INVESTIGATION OF RECLAIMED DRILL SITES, PEBBLE PROSPECT, 2016

Center for Science in Public Participation
for
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Contents

Appendices

Executive Summary

Advanced exploration at mine sites may require drilling hundreds of drill holes in sulfide mineralization. Reclamation involves cementing and grouting drill holes, which may be thousands of feet deep, and re-establishing native vegetation. Sulfidic drill holes that are not properly reclaimed could go acid, and potentially allow groundwater to carry metals to the surface. Many of these holes may go uninspected by land owners, or develop problems after inspection.

The Pebble ore deposit was intensively explored between 2004 and 2012. Active exploration has not occurred in the past four years. The site has 1,355 drill holes ranging from shallow geotechnical holes to exploration holes 6,000 feet deep. In August 2016, a team from the Center for Science in Public Participation (CSP2) inspected 107 sites, including 100 drill hole sites, over five days. One-third had been fully reclaimed, while 25% had issues such as drill casings still protruding above the surface and posing physical hazards, and 41% had environmental issues such as dead vegetation, acid soil, artesian wells, or water, soil or sediment with elevated metals. While there is no evident widespread contamination, there are localized areas with elevated copper and other elements in soil and water.

During exploration, some drilling waste was discharged to the landscape. Some of this material – high in copper and molybdenum -- is still evident on the landscape as oxidized orange or grey fine-grained material, accompanied by dead brush and tundra. Many samples were acidic, and may be continuing to impact vegetation. There is some indication that a sump may be leaking metals into a wetland spring, but a more detailed investigation is needed for verification

Drill cuttings have also flushed from open drill casings frequently cut off just above the ground surface. These were all acidic, and high in copper and molybdenum. If these are flushing periodically, this suggests that either the holes were not cemented, or the cement has failed. As wells age, it will be important to know if the problem is observed at more drill holes.

Artesian sites are bringing water, neutral in pH but elevated in metals, to the surface. Artesian conditions were observed both where drill casings were present, and where removed. The Alaska Department of Natural Resources (DNR) focused the most recent investigation on drill sites with potential subsidence, and/or artesian conditions. Artesian wells and drill holes that are flushing will require ongoing maintenance until fully stable. The question of the competency of the reclamation of drill holes should be investigated as these sites may represent ongoing environmental and potentially financial risks. Stable sites are not equivalent to reclaimed sites.

It is evident that there may be long-term reclamation and maintenance issues. Currently DNR requires no reclamation plan, and can continue to waive the reclamation bond for the site as it has for the most recent land use permit.

Background

Mineral exploration for copper, gold, and molybdenum at the proposed Pebble mine site began in 1986 and intensified during 2004 - 2012. Geologists outlined the ore deposits by examining cores from diamond drill exploration holes (DDH), finding a near-surface deposit (Pebble West) and a deep subsurface deposit (Pebble East). Exploration drilling generates waste containing drilling muds, used to lubricate the drill bit, and fine rock "cuttings", created as the drill bit moves through bedrock. Holes to define the mineral ore body were up to 6,000 feet deep; deeper holes generate more drilling waste material than shallow ones. Drilling waste is discharged onto land, or allowed to settle in sump pits.

Holes were also drilled to inform mine facility development. Geotechnical holes (GH) for determining bedrock competency, piezometer holes (P) for determining water table fluctuations, and monitoring wells (MW) for determining groundwater quality were generally less than 500 feet deep.

Holes drilled through sulfide rock with rock flour "cuttings" deposited on the land could create an acidic environment, particularly at deep exploration holes. Additionally, acidic reactions may take place "downhole" in the open space where the drill core has been removed – and eventually acidic water could make its way to the surface – if the hole is not properly cemented and grouted.

The Pebble Limited Partnership (PLP) operates under a Miscellaneous Land Use Permit, in part to continue reclamation work. PLP rates reclaimed drill holes as "active", "inactive", or "plugged", and within each of these rates the degree of maintenance required, from A – significant repairs necessary, to E – site is stable and fully reclaimed. DNR uses this self-reported rating system to grade these sites.

In November 2015, the United Tribes of Bristol Bay (UTBB) and others petitioned DNR to investigation the status of reclamation, including drill holes that had not been properly plugged, unsuccessful revegetation efforts, and the continuing presence and impact of drilling waste.

In July, 2016, DNR inspected 141 sites, including 34 identified by PLP as sites that needed monitoring or repair work.1 A Center for Science in Public Participation (CSP2) team inspected 107 sites in August, 2016. At 23 drill sites that CSP2 and DNR both inspected, within a week of each other, DNR identified problems at 3 and CSP2 determined that at least 8 of the 23 had problems.

[1] DNR Field summary report for APMA A20146118 and A20142788, July 26-27 2016
http://dnr.alaska.gov/mlw/mining/largemine/pebble/field-reports/A166118_20160726_TripReport_FINAL.pdf

Drill waste disposal methods

Drills operating near water bodies are known to have pumped drilling waste up to 1,000 feet away to deposit them on depressions on the landscape. Kettle ponds were also used for drill waste disposal (Figure 1).

Drilling fluids can be discharged onto land, into water bodies such as "kettle ponds",[2] or may go through drill sumps to settle cuttings before discharge (Figure 2).

Drill sump pits were in use at the Pebble site since at least as early as 2003, but drill waste was discharged in winter without sumps through at least 2007 (Figure 3).

Photo #14. Clay deposited in a dry depression by discharged drilling fluids.

Figure 1. Drilling waste discharged to land. *Kettle ponds are small bodies of water in depressions; some are connected to groundwater while others are not. Large pumps move water uphill from the sump approximately 1000 feet to upland ponds (DNR inspection report June 2005), such as the one shown in this photo (DNR inspection report July 2007).*

Figure 3. Sump pits (on left) and tundra stock pile being saved for reclamation (on right).

