailings. Water samples suggest that metal concentrations in the drainage from the Terrible #3 adit increase substantially as the water flows through the mine waste (Figure 2, red polygon). Future underground development by OSMI could potentially intercept some or all of the flow that exits the mine workings via the adit and redirect it into the Revenue tunnel where it will be treated by OSMI's passive treatment system before discharge into Sneffles Creek under CPDES permit C00000003.

OSMI estimates that only 20-25% of the ore from the Virginius and Terrible mines was processed before both mines ceased operations in 1895. Over time, erosion has increased the footprint of the tailings area. Erosion and transport issues are exacerbated where Governor Basin road traverses the mine site. Tailings limit plant growth throughout this area (Figure 2, red and orange polygons).

Sediment leachate samples indicate that infiltration through the Terrible waste rock and tailings mobilizes metals. Water quality samples collected on site, in Governor Creek, and other downstream locations further confirm that mine waste from Governor Basin, particularly from the Terrible Mine, impairs water quality and aquatic life and degrades the condition of riparian and alpine habitat.

Figure 1. Map of the Uncompahgre River watershed in southwest Colorado (UWP, 2013). Governor Basin is located near the star.

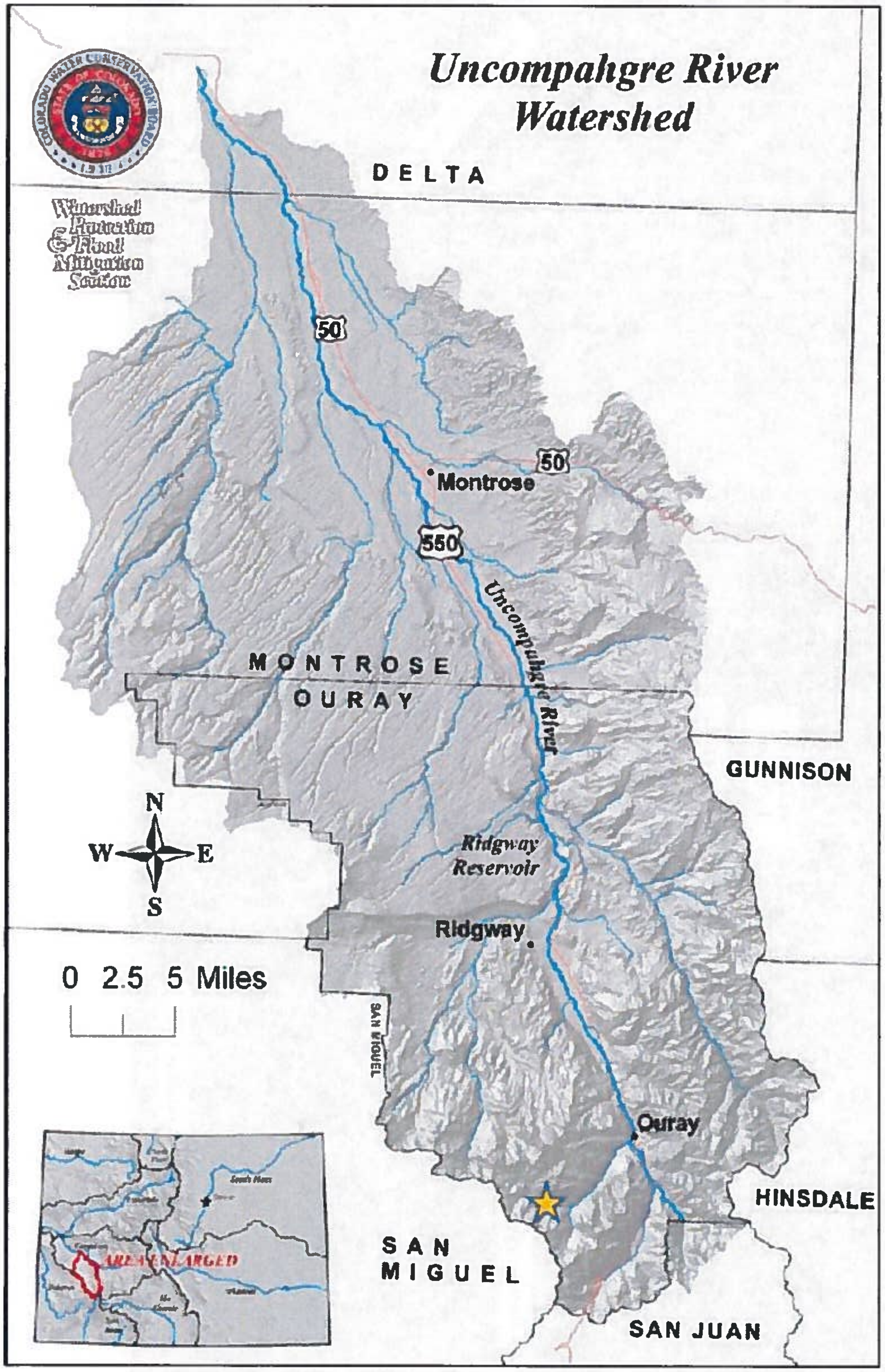
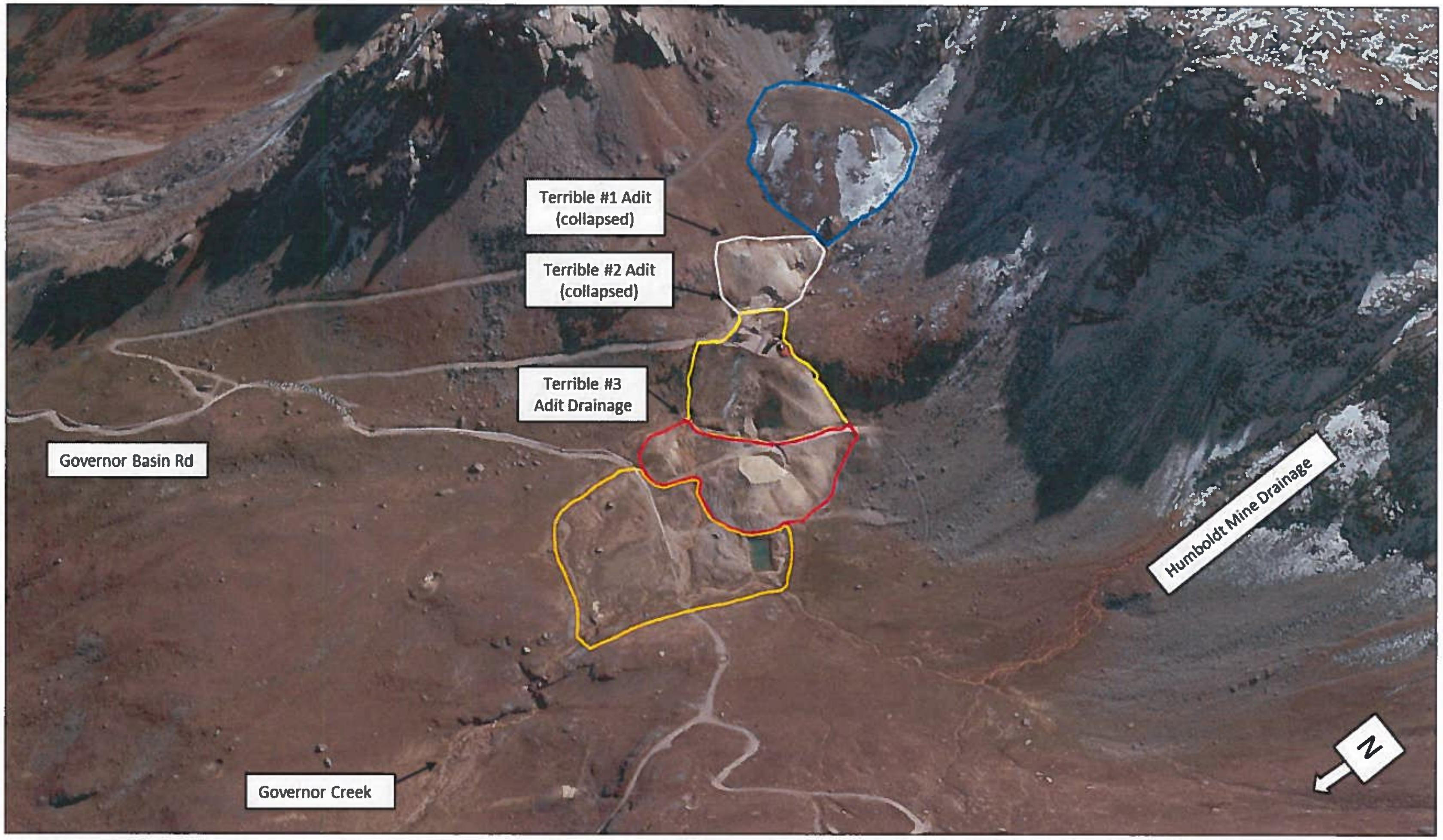


Figure 2. Governor Basin, near Governor Basin Road in Ouray County, Colorado. The Virginius mine dump (blue polygon), The Terrible #1, #2, and #3 mine dumps (white, yellow, red polygons, respectively), and tailings derived from the Terrible and Virginius veins (orange polygon).



2.1 LAND USE AND OWNERSHIP

Governor Basin attracts recreational visitors for its mining history, wildflowers, and incredible scenery. Governor Basin is accessible by a 4x4 road (Ouray County Road 26A), during the summer months after the snow has melted. During the summer, the road is a popular destination for both private and commercial recreational off-road vehicles.

The Governor Basin watershed is predominantly public land managed by the US Forest Service. However, the proposed project area in upper Governor Basin is approximately 97% private land owned by OSMI (94%) and Caldera Resources (3%). The USFS owns the remaining 3% of the surface. Figure 3 presents patented and unpatented mine claims in Governor Basin. Table 1 summarizes the landownership of the Virginius and Terrible mine features. The information provided in Table 1 is based on a survey completed by OSMI in the fall of 2017. USFS staff plan to evaluate the landownership survey in 2019.

Table 1. Landownership, mine claim number and name, and estimated size by feature within the proposed project area.

Feature	Claim Number	Claim Name	Claim Owner	Estimated Percent of Feature	Estimated Percent of Total Area
Virginius Waste Rock Dump	523	Monongahela	OSM	85%	17%
	NA	Unpatented	OSM	3%	1%
	13424B	Hill Top MS	OSM	12%	2%
Terrible #1 Waste Rock Dump	523	Monongahela	OSM	90%	18%
	NA	Unpatented	OSM	1%	0.2%
	1592	Terrible	OSM	9%	2%
Terrible #2 Waste Rock Dump	1592 & 523	Terrible & Monongahela	OSM	45%	9%
	1592	Terrible	OSM	25%	5%
	523	Monongahela	OSM	5%	1%
	NA	Unpatented	OSM	25%	5%
Terrible #3 Waste Rock Dump	1592 & 523	Terrible & Monongahela	OSM	20%	4%
	1592	Terrible	OSM	42%	8%
	523	Monongahela	OSM	15%	3%
	7096	Terrible No 2	OSM	3%	1%
	Na	Unpatented	OSM	18%	4%
	459	Blue Grass	Caldera	2%	0.4%
Terrible and Virginius Tailings	459	Blue Grass	Caldera	16%	3%
	NA	Unpatented	OSM	20%	4%
	18526	Waverly	USFS	16%	3%
	7096	Terrible No 2	OSM	35%	7%
	1592 & 523	Terrible & Monongahela	OSM	1%	0.2%
	1592	Terrible	OSM	12%	2%

Active mining operations occur underground and no additional surface disturbance will occur in upper Governor Basin. OSMI has two active permits in Governor Basin, P2015-003 and M2012-032, both on privately owned land.

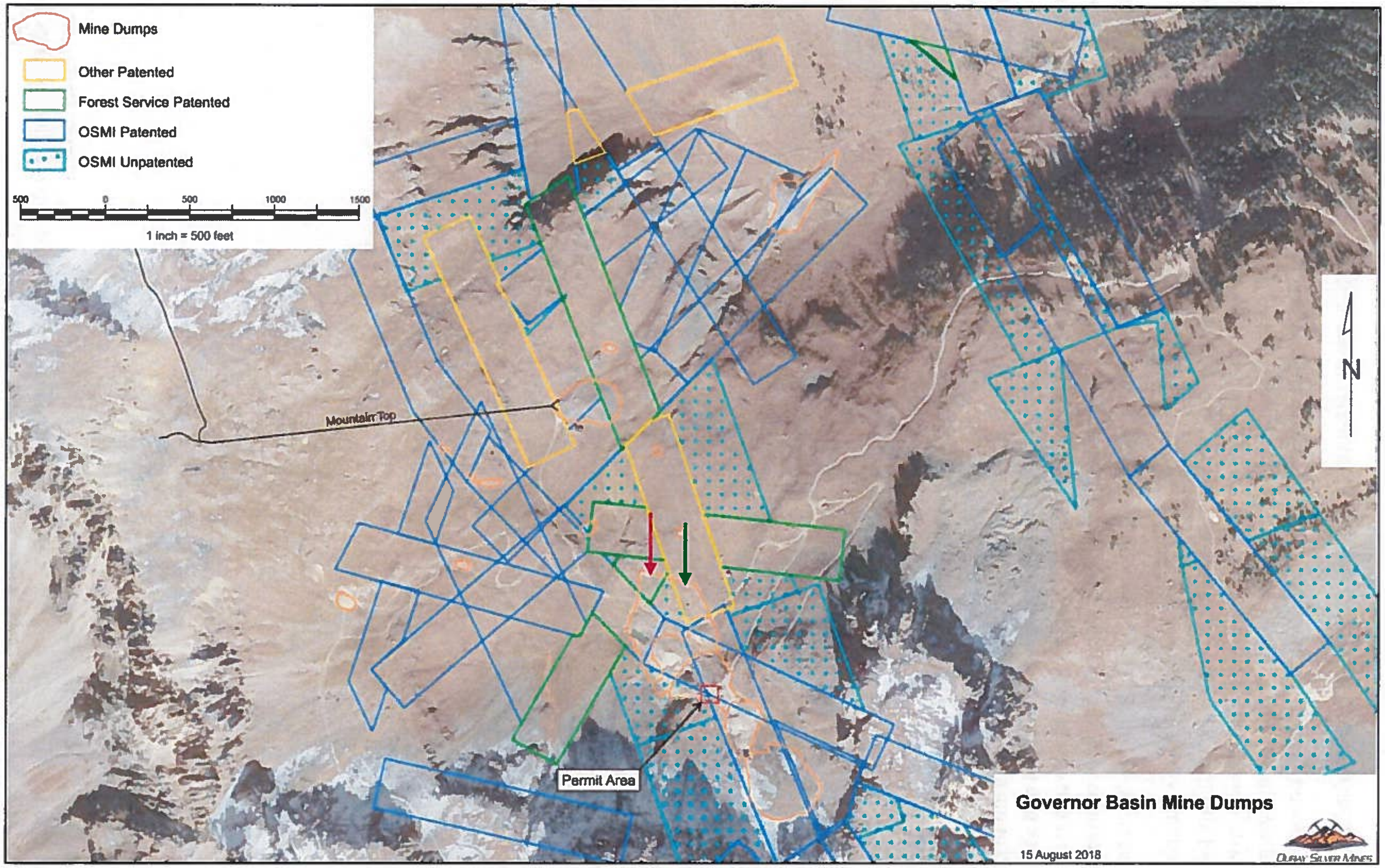
P2015-003 is a prospecting permit that allowed for four drill holes with a total footprint of 0.2 acres. One of the four drill holes is located in Governor Basin, on the Terrible #3 mine waste dump. Drilling was completed in 2015 and all drill holes have been properly abandoned. The reclamation plan for P2015-003 includes regrading with native materials. Reclamation of the drill pads will be completed prior to construction of the restoration project and before the completion date, March 2020, specified in the permit. P2015-003 will be inspected and closed by DRMS prior to the start of the Governor Basin Restoration Project. Both OSMI and DRMS have provided letters documenting their commitments to closing P2015-003 prior to the project. No additional exploration drilling is planned in Governor Basin.

M2012-032 permits the vent raise and emergency escapeway for the Revenue Virginius Mine. All other mining activities associated with the Revenue Virginius Mine occur outside of Governor Basin. The permitted area for the vent raise and emergency escapeway is a 100 by 100-foot square (Figure 3, red polygon). The reclamation plan includes covering the vent raise with a steel plate, regrading to match local topography with a minimum of three feet of local subsoil and one foot of topsoil. Restoration of the vent raise and emergency escapeway will not disturb areas restored as part of the Governor Basin Restoration Project. Reclamation for permit M2012-032 will not occur until after mining operations are complete. All restoration activities associated with the NRD funds will occur outside of the permitted area. Section 4.0 details the construction plan and identifies the techniques to avoid the permitted area.

OSMI has agreed to apply an environmental covenant to the title of their property to assure that the restoration area is permanently protected from any future surface disturbance. Project partners are discussing environmental covenants with Caldera (Figure 3, green arrow). Project partners are working with USFS staff to formally approve the portion of the restoration area on USFS land (Figure 3, red arrow). If necessary, the portion of the proposed restoration area owned by Caldera or USFS could be omitted from the final restoration area.

Photo 2. View of tailings near Governor Basin Road. The tailings limit plant growth in the area. The red polygon shows the approximate area of the USFS claim.

Figure 3. Mine claim ownership and active permit area in Governor Basin. The red arrow points to the USFS claim within the restoration area. The green arrow points to the Caldera claim. All other portions of the restoration area are owned by OSMI. Map courtesy of OSMI.