Figure 2. Drill waste sumps in use. *From DNR inspection report June 2010*

Figure 4. Water and cuttings discharge on uplands.

Figure 3. Water and sediment from the drill cuttings was discharged as permitted onto the uplands directly from the drill rigs. *During ice free months a sump pit will be dug to retain drill cuttings. (DNR inspection report, April 5 2007)*

[2] Kettle ponds form in depressions on the landscape. They may be connected to groundwater or may be fed only by surface runoff. Rains, M. 2011. Water sources and hydrodynamics of closed-basin depressions, Cook Inlet Region, Alaska. Wetlands 31: 377-387.

DNR has described the practice of drill waste disposal:

> ***The practice results in the deposition of finely ground rock, bentonitic clay, and other additive materials being deposited on the tundra****. … Gray coatings of clay were seen in areas where drill fluids have been recently discharged, but in areas where drilling was done in previous years there was no evidence of the coatings, and the tundra appears healthy. … .....There is some concern in places where multiple wells are being discharged into topographic depressions. This practice can result in considerable amounts of clay material being deposited in the depression.* (DNR inspection report July 26-27, 2007)

Drill site inspections

Drill site inspections can determine how waste is handled during drilling and the status of the site after drilling is complete. PLP has drilled 1,355 bore holes (Table 1)[3] on 1,719 mineral claims totaling 158,276 acres of state land (Appendix A).[4] Based on DNR Field Inspection reports available on the DNR website (Appendix F),[5] over 1,000 sites have never had a State inspection.

Table 1. Drill hole number and types at the Pebble exploration site.
Compiled from a spreadsheet provided to DNR by PLP in spring 2016.

Borehole Purpose	Hole Designation	Well depth (feet)	Number of boreholes
Exploration	DDH	40-6,425	700
Monitoring/Study	DDH	500-5,700	33
	GH	20-600	393
	P or PW	1-300	194
	MW	17-195	30
	others	24-84	5

The Multiple Land Use Permit (MLUP) that DNR issued to allow Pebble mine exploration on state land requires specific reclamation actions, including cutting abandoned drill casings off below ground surface, filling drill holes with a minimum of 10 feet of cement, removing equipment and buildings, and submitting an annual reclamation statement.[6] A "monument marker" is commonly placed to mark the location of the old drill hole (Figure 4).

PLP has a method of classifying the reclamation status of drill sites based on whether they are active, inactive, or plugged and the extent of reclamation work remaining (Appendix B).

Figure 4. Monument marker. *A wooden post with the drill hole number is commonly placed where the drill casing has been removed.*

[3] In this document, the terms "borehole" and "drill hole" are used interchangeably
[4] 2014-2016 MLUP, http://dnr.alaska.gov/mlw/mining/largemine/pebble/pdf/a156118permit.pdf
[5] http://dnr.alaska.gov/mlw/mining/largemine/pebble/field-reports/
[6] ibid

Methods

To determine the status of reclamation at the exploration area, United Tribes of Bristol Bay (UTBB) convened a team of three people to perform field inspections: Kendra Zamzow of the Center for Science in Public Participation (CSP2), Dave Chambers of CSP2, and George Alexie, board member of UTBB and resident of Nondalton. Site inspections occurred August 1-5, 2016. A summary of methods is provided below.

Site selection

PLP provided DNR with a document of the 1,355 holes drilled and their locations, which UTBB and CSP2 reviewed for site selection after receiving it from DNR.

Sites of interest to UTBB were prioritized, to best use the limited time available, based on a history of artesian conditions, proximity to water bodies, age and depth (Table 2). Older boreholes may have had more time to develop problems, deeper boreholes would have greater volumes of waste, artesian conditions indicate a potential to bring groundwater in contact with mineralized ore to the surface, and seeps within 200 feet or streams within 100 feet could be at higher risk of receiving mobilized contaminants. CSP2 lacked data to prioritize based on hole sulfide lithology.

In all, 305 sites were identified as having conditions of interest. In addition to sites with known issues (artesian, etc.), CSP2 included sites recorded to have no previous issues, sites that were plugged and grouted, or had other indications that they were fully reclaimed. CSP2 created the list as a way to classify and consider sites to inspect, but intended to re-assess once in the field, and to inspect sites opportunistically, for example if they were near a target site.

Table 2. Categories to prioritize sites. *Five different levels of priority were developed; only the top two are shown. In addition to these, there were 38 sites in the #3 priority, 35 sites in the #4 priority, and 181 sites in the lowest #5 priority category.*

Priority	# sites	Context for categorization						
#1	14	Artesian, near stream, possibly active (5)	Artesian, near stream, very deep, inactive (1)	Artesian, old, in weathered bedrock or sulfide, active (2)	Near seep, old, previous issues (2)	Near stream, previous issues, active (4)		
#2	38	Artesian, near stream, active (2)	Artesian, active (15)	Artesian, inactive (1)	Set in weathered bedrock (2)	Near seep, old or very old, no previous issues, plugged (8)	Near stream, old or deep, no previous issues, active (8)	Old, deep or very deep, previous issues, active (2)

Field methods

Upon arrival at a site, the area was photo-documented. The location was noted using a handheld ETrex 10 or ETrex 20 GPS. Site-sketches were frequently made in logbooks. Notations were made regarding whether drill sumps appeared to be present.

Field soil pH was collected at 15 sites, and water pH, SC, and/or temperature were collected at 16-21 sites. Water in wetlands, springs and ponds adjacent to drill sites, in standing water at the base of drill casings, and from the casing at artesian drill holes was measured with either a YSI 556 or a YSI 1030 for pH and for specific conductance (SC) if there was enough water to immerse the conductivity probe. For soil pH, 2-3 samples were homogenized and mixed in a glass beaker with a small amount of distilled water; the mixture was allowed to sit for several minutes until the pH stabilized.

Field meters were calibrated each morning and checked each evening in pH buffers (pH 4.01, 7.00, 10.01) and conductivity solution (447 µS/cm). On August 4, the YSI 556 did not correctly measure pH buffers during the evening check; laboratory measurements were utilized for site data collected on that day.

Two sump pits were sampled using a shovel, and a steel pipe as a coring implement, to attempt to retrieve a small sample of the sump pit material below the overburden cover. A 3" sample of pit waste was recovered from site DDH 11540, and the overburden cover material was too thick to obtain a sample at the second site, DDH 11526-11527.

Sample collection for laboratory analysis

Water was collected as grab samples in a 1 liter (1L) HDPE container rinsed three times in site water. Water to be submitted for petroleum analysis was collected in a glass bowl and distributed into amber, 1L glass containers provided by the lab for RRO and DRO.

Soil and sediment were collected from 2-3 locations within a few feet of each other and homogenized in a Ziploc bag; the sample was double-bagged for storage and transport.

Samples were submitted for analysis of petroleum components (SGS, Anchorage) or for analysis of general chemistry (cations, anions, total organic carbon, and total metals – University of Alaska Applied Science, Engineering, and Technology (ASET) lab). Analyses were performed on soil, sediment, and water for pH, specific conductance, fluoride, chloride, sulfate, nitrate, beryllium, sodium, magnesium, aluminum, potassium, calcium, vanadium, chromium, manganese, iron, cobalt, nickel, copper, zinc, arsenic, selenium, molybdenum, silver, cadmium, antimony, barium, thallium, lead, thorium, and uranium. Total organic carbon was analyzed in water samples. An ion chromatograph (IC) Dionex ICS 5000+ was used to determine anion concentrations in water and soil extracts (1 soil: 5 distilled water). Total metals were determined using an ICP-MS (EPA 200.8, extract method EPA 3050b). For soil and sediment, anions, pH and SC were determined from 1:5 water extracts.

Duplicate soil samples were collected at four sites and duplicate water samples were collected at three sites. Trip blanks and equipment blanks were provided to the ASET laboratory.

Results of 2016 field investigations

The CSP2 team documented 111 sites and visited 107 sites (Figures 5 and 6). Of these, 36 appeared to be fully reclaimed while 44 had environmental hazards and 27 had physical hazards or minor (e.g. no site identification) issues (Table 3).

The primary issues are:

- Open drill casings from which drill cuttings had flushed out onto the landscape. These locations had acid soil and dead vegetation around and downgradient from the drill hole. Drill cuttings were evident as fine-grained silty or muddy material and yellow, orange, or grey in color, generally distinct from background soils.

- Free-flowing artesian water. This was observed at sites that had open drill casings and at sites where drill casings had been removed but artesian water appeared to flow from the old drill hole. There were also drill casing standpipes that had plugs or metal caps welded onto them, or had a valve installed; these may be artesian.

- Locations where drill waste appeared to have been discharged over a large area, encompassing several drill holes, accompanied by dead vegetation.

- Vegetation not establishing on waste sumps and trenches.

- Drill casings not removed from reclaimed sites, frequently open (no cap).

- Sites with no identification.

Chemistry determined that sites with drill cuttings, whether at the base of drill casings that were flushing or in areas where drill waste had been discharged over a wide area, were universally elevated in copper and molybdenum, and could be elevated in other analytes. The pH of drill cuttings was acidic, and drill waste areas had pH less than 7. In contrast, artesian water tended to be neutral pH with no universally common analyte in exceedance, but rather could be elevated in one to several analytes. Sump overburden samples had neutral pH and no elevated analytes indicating that the lack of vegetative growth was not due to soil chemistry.

Sites visited

Site inspections occurred at 100 drill hole sites over five days, representing 7% of the total holes in the area. The Main Camp, Geochemistry Testing Barrels, four ponds and one soil site between drill sites were also inspected for a total of 107 sites visited. There were an additional 4 sites noted in log books but without descriptions.

Not all #1 and #2 priority sites were inspected (Table 3). Over half of the sites visited were initially categorized, before the trip, as low priority or not a priority. The high number of low priority site visits was due to opportunistic inspection of drill holes within walking distance of target sites; in all there were 19 clusters of two to twelve drill holes involving over 70 drill sites at these types of locations.

Of the sites visited, 34% had no issues, 41% had environmental issues, and 25% had minor issues such as open casings, frost-jacked casings, casings with plugs and valves, or no site identification. A site was categorized as having environmental issues due to the presence of dead vegetation, non-native grasses, artesian drill holes, acid soil, or samples showed elevated metals, sodium, or sulfate in water or soil.

The sample set should not be extrapolated to the entire 1,355 drill holes unless further analysis is conducted to determine representativeness. Although a high number of drill sites were inspected that were not anticipated to have issues, inspections weighted towards DDH holes, the site visits were not random, and inspections did not include any drill holes on the Sill, the 38 zone, the North Fork Koktuli valley, and only a few in the South Fork Koktuli valley.