2.2 Virginius and Terrible Waste Rock Sediment Chemistry

The Abandoned Mine Lands Inventory, conducted by Colorado Geologic Society in 1994, estimated that the total volume of mine waste in Governor Basin is approximately 38,000 cubic yards. However, the mine waste dumps originate from different veins and have different chemistries. The Virginius vein produced alkaline waste with modest buffering capacity and limited metals solubility. The Terrible vein produced fine-grained highly and acidic waste with very high metal concentrations.

On October 18, 2016, DRMS, in partnership with OSMI, collected composite sediment samples from seven locations in Governor Basin. Three locations, east, middle, and west, were sampled from the uppermost pile of waste rock associated with the Virginius Mine (Figure 2, blue polygon). The Terrible #2 waste rock pile was sampled downgradient of the vent raise (Figure 2, yellow polygon below vent raise outlined in purple). The Terrible #3 waste rock pile was sampled to the east of the Terrible #3 Adit drainage (Figure 2, red polygon). Waste Rock from the Terrible #1, (Figure 2, white polygon) was not sampled. A mixture of waste rock and tailings was sampled in an area upgradient and east of the sediment pond within the red polygon in Figure 2. The Virginius Tailings (a mixture of material from both the Virginius and Terrible veins) were sampled north of Governor Basin road (Figure 2, orange polygon).

Mine waste associated with the Virginius vein, on the upper portion of the site, had relatively low metal concentrations that were substantially lower than metal concentrations in mine waste and tailings on the lower part of the site. The Virginius mine waste also had modest buffering capacity as measured by pH and total alkalinity.

Lead concentrations measured in the leachate from the Terrible #2 and #3 dumps and in the tailings ranged from 1,090 to 7,710 ug/L (Figure 2, yellow, red, and orange polygons). Lead concentrations in the leachate ranged from 90 to 642 times the acute aquatic life standard and were 22 to 154 times the water supply standard for lead[1]. The mine waste and contaminated surface runoff pose a risk to both human-health and ecological receptors. Zinc concentrations measured in the leachate from the Terrible #2 and #3 dumps and in the tailings ranged from 821 to 7,050 ug/L (Figure 2, yellow, red, and orange polygons). Zinc concentrations in the leachate ranged from 13 times to over 110 times the acute aquatic life standard.

[1] It is not a standard practice to evaluate leachate concentrations against surface water quality standards. But is illustrative in this case given limited water quality data from the Terrible Mine site.

Photo 3. View from above Terrible #1 waste rock. Terrible #1 waste rock is approximately 1.0 acre.

2.3 Impacts to Surface Water Quality

Governor Creek is on the 303(d) List for impairment of aquatic life standards for cadmium, copper, lead, and zinc and for impairment of the manganese water supply standard (Regulation 93, 2018). Sneffels Creek downstream of Governor Creek is on the 303(d) List for impairment of the aquatic life standards for cadmium, lead, and zinc, and for impairment of the manganese water supply standard[2]. Canyon Creek does not attain the aquatic life use for zinc and is also on the 303(d) List.

In recent years, there have been three water quality sample events within Governor Basin. Each event targeted specific areas including the Humboldt, Virginius, and Terrible mines. In 2018, UWP evaluated the existing data in an assessment report which is provided as Appendix A. Water quality data collected during high flow in 2014 from the lower portion of the Terrible Mine site and in Governor Creek are summarized in the paragraphs below.

In the drainage that flows through waste rock downgradient of the Terrible #3 adit (Figure 2, see red polygon), dissolved and total arsenic concentrations were 5.8 and 180 ug/L, respectively. In the drainage near the perimeter of the tailings area (Figure 2, see orange polygon), dissolved and total arsenic concentrations were 0.4 and 15 ug/L, respectively. Drainage from the Terrible waste rock dumps and the tailings area increased metal concentrations in Governor Creek to 1.4 and 25 ug/L for dissolved and total arsenic, respectively. Total arsenic concentrations exceeded the water plus fishand water supply standards in all samples. Total arsenic concentrations in Governor Creek increased downstream of the Terrible Mine site. During high flow, average total arsenic concentrations downstream of the mine sites were approximately 11 times higher than the San Sophia reference stream.

In the drainage that flows through waste rock downgradient of the Terrible #3 adit (Figure 2, see red polygon), dissolved and total cadmium concentrations were 27 and 27 ug/L, respectively. Cadmium concentrations exceeded the chronic and acute aquatic life standards, and the water supply standard. In

[2] The lower portion of Sneffles Creek on Segment 9 (from the Revenue Virginius Mine to confluence with Canyon Creek) is not classified as a water supply and is therefore not listed for manganese.

the drainage near the perimeter of the tailings area (Figure 2, see orange polygon), dissolved and total cadmium concentrations were 2 and 2.1 ug/L, respectively. Dissolved cadmium concentrations exceeded the chronic and acute aquatic life standards. The Terrible waste rock dumps and the tailings increased dissolved and total cadmium concentrations in Governor Creek by a factor of ten.

In the Terrible #3 waste rock drainage (Figure 2, see red polygon) dissolved copper was 228 ug/L; over 71 times higher than the perimeter waste rock drainage. The dissolved copper concentration measured in the Terrible # 3 waste rock drainage was over 43 times the acute standard. Copper concentrations in Governor Creek (Figure 2) downstream of the Terrible waste rock dumps and tailings were approximately 8 to 12 times higher than copper concentrations in the unnamed drainage upgradient of the Terrible Mine site. Dissolved copper concentrations in Governor Creek below the Terrible Mine site were 6 to 21 times higher than the chronic standard and 4 to 15 times higher than the acute standard.

In the Terrible #3 waste rock drainage (Figure 2, see red polygon) dissolved and total lead concentrations were 127 and 142 ug/L, respectively. Dissolved lead concentrations exceeded the chronic and acute aquatic life standards by a wide margin. The dissolved lead concentration in the Terrible #3 waste rock drainage was over 46 times higher than the perimeter waste rock drainage and 105 times higher than the unnamed drainage upgradient of the mine site. The total lead concentration in the Terrible #3 waste rock drainage was nearly three times greater than the domestic water supply standard.

In the Terrible #3 waste rock drainage (Figure 2, see red polygon) the dissolved zinc concentration was 6,130 ug/L. The dissolved zinc concentration was over 13 times higher than the waste rock perimeter channel (Figure 2, see orange polygon) and over 11 times higher than in the unnamed tributary upgradient of the site. The dissolved zinc concentration was nearly 100 times the acute standard for aquatic life. In Governor Creek (Figure 2) downstream of the Terrible waste rock dumps and the tailings area the dissolved zinc concentration was 1,170 ug/L or nine times higher than the concentration measured in the unnamed drainage upgradient of the site. The Terrible Mine site substantially increased dissolved zinc in Governor Creek.

2.4 Impacts to Aquatic Life

Macroinvertebrates s are sensitive to pollution and are excellent indicators of long-term water quality and overall watershed health. In addition to the metals impairments discussed in the previous section, Sneffels Creek downstream of Governor Basin is also impaired for aquatic life use due to a lack of aquatic invertebrates and insects; Sneffels Creek near the confluence with Canyon Creek is on the monitoring and evaluation list for aquatic life use (Regulation 93, 2018). Macroinvertebrates have not been sampled in Governor Creek. However, impairment of the aquatic community is likely given the water quality and proximity to streams impaired due to a lack of macroinvertebrates.

The lack of macroinvertebrates in upper Sneffels Creek, which is in part due to metals loading from Governor Creek, suggests that Sneffels Creek lacks the food chain necessary to support a robust fishery. Fish have been observed in Sneffels Creek, but not sampled to characterize community composition, structure, size or density. Water quality conditions suggest that the fishery in Sneffels Creek would not be as robust as fisheries in undisturbed reference streams.

The proposed Governor Basin restoration project will reduce metal concentrations in tributaries to Governor Creek and create more suitable habitat within the Canyon Creek watershed including in Governor Creek, Sneffels Creek, and Canyon Creek.

2.5 Impacts to Alpine Habitat, Riparian Corridor, and Watershed Health

The lower portion of the site lacks vegetation and is susceptible to additional erosion. On-going erosion poses a risk to downgradient alpine and riparian habitat and reduces the overall resiliency of the watershed.

3.0 Project Goals

The goal of the proposed Governor Basin restoration project is to restore alpine, riparian, and aquatic habitat and water quality in Governor Creek, Sneffels Creek, and Canyon Creek by decreasing run-off of metals-laden water and isolating mine waste and tailings from the environment. Due to its location in the headwaters of the Canyon Creek watershed, the Governor Basin restoration project has the potential to improve riparian and watershed health in up to 8 miles of downstream waters.

These goals will be accomplished through a series of best management practices including: capping and covering mine wastes with neutralizing material, establishing designated drainage channels to minimize surface water contact with contaminated materials, and re-vegetation. Section 4.0 provides a more detailed explanation of the project plan.

4.0 Project Description

The proposed restoration project will use several best management practices, in a cost-effective approach, to minimize the effect of mine waste on water quality, aquatic life, riparian habitat, and sensitive alpine tundra. Briefly, the Governor Basin restoration project will cap and cover contaminated materials, recontour, cover, and revegetate disturbed areas to restore alpine, riparian, and aquatic habitat; and improve water quality to create additional downstream benefits. The sub-sections below further describe the steps required to implement the Governor Basin restoration project.

4.1 Design, Engineering, and Permitting: 2019 and 2020

The existing conceptual design for the Governor Basin restoration project is provided in Section 4.2. The UWP technical committee, which includes OSMI, DRMS, USFS, and TU staff, will further refine the conceptual project design. Any changes to the conceptual design will be incorporated into the CWCB grant application (see Section 5.2). CDPHE will also be notified of any changes to the project design.

During 2019, DRMS and the USFS plan to complete a NEPA analysis for an existing abandoned mine closure project in Governor Basin. The NEPA analysis for the mine closure project will include much of the same characterizations required for the Governor Basin restoration project. For example, the wildlife evaluations for both the mine closure project and Governor Basin restoration project would be nearly identical due to the proximity of the project sites. To the extent possible, UWP, DRMS, and USFS staff will collaborate to support two NEPA analyses to implement both projects more effectively.

In 2019 landownership in Governor Basin will be definitively confirmed. This proposal uses data provided by OSMI based on a survey completed in late 2017. The survey corners in Governor Basin are staked. During 2019 USFS staff will conduct a review of the 2017 survey data to assure it satisfies their requirements.

A licensed engineer will develop the final project design in mid to late 2019. The existing Governor Basin Assessment Report (Appendix A) was written to support the development of an Environmental Assessment (EA) and/or Engineering Evaluation Cost Estimate (EE/CA). The existing assessment report and the engineered design will be used as the basis for the NEPA analysis. UWP staff will coordinate with technical committee members and USFS staff to navigate the NEPA process. Project design and engineering costs will be covered by UWP, OSMI, DRMS, TU, CWCB, and GBRT funds.

4.2 Construction and Implementation: 2020

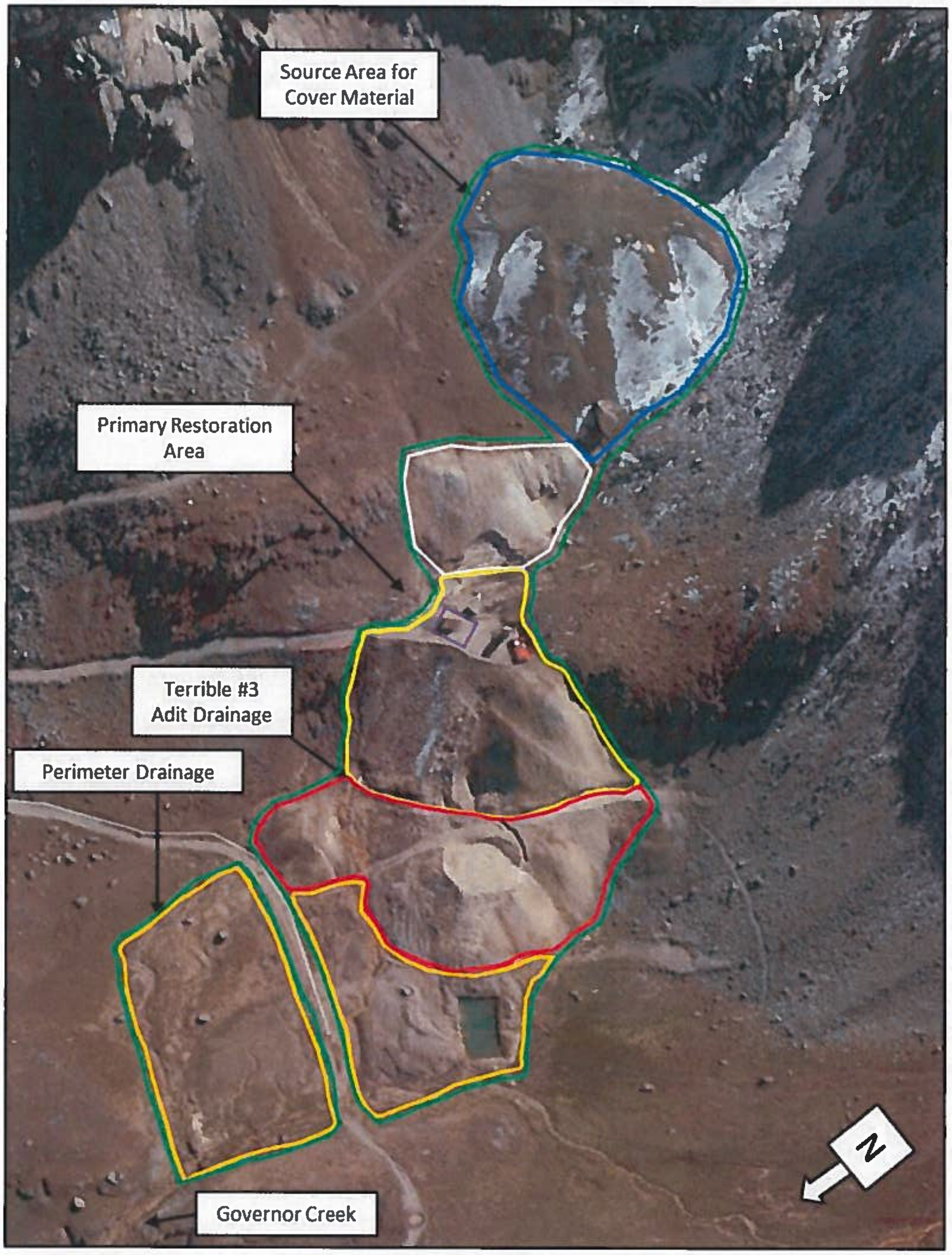
The restoration area is approximately 7.6 acres (Figure 4). No substantial work will take place in the Governor Basin road corridor. Waste rock from the Terrible #1, #2, and #3 mine waste dumps and tailings will be capped and covered. Cover soil and rock from the Virginius waste rock dump (Figure 4, blue polygon), which has substantial neutralizing capacity and low metal content, will be used to create a cap, of at least a one-foot depth, throughout the restoration area. Some fine-grained tailings may be removed from drainage areas, if necessary.

In-situ amendments and a custom high alpine seed mix will be used to revegetate the area. The seed mix will be weed-free and approved by DRMS and Ouray County. The seed bed will be scarified to promote seed germination and the surface will be roughened to minimize erosion within the restored area. All construction activities will occur outside of the permitted area near the vent raise and emergency escapeway. The portion of the Virginius mine dump used to supply cover material will be regraded to contour local topography and seeded.

Three drainage channels will be constructed in the restoration area to limit surface water interaction with covered mine waste. The Governor Creek channel will capture flow from the unnamed tributary that flows east toward the project area. The Governor Creek channel will use the existing channel to the extent possible. The Terrible #3 Adit drainage channel will be constructed to convey water from the adit. The channel will be sinuous and terminate in a catch-basin to prevent erosion in the restored area and promote water infiltration into the subsurface. The perimeter drainage channel will intercept water that seeps from the bedrock outcrop upgradient of restoration area. The perimeter drainage channel will convey water to Governor Creek to minimize erosion within the restored area. The channels will be designed to accommodate peak flows during runoff. The channel will have moderately sloping sides to facilitate plant growth. Low water crossings will be installed where Governor Creek flows over Governor Basin Road.

Currently, the Terrible Mine dumps and downgradient tailings erode into Governor Creek. The restoration project will substantially reduce erosion and improve habitat. The long-term benefits of the project greatly outweigh the short-term impacts associated with construction. Appropriate stormwater BMPs will be used to prevent erosion during the construction phase of the project.

Figure 4. Conceptual project design for the Governor Basin restoration project.



4.3 MEASURING OUTCOMES: 2020 TO 2023

In 2020 UWP will develop a monitoring and evaluation plan to support pre and post-project monitoring to evaluate project outcomes. The monitoring and evaluation plan will include vegetation, erosion, and water quality monitoring. Monitoring will continue for three years after project implementation.

Prior to the project, vegetation will be evaluated in the restoration area and at an appropriate reference site adjacent to the project area. Post-project vegetation monitoring will occur once per year, typically in mid-August. At a minimum, the vegetation monitoring program will include species identification and percent cover estimates.

Erosion monitoring will be conducted weekly during construction and annually for three years following construction. During construction, erosion monitoring will be used to evaluate the effectiveness of erosion control measures. Following construction, erosion monitoring will be used to determine whether follow-up actions are required.