Table 3. Categories of sites inspected. *"Minor issues" refers to sites with no problems other than the presence of drill casings, open drill casings, frost-jacked drill casings, monument marker down, casings with plugs or valves, or the site has no identification. "Environmental issues" refers to dead vegetation, non-native vegetation, artesian holes, acid soil, and elevated metals, sulfate, or sodium in water or soil. In parentheses with "Total" row is the percent of visited sites that had no issues, minor issues, or environmental issues. Four sites were noted in log book sketches but did not have notes and were not included here.*

Initial categories ranking sites	**Initial sites**	**Visited sites**	**Fully reclaimed sites**	**Sites with only minor issues**	**Sites with environmental issues**
#1 priority	12	7	3	3	1
#2 priority	27	8	4	0	4
#3 priority	8	8	3	1	4
#4 priority	25	14	1	4	9
#5 priority	159	25	8	4	13
Not a priority	1, 124	45	17	15	13
Total	***1,355***	***107***	***36 (34%)***	***27 (25%)***	***44 (41%)***

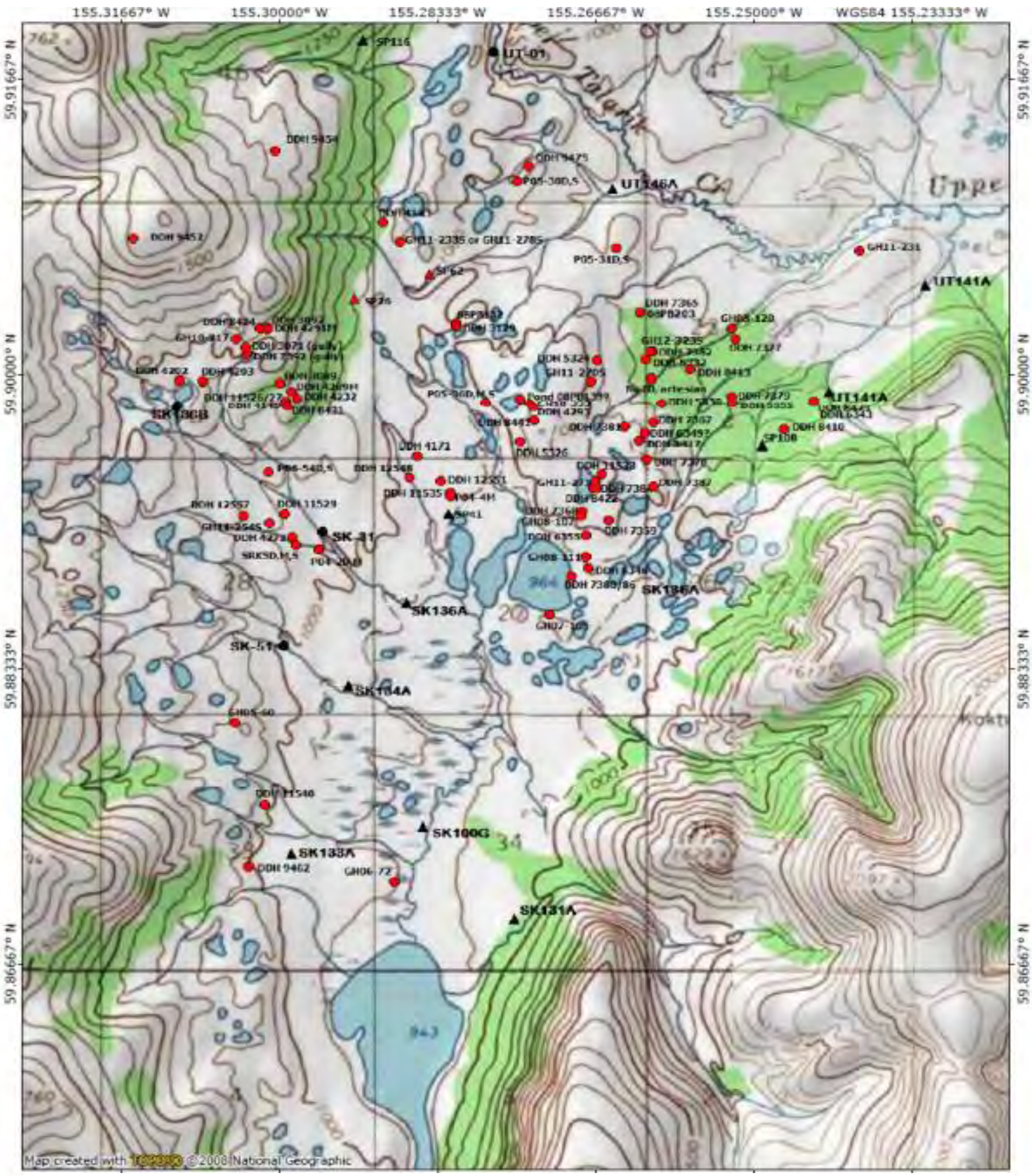

Figure 5. CSP2 field investigations map 1. *This map shows inspection sites north of Frying Pan Lake. Sites visited are marked with a red dot and the site name. Black triangles show former PLP surface water monitoring stations.*

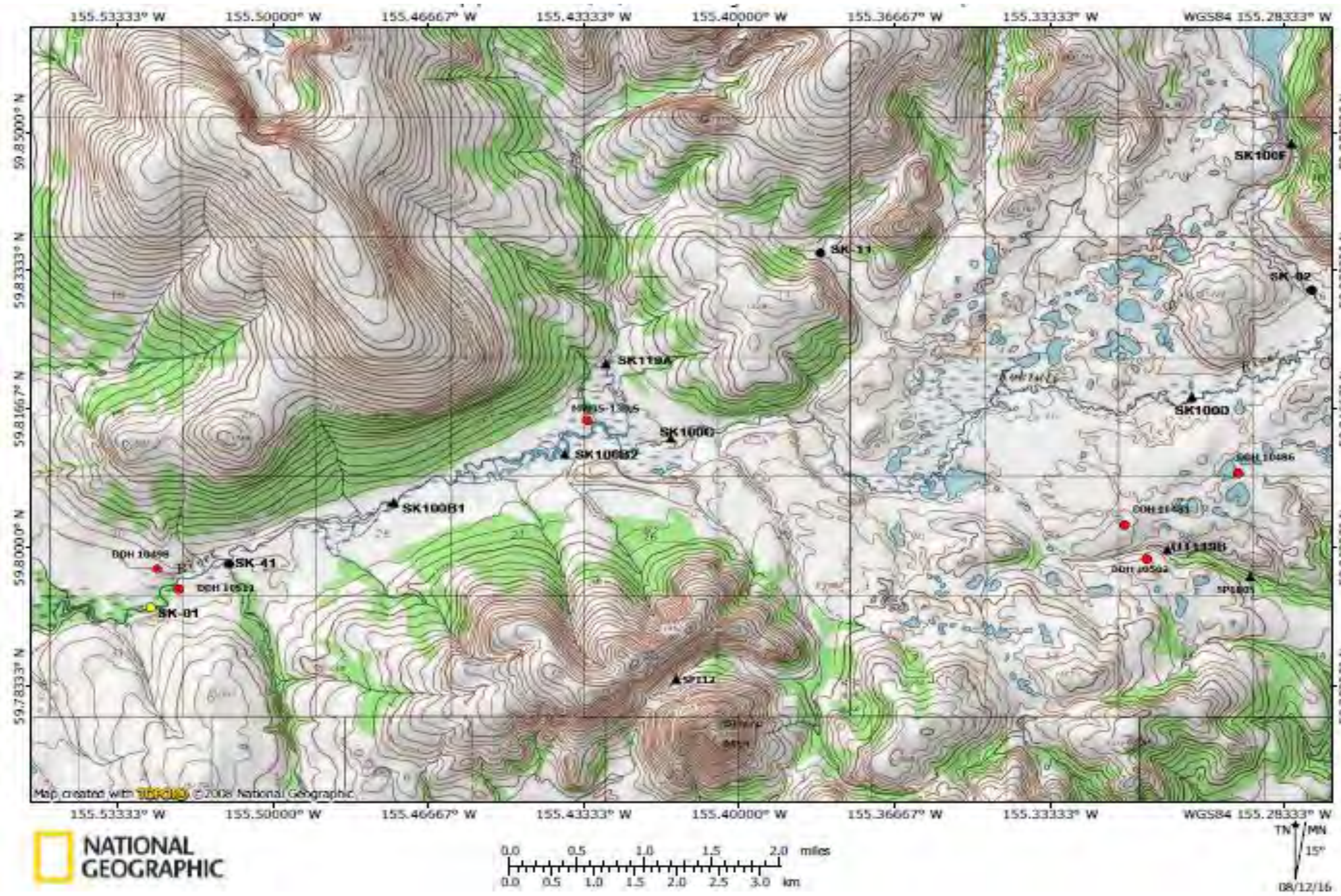

Figure 6. CSP2 field investigations map 2. *This map shows sites inspected along the South Fork Koktuli valley.*

Field observations

Our study determined that 71 of 107 sites inspected were not fully reclaimed. Evidence of impacts was documented through photos, pH and conductivity field meters, and laboratory analysis. Impacts observed in the field were largely dead vegetation, artesian flows, and the presence of open, apparently abandoned, drill casings (Table 4, Appendix C).

<u>Visual</u>

Dead vegetation was one of the most common sightings. Additionally some sites had "squirrel grass" (species not known) identified by a local resident as not native to the area (Figure 7). At site DDH 11533 it appears to be spreading downwind from the original site of application. These sites also had areas of dead vegetation, indicating that non-natives were applied when natural vegetation failed to re-establish. There is also a note in the August 2010 Field Inspection report that Kentucky Bluegrass was seeded at DDH 8417 to control erosion.[7]

Figure 7. Squirrel grass. Reddish-colored grasses in foreground and center.

At several sites tundra mats placed on sump pits failed to grow, vegetation did not establish on overburden on sumps (Figure 8), or vegetation was failing to thrive as evidenced by dead patches. The October 2012 field inspection report by ADFG noted that *"stockpiled squares of tundra mat on-site were desiccated, overturned, broken and flaking apart, and scattered by the wind with no apparent effort to cover or protect them"*. Tundra mats may be failing to thrive due to poor handling, soil quality, or a combination.

Drill casings had been, and potentially still are, periodically flushing material onto the surface. At these sites, fine-grained orange-yellow or grey material presumed to be drill cuttings were present in a trail leading from the casing downgradient. Cuttings directly covered vegetation (tundra mats) and killed vegetation in the path of the trails. In some areas, drill cuttings had been apparently discharged over a wide area, and were evident as patches of cuttings and dead vegetation, particularly in depressions. Impacts from cuttings are distinct from locations where vegetation did not re-establish on drill sumps and trenches (Figure 8).

[7] Field Monitoring Report, August 3, 2010, 16 pages. Two DNR personnel on site.