Water quality monitoring will occur during high and low flow conditions the year prior to construction and for three years following construction. Seven locations, identified below, will be sampled:

- Drainage channel downstream of the Terrible #3 Adit: reference to characterize mine drainage. Previous studies indicate adit concentrations are typically lower than drainage channel concentrations.
- Terrible #3 Adit drainage channel immediately upstream of confluence with Governor Creek: characterize the extent of contamination due to Terrible #3 mine dump and tailings. This location will be critical to evaluating the benefit of the restoration project.
- Perimeter channel upgradient of restored area: reference location to characterize loading from native groundwater.
- Perimeter channel immediately upstream of confluence with Governor Creek: characterize the extent of contamination due to tailings. This location will be critical to evaluating the benefit of the restoration project.
- Governor Creek upgradient of the site: reference location to characterize conditions upstream of the restoration site.
- Governor Creek downstream of the restoration site: characterize conditions downstream of the restoration project. This location will be critical to evaluating the benefit of the restoration project.

The water quality monitoring associated with the Atlas Mill restoration project, funded by OSMI through the Supplemental Environmental Projects (SEP) program[3], and implemented by Trout Unlimited, may support data evaluation of the Governor Basin project, due to proximity. Water quality data collected to evaluate the Atlas Mill restoration project will provide additional data to evaluate the outcomes of the Governor Basin restoration project. The Atlas Mill monitoring program includes water quality sampling in Governor Creek immediately upstream of the confluence with Sneffels Creek and at several locations

[3] Funding for the project is a result of an enforcement action taken by the Colorado Department of Public Health and Environment for violations of the discharge permit at the Revenue Virginius Mine.

in Sneffels Creek. Data sharing will reduce post-project monitoring costs and allow for additional evaluation of downstream locations (i.e. Sneffels Creek).

4.4 Project Coordination and Administration: 2018 to 2023

The proposed Governor Basin restoration project relies on funding from multiple sources, including funds requested from the NRD program, CWCB Water Plan grant program, and the GBRT grant program. Project administration and coordination will be led by UWP.

The Governor Basin restoration project is a strong candidate for funding through the environmental and recreational project category of CWCB's Water Plan Grants because the Governor Basin restoration project will restore riparian and aquatic habitat and restoration projects in the upper Uncompahgre Watershed that were identified as a priority in the Gunnison Basin Implementation Plan, a substantial factor in CWCB's evaluation process. The grant application is due February 1, 2019. The CWCB funds may be used for project design and engineering. If awarded CWCB funding for the Governor Basin restoration project, contracting would occur shortly after final board approval in May 2019. The GBRT uses similar criteria to evaluate grant applications and has identified restoration projects in the upper Uncompahgre watershed as a priority in several planning documents.

UWP will manage all grant reporting for the Governor Basin restoration project. Grant reports and project updates will be provided as specified in the grant contracts. UWP staff have extensive experience with grant reporting.

UWP board members will provide lodging to UWP and TU staff during project construction which is a substantial in-kind contribution.

UWP will manage public outreach and communication. Additional details are provided in Section 8.0.

Ouray County has offered assistance on road maintenance, road access, and weed control.

4.5 Post-Project Maintenance

During the first three years following construction, post-project monitoring will provide an opportunity to evaluate project maintenance needs. Anticipated project maintenance tasks include: reseeding, weed removal, or maintenance of erosion control measures. OSMI will be responsible for post-project maintenance for the portion of the restoration area on private lands. The USFS will be responsible for post-project maintenance for the portion of the restoration area on public lands. The Ouray County roads section will maintain the Governor Basin road right of way. Additional maintenance, beyond three years, is not anticipated.

4.6 Project Deliverables

UWP staff will collaborate with project partners to provide the following project deliverables:

- Reports or analyses generated during the project planning process (e.g. NEPA documents).
- Final engineered project design.
- Construction schedule and regular updates during construction.
- As-built drawings.
- Pre-project monitoring data.
- Post-project monitoring data.
- Final project report including all data evaluation to characterize the outcome of the project.

Project reporting will occur on a biannual basis. Annual reports will be submitted to the NRD staff and trustees by December 31 for the duration of the grant. The CWCB grant requires progress reports every six months; the CWCB grant reports will also be provided to NRD program staff. Project deliverables will be provided during project updates and as part of regular grant reporting.

5.0 Budget

The project budget is divided into two elements. The conceptual project design was used to create the project cost estimate. Project funding and in-kind match were developed in recent conversations with project partners. UWP is requesting $67,215.75 from the NRD Fund to implement the Governor Basin Restoration Project. The total project budget is approximately $165,965.75 and includes in-kind support from UWP, DRMS, and OSMI; and funding requests to the CWCB and the GBRT grant programs.

5.1 Project Cost Estimate

The estimated project cost to implement the Governor Basin restoration is $165,965.75 based on the conceptual project design presented in Section 4.0 and local rates for project services (e.g. UWP technical coordinator, heavy equipment operators, etc).

Table 2. Governor Basin restoration project budget.

Item	Quantity	Unit	Unit Cost	Item Cost	Notes
Design, Engineering, and Permitting Costs: 2019 and 2020					
Finalize conceptual design	30	hours	$ 75.00	$ 2,250.00	In-kind support from UWP technical committee members.
Engineered design	1	LS	$15,000.00	$ 15,000.00	
NEPA and permitting	50	hours	$ 75.00	$ 3,750.00	Multiple partners. In-kind time at technical committee meetings to support NEPA process.
Confirm landownership	25	hours	$50.00	$ 1,250.00	
Subtotal for Design, Engineering, and Construction Costs:				**$ 22,250.00**	
Construction and Implementation Costs: 2020					
Bid project and secure contractors	60	hours	$ 50.00	$ 3,000.00	UWP and TU
Contract management	60	hours	$ 50.00	$ 3,000.00	UWP and TU
Mobilization/demobilization	1	LS	$ 5,000.00	$ 5,000.00	
Erosion control	1	LS	$ 5,000.00	$ 5,000.00	Erosion control BMPs during active construction.
Excavate waste rock	120	hours	$ 200.00	$ 24,000.00	2 Excavators and operators.
Place cover materials	80	hours	$ 175.00	$ 14,000.00	Combination of dozer and excavator
Grade and fill to direct drainage	40	hours	$ 175.00	$ 7,000.00	Combination of dozer and excavator
Construct drainage channels	40	hours	$ 175.00	$ 7,000.00	1500 linear feet.
Road improvements and low water crossings	1	LS	$ 2,500.00	$ 2,500.00	Gravel and grading work to minimize erosion
Grading and seed bed preparation	60	hours	$ 200.00	$ 12,000.00	Combination of dozer and excavator
Amendments, seed, and cover materials	7	acres	$ 1,750.00	$ 12,250.00	
On-site project manager	250	hours	$ 50.00	$ 12,500.00	
Lodging for project manager	40	nights	$ 125.00	$ 5,000.00	UWP supplies lodging in-kind.
Project manager mileage	3600	miles	$ 0.55	$ 2,015.75	
Subtotal for Construction and Implementation Costs:				**$ 114,265.75**	
Monitoring and Evaluation Costs: 2020 to 2023					
Monitoring and evaluation plan	40	hours	$ 50.00	$ 2,000.00	UWP
Vegetation and erosion evaluations	42	hours	$ 50.00	$ 2,100.00	UWP and TU. Pre-project, weekly during construction, and annually after construction.
Water quality monitoring	90	hours	$ 50.00	$ 4,500.00	UWP and DRMS. Pre-project and post-project high and low flow (3 years total).
Lab analysis costs	48	Lab	$ 200.00	$ 9,600.00	Estimate based on quote from commercial lab and recent shipping charges
Subtotal for Monitoring and Evaluation:				**$ 18,200.00**	
Project Coordination and Administration Costs: 2019 to 2022					
Project coordination	55	hours	$ 50.00	$ 2,750.00	UWP
Grant reports and project updates	130	hours	$ 50.00	$ 6,500.00	UWP, biannual reports to grantors
public outreach and communication	50	hours	$ 40.00	$ 2,000.00	UWP, biannual updates to the community and general outreach via monthly newsletter and coverage in local newspapers.
Subtotal for Coordination and Administration:				**$ 11,250.00**	
Total Cost of Governor Basin Restoration Project:				**$ 165,965.75**	

5.2 Project Funding and In-Kind Match

UWP and project partners have secured $81,750.00 in cash and in-kind contributions to implement the project. UWP would like $67,215.75 from the NRD program for the Governor Basin restoration project. The anticipated grant request to CWCB and GBRT is $17,000.00.

OSMI will provide staff, contractors, and equipment during the construction phase of the project. UWP board members will provide lodging to UWP contractors during the construction phase of the project. The project funding allocations are presented in Table 3.

Table 3. Summary of funding allocations for the Governor Basin restoration project. The percent match for the project is 122%.

Item	Item Cost	Funding Source					
		UWP	OSMI	DRMS	TU	CWCB/ GBRT	NRD
Design, Engineering, and Permitting Costs: 2019 and 2020							
Finalize conceptual design	$ 2,250.00	$ -	$ 750.00	$ 750.00	$ 750.00	$ -	$ -
Engineered design	$ 15,000.00	$ -	$ -	$ -	$ -	$ 15,000.00	$ -
NEPA and permitting	$ 3,750.00	$ -	$ 750.00	$ 1,500.00	$ 750.00	$ 750.00	$ -
Confirm landownership	$ 1,250.00	$ -	$ -	$ -	$ -	$ 1,250.00	$ -
Subtotal for Design, Engineering, and Construction Costs:	**$ 22,250.00**	**$ -**	**$ 1,500.00**	**$ 2,250.00**	**$ 1,500.00**	**$ 17,000.00**	**$ -**
Construction and Implementation Costs: 2020							
Bid project and secure contractors	$ 3,000.00	$ -	$ -	$ -	$ -	$ -	$ 3,000.00
Contract management	$ 3,000.00	$ -	$ -	$ -	$ -	$ -	$ 3,000.00
Mobilization/demobilization	$ 5,000.00	$ -	$ 5,000.00	$ -	$ -	$ -	$ -
Erosion control	$ 5,000.00	$ -	$ -	$ -	$ -	$ -	$ 5,000.00
Excavate waste rock	$ 24,000.00	$ -	$24,000.00	$ -	$ -	$ -	$ -
Place cover materials	$ 14,000.00	$ -	$14,000.00	$ -	$ -	$ -	$ -
Grade and fill to direct drainage	$ 7,000.00	$ -	$ 7,000.00	$ -	$ -	$ -	$ -
Construct drainage channels	$ 7,000.00	$ -	$ 7,000.00	$ -	$ -	$ -	$ -
Low water crossing	$ 2,500.00	$ -	$ 2,500.00	$ -	$ -	$ -	$ -
Grading and seed bed preparation	$ 12,000.00	$ -	$12,000.00	$ -	$ -	$ -	$ -
Amendments, seed, and cover materials	$ 12,250.00	$ -	$ -	$ -	$ -		$ 12,250.00
On-site project manager	$ 12,500.00	$ -	$ -	$ -	$ -		$ 12,500.00
Lodging for project manager	$ 5,000.00	$ 5,000.00	$ -	$ -	$ -	$ -	$ -
Project manager mileage	$ 2,015.75	$ -	$ -	$ -	$ -		$ 2,015.75
Subtotal for Construction and Implementation Costs:	**$ 114,265.75**	**$ 5,000.00**	**$71,500.00**	**$ -**	**$ -**	**$ -**	**$ 37,765.75**
Monitoring and Evaluation Costs: 2020 to 2023							
Monitoring and evaluation plan	$ 2,000.00	$ -	$ -	$ -	$ -	$ -	$ 2,000.00
Vegetation and erosion evaluations	$ 2,100.00	$ -	$ -	$ -	$ -	$ -	$ 2,100.00
Water quality monitoring	$ 4,500.00	$ -	$ -	$ -	$ -	$ -	$ 4,500.00
Lab analysis costs	$ 9,600.00	$ -	$ -	$ -	$ -	$ -	$ 9,600.00
Subtotal for Monitoring and Evaluation:	**$ 18,200.00**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 18,200.00**
Project Coordination and Administration Costs: 2019 to 2022							
Project coordination	$ 2,750.00	$ -	$ -	$ -	$ -		$ 2,750.00
Grant reports and project updates	$ 6,500.00	$ -	$ -	$ -	$ -		$ 6,500.00
Public outreach and communication	$ 2,000.00	$ -	$ -	$ -	$ -		$ 2,000.00
Subtotal for Coordination and Administration:	**$ 11,250.00**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 11,250.00**
Total funding by organization: cash and in-kind donations:		**$ 5,000.00**	**$73,000.00**	**$ 2,250.00**	**$ 1,500.00**	**$ 17,000.00**	**$ 67,215.75**
Total Cost of Governor Basin Restoration Project:							**$165,965.75**
Percent Match to NRD Funds:							**122%**

6.0 PROJECT TIMELINE

The project timeline is presented below.

Table 4. Anticipated schedule for the Governor Basin Restoration Project.

Task	Item	2019				2020				2021				2022				2023			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Design, Engineering, and Permitting: 2019 and 2020	Finalize conceptual design																				
	Engineered design																				
	NEPA and permitting																				
	Confirm landownership																				
Construction and Implementation: 2020	Bid project and secure contractors																				
	Contract management																				
	Mobilization/demobilization																				
	Erosion control																				
	Excavate waste rock																				
	Place cover materials																				
	Grade and fill to direct drainage																				
	Construct drainage channels																				
	Road improvements and low water crossings																				
	Grading and seed bed preparation																				
	Amendments, seed, and cover materials																				
	On-site project manager																				
Monitoring and Evaluation: 2020 to 2022	Monitoring and evaluation plan																				
	Vegetation and erosion evaluations																				
	Water quality monitoring																				
Project Coordination and Administration: 2019 to 2022	Project coordination																				
	Grant reports and project updates																				
	Public outreach and communication																				

Notes
Dark blue CWCB and GBRT grant deadlines (February 1, 2019) and anticipated grant contracting period.
Dates in teal are firm.
Dates in grey are tentative or estimated.
Tasks in yellow continue through the duration of the project.
Purple deliverable due dates for design, construction, and monitoring activities

7.0 ROLES AND RESPONSIBILITIES

UWP will partner with OSMI, DRMS, TU, and USFS to implement the project. UWP will oversee project funds, on-site project management, administration, grant reporting, and project evaluation. Qualified and insured contractors with experience in the San Juan mountains will complete the project engineering and construction. DRMS, TU, and USFS will provide technical expertise throughout project implementation and post-project monitoring and evaluation.

8.0 STRATEGY FOR PUBLIC COMMUNICATION

UWP will lead public outreach and communication. Community input will be discussed at the Board of County Commissioner's meetings and UWP board meetings. The City of Ouray and County of Ouray will provide space for community meetings.

To date, local stakeholders have participated in three Ouray County Board of County Commissioners meetings, along with five UWP technical committee and board meetings to develop the Governor Basin NRD application.

8.1 Point of Contact for Project

Ashley Bembenek, technical coordinator for UWP, will be the primary point of contact for this project.

9.0 Project Eligibility

The Governor Basin Restoration Project advances the objectives of the NRD Program by restoring equivalent natural resources including alpine, riparian, and aquatic habitat similar to those injured by the Idarado Project. Due to its location in the headwaters, improvements to watershed health and function in Governor Creek have the potential to improve riparian and aquatic health throughout the Canyon Creek Watershed. An estimated 8 miles of surface waters and adjacent riparian area from Governor Creek to Canyon Creek would benefit from the proposed restoration activities. The health of the Uncompahgre River Watershed is impaired due to the Idarado project. Water quality and watershed health improvements in the Canyon Creek watershed, which is immediately adjacent to the Red Mountain Creek watershed, will benefit the Uncompahgre River Watershed.

9.1 Proponents, Partners, and Abilities

The partnerships associated with the proposed Governor Basin further increase the likelihood of project implementation. UWP, DRMS, OSMI, and USFS have been exploring opportunities to complete a restoration project in Governor Basin since 2015. The parties are very pleased to apply for project funding through the NRD program.

9.2 Proponents: Uncompahgre Watershed Partnership

The Uncompahgre Watershed Partnership (UWP) was formed in 2007. Stakeholders make decisions on a consensus basis to promote sustainable use of water resources, improve water quality, and ecological resiliency in the Uncompahgre Watershed. In 2013, UWP was incorporated as a 501c(3) non-profit organization. In 2012, UWP was awarded a nonpoint source (NPS) grant to complete three restoration projects: Sneffels Creek bank stabilization and restoration, Michael Breen Mine restoration, and the Vernon Mine restoration.

The Sneffels Creek bank stabilization project was designed to minimize erosion of the Atlas Mill tailings by reshaping the stream channel. In the summer of 2016, a 450-foot reach of Sneffels Creek was reshaped to form a single-thread channel with three lateral stages to increase channel capacity during high flows. The western stream bank was further stabilized with three vane features made with large boulders, rip-rap, and log-cribbing. Native willows were transplanted onto the vanes to further stabilize the western stream bank.

In October 2014, restoration of the Michael Breen adit began. Previously, the adit drainage flowed over and infiltrated into fine-grained mine waste, likely increasing metal concentrations in both surface and groundwater. Drainage was consolidated into a ditch to prevent further contamination. In October 2015, a one-acre contaminated area between the adit and the Uncompahgre River was amended with biochar, seeded with a native seed mix, and covered with a shredded aspen mulch to facilitate plant growth. Additional maintenance to improve vegetation cover occurred in 2016.

In the fall of 2015, for the Vernon Mine restoration project, approximately 1,500 cubic yards of waste rock was removed from areas adjacent to Gray Copper Gulch and placed in a consolidation area. Soil amendments and aspen mulch were applied in the waste removal area. A drainage ditch was constructed to convey water draining from the adit to minimize erosion and interaction with contaminated materials. Disturbed areas, including the removal area, were seeded with a custom high alpine seed mix. Site maintenance continued in 2017, including additional seeding, amendments, and hydromulch.

Together, the successful implementation of these projects demonstrates UWP's ability to collaborate, plan, and implement projects that restore stream structure and function to improve the ecological resiliency of the Uncompahgre Watershed.