Table 4. Field observations. *Categories of issues observed in the field, and the drill sites at which the issues were observed, are listed. Some drill sites had no identification at all, and at one location two monument markers were laid together next to one artesian hole where the casing had been removed. Italics = site is listed in more than one category. Bold = sites that were also inspected by DNR in 2016 * = sites at which samples were collected for laboratory analysis*

Category	**Subcategory**	**Sites**
Acid soil (field pH)	Possible drill cuttings	*DDH 3129*, DDH 5324*, DDH 6355*, DDH 7392M*,* ***DDH 6348****/GH08-111* area,*
Vegetation	At sites that appear to have fine cuttings flushed from the drill hole	*DDH 3129*,* DDH 4145, *DDH 4171*,* DDH 4232, *DDH 5324*, DDH 5326, DDH 6355*, DDH 7392M*,* DDH 11526/11527*, *GH05-60*, GH08-111**
	Over wide areas, in depressions	*DDH 4171*/*DDH 12548* *area,* ***DDH 6348****/GH08-111* area, DDH 6355* area, DDH 7384 area,* DDH 12551*
	Patchy, not growing at base of casing, trench, or on sumps	DDH 3071, ***DDH 6343,*** DDH 7378, **DDH 8417,** DDH 8424M, *DDH 8441,* DDH 9452, DDH 9454, *DDH 9462,* **DDH 10481**, DDH 10486, *DDH10498,* DDH 10502, *DDH 11533,* DDH 11540, DDH 12557*, GH07-105, GH10-217, *GH11-254S*
	Non-native grass	DDH 8422, *DDH 9462, DDH 11533,* DDH 11535
Artesian	With no casing	DDH 7380/7386*, **DDH 9475***
	Artesian water from casing	DDH 7379, **DDH 7382*,** ***GH06-72****, Unknown.DDH*,
	Possibly leaking/artesian	*DDH 4202*,* ***DDH 5330***
Fuel smell		DDH 7359*
Drill casings	Open casing, caps not present	DDH 3092, *DDH 4202**, DDH 4291M, *DDH 5324*, DDH 5326,* ***DDH 5330*,*** DDH 7367, DDH 7381, *DDH 7392M*, DDH 8441, DDH10498, GH05-60*, GH08-107, GH08-120,* P04-4M, unknown GH, unknown DDH
	Caps present but open	P04-2D/M, DDH 4183, ***GH06-72****, GH08-111,** GH11-233, GH11-271
	Casing or PVC pipe inside are frost-jacked	GH11-231, *GH08-120, GH11-254S*, **SRK5S**, DDH 6349 or 8438, *Unknown DDH*
	Casings with bolts, valves, plugs	DDH 5335, ***DDH 6343***, **DDH 7365*,** DDH 7377, DDH 8410, **DDH 8413**, **DDH 8423**, unknown DDH,
Other impact	Trash around site	**P05-36D/M/S**
	Monument marker down	**DDH 5332**
No observed impact	DDH 3089, DDH 4203, DDH 4272, DDH 4289M, DDH 4293, DDH 7366, DDH 7368, DDH 7376, DDH 7387, DDH 8405, DDH 8421, DDH 8431, DDH 10511, GH10-222, **GH11-270S**, GH12-323S, **MW05-13D/S**, **SRK5D/M**, **P05-30D/S**, **P05-31D/S**, P08-54D/S, **Main Camp, Geochemistry Test Barrels**	
Site sketch only	DDH 3131 or **3127**, DDH 11529, GH11-288S, Unknown #5	

Figure 8. Vegetation impacts. *(Top) Vegetation failing to grow on sumps at DDH 11540. (Middle) Drill cuttings flushed from open casings at GH05-60 (left) and DDH 7392 (right). (Bottom) Landscape and soil profiles of drill cuttings where drilling waste has been discharged over large areas near DDH 6355 (left) and DDH 12548 (right).*

Some drill casings had large plugs bolted to the sides or top of drill casings (e.g. DDH 6343, 8413, 8423) which may be temporary measures applied to contain artesian water (Appendix C). At least two sites had spray foam applied around the casing, which seems it would be a very temporary measure. These may need continual maintenance and may be a risk of release of waters elevated in copper and other metals.

Field pH and conductivity

Soil or sediment pH was collected in the field at 15 sites, water pH/conductivity at 23 locations on 16 sites, and water temperature at 21 sites.

Water samples were all low-neutral pH (pH 5.3 to 7.8). Specific conductance and water temperature correlated, and were associated with artesian flows. Surface water temperatures (ponds, wetlands) were 11˚C - 24˚C with specific conductance of 9-109 µS/cm. Artesian sites had lower water temperatures, reflecting groundwater sources, at 6˚C - 11˚C[8] and higher specific conductance of 97- 289 µS/cm, also generally associated with groundwater. Site DDH 9475 had an outlier of 1,360 µS/cm; at this site artesian water issued up out of a former drill hole.[9]

Sediment fell within natural wetland pH, between 4.9 and 7.2. At site DDH 7382, gravel was packed around the base of the casing, with a grey, putty-textured material extending several inches below the gravel; a milky fluid was welling up and moving downgradient into a wetland. The pH of the gravel-putty mix was 6.50 in the field but pH 9.5 in the laboratory. The color, texture, and pH suggest the material was bentonite or cement.

Soil pH varied from acidic to neutral when collected in locations where drill cuttings had settled on the landscape (Table 5). The upper 1-4" was acidic (pH 2.6-3.7) at five sites and low-neutral (pH 5.3 – 7.3) at four sites. Variation may have been due to the depth and the amount of vegetation and natural organic material captured in the sample. Sumps were covered in over two feet of overburden; this sump overburden, collected from the surface and from 24" within the cover, was pH 4.1-5.1; although pH 4.1 is lower than observed under most natural conditions, the sample was pH 6.2 in the laboratory suggesting all sump material tested was uncontaminated with drill cuttings or mineralized sulfide material.

[8] A higher temperature of 20 ˚C was recorded at an unknown artesian standpipe slowly leaking from the top and from a hole in the side of the casing. It was not possible to collect the temperature of the water in the casing, and the temperature measured in the collecting bowl warmed during the 30-minute collection period.
[9] There was some question as to whether the 1,360 S/cm was accurate, as the YSI 556 meter did not calibrate on return to camp. However, the laboratory measured a similar specific conductance when a water sample was submitted.