In early 2018, UWP completed three water quality assessment reports using data collected from the Uncompahgre Watershed from 2012 to 2017. The reports informed UWP's strategic plan which identifies restoration in Governor Basin as a top priority for UWP in their continued effort to improve watershed health in the upper Uncompahgre Watershed.

The UWP Board of Directors has provided a letter of support for the Governor Basin Restoration Project (Appendix A).

9.3 Project Partners

Ouray Silver Mines Incorporated

OSMI owns and operates the Revenue-Virginius Mine located near the historic Sneffels townsite, approximately 6.0 miles outside of Ouray. OSMI has a road maintenance agreement, that includes substantial in-kind donations, with Ouray County to maintain Camp Bird Road which is used to access Governor Basin. OSMI and UWP have collaborated to complete a bank stabilization project in Sneffels Creek. OSMI and their consultants are active members of the UWP technical committee.

OSMI has provided a letter of support for the Governor Basin Restoration Project (Appendix A).

US Forest Service

The USFS is an active member of the UWP technical committee. Initial discussions regarding the proposed Governor Basin restoration project started in late 2016. Local parties have discussed the steps necessary to navigate National Environmental Policy Act (NEPA) requirements related to work on Forest Service Lands.

Colorado Department of Reclamation Mining and Safety

The Colorado DRMS is one of UWP's longest standing partners. DRMS staff will provide technical expertise to assist UWP as the Governor Basin Restoration Project is implemented and during the post-project monitoring period. Local DRMS staff have extensive expertise regarding geology, historic mine sites, and restoration in the San Juan Mountains.

Trout Unlimited

TU is a nationally recognized organization that has implemented several successful mine reclamation projects throughout Colorado. The Colorado Abandoned Mine Land Program Manager for TU will provide assistance to support project planning, design, and implementation.

Ouray County and City of Ouray

Ouray County and the City of Ouray are supportive of the proposed Governor Basin restoration project. Ouray County and the City of Ouray have assisted and plan to continue assisting with public communications related to the project. Ouray County is also interested in evaluating revegetation and supporting weed management following project construction.

Ouray County has provided a letter of support for the Governor Basin Restoration Project (Appendix A).

APPENDIX A: LETTERS OF SUPPORT

Uncompahgre Watershed Partnership
P.O. Box 392, Ridgway, CO 81432
970-325-3010 • uwpcoordinator@gmail.com

December 19, 2018

Ross Davis, Idarado Project Manager
Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South
Denver, CO 80246-1530
Delivered via email: ross.davis@state.co.us

RE: Natural Resource Damage Funds Project Proposal for the Governor Basin Restoration Project

Dear Mr. Davis,

The Uncompahgre Watershed Partnership (UWP) is pleased to submit the attached Natural Resource Damage (NRD) Funds project proposal for the Governor Basin restoration project. Since 2015, UWP, the Colorado Division of Reclamation, Mining, and Safety (DRMS), Ouray Silver Mines, Inc. (OSM), and Trout Unlimited (TU) have been evaluating water quality and environmental conditions, conceptual project designs, and potential funding sources to complete a restoration project in Governor Basin. The funding opportunity provided through the NRD program is an exciting opportunity to fund stream and watershed restoration that is consistent with the goals of several local organizations.

The proposed restoration site is in upper Governor Basin where waste rock and tailings from the Terrible and Virginius mines leach metals that impair water quality, downgradient aquatic and terrestrial habitat, and watershed health. The proposed restoration project will use several best management practices to minimize the effect of mine waste on water quality, aquatic life, riparian habitat, and sensitive alpine tundra. The proposed restoration project will restore natural resources equivalent to those damaged at the Idarado site.

Sincerely,

Judi Chamberlin
Board Secretary
Uncompahgre Watershed Partnership

Ouray Silver Mines, Inc.
1900 Main St. Unit 1
PO Box 564
Ouray, CO 81427

OURAY SILVER MINES

To: **Ross Davis**
Idarado Project Manager
Colorado Department of Public Health and Environment
Hazardous Materials and Waste Management Division
4300 Cherry Creek Drive S.
Denver, CO 80246-1530

Date: **December 18, 2018**

Subject: **Governor Basin NRD Proposal**

Dear Mr. Davis,

Ouray Silver Mines Inc. (OSMI) is pleased to submit this letter supporting the Uncompahgre Watershed Partnership NRD fund application for the Governor Basin Restoration Project. OSMI owns and operates the Revenue-Virginius under Division of Reclamation, Mining, and Safety (DRMS) 112d mining permit M2012-032, which includes a small active mining area associated with a vent raise and emergency escapeway on OSMI property in Governor Basin. This small active area surrounding the vent raise should be relatively easy to avoid during construction.

In addition to the 112d active mining permit, OSMI has an Exploration Notice of Intent (NOI P2015-003) in Governor Basin associated with past exploration drilling. All the drill holes associated with the NOI have been plugged. One drill pad in Governor Basin remains to be reclaimed, along with three in a neighboring basin. The NOI expires in March 2020. The Governor Basin drill pad will be reclaimed during the summer of 2019 in preparation for closing the NOI in a timely fashion. No additional exploration drilling is planned in Governor Basin.

OSMI has worked for several years with DRMS Inactive Mine Reclamation Board and UWP towards a restoration plan for legacy mining impacts in Governor Basin. The capping of acid generating materials with neutralizing waste rock from the Virginius vein is expected to drastically reduce metal loading and reduce water quality impairment in the drainage. OSMI is committed to an environmental covenant or on the consolidation area so that it will not be disturbed by later mining impacts by OSMI.

As a part of the ongoing multi-stakeholder effort to restore legacy mining impacts in Governor Basin and improve aquatic conditions down gradient, OSMI has agreed to in-kind contributions with equipment and operators in addition to analytical work, mapping, and planning.

Thank you for considering UWP's Governor Basin Restoration Project application. Please do not hesitate to call me with concerns or questions at 970-325-9830.

Sincerely,

Brian K. Briggs, P.E.
CEO

DON BATCHELDER
JOHN E. PETERS
BEN TISDEL

BOARD OF COUNTY COMMISSIONERS

541 4th Street • P.O. Box C • Ouray, Colorado 81427 • 970-325-7320 • FAX: 970-325-0452

December 4, 2018

Ross Davis, Idarado Project Manager
Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South
Denver, CO 80246-1530

Re: Ouray County Support for Governor Basin Restoration Project

Dear Mr. Davis,

During the spring and summer of 2018, Ouray County hosted a series of meetings with local stakeholders to help identify and prioritize projects in the upper Uncompahgre Watershed. The public process incorporated feedback from multiple stakeholders and evaluated potential projects relative to Natural Resource Damage Fund program guidelines. Through this process, local stakeholders identified the Governor Basin Restoration Project as a priority for funding.

The County of Ouray strongly supports the Governor Basin Restoration Project. Historic mining activities and abandoned mine waste in upper Governor Basin have impaired natural resources in the upper Uncompahgre watershed. The proposed restoration project will restore natural resources through a cap and cover project that minimizes surface water interaction with mine waste. The restoration activities will improve alpine, aquatic, and riparian habitat, as well as water quality, in a headwaters region, which benefits downstream waters such as Sneffels and Canyon Creek. The project will not only improve watershed health in the Uncompahgre watershed, but also provide benefits to recreational users. Governor Basin is a popular 4X4 area for nature viewing and improvements to downstream fish habitat benefits anglers.

Moving forward, the County plans to continue to support the Governor Basin Project by assisting with public communication to facilitate further project discussions and stakeholder input.

Sincerely,

Don Batchelder
Board of County Commissioners
Ouray County

APPENDIX B: ASSESSMENT REPORT: GOVERNOR BASIN: HUMBOLDT, VIRGINIUS, AND TERRIBLE MINE SITES NEAR OURAY, COLORADO

ASSESSMENT REPORT: GOVERNOR BASIN: TERRIBLE, VIRGINIUS, AND HUMBOLDT MINE SITES NEAR OURAY, COLORADO

PREPARED FOR THE UNCOMPAHGRE WATERSHED PARTNERSHIP

PREPARED BY: ALPINE ENVIRONMENTAL CONSULTANTS LLC

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ABBREVIATIONS AND ACRONYMS

CDPHE: Colorado Department of Public Health and Environment

CGS: Colorado Geological Survey

DRMS: Division of Mining, Reclamation and Safety, a part of the Colorado Department of Natural Resources

EE/CA: Engineering Evaluation/Cost Analysis

EPA: Environmental Protection Agency or US EPA

ug/L: micrograms per liter, equivalent to parts per billion (ppb)

mg/L: milligrams per liter, equivalent to parts per million (ppm)

mg/kg: milligrams per kilogram, on a dry weight basis, equivalent to parts per million (ppm)

NRCS: Natural Resources Conservation Service

OSM: Ouray Silver Mines Inc.

SAP or SAPP: sampling and analysis plan or sampling and analysis project plan.

SPLP: synthetic precipitation leaching procedure (EPA Method 1312). A soil or sediment test that quantifies the release of pollutants under simulated environmental conditions. The leachate is analyzed to determine constituent concentrations and the results are reported in mass per unit volume (e.g. ug/L). This report refers to these samples as SPLP samples.

USFS: Unites States Forest Service

USGS: United States Geological Survey

UWP: Uncompahgre Watershed Partnership

WQCD: Water Quality Control Division, a division of the Colorado Department of Public Health and Environment.

1.0 INTRODUCTION

Governor Basin is in the Sneffels Mining District in the Canyon Creek watershed, in Ouray county, Colorado. The basin contains several abandoned mine features that contribute metals to the water that drains from the basin. Waste piles and adits associated with the Humboldt, Virginius, and Terrible mines appear to be the primary sources of contamination. Governor Basin is tributary to Sneffels Creek which meets Imogene Creek to form Canyon Creek. Canyon Creek flows into the Uncompahgre River in Ouray, Colorado (Figure 1).

Governor Basin is on the 303(d) List for impairment of aquatic life standards for cadmium, copper, lead, and zinc and for impairment of the manganese water supply standard (Regulation 93, 2018). Sneffels Creek downstream of Governor Basin is on the 303(d) List for impairment of the aquatic life standards for cadmium, lead, and zinc and for impairment of the manganese water supply standard. Sneffels Creek downstream of Governor Basin is also impaired for aquatic life (Regulation 93, 2018). Canyon Creek does not attain the aquatic life use for zinc and is also on the 303(d) List. In addition to the 303(d)-listed parameters, this analysis also includes mercury and arsenic concentrations to assess risks to human-health. Silver was also included in the assessment.

1.1 OBJECTIVES

This removal assessment report describes site characteristics, sampling activities, summarizes existing data, and analyzes potential contaminant pathways. The assessment was completed to evaluate the need for reclamation of abandoned mine waste in Governor Basin to minimize risks to human-health, ecological receptors, and to improve water quality in Governor Basin, Sneffels Creek, and the Canyon Creek watershed. This report primarily relies upon data collected between 2014 and 2017.

2.0 WATERSHED CHARACTERISTICS

The Canyon Creek watershed is approximately 25 square miles and contains several smaller sub-watersheds including Governor Basin, Yankee Boy Basin, Imogene Basin, Silver Basin, and Richmond Basin. The Uncompahgre River watershed drains a 1,115-square mile area from the headwaters in the San Juan Mountains. Nearly 75 miles downstream the Uncompahgre River flows into the Gunnison River near Delta, Colorado (Figure 1; UWP, 2013). The Gunnison River flows into the Colorado River near Grand Junction, Colorado.

2.1 LAND OWNERSHIP

The Canyon Creek watershed is predominantly public land managed by the US Forest Service. There are privately owned, patented and unpatented mine claims in Governor Basin. Most of the private land in Governor Basin is owned by OSMI. Appendix A presents patented and unpatented mine claims in Governor Basin.

2.2 CLIMATE

The nearest climate station is in Telluride, approximately 5 miles east southeast and about 3,500 feet lower in elevation. Generally, summers in the Telluride and the surrounding mountains are cool and comfortable while winters are snowy with low temperatures that fall below zero. The warmest average temperatures, which range from 72 to 77 degrees Farenheit, occur in June, July, and August. From

October to May the average low temperature remains below 32 degrees Farenheit (Western Regional Climate Center, 2018). Historically, the median snow water equivalent peaks in April or May, at up to 42 inches at Red Mountain Pass (NRCS, 2017). In the uppermost portions of the basin, snow can persist until August. Typically, lingering snowcover prevents access to Governor Basin until mid-July.

2.3 Geology and Geomorphology

The Canyon Creek watershed is within the San Juan Mountains of southwest Colorado. The San Juans are a rugged, steep, and highly mineralized mountain range in the Rocky Mountain system. The San Juan Mountains are Precambrian metamorphic rock with mid-Tertiary Andesitic volcanic intrusions (UWP, 2013). The bedrock in the area is fractured volcanic rock that is intruded by breccia pipes and veins (Montgomery Watson, 2001). Small clusters of the breccia pipes contain rich orebodies that have extractable quantities of several minerals, including gold, lead, silver, and copper (Nash, 2002). Extensive glacial activity shaped the valleys and cirques of the San Juan Mountains and the wide valley floors below. Glaciers melted by the end of the Pleistocene Period 10,000 years ago and left steep, scoured mountainsides with Quaternary alluvial deposits in the basins. The steep topography and high elevation of Governor Basin provide conditions for erosional geomorphic processes such as avalanches, rock glaciers, mass wasting, and a high volume of natural sediment transport.

2.4 Vegetation

Governor Basin is situated at approximately 11,000 feet and is above tree line. The basin is alpine tundra with a wide variety of wildflowers, grasses, sedges, cushion plants, and lichens during the short, alpine growing season. Most areas disturbed by historic mining activity or natural hillslope erosion are barren. The lower basin is below tree line and the north-facing slope is comprised of patchy sub-alpine forests with Engelmann spruce and subalpine fir. The south-facing slope of the lower basin is steep and mostly covered with bare rock and short, alpine vegetation, but some patches of shrubs and conifers populate the lower slopes.

2.5 Aquatic Life

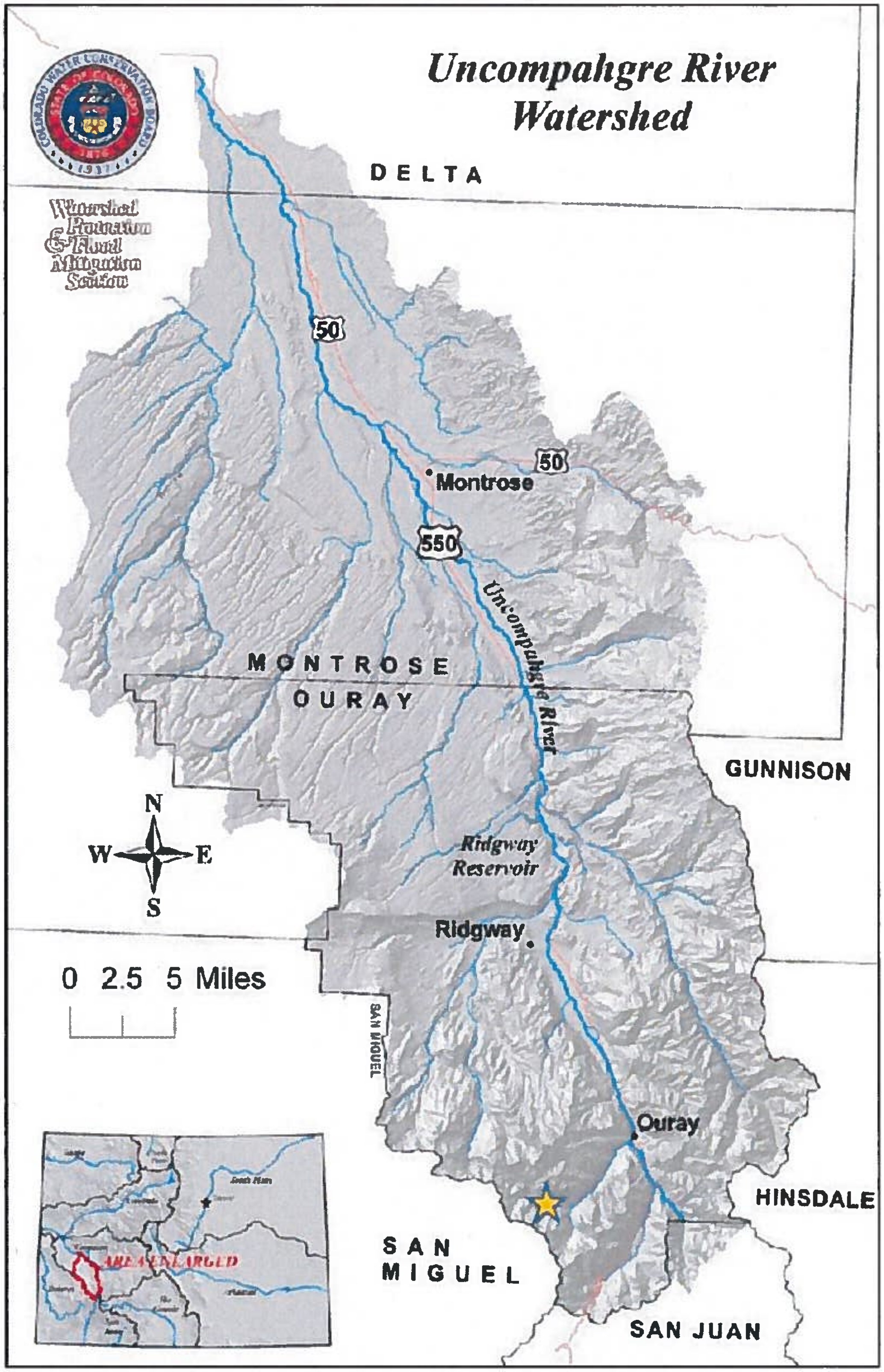
The Colorado Water Quality Control Commission classifies Governor Creek (Segment 5) and Sneffels Creek (Segment 9) as aquatic life cold water class 2 streams, meaning they could be suitable habitat for a variety of cold water biota but for correctable water quality impairments. Sneffels Creek (Segment 5) is on the 303(d) List for impairment of the macroinvertebrate community, lower Sneffels Creek (Segment 9) is on the M&E list for impairment of the macroinvertebrate community.