Table 5. Field pH, soil and sediment. *Soil was collected from the top 1-6 inches, with the exception of one sample collected 24" down in sump overburden cover and one sample collected under dead tundra mat. Sites are listed from lowest pH to highest pH. Field pH was not collected at site DDH 11526/11527; this was a sample of sump overburden material with a pH of 5.1.*

Site	Soil pH	Observation and soil profile	Sample collected
DDH 7392	2.60	Profile: 2" fine yellow-orange material, vegetation below	Top 4"
DDH 3129	2.78	Profile: Fine yellow surface, grey, then vegetation	Top 1"
DDH 6355 #2	2.90	Profile: fine yellow or orange material	Top 2"
GH05-60	3.00	Profile: 2" yellow-orange material, vegetation and brown organic material below	Top 4"
6348/GH08-111 area	3.67	Grey layer amid dead vegetation	No notes
DDH 5324	4.10	Profile: muddy brown, possible sump cover	Top 4"
DDH 12557	4.87	Topsoil under dead tundra mat on top of sump	2" below tundra
DDH 9462	5.14	Sump overburden	Core, 24" bgs
DDH 6355 #3	5.30	Profile: 1" yellow-orange material, vegetation below	Top 1"
GH05-60	5.70	Background soil	Top 4"
DDH 5326	6.40	Profile: 2" fine orange material, gray below	Top 4"
DDH 4171	7.09	Profile: 1" fine grey, vegetation, orange-brown below	Top 6"
DDH 6355 #1	7.30	Profile: 1" yellow-orange material, gray below	Top 4"
	Sediment pH		
Unknown artesian	4.94	Leaking standpipe	Sediment, no notes
DDH 11540	4.96	Wetland below drill sumps	Sediment, top 4"
DDH 4202	6.28	Wet soil at base of casing, possibly artesian or leaking	Sediment, top 4"
DDH 5330	7.16	Wet soil at base of casing, possibly artesian or leaking	Sediment, top 4"
DDH 7382	6.50 (9.5 lab)	Gravel with (grouting?) upwelling around casing	Top 4"

Laboratory results and comparison to background

Environmental media were submitted for analysis of pH, specific conductance, cations, anions, and trace elements from 21 sites that included samples of; vegetation (3), soil with or sump overburden (4), drill cuttings on soil (8), sump core contents (1), wetland or pond sediment (3), sediment at casings or artesian holes (4), artesian water (4), pond or wetland water (7), water pooled at casings (2). Trace elements (metals and metalloids) were measured in the total (unfiltered) form.

Sites had contamination from

- Petroleum products
- Low pH, and one strongly alkaline pH
- Trace metals, minor metals, sulfate, and sodium

Sample results were compared to available background information. PLP collected background water, soil, and sediment data from 2004-2008, in order to get a general idea of whether our samples fell within the range naturally observed. The background soil and sediment information from PLP is provided by site, and the site locations are shown on a map, but coordinates are not given.[10]

The USGS sampled water, soils, and sediment in 2007 and 2008 across the ore body.[11] The USGS provided site coordinates along with descriptive notes on the sample type and location. CSP2 compared results to the nearest USGS site with the same sample media (soil, sediment, water).

Extensive drilling – and disposal of drill waste – was occurring during these time periods, particularly in 2007-2008. Due to natural soil chemistry variations and the caveats noted above, CSP2 considered sites potentially contaminated only if site parameters exceed previous concentrations by more than an order of magnitude.

Water, general chemistry

In order to determine if water quality at sites in 2016 represented impacts from drilling, data were compared with pond water sampled in 2007-2008 (USGS) and with nearby and site area water quality from the PLP data base. Pond water was collected in 2016 at three sites that had been sampled by USGS in 2008. Pond water had not changed, with the exception of higher iron and sulfate observed at site DDH 4202 (2016). DDH 4202 water was in a wetland at the edge of the pond and the USGS sample was in the pond.

PB139 is a pond located about 150' from DDH 4293 and GH10-222 with USGS data from 2008. Neither drill sites had visually-observed impact. Water quality at PB 139 was very similar in 2008 and 2016. Iron was an order of magnitude higher in 2016 (178 ug/L v 9 ug/L), but both concentrations are very low.

PB177 is a beaver pond within a few feet of DDH 4202, a site with an open casing surrounded by pooled wetland water. Water quality was very similar, with the exception that sulfate and iron were elevated at DDH 4202 (sulfate at 35 mg/L vs 11 mg/L and iron at 2.7 mg/L vs 0.6 mg/L).

PB202 is a pond about 30' from DDH 7365, a standpipe with a valve to prevent artesian pressure from leaving the casing. In 2008, USGS collected "free-flowing water from the drill stem" (sample PB203) as well as from pond PB202. In 2016, CSP2 also collected water from the standpipe and pond. The pond water quality had not changed. The standpipe water was higher in copper (15 ug/L vs 3 ug/L) and iron (2 mg/L vs 0.4 mg/L), and the standpipe had high concentrations of manganese (~180 ug/L), sodium (> 35 mg/L), and lead (~0.6 ug/L) in both years (Table 6). Copper is in concentrations that would be toxic to aquatic life if the standpipe leaked.

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[10] PLP. 2011. Environmental Baseline Document, 2004 – 2008. Chapter 10 – Trace elements and other naturally occurring constituents.