2.6 Surface Water Quality

Governor Basin is on the 303(d) List for impairment of aquatic life standards for cadmium, copper, lead, and zinc and for impairment of the manganese water supply standard (Regulation 93, 2018). Sneffels Creek downstream of Governor Basin is on the 303(d) List for impairment of the aquatic life standards for cadmium, lead, and zinc and for impairment of the manganese water supply standard. Sneffels Creek downstream of Governor Basin is also impaired for aquatic life; Sneffels Creek near the confluence with Canyon Creek is potentially impaired for aquatic life (Regulation 93, 2018). Canyon Creek does not attain the aquatic life use for zinc and is also on the 303(d) List. In addition to the 303(d)-listed parameters, this analysis also includes mercury and arsenic concentrations to assess risks to human-health. Silver was also included in the assessment.

Historic abandoned mine and mill sites distributed throughout the watershed are a source of metal pollution in the watershed. However, mineralized geology in the watershed likely accounts for a portion of the metal pollution.

Figure 1: Map of the Uncompahgre River watershed in southwest Colorado (UWP, 2013). Governor Basin is located near the star.



3.0 SITE CONDITIONS AND BACKGROUND

Governor Basin is southwest of Ouray in the southwest portion of Ouray County, Colorado on land owned by both the USFS and Ouray Silver Mines. The following sections describe the site in detail.

3.1 LOCATION

Governor Basin is located in the headwaters of the Canyon Creek watershed within the San Juan Mountains, at over 11,000 feet above sea level. San Sophia ridge is located on the west side of Governor Basin. San Sophia Ridge and an adjacent ridge that bears south form the border between Ouray and San Miguel counties. Governor Basin is accessed via Governor Basin Road from Camp Bird Road and is approximately 10 miles southwest of Ouray, Colorado. Water drains from Governor Basin via an unnamed tributary to Sneffels Creek that will be called Governor Creek throughout this report. Governor Creek flows into Sneffels Creek upstream of the Revenue Mine. Canyon Creek flows into the Uncompahgre River in the town of Ouray. Governor Creek is part of WQCC segment COGUUN05 (segment 5, Regulation 35, 2017).

Segment 5 includes several tributaries to the Uncompahgre River. Upper Sneffels Creek is also part of segment COGUUN05 until it becomes COGUUN09 at a point immediately downstream of Atlas Mill, 1.5 miles upstream of the confluence of Sneffels Creek and Imogene Creek that forms Canyon Creek.

3.2 SITE HISTORY

Governor Basin is within the historic Sneffels Mining district and was home to the Virginius, Terrible, Humboldt, and Mountain Top mines. Other small mine claims exist throughout the basin, especially on the west slope. Previous report suggests that the adits lack flow and waste rock piles are typically small. Principal ore bearing deposits were discovered within the district between 1875 and 1881. The Mountain Top Mine and Mill was one of five processing mills that operated in the Canyon Creek Watershed (CDPHE, 1999).

3.3 SITE CHARACTERISTICS

The Virginius, Terrible, and Humboldt mines are situated in upper Governor Basin and both have extensive underground workings that follow veins rich in silver and gold. In this report, the Virginius Mine refers to mining that occurred along the Virginius vein and the Terrible Mine refers to mining that occurred on the Terrible vein. The Virginius vein typically occurs in San Juan Tuft and materials tend to have limited acidity and decreased metal solubility. The Terrible vein tends to generate fine-grained and very acidic mine waste that tends to have very high metal concentrations.

Runoff from the mine dumps and drainage from the adits contribute a substantial volume of water to Governor Creek (CGS, 1997). Snowmelt, precipitation, and drainage from the Terrible and Humboldt Mine adits flow over and through the mine waste piles in the basin (Figure 2). The Humboldt and Terrible mine adits flow intermittently; field observations suggest that the Virginius adit lacks flow. Flow from the adits likely peaks following snowmelt, but little else is known about flow patterns at the Humboldt and Terrible adits.

The steep basin walls are covered in thick talus deposits. Mining activity changed the morphology of the basin by adding waste rock and fines associated with large mine dumps (CGS, 1997). Tailings and waste rock have been transported down the steep hillslopes and onto the basin floor by erosional processes.

Mine waste was deposited in stair-stepped fashion with three main tiers of waste. The tiers were created as different veins were mined. The uppermost waste rock dump is associated with the Virginius Mine. The lower three waste rock dumps are associated with the Terrible vein which was accessed via the Terrible #2 and Terrible #3 mine adits. Terrible #3 adit drains periodically and forms two channels that flow across the lowest tier of mine waste. The tailings on the floor of the basin are from both the Virginius and Terrible mines; Governor Basin road crosses the mine waste. There are approximately 38,000 cubic yards of mine waste at the Virginius-Terrible site (CGS, 1997). In a 1994 field survey, CGS recorded a pH of 3.6 in a channel draining the mine dumps near the Terrible Mine.

There are multiple small channels that drain Governor Basin; the channels originate from seeps, springs, snowmelt, and mine adits. Some of the channels flow across the Terrible Mine waste, another channel originates from the Humboldt Mine adit. The channels that flow across mine waste feature orange and red-brown precipitates. The channels converge lower in the basin and flow out of Governor Basin via Governor Creek (Figure 2). The stream crosses the road that accesses the upper basin at a point adjacent to the lowest tier of the Terrible waste (Figure 2).

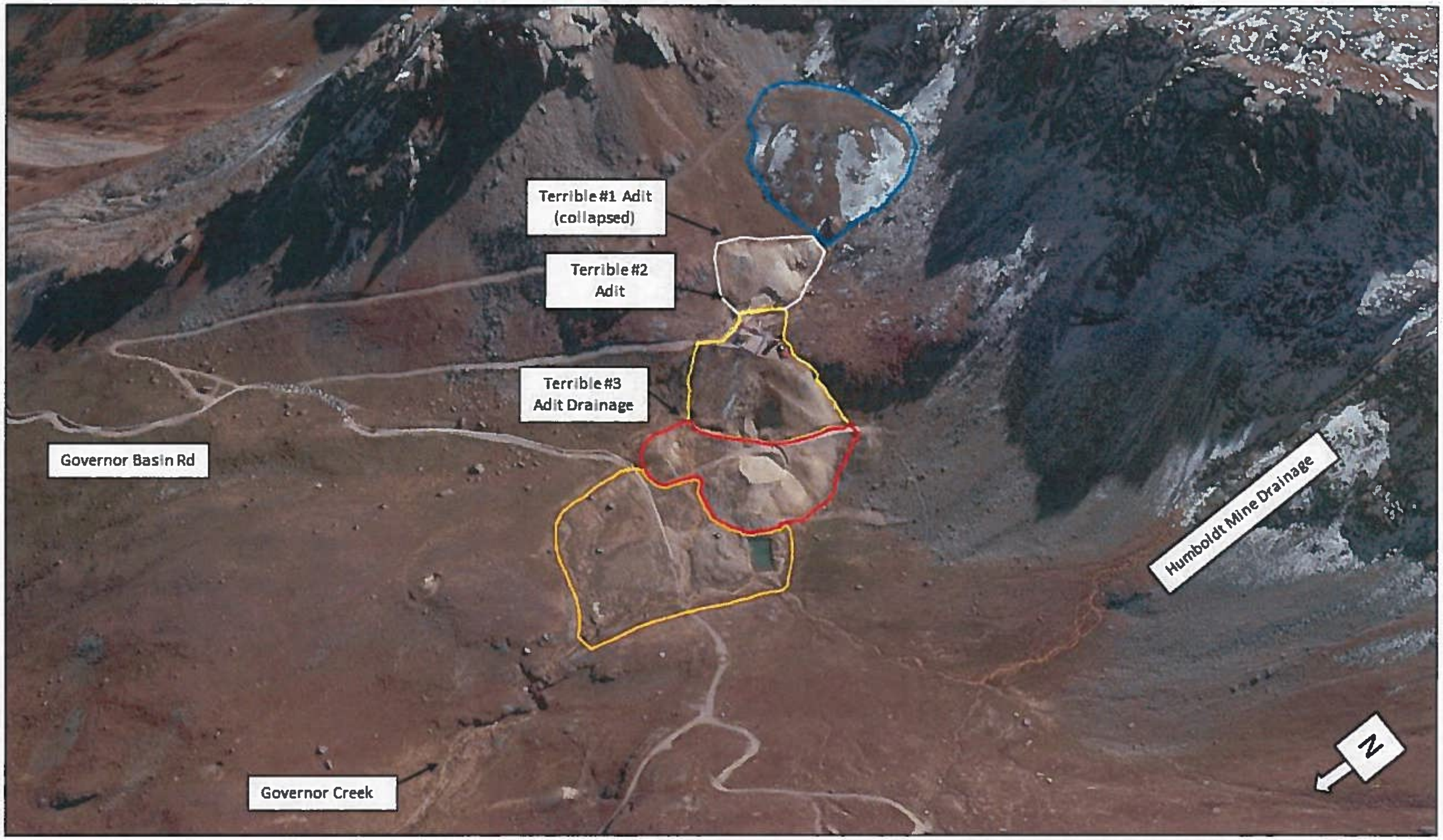
Portions of the historic Terrible Mine waste are within the patented mine claim owned by Ouray Silver Mines Inc (OSM). Recently, OSM completed maintenance work on the underground workings of their mine, including a vent raise that reaches the surface near the Terrible dump in Governor Basin. During the process to improve the vent raise, OSM constructed a staging area, pond, safety shed, and improved the access road. The remainder of the land near the Virginius and Terrible mine waste is owned by the USFS (see Appendix A).

3.4 Current Uses

Mining history, alpine wildflowers, and incredible scenery attract visitors to the Ouray area. Governor Basin is accessible by a 4x4 road, during the summer months after the snow has melted. During the summer, the road is a popular destination for both private and commercial recreational off-road vehicles.

In addition to recreational use, a portion of the basin is used by OSM. The Revenue-Virginius Mine has a vent raise in Governor Basin. The area near the vent, on OSM property, is used to stage materials and a safety escape shed that is accessible from the underground workings of their mine.

Figure 2. Mine features in Governor Basin. The Virginius Mine waste rock pile is outlined in blue. The Terrible #1 mine dump is outlined in white, #2 mine dump in yellow, and #3 mine dump in red. Additional contamination attributed to the Terrible and Virginius mine tailings is outlined in orange on the downgradient end of the site. Governor Creek forms downgradient (north) of Governor Basin Road. OSM's vent raise and active permit area is outlined in purple. All polygon boundaries are approximate. The Humboldt Mine drainage flows north from the adit toward the Terrible Mine and turns east on the basin floor to join Governor Creek. Imagery courtesy of Google Earth.



4.0 Data Collection Activities

Data collection included in this site assessment occurred between 2014 and 2017. Sample collection was completed by DRMS, WQCD, UWP and partners, and the former owners of the Revenue Mine.

4.1 2016 Virginius and Terrible Sediment Samples

On October 18, 2016, DRMS, in partnership with OSMI collected sediment samples from seven mine waste locations associated with historic mining at the Virginius and Terrible Mines. A portable XRF was used to survey mine waste at the Virginius and Terrible site. The XRF data and observations were used to select sample seven locations across the site. At each location a composite sample was collected from the surface of the mine dump. The samples were submitted for analysis at ACZ Laboratories. The leachate was analyzed for metals using ASTM standard methods (e.g. SM 6020, SM6010B, and SM7470A).

4.2 2014, 2015, and 2017 Surface Water Samples

In 2014, 2015, and 2017, DRMS, WQCD, and UWP sampled Governor Creek to provide a baseline characterization of abandoned mine sites in Governor Basin. Since 2012, DRMS, WQCD, and UWP sampled water quality throughout the Canyon Creek watershed under high and low flow conditions. In 2014 they added sites in lower Governor Basin; additional sites were added in subsequent events in 2015 and 2017. In total, DRMS, WQCD, and UWP sampled four locations in the upper Governor Basin watershed (Figure 3).

In July 2014, Fortune Minerals, the mining company that owned the Revenue-Virginius mine, collected surface water samples at five locations in upper Governor Basin. Samples were collected from four separate tributaries including a channel from San Sophia Basin to the west, the Humboldt Mine drainage, and two drainage channels that originate from and pass over the Terrible mine waste. One sample was collected below the point where these drainage channels converge in the upper basin (Figure 4).

5.0 RESULTS DISCUSSION

The following section presents results for each type of data collected at the site.

5.1 ASSESSMENT OBJECTIVES

Environmental data was collected by multiple entities to characterize baseline conditions in Governor Basin and to better understand the nature and extent of metal contamination in surface water and waste rock due to historic mining activities within the basin. The compiled data will be used to identify impacts and data gaps.

The surface water quality and waste rock data will be used to determine whether:

1. Significant leaching or discharge occurs at concentrations above water quality criteria or other benchmarks, and
2. Contaminant concentrations are at levels of concern for aquatic life.

5.2 ESTIMATED MINE WASTE VOLUMES

The Abandoned Mine Lands Inventory, conducted by Colorado Geologic Society in 1994, estimates the total volume of mine waste associated with the Virginius and Terrible mines is approximately 38,000 cubic yards. However, the waste originates from different veins and have different chemistries (Section 5.3). The volume of mine waste at the Humboldt Mine is unknown.

Future field investigations should measure or estimate the volume of mine waste more precisely at the Virginius, Terrible, and Humboldt mines, and note the source of the waste.

5.3 WASTE ROCK SEDIMENT SAMPLE RESULTS

Three locations, east, middle, and west, were sampled from the uppermost pile of waste rock associated with the Virginius Mine (Figure 2, blue polygon). The Terrible #2 waste rock pile was sampled downgradient of the vent raise (Figure 2, yellow polygon). The Terrible #3 waste rock pile was sampled to the east of the Terrible #3 Adit drainage (Figure 2, red polygon). Waste Rock from the Virginius #1, (Figure 2, white polygon) was not sampled. A mixture of waste rock and tailings was sampled in an area upgradient and east of the sediment pond within the red polygon in Figure 2. The Virginius Tailings (a mixture of material from both the Virginius and Terrible veins) were sampled north of Governor Basin road within the orange polygon in Figure 2. GPS coordinates were not recorded at the sediment sample locations.

Table 1. SPLP metal concentrations in sediment samples collected from mine waste piles associated with the Virginius and Terrible veins in Governor Basin on October 18, 2016.

Sample Location	SPLP Metal Concentrations in ug/L						
	pH	Arsenic	Cadmium	Copper	Lead	Mercury	Zinc
Virginius West	6.3	2.6	2.8	2.5 (J)	39.1	<0.2	359
Virginius East	8.4	2.7	0.1 (J)	1.5 (J)	5.7	<0.2	6
Virginius Middle	8.3	1.8	<0.1	0.5 (J)	0.2 (J)	<0.2	<2
Terrible 2	4.0	13	45	173	3,340	<0.2	7,050
Terrible 3	3.4	9.4	4.2	27	1,090	<0.2	821
Mix of Virginius and Terrible 2	2.9	36	10	73	2,090	0.8 (J)	1,930
Virginius Tailings	4.2	1.1	45	384	7,710	<0.2	6,560

Notes

(J)= estimated result. Concentration between method detection limit and practical quantation limit.

5.3.1 Sediment pH

Sediment pH at the upper Virginius waste pile (Figure 2- blue polygon) ranged from basic to mildly acidic (Table 1). Sediment pH in the Terrible #2, Terrible #3, Virginius Tailings, and mixed sample was acidic ranging from 2.9 to 4.2 (Figure 2- yellow, red, and orange polygons).

5.3.2 Arsenic Concentrations in Sediment

Arsenic concentrations ranged from 1.1 ug/L in the lowermost Virginius Tailings to 36 ug/L in the mixed sample from the Virginius and Terrible #2 (Table 1). Waste associated with the Terrible vein had higher concentrations of arsenic than the Virginius waste. The sediment samples suggest that the waste could leach arsenic at concentrations capable of exceeding water quality standards (i.e. water + fish, human-health, and water supply).

5.3.3 Cadmium Concentrations in Sediment

Cadmium concentrations ranged from <0.1 ug/L in the waste rock at the Virginius Middle site to 45 ug/L in the Virginius Tailings (Table 1). Waste associated with the Virginius Tailings (orange polygon in Figure 2) and the Terrible vein had higher concentrations of cadmium than the Virginius waste rock located on the upper portion of the site (Figure 4). Cadmium measured in the leachate of all the samples except the Virginius East and Middle samples suggest that the waste may leach cadmium at concentrations greater than the acute aquatic life standard.

5.3.4 Copper Concentrations in Sediment

Copper concentrations ranged from 0.5 ug/L in the waste rock at the Virginius Middle site to 384 ug/L in the Virginius Tailings on the lower portion of the site (Table 1). Copper concentrations in the Virginius mine waste, located on the upper portion of the site, were less than the practical quantitation limit. The waste rock on upper portion of the site is not a substantial source of copper. Mine waste associated with the Terrible Vein and Virginius Tailings may leach copper at concentrations greater than the acute aquatic life standard.

5.3.5 Lead Concentrations in Sediment

Lead concentrations in the sediment samples ranged from 0.2 ug/L at Virginius Middle site to 7,710 ug/L at the Virginius Tailings (Table 1). Waste associated from the Virginius Tailings and the Terrible vein on the lower portion of the site had far higher concentrations of lead than the Virginius waste rock located on the upper portion of the site (Figure 2). Lead concentrations in the leachate from the Terrible mine waste and Virginius Tailings may increase surface water lead concentrations above water quality standards (i.e. aquatic life and water supply).

5.3.6 Mercury Concentrations in Sediment

Mercury was below the method detection limit of 0.2 ug/L in all locations except the mixed sample of the Virginius and Terrible #2 waste rock where the mercury concentration was 0.8 ug/L. Mercury concentrations measured in the waste rock and tailings do not warrant follow-up actions.

5.3.7 Zinc Concentrations in Sediment

Zinc concentrations ranged from <2 ug/L at Virginius Middle waste rock to 7,050 ug/L at Terrible #2 waste rock. Like other metals, the Terrible waste rock and Virginius Tailings had substantially higher concentrations than the Virginius waste rock located on the upper portion of the site (Table 1). Based on zinc concentrations in the leachate, runoff from the waste rock and tailings on the lower portion of the site is likely to increase zinc concentrations in adjacent surface waters.

5.3.8 Summary of Sediment Results

Mercury concentrations in the leachate from all sediment samples was less than the practical quantitation limit. The laboratory analysis suggests that the mine waste is not a source of mercury.

The Virginius vein typically occurs in San Juan Tuff and materials tend to have limited acidity and decreased metal solubility. Mine waste associated with the Virginius vein, on the upper portion of the site, has lower metal concentrations than the mine waste and tailings associated with the Terrible Mine and Virginius Tailings found on the lower part of the site. The Terrible vein tends to generate fine-grained and very acidic mine waste that tends to have very high metal concentrations. Metal concentrations in the sediment leachate suggest that reclamation to isolate mine waste associated with the Terrible Vein and the Virginius Tailings, located on the lower portion of the site, from surface water, runoff, and groundwater could improve surface water quality in Governor Creek and downstream areas.

5.4 Surface Water Quality Results

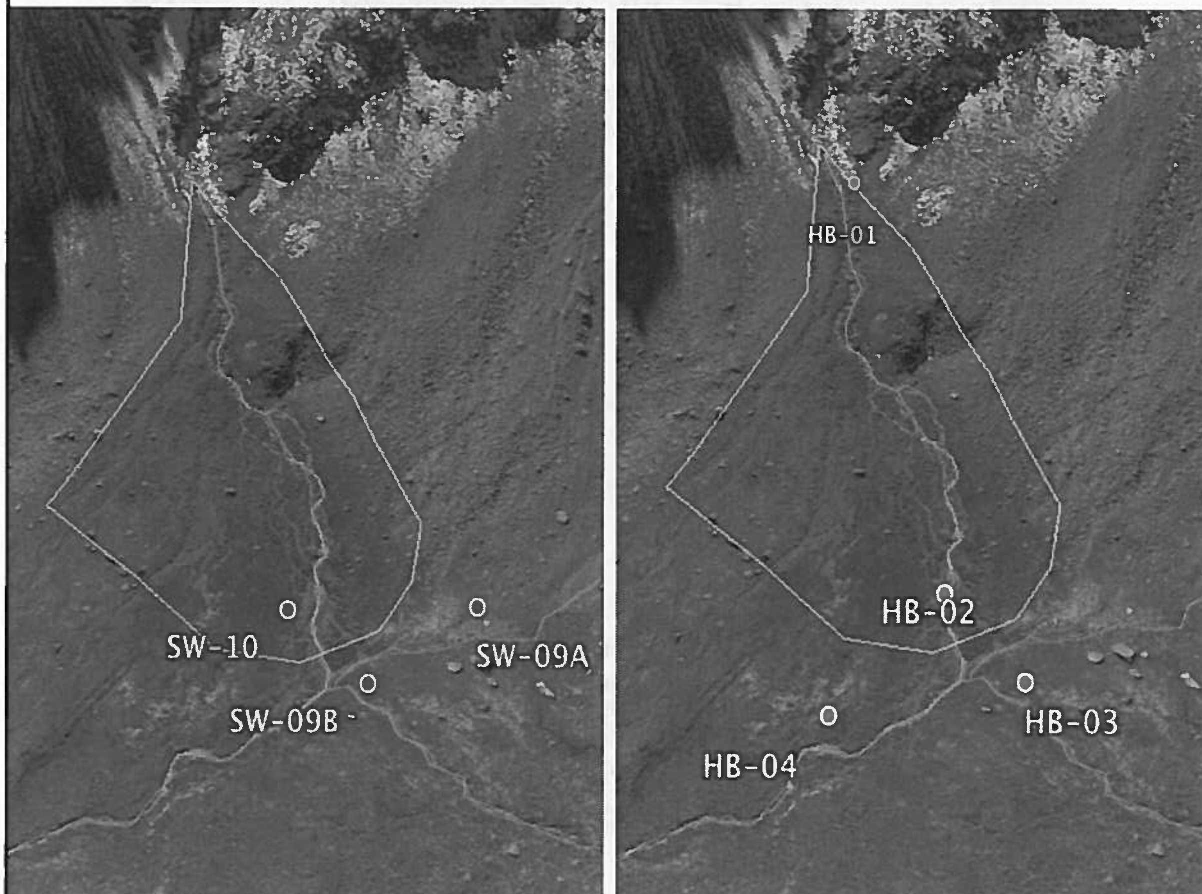
Water quality samples from upstream and downstream of the Humboldt Mine drainage were evaluated to assess the effect of the historic Humboldt Mine on surface water quality. There are two upgradient reference locations: HB-03, sampled once by UWP and partners in 2017, and SW-09, sampled once by previous mine operators in 2014 (Figures 3 and 4). There are two sample locations from the Humboldt drainage channel: HB-02, sampled once by UWP in 2017, and SW-10, sampled once by previous mine operators in 2014. There is one downstream sample location, HB-04, sampled once by UWP and partners in 2017.

Evaluating the impact of the Virginius and Terrible mines is somewhat challenging due to complex drainage patterns on the site and in the basin, which prevented field personnel from bracketing the mine sites with sample locations. However, the sediment leachate samples clearly suggest that the Terrible mine dumps and the Terrible and Virginius Tailings are the primary source of metals and acidity. The 2014 sample event did not include a reference location in the upper portion of the basin (e.g. area upgradient of Virginius waste rock). The San Sophia drainage (SW-09) located upgradient and west of the Humboldt mine drainage can serve as a reference sample (Figure 3); however, geology within the basin may vary. Field notes attributed flow at SW-12 to the Terrible #3 adit and the upper basin drainage. Review of the aerial imagery suggests that flow at SW-12 may be generated from natural sources (i.e. the upper basin drainage) rather than the portal, and the channel lacks iron precipitates characteristic of draining portals in the basin (Figure 4). Water collected at SW-12 flows through dispersed waste rock near the edge of the disturbed area. At SW-11 flow originates from the Terrible #3 portal and passes through Terrible Vein waste rock (Figure 4). Because flow at SW-11 originates from the Terrible #3 portal and passes through mine waste, it better characterizes the effect of the Terrible Mine site. SW-13 characterizes water quality influenced by both the Virginius, Terrible and Humboldt mine sites.

All stream channels in Governor Basin are a part of segment COGUUN05 (Segment 5). Segment 5 is classified as a water supply. However, Governor Creek is not currently used as a water supply. Hardness was not measured in July 2014. The average hardness values measured in 2015 and 2017 were used to calculate hardness-dependent aquatic life standards. Sample locations are presented in Figure 3.

Figure 3. Detailed maps of Humboldt Mine site, the map on the left presents 2014 water quality sample locations and the map on the right presents 2017 water quality sample locations. The exact location of SW-09 is unknown, but likely between SW-09A and SW-09B. Imagery courtesy of Google Earth.

Detailed Maps of Humboldt Mine Site



Legend:

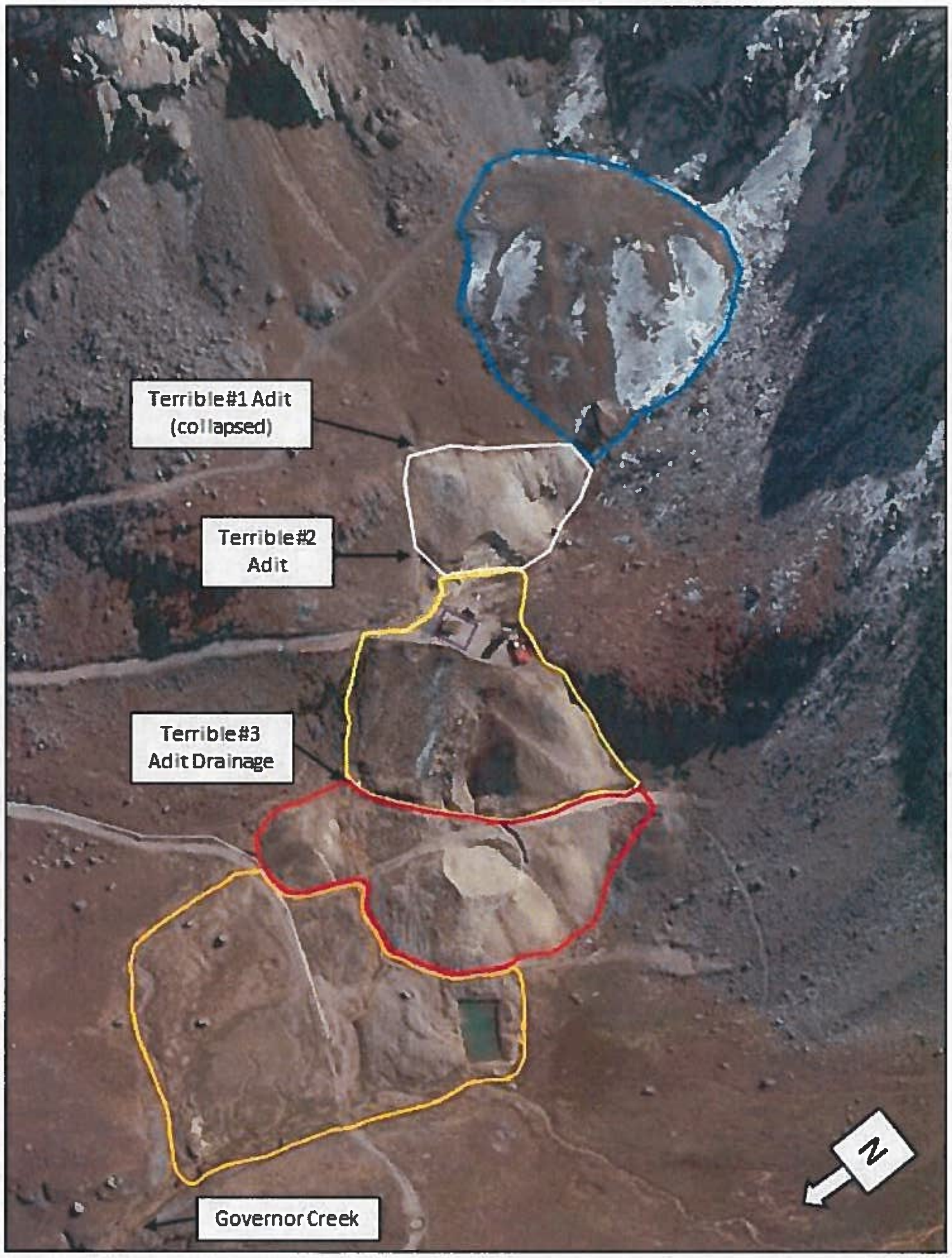
Surface water tributaries

2017 water quality sample locations

2014 water quality sample locations

Flow from the Humboldt Mine adit passes through a debris fan and flow north into an unnamed tributary that flows east to Governor Creek. Reference channels that flow down the west side of the basin from the San Sophia Ridge were sampled as locations HB-03, SW-09A and SW-09B. HB-01 was not sampled due to snow cover in 2017.

Figure 4. Detailed map of the Virginius and Terrible Mine sites. The Virginius waste rock is outlined in blue. The Terrible #1 mine dump is outlined in white, #2 mine dump in yellow, and #3 mine dump in red. Mixed tailings from the Virginius and Terrible veins are outlined in orange. The polygon boundaries are approximate. Imagery courtesy of Google Earth.



5.4.1 pH in Surface Water

The pH of the Humboldt Mine drainage was 3.5, strongly acidic, during high flow in 2017. pH in the tributary downstream of the Humboldt Mine drainage was 5.74, slightly acidic, during high flow in 2017. The pH in Governor Creek downstream of the Humboldt, Virginius, and Terrible mines ranged from 5.15 during low flow in 2015 to 6.13 during high flow in 2015. pH was not reported during the sample event in July 2014.

5.4.2 Arsenic Concentrations in Surface Water

San Sophia Reference Stream (SW-09 and HB-03)

Dissolved arsenic concentrations ranged from 1.4 to 3.1 ug/L during high flow sample collection in 2014 and 2017 (Tables 2 and 4). Dissolved arsenic concentrations were less than the aquatic life standard.

Total arsenic concentrations ranged from 1.4 to 3 ug/L during high flow sample collection in 2014 and 2017 (Tables 2 and 4). Total arsenic concentrations exceeded the water and fish standard.

Humboldt Mine Drainage (SW-10 and HB-02)

Dissolved arsenic concentrations ranged from 0.2 to 1.1 ug/L during high flow sample collection in 2014 and 2017 (Tables 2 and 4). Dissolved arsenic concentrations were less than the aquatic life standard.

Total arsenic concentrations ranged from 7.2 to 8.5 ug/L during high flow sample collection in 2014 and 2017 (Tables 2 and 4). Total arsenic concentrations exceeded the water and fish standard.

Downstream of Humboldt Mine Drainage (HB-04)

Downstream of the Humboldt Mine drainage the dissolved arsenic concentration was 1 ug/L during high flow in 2017 (Table 4). Dissolved arsenic concentrations were less than the aquatic life standard.

During high flow in 2017, the total arsenic concentration was 2.6 ug/L downstream of the Humboldt Mine drainage (Table 4). Total arsenic concentrations exceeded the water and fish standard.

Effect of Humboldt Mine Drainage

The Humboldt Mine did not increase dissolved arsenic concentrations. Although total arsenic concentrations measured in the Humboldt Mine drainage were two to six times higher than total arsenic concentrations measured in the reference stream, the was no increase in total arsenic concentrations downstream of the Humboldt Mine drainage.

Terrible #3 Portal and Waste Rock (SW-11)

During high flow in 2014, dissolved and total arsenic concentrations were 5.8 and 180 ug/L, respectively (Table 2). The total arsenic concentration exceeded the water and fish, and water supply standards.

Perimeter Waste Rock Drainage (SW-12)

During high flow in 2014, dissolved and total arsenic concentrations were 0.4 and 15 ug/L, respectively (Table 2). The total arsenic concentration exceeded the water and fish, and water supply standards.

Downstream of Humboldt and Terrible Mine Sites (SW-13 and GB-03)

During high flow in 2014, dissolved and total arsenic concentrations were 1.4 and 25 ug/L, respectively (Table 2). The total arsenic concentration exceeded the water and fish, and water supply standards.

During high flow in 2015 and 2017, total arsenic ranged from 14 to 35 ug/L (Tables 3 and 4); dissolved arsenic ranged from 0.36 to 0.65 ug/L.

Effect of Humboldt and Terrible Mine Sites

Total arsenic concentrations in Governor Creek increased downstream of the mine sites. During high flow, average total arsenic concentrations downstream of the mine sites were approximately 11 times higher than the San Sophia reference stream. Dissolved arsenic concentrations downstream of the mine sites were similar to dissolved arsenic concentrations in the San Sophia reference stream.

5.4.3 Cadmium Concentrations in Surface Water

San Sophia Reference Stream (SW-09 and HB-03)

During high flow in 2014 and 2017, dissolved and total cadmium concentrations were less than method detection limits in the San Sophia Reference stream (Tables 2 and 4).

Humboldt Mine Drainage (SW-10 and HB-02)

During high flow in 2014 and 2017, dissolved cadmium concentrations were 2.4 and 1.9 ug/L, respectively (Tables 2 and 4). Dissolved cadmium exceeded the chronic and acute standards in both samples.

During high flow in 2014 and 2017, total cadmium concentrations were 2.3 and 1.9 ug/L, respectively (Tables 2 and 4). Total cadmium concentrations attained the water supply standard.

Downstream of Humboldt Mine Drainage (HB-04)

During high flow in 2017, dissolved and total cadmium concentrations were 0.5 and 0.5 ug/L, respectively (Table 4). The dissolved cadmium concentration exceeded both the chronic and acute standards for aquatic life. The total cadmium concentration attained the water supply standard.

Effect of Humboldt Mine Drainage

The Humboldt Mine drainage increased cadmium concentrations in the downstream tributary. In the San Sophia reference stream dissolved and total cadmium concentrations were less than method detection limits. Downstream of the Humboldt Mine drainage total and dissolved cadmium concentrations increased by approximately 1.25 and 5 times, respectively.

Terrible #3 Portal and Waste Rock (SW-11)

During high flow in 2014, dissolved and total cadmium concentrations were 27 and 27 ug/L, respectively (Table 2). Cadmium concentrations exceed the chronic and acute aquatic life standards and the water supply standard.

Perimeter Waste Rock Drainage (SW-12)

During high flow in 2014, dissolved and total cadmium concentrations were 2 and 2.1 ug/L, respectively (Table 2). Dissolved cadmium concentrations exceed the chronic and acute aquatic life standards. Total cadmium concentrations attained the water supply standard.

Downstream of Humboldt and Terrible Mine Sites (SW-13 and GB-03)

During high flow, dissolved cadmium concentrations in Governor Creek downstream of the Humboldt and Terrible Mine sites ranged from 5.3 to 8.6 ug/L (Tables 2, 3, and 4). During low flow, dissolved cadmium was 19 ug/L (Table 3). Dissolved cadmium concentrations exceeded both the chronic and acute aquatic life standards in all samples.

During high flow, total cadmium concentrations ranged from 5.2 to 7.9 ug/L (Tables 2, 3, and 4). During low flow total cadmium was 19 ug/L in Governor Creek downstream of the Humboldt Virginius, and Terrible mine sites. All total cadmium concentrations exceeded the water supply standard.

Effect of Humboldt and Terrible Mine Sites

The Humboldt Mine site caused an increase in cadmium concentrations relative to the concentrations measured in the San Sophia reference stream. The Terrible Mine site further increased cadmium concentrations. The Terrible Mine site increased dissolved and total cadmium concentrations by ten times.

5.4.4 Copper Concentrations in Surface Water

San Sophia Reference Stream (SW-09 and HB-03)

During high flow in 2014 and 2017, dissolved copper was not detected in the San Sophia reference stream (Tables 2 and 4).

Humboldt Mine Drainage (SW-10 and HB-02)

During high flow in 2014 and 2017, dissolved copper concentrations were 37 and 31 ug/L, respectively (Tables 2 and 4). Dissolved copper concentrations exceeded the chronic and acute aquatic life standards.

Downstream of Humboldt Mine Drainage (HB-04)

During high flow in 2014, the dissolved copper concentration in the drainage downstream of the Humboldt Mine was 3.4 ug/L (Table 2). Dissolved copper concentrations exceeded the chronic and acute aquatic life standards.

Effect of Humboldt Mine Drainage

Dissolved copper concentrations were below method detection limits in the San Sophia reference stream and increased to 3.4 ug/L downstream of the Humboldt Mine drainage (Table 4). The Humboldt Mine drainage increased copper concentrations by approximately 750%.

Terrible #3 Portal and Waste Rock (SW-11)

During high flow in 2014, dissolved copper in the waste rock drainage was 228 ug/L (Table 2); over 71 times higher than the perimeter waste rock drainage and six times higher than the Humboldt Mine drainage. The dissolved copper concentration exceeded the chronic and acute aquatic life standards. The dissolved copper concentration was over 43 times the acute standard.

Perimeter Waste Rock Drainage (SW-12)

During high flow in 2014, dissolved copper in the waste rock perimeter drainage was 3.2 ug/L (Table 2). Dissolved copper concentrations attained the chronic and acute aquatic life standards.

Downstream of Humboldt and Terrible Mine Sites (SW-13 and GB-03)

During high flow in 2014, 2015, and 2017 dissolved copper concentrations ranged from 28 to 40 ug/L (Tables 2, 3, and 4). During low flow in 2015, dissolved copper was 140 ug/L. The low flow concentration is approximately four higher than the high flow copper concentrations. Additional low flow water quality data would be helpful to better characterize water quality in Governor Basin and to assess the effect of each mine site.

Effect of Humboldt and Terrible Mine Sites

Copper concentrations in Governor Creek downstream of the Virginius and Terrible Mine sites were approximately 8 to 12 times higher than copper concentrations in the drainage downstream of the Humboldt Mine site. The Terrible Mine site increases copper concentrations in Governor Creek; the Terrible Mine site contributes more copper than the Humboldt Mine site.

All samples collected in Governor Creek downstream of the mine sites exceeded the chronic and acute aquatic life standards for copper (Tables 2, 3, and 4). Dissolved copper concentrations at GB-03 were 6 to 21 times higher than the chronic standard and 4 to 15 times higher than the acute standard.

5.4.5 Lead Concentrations in Surface Water

San Sophia Reference Stream (SW-09 and HB-03)

During high flow in 2014 and 2017, dissolved and total lead concentrations were less than method detection limits (Tables 2 and 4).

Humboldt Mine Drainage (SW-10 and HB-02)

During high flow in 2014 and 2017, dissolved lead concentrations in the Humboldt Mine drainage were 1.4 and 1.6 ug/L, respectively (Tables 2 and 4). Dissolved lead concentrations exceeded the chronic aquatic life standard; the acute standard was attained in both samples. Dissolved lead concentrations were roughly four times higher than the chronic standard.

During high flow in 2014 and 2017, total lead concentrations were 1.3 and 2.0 ug/L, respectively (Tables 2 and 4). Total lead concentrations attained the water supply standard.

Downstream of Humboldt Mine Drainage (HB-04)

During high flow in 2017, the dissolved lead concentration downstream of the Humboldt Mine drainage was 0.1 ug/L (Table 4). Dissolved lead was less than the acute and chronic aquatic life standards. The total lead concentration was 0.5 ug/L and attained the domestic water supply standard.

Effect of Humboldt Mine Drainage

Dissolved lead concentrations were less than method detection limits in the San Sophia reference stream. Downstream of the Humboldt Mine drainage dissolved lead concentrations increased slightly to 0.1 ug/L. Likewise, total lead concentrations were less than method detection limits and increased to 0.5 ug/L. The Humboldt Mine may increase lead concentrations by a very slight margin; additional data would be helpful to better understand lead concentrations.

Terrible #3 Portal and Waste Rock (SW-11)

During high flow in 2014, the dissolved and total lead concentrations in the portal and waste rock drainage were 127 and 142 ug/L, respectively (Table 2). Dissolved lead concentrations exceeded the chronic and acute aquatic life standards. The dissolved lead concentration in the portal and waste rock drainage was over 46 times higher than the perimeter waste rock drainage and 105 times higher than the Humboldt Mine drainage (Tables 2, 3, and 4). The total lead concentration in the portal and waste rock drainage was nearly three times higher than the domestic water supply standard.

Perimeter Waste Rock Drainage (SW-12)

During high flow in 2014, the dissolved and total lead concentrations in the perimeter waste rock channel were 2.7 and 47 ug/L, respectively (Table 2). The dissolved lead concentration exceeded the chronic standard but attained the acute standard. The total lead concentration attained the water supply standard.

Downstream of Humboldt and Terrible Mine Sites (SW-13 and GB-03)

During high flow in 2014, 2015, and 2017, dissolved lead concentrations ranged from 2.7 ug/L to 32 ug/L in Governor Creek downstream of the Humboldt and Terrible Mine sites (Tables 2, 3, and 4). During low flow conditions in 2015, dissolved lead was 240 ug/L in Governor Creek downstream of the mine sites (Table 3). All dissolved lead concentrations exceeded the chronic aquatic life standard. Two samples exceeded the acute standard for lead. Dissolved lead 2015 low flow sample was 20 times greater than the high flow sample. This variation underscores the need for additional low flow data collection.

Total lead concentrations ranged from 52 to 290 ug/L in Governor Creek downstream of the Humboldt and Terrible Mine sites. Total lead concentrations in all samples exceeded the water supply standard.

Effect of Humboldt and Terrible Mine Sites

During high flow in 2017, dissolved lead downstream of the Humboldt Mine site was 0.1 ug/L and increased by a factor of 27, to 2.7ug/L downstream of the Terrible Mine site (Table 4). Additionally, 2017 high flow concentrations were substantially lower than high flow concentrations measured in 2014 and 2015, which may be attributed to the larger than average snow pack in 2017. In average years, dissolved lead concentrations may increase by a larger margin due to the Terrible Mine site.

During high flow in 2017, the total lead concentration downstream of the Humboldt Mine was 0.5 ug/L and increased by a factor of 104 to 52.4 ug/L downstream of the Terrible Mine site.

The Terrible Mine increases dissolved and total lead concentrations in Governor Creek; the Humboldt mine does not substantially increase lead concentrations in Governor Creek.

5.4.6 Manganese Concentrations in Surface Water

San Sophia Reference Stream (SW-09 and HB-03)

During high flow in 2014 and 2017, dissolved manganese concentrations were less than or near method detection limits. Dissolved manganese concentrations in the San Sophia reference stream were less than the aquatic life and water supply standards.

Humboldt Mine Drainage (SW-10 and HB-02)

During high flow in 2014 and 2017, dissolved manganese concentrations were 421 and 981 ug/L, respectively (Tables 2 and 4). Dissolved manganese concentrations attained the aquatic life standards but exceeded the water supply standard.

Downstream of Humboldt Mine Drainage (HB-04)

During high flow in 2017, the dissolved manganese concentration in the tributary downstream of the Humboldt Mine drainage was 60 ug/L (Table 4). The dissolved manganese concentration attained the aquatic life standards but exceeded the water supply standard.

Effect of Humboldt Mine Drainage

Dissolved manganese concentrations in the San Sophia reference stream were near method detection limits. Downstream of the Humboldt Mine drainage dissolved manganese concentration was 60 ug/L. The Humboldt Mine drainage increases manganese concentrations.

Terrible #3 Portal and Waste Rock (SW-11)

During high flow in 2014, the dissolved manganese concentration was 18,100 ug/L in the portal and waste rock drainage (Table 2). The dissolved manganese concentration in the portal and waste rock drainage is over 64 times higher than the perimeter waste rock drainage and nearly 43 times higher than in the Humboldt Mine drainage. Dissolved manganese concentrations exceeded the chronic and acute aquatic life standards and the water supply standard.

Perimeter Waste Rock Drainage (SW-12)

During high flow in 2014, the dissolved manganese concentration in the perimeter waste rock drainage was 282 ug/L (Table 2). Dissolved manganese concentrations exceeded the water supply standard but attained the chronic and acute aquatic life standards.

Downstream of Humboldt and Terrible Mine Sites (SW-13 and GB-03)

Dissolved manganese concentrations ranged from 2,710 ug/L to 6,400 ug/L downstream of the Humboldt and Terrible Mine sites (Tables 2, 3 and 4). Dissolved manganese concentrations in all three samples collected at this location exceeded the chronic and acute aquatic life standards and the water supply standard.

Effect of Humboldt and Terrible Mine Sites

During high flow sampling in 2017, dissolved manganese downstream of the Humboldt Mine drainage was 60 ug/L. Dissolved manganese increased by a factor of 45 to 2,710 ug/L downstream of the Terrible Mine site (Table 4). The Terrible Mine site substantially increases dissolved manganese concentrations in Governor Creek.

5.4.7 Mercury Concentrations in Surface Water

All mercury concentrations in Governor Basin were less than method detection limits (Tables 2, 3, and 4).

5.4.8 Silver Concentrations in Surface Water

San Sophia Reference Stream (SW-09 and HB-03)

Dissolved silver concentrations were less than method detection limits during high flow in 2014 and 2017 (Tables 2 and 4).

Humboldt Mine Drainage (SW-10 and HB-02)

During high flow in 2014 and 2017, dissolved silver concentrations were near or less than method detection limits (Tables 2 and 4).

Downstream of Humboldt Mine Drainage (HB-04)

During high flow in 2017, dissolved silver concentrations were less than method detection limits in the tributary downstream of the Humboldt Mine drainage (Table 4).

Effect of Humboldt Mine Drainage

The Humboldt Mine drainage lacks measurable silver.

Terrible #3 Portal and Waste Rock (SW-11)

During high flow in 2014, dissolved silver in the portal and waste rock drainage was 1.5 ug/L (Table 2). Dissolved silver concentrations exceeded the chronic and acute aquatic life standards.

Perimeter Waste Rock Drainage (SW-12)

Dissolved silver was not detected in the sample collected from the perimeter waste rock channel during high flow in 2014.

Downstream of Humboldt and Terrible Mine Sites (SW-13 and GB-03)

During high flow in 2014, 2015, and 2017, dissolved silver concentrations were near or less than method detection limits (Tables 2, 3, and 4). Due to low hardness and aquatic life's sensitivity to silver, two samples collected from Governor Creek downstream of the Humboldt and Terrible Mine sites exceeded the chronic aquatic life standard (Table 3).

Effect of Humboldt and Terrible Mine Sites

Downstream of the Humboldt Mine drainage dissolved silver concentrations were less than method detection limits, during high flow in 2017. The Humboldt Mine drainage is not a source of silver. In Governor Creek downstream of the Humboldt and Terrible Mine sites dissolved silver concentrations may increase; but the magnitude of the increase is somewhat uncertain due to variation in the practical quantitation limit.

5.4.9 Zinc Concentrations in Surface Water

San Sophia Reference Stream (SW-09 and HB-03)

During high flow in 2014 and 2017, the dissolved zinc concentration in the San Sophia reference stream was less than 20 and 20 ug/L, respectively (Tables 2 and 4).

Humboldt Mine Drainage (SW-10 and HB-02)

During high flow in 2014 and 2017, the dissolved zinc concentrations in the Humboldt mine drainage were 520 and 419 ug/L, respectively (Tables 2 and 4). Both samples exceeded the chronic and acute standards for aquatic life. In 2017, the dissolved zinc concentration was over 14 times greater than the chronic standard and over 10 times greater than the acute standard.

Downstream of Humboldt Mine Drainage (HB-04)

During high flow in 2017, the dissolved zinc concentration was 120 ug/L downstream of Humboldt Mine drainage (Table 4).

Effect of Humboldt Mine Drainage

Dissolved zinc concentrations increased six-fold downstream of the Humboldt Mine drainage. The Humboldt Mine drainage increases dissolved zinc in the tributary to Governor Creek.

Terrible #3 Portal and Waste Rock (SW-11)

During high flow in 2014, the dissolved zinc concentration in the portal and waste rock drainage was 6,130 ug/L (Table 2). The dissolved zinc concentration is over 13 times higher than the waste rock perimeter channel and over 11 times higher than in the Humboldt mine drainage. The dissolved zinc concentration was nearly 100 times the acute standard for aquatic life.

Perimeter Waste Rock Drainage (SW-12)

During high flow in 2014, the dissolved zinc concentration in the perimeter waste rock drainage was 450 ug/L (Table 2). Dissolved zinc concentrations exceeded the chronic and acute standards for aquatic life.

Downstream of Humboldt and Terrible Mine Sites (SW-13 and GB-03)

During high flow in 2014, 2015, and 2017 dissolved zinc concentrations ranged from 1,170 ug/L to 1,760 ug/L in Governor Creek downstream of the Terrible Mine site (Tables 2, 3, and 4). During low flow in 2015, dissolved zinc was 4,000 ug/L. Additional data is needed to better characterize low flow conditions in Governor Basin. Dissolved zinc in all Governor Creek samples exceeded the acute and chronic aquatic life standards. In four samples, dissolved zinc concentrations were 21 to 46 times higher than the chronic aquatic life standard and 16 to 35 times higher than the acute standard.

Effect of Humboldt and Terrible Mine Sites

During high flow in 2017, dissolved zinc downstream of the Humboldt Mine drainage was 120 ug/L, a six-fold increase over the concentrations in the San Sophia reference stream. In Governor Creek downstream of the Terrible mine site the dissolved zinc concentration was 1,170 ug/L or nine times higher. The Terrible Mine site increases dissolved zinc in Governor Creek. Additional data is needed to better characterize low flow conditions.

Table 2. Water quality standards evaluation of samples collected in Governor Basin downstream of the Humboldt and Terrible mine sites during high flow in 2014.

Parameter	Location	SW-09	SW-10	SW-11	SW-12	SW-13
	Flow			High Flow		
	Segment			COGUUN05		
	Average Hardness (mg/L)[1,2]			37		
Arsenic	Total Arsenic	1.4	8.5	180	15	25
	Dissolved Arsenic	1.4	0.2 (B)[3]	5.8	0.4 (B)	1.4
	Water + Fish (T)			0.02		
	Water Supply Standard (T)			10		
	Aquatic Life Standard			340		
	Attains Water + Fish Standard	No[2]	No	No	No	No
	Attains Water Supply Standard	Yes	Yes	No	No	No
	Attains Aquatic Life Standard	Yes	No	Yes	No	Yes
Cadmium (ug/L)	Dissolved Cadmium	U[3]	2.4	27	2	8.6
	Total Cadmium	U	2.3	27	2.1	7.9
	Chronic Aquatic Life Standard			0.34		
	Acute Aquatic Life Standard			0.71		
	Water Supply Standard (T)			5.0		
	Attains Chronic Standard	Yes	No	No	No	No
	Attains Acute Standard	Yes	No	No	No	No
	Attains Water Supply Standard	Yes	Yes	No	Yes	No
Copper (ug/L)	Dissolved Copper	U	37	228	3.2	56
	Chronic Aquatic Life Standard			3.9		
	Acute Aquatic Life Standard			5.3		
	Attains Chronic Standard	Yes	No	No	Yes	No
	Attains Acute Standard	Yes	No	No	Yes	No
Lead (ug/L)	Dissolved Lead	U	1.2	127	2.7	32
	Total Lead	U	1.3	142	47	65
	Chronic Aquatic Life Standard			0.8		
	Acute Aquatic Life Standard			21.8		
	Water Supply Standard (T)			50.0		
	Attains Chronic Standard	Yes	No	No	No	No
	Attains Acute Standard	Yes	Yes	No	Yes	No
	Attains Water Supply Standard	Yes	Yes	No	Yes	No
Manganese (ug/L)	Dissolved Manganese	U	421	18,100	282	4,390
	Chronic Aquatic Life Standard			1,188		
	Acute Aquatic Life Standard			2,150		
	Water Supply Standard			50		
	Attains Chronic Standard	Yes	Yes	No	Yes	No
	Attains Acute Standard	Yes	Yes	No	Yes	No
	Attains Water Supply Standard	Yes	No	No	No	No
Mercury (ug/L)	Total Mercury	U	U	U	U	U
	Chronic Aquatic Life Standard (T)	0.01	0.01	0.01		0.01
	Attains Chronic Standard	Yes	Yes	Yes	Yes	Yes
Silver (ug/L)	Dissolved Silver	U	0.14 (B)	1.5	U	0.05 (B)
	Chronic Aquatic Life Standard			0.01		
	Acute Aquatic Life Standard			0.37		
	Attains Chronic Standard	Yes	Yes	Yes	Yes	Yes
	Attains Acute Standard	Yes	Yes	Yes	Yes	Yes
Zinc (ug/L)	Dissolved Zinc	U	520	6,130	450	1,760
	Chronic Aquatic Life Standard			49.5		
	Acute Aquatic Life Standard			65.3		
	Attains Chronic Standard	No	No	No	No	No
	Attains Acute Standard	No	No	No	No	No

Notes:

1. Hardness was not measured in 2014. The average hardness measured in 2015 and 2017 was used to calculate hardness-dependent standards.
2. "Yes" indicates the result attained the standard, "No" indicates the result exceeded the standard.
3. "U" indicates that the sample concentration was less than the method detection limit.
3. "B" indicates that the sample concentration was estimated (i.e. between method detection limit and practical quantitation limit).

Table 3 Water quality standards evaluation of water samples collected in Governor Basin downstream of the Humboldt and Terrible mine sites during high and low flow in 2015.

Parameter	Location	GB-03	
	Flow	High	Low
	Segment	COGGUN05	
	Hardness (mg/L)[1,2]	49	68
Arsenic	Total Arsenic	35	6.3
	Dissolved Arsenic	0.36	0.65
	Water + Fish (T)	0.02	
	Water Supply Standard (T)	10	
	Aquatic Life Standard	340	
	Attains Water + Fish Standard	No	No
	Attains Water Supply Standard	No	Yes
	Attains Aquatic Life Standard	Yes	Yes
Cadmium (ug/L)	Dissolved Cadmium	6.2	19
	Total Cadmium	6.4	19
	Chronic Aquatic Life Standard	0.42	0.54
	Acute Aquatic Life Standard	0.92	1.25
	Water Supply Standard (T)	5.0	
	Attains Chronic Standard	No	No
	Attains Acute Standard	No	No
	Attains Water Supply Standard	No	No
Copper (ug/L)	Dissolved Copper	40	140
	Chronic Aquatic Life Standard	4.9	6.4
	Acute Aquatic Life Standard	6.9	9.3
	Attains Chronic Standard	No	No
	Attains Acute Standard	No	No
Lead (ug/L)	Dissolved Lead	12	240
	Total Lead	140	290
	Chronic Aquatic Life Standard	1.1	1.6
	Acute Aquatic Life Standard	29.5	42.3
	Water Supply Standard (T)	50.0	
	Attains Chronic Standard	No	No
	Attains Acute Standard	Yes	No
	Attains Water Supply Standard	No	No
Manganese (ug/L)	Dissolved Manganese	4,000	6,400
	Chronic Aquatic Life Standard	1,301	1,451
	Acute Aquatic Life Standard	2,354	2,626
	Water Supply Standard	50	
	Attains Chronic Standard	No	No
	Attains Acute Standard	No	No
	Attains Water Supply Standard	No	No
Mercury (ug/L)	Total Mercury	<0.04	<0.042
	Chronic Aquatic Life Standard (T)	0.01	0.01
	Attains Chronic Standard	Yes	Yes
Silver (ug/L)	Dissolved Silver	0.1	0.2
	Chronic Aquatic Life Standard	0.02	0.04
	Acute Aquatic Life Standard	0.59	1.05
	Attains Chronic Standard	No	No
	Attains Acute Standard	Yes	Yes
Zinc (ug/L)	Dissolved Zinc	1,600	4,000
	Chronic Aquatic Life Standard	63.3	85.3
	Acute Aquatic Life Standard	83.6	112.7
	Attains Chronic Standard	No	No
	Attains Acute Standard	No	No

Notes:

1. Where appropriate standards were calculated using paired hardness results.
2. "Yes" indicates the result attained the standard, "No" indicates the result exceeded the standard.

Table 4. Water quality standards evaluation of water samples collected in Governor Basin upstream and downstream of the Humboldt mine drainage confluence and upstream and downstream of the Terrible mine site during high flow in 2017.

Parameter	Location	HB-03	HB-02	HB-04	GB-03
	Flow	High Flow			
	Segment	COGUUN05			
	Hardness (mg/L)[1,2]	23	21	22	41
Arsenic	Total Arsenic	3	7.2	2.6	14
	Dissolved Arsenic	3.1	1.1	1	<0.2
	Water + Fish (T)	0.02			
	Water Supply Standard (T)	10			
	Aquatic Life Standard	340			
	Attains Water + Fish Standard	No[2]	No	No	No
	Attains Water Supply Standard	Yes	Yes	Yes	No
	Attains Aquatic Life Standard	Yes	Yes	Yes	Yes
Cadmium (ug/L)	Dissolved Cadmium	<0.1	1.9	0.5	5.3
	Total Cadmium	<0.4	1.9	0.5	5.2
	Chronic Aquatic Life Standard	0.24	0.22	0.23	0.37
	Acute Aquatic Life Standard	0.45	0.42	0.43	0.78
	Water Supply Standard (T)	5.0			
	Attains Chronic Standard	Yes	No	No	No
	Attains Acute Standard	Yes	No	No	No
	Attains Water Supply Standard	Yes	Yes	Yes	No
Copper (ug/L)	Dissolved Copper	<0.4	31	3.4	28
	Chronic Aquatic Life Standard	2.6	2.4	2.5	4.2
	Acute Aquatic Life Standard	3.4	3.1	3.2	5.8
	Attains Chronic Standard	Yes	No	No	No
	Attains Acute Standard	Yes	No	No	No
Lead (ug/L)	Dissolved Lead	<0.1	1.6	0.1(B)[3]	2.7
	Total Lead	<0.1	2	0.5	52.4
	Chronic Aquatic Life Standard	0.5	0.4	0.5	0.9
	Acute Aquatic Life Standard	12.6	11.4	12.0	24.2
	Water Supply Standard (T)	50.0			
	Attains Chronic Standard	Yes	No	Yes	No
	Attains Acute Standard	Yes	Yes	Yes	Yes
	Attains Water Supply Standard	Yes	Yes	Yes	No
Manganese (ug/L)	Dissolved Manganese	0.5 (B)	238	60	2,710
	Chronic Aquatic Life Standard	1,011	981	996	1,226
	Acute Aquatic Life Standard	1,830	1,775	1,803	2,219
	Water Supply Standard	50			
	Attains Chronic Standard	Yes	Yes	Yes	No
	Attains Acute Standard	Yes	Yes	Yes	No
	Attains Water Supply Standard	Yes	No	No	No
Mercury (ug/L)	Total Mercury	<0.2	<0.2	<0.2	<0.2
	Chronic Aquatic Life Standard (T)	0.01	0.01	0.01	0.01
	Attains Chronic Standard	Yes	Yes	Yes	Yes
Silver (ug/L)	Dissolved Silver	<0.5	<0.5	<0.5	<0.5
	Chronic Aquatic Life Standard	0.006	0.005	0.006	0.016
	Acute Aquatic Life Standard	0.16	0.14	0.15	0.44
	Attains Chronic Standard	Yes	Yes	Yes	Yes
	Attains Acute Standard	Yes	Yes	Yes	Yes
Zinc (ug/L)	Dissolved Zinc	20	419	120	1,170
	Chronic Aquatic Life Standard	31.8	29.3	30.6	53.9
	Acute Aquatic Life Standard	42.0	38.7	40.4	71.1
	Attains Chronic Standard	Yes	No	No	No
	Attains Acute Standard	Yes	No	No	No

Notes:
1. Where appropriate standards were calculated using paired hardness results.
2. "Yes" indicates the result attained the standard, "No" indicates the result exceeded the standard.
3. "B" indicates that the sample concentration was estimated (i.e. between method detection limit and practical quantitation limit).

5.4.10 Surface Water Summary

There is a lack of low flow data from Governor Basin. Low flow water quality data would improve our understanding of water quality impacts attributed to the Humboldt, Virginius, and Terrible mine sites.

In recent years there have been three sample events within Governor Basin. Each event targeted specific areas within the basin. To date, there has not been a basin-wide sample event. Additional sample locations to better bracket potential metal sources would help improve our understanding of the origin of water quality issues within Governor Basin. However, the sediment leachate results clearly suggest that the bulk of the metals originate from mine waste generated from the Terrible vein (referred to as the Terrible Mine in this document).

In 2016 OSM completed maintenance and improvement activities that may affect flow patterns on the Terrible Mine site. The Mountain Top Mine may also influence water quality in the basin.

In 2017, the snowpack was larger than average. Metal concentrations measured in the Canyon Creek watershed during high flow in 2017 were typically lower than metal concentrations measured during high flow in 2014 and 2015. Data collected in 2017 may not be representative of average high flow conditions. Additional data could be useful but may not be necessary as metal concentrations measured in 2017 demonstrate the need for mine reclamation in Governor Basin, particularly at the Terrible Mine site.

The Humboldt Mine drainage increases cadmium, copper, manganese, and zinc concentrations relative to the concentrations measured in the San Sophia reference stream. The Terrible Mine site substantially increases cadmium, copper, lead, manganese, and zinc concentrations in Governor Creek, relative to the concentrations measured downstream of the Humboldt Mine. Although the data set is small, the data indicate that the Virginius Mine site impairs water quality more than the Humboldt Mine.

6.0 PATHWAYS ANALYSIS

The pathways for soil, surface water, groundwater and air migration are evaluated below. The pathways describe potential routes for on-site contamination to create risks to human health, ecological receptors, and the environment.

6.1 CONTAMINATION SOURCES AND WASTE CHARACTERISTICS

The adits at the Humboldt, Virginius, and Terrible mines and drainages that flow through waste rock piles are likely the primary sources of contamination. Existing data suggest that leaching from the mine waste is more problematic than drainage from the adits.

Metal concentrations measured in waste rock derived from the Terrible Vein and Virginius Tailings, located on the lower portion of the site had much higher metal concentrations and lower pH than waste rock from Virginius Mine located in the upper portion of the basin. Waste rock associated with the Terrible Mine and the Virginius Tailings, adjacent to Governor Basin Road, could pose a risk to human or ecological health.

6.2 SEDIMENT EXPOSURE PATHWAY AND TARGETS

The site is located immediately adjacent to Governor Basin Road, a popular route used by off-road vehicles for part of the year. Recreational use is heaviest during the summer and early fall. OSM occasionally uses portions of the site to support mining operations at the Revenue Mine, located downstream of Governor Basin.

6.3 SURFACE WATER PATHWAYS AND TARGETS

Water flows from adits in the basin; however, there is very limited information regarding the timing and magnitude of flow from each adit. Flow from the Terrible Mine adits passes through mine waste. Seeps and small tributaries also flow through mine waste on the lower portion of the site. Drainage pathways, rills, and gullies are visible in aerial imagery (Figures 2, 3 and 4). On the lower portion of the site most of the mine waste is fine-grained, lacks vegetation, and is susceptible to additional erosion.

6.3.1 Wetlands

A formal wetland delineation has not been completed in Governor Basin. Field notes from water quality sample events suggest there are wetlands within the basin. Additional information is required prior to any reclamation work.

6.3.2 Fisheries

The habitat in Governor Creek has not been assessed, so it's suitability as a fishery is unknown. Further, Fish tissue sampling has not occurred, so it is not possible to evaluate the potential for impairment of the fishery as it relates to the mine sites.

6.3.3 Endangered, Threatened or Species of Special Concern

The following endangered, threatened or species of special concern that could potentially occur are: Canada lynx and North American wolverine (USFWS IPaC, 2018). However, wolverines are not expected to occur due to intense recreational use and proximity to roads in the basin. Lynx are possible in this location, but the site area is outside of designated critical habitat. Lynx are most likely to use the area as a travel corridor rather than a long-term habitat due to their preference for dense timber habitat. This area is not listed as a critical habitat for any animal, bird, fish, or insect species. Additional review may be needed, but threatened and endangered species are unlikely to occur within upper Governor Basin.

6.4 GROUNDWATER PATHWAYS AND TARGETS

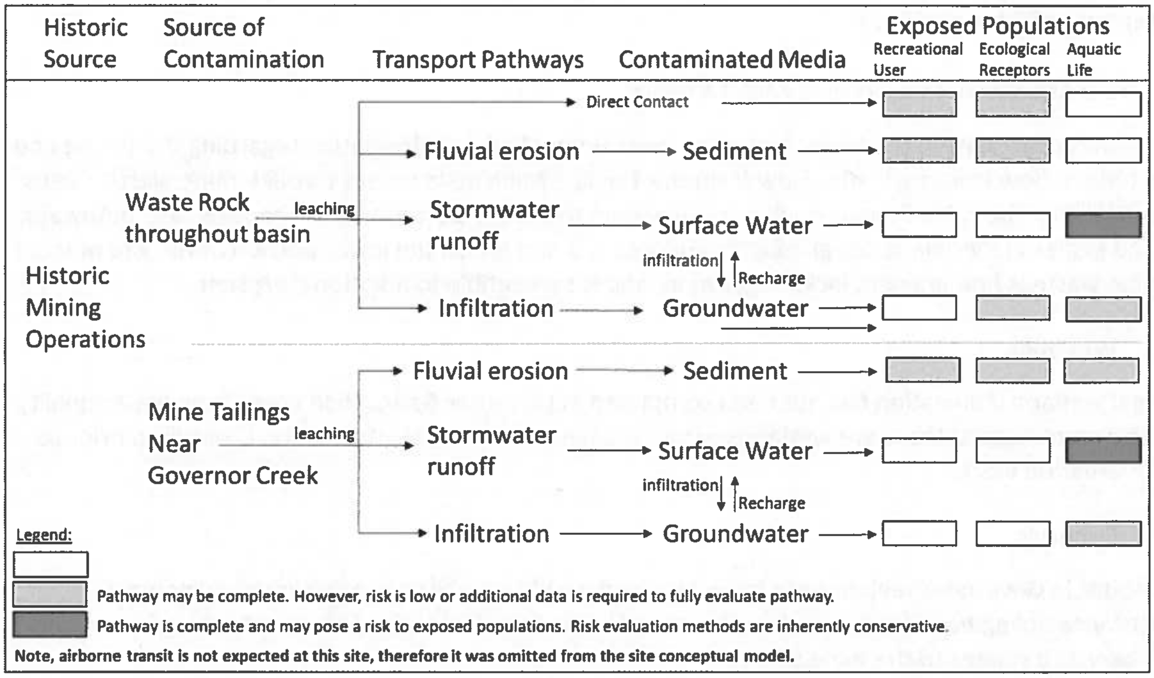
The presence of seeps, springs, and saturated marshy ground in the upper basin indicates a very limited depth to groundwater in parts of Governor Basin. Limited depth to groundwater in the project area suggests that groundwater contamination is likely.

6.5 AIR PATHWAY AND TARGETS

There is no physical evidence to suggest that waste material migrates off-site via airborne particulates. However, under very dry or dusty conditions inhalation may be possible. Some contaminants may migrate off-site as recreational users pass through the site (e.g. hiking shoes).

6.6 CONCEPTUAL SITE MODEL

Figure 5. Conceptual site model of Governor Basin.



7.0 CONCLUSIONS

Leachate from waste rock and tailings collected from the Terrible Mine site had elevated concentrations of arsenic, cadmium, lead, and zinc. Elevated metal concentrations in the sediment could pose a risk to human health and ecological receptors, although that was not evaluated directly.

The Humboldt Mine drainage increases cadmium, copper, manganese, and zinc concentrations in the Governor Basin tributary. Cadmium, copper, and zinc concentrations downstream of the Humboldt Mine drainage exceeded acute and chronic aquatic life standards. The Humboldt Mine adit has not been sampled. Sediment from the Humboldt Mine has not been sampled. There is limited information about the Mountain Top Mine.

The Terrible mine increases cadmium, copper, lead, manganese, and zinc concentrations. Governor Creek downstream of the Terrible mine site exceeded chronic and acute aquatic life standards for cadmium, copper, manganese, and zinc. Lead concentrations exceeded the chronic aquatic life standard. The standards evaluation indicates this reach of Governor Creek does not support aquatic life. Elevated metal concentrations in Governor Creek suggest that the basin contributes to water quality impairments in Sneffels Creek.

While the existing water quality data in Governor Basin is limited, it suggests that reclamation of the Humboldt, Virginius, and Terrible mine sites could potentially improve the water quality Governor Creek, a tributary to Sneffels Creek. There are several reclamation strategies, including a combination of waste rock and tailings consolidation, run-on controls, designated drainages to minimize contact with waste rock, and revegetation. Metal concentrations in the waste rock perimeter channel were far lower than drainage from the portal and mine waste channel. The northeast side of the site may be less contaminated and could be used to route run-on around waste consolidation areas. The sediment pond down-gradient from the Revenue-Virginius Mine vent could potentially be incorporated into the reclamation design as a passive treatment cell or sediment retention/settling pond. However, the water quality in the pond should be sampled prior to incorporating the pond into the reclamation design.

Governor Basin Road provides access to the mine sites each summer and fall, albeit briefly, making reclamation more practical than some other locations in the Watershed. OSM is willing to partner on a reclamation project at the Virginius site. Other partners, such as Trout Unlimited, have expressed interest in reclamation in the basin. Collaboration with multiple parties, including USFS and DRMS, would support reclamation and address the greatest extent of contamination.

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APPENDIX A: MAP OF MINE CLAIMS IN GOVERNOR BASIN

Mine claim ownership and active permit area in Governor Basin. Map courtesy of OSMI.