[11] Fey, DL, Granitto, M, Giles, SA, Smith, SM, Eppinger, RG, and Kelley, KD. 2009. Geochemical data for samples collected in 2008 near the concealed Pebble porphyry Cu-Au-Mo deposit, southwest Alaska: U.S. Geological Survey Open-File Report 2009-1239, 107 p., http://pubs.usgs.gov/of/2009/1239. Fey, DL, Granitto, M, Giles, SA, Smith, SM, Eppinger, RG, and Kelley, KD. 2008. Geochemical data for samples collected in 2007 near the concealed Pebble porphyry Cu-Au-Mo deposit, southwest Alaska: U.S. Geological Survey Open-File Report 2008-1132, 2008, 154 p., http://pubs.usgs.gov/of/2008/.

Additional samples in 2016 that did not have corresponding 2007-2008 pond samples were compared to water quality of the nearest USGS ponds: DDH 11540 (wetland spring) with PB159 (715' distance), GH05-60 (pond water) with PB159 (935' distance), DDH 12551 (pond water) with PB137 (1,020' distance). Water quality in 2016 was similar to that in 2007-2008 with the exception of higher iron in 2016 at the GH05-60 pond set (3.5 mg/L vs 0.15 mg/L) and the DDH 11540 pond set (7 mg/L vs 0.13 mg/L).

Table 6. Artesian water chemistry. *Site DDH 7365 was artesian but not leaking; water was collected by opening a valve. Only one site had been inspected prior to 2016, based on publicly available DNR field inspection reports. Bold indicates analytes over an order of magnitude above background. PLP data is from PLP. 2011. Environmental Baseline Document. Chapter 9 – Water quality, Table 9.1-22 and Appendix 9.1l.*

	General chemistry, artesian water						
Site	**pH**	**Sulfate (mg/L)**	**Cu (µg/l)**	**Na (mg/L)**	**Fe (mg/L)**	**Others**	**State inspections**
PLP seeps, mean	6.5	10	4	2			
PLP seep SP26	3.8-4.2	30-69	219-554	2-3	0.1	--	
DDH 7365, contained in standpipe	7.0	11	15	**35**	2	Mn, Pb	July 2016
DDH 7365, free-flowing, 2008	6.7	12	3	**42**	0.4	--	--
Unknown artesian, leaking standpipe	6.9	6	0.7	8	0.2	Zn	na
DDH 7380/7386, artesian flow from ground	na	8	**76**	13	**8**	Be, Al, K, Ca, Mn, Zn, As, Ag, Cd, Pb, Th, U	7386 inspected Oct 2007
DDH 9475, artesian flow from ground	6.9-7.4	**700-720**	< 2	**196**	0.4	SC, Cl, Mg, Al, Ca, Mn	July 2016
DDH 7382, wetland water downhill from leaking casing	5.2	7	**215**	5	**178**	Ba, Al, Mn, Zn, As, Pb	July 2016

The remaining sites were artesian (Table 6). One site of interest was DDH 9475. This site was listed as "converted to active well", but had no drill casing. It was located on a topographic high, unusual for an artesian site. Attempts to stop the artesian flow had failed, and artesian water very high in sodium and sulfate, and elevated in some metals, was flowing downhill about 130 feet into vegetation. This site is on a tributary of the Upper Talarik

Soil and sediment, general chemistry

Sediment was collected at one pond, in one wetland about 12' from a leaking drill casing, at one artesian site, and at two drill casings in standing water. These were compared to PLP sites in the same general area and two were compared to nearby USGS sites with sediment chemistry. Two sites in 2016 had higher copper and molybdenum (Table 7). Also, copper is most elevated in the USGS 2008 sample from PB137, described as: "*Pond sediment (with high organic content). Almost no fine mineral sediment….one location found with highly organic black sediment; substrate very rocky bottom, staining on substrate not noted".* No contamination had been observed at the site, so it is unclear why such high concentrations were observed.

Table 7. Sediment chemistry. *Sediment was collected at the base of the casing of DDH 4202, an open casing in a wetland a few feet from pond PB177. A pond about 150' from site 12551 was sampled in 2016, but the nearest USGS-sampled pond was PB137 about 1,000' away. The remaining sites did not have a USGS sediment sample nearby. DDH 5330 sediment was also collected at the base of a casing in standing water. Bold indicates metals more than an order of magnitude above background. PLP data is from PLP, 2011, Environmental Baseline Document, Chapter 10-Trace elements.*

	pH	**Sulfate mg/L**	**Al mg/kg**	**As mg/kg**	**Ba mg/kg**	**Cu mg/kg**	**Fe mg/kg**	**Mn mg/kg**	**Mo mg/kg**	**Zn mg/kg**
PLP, nearby sites	--	13-67	11,000	2-4	80-150	9-20	9,000-28,000	92-350	0.4	25-76
PLP, mine area		1-2600	2,000-25,000	1-270	12-239	1-200	3,000-83,000	29-7,000	0.3-22	10-313
PB177, 2008	na	na	60,000	11	619	83	36,000	380	5	72
DDH 4202 sediment, 2016	5.0	38	5,000	26	54	**1,892**	19,000	65	**246**	60
PB137, 2008	na	na	61,000	4	471	**2,080**	18,000	282	1	125
DDH 12551 pond, 2016	5.1	9	15,000	3	84	78	6,000	92	1	27
DDH 5330 sediment, 2016	6.2	15	9,000	11	110	**621**	17,000	201	**98**	209
DDH 7380/7386, artesian sed., 2016	6.3	3	7,000	15	275	**599**	14,000	244	**43**	69
DDH 7382, artesian sed., 2016	6.3	10	14,000	7	209	**186**	27,000	304	**37**	55

Soil data was compared to four PLP samples from the eastern edge of the ore body, two samples on the western zone, and two USGS sites between 50' and 800' from our sample sites. Surface soil on the west zone may be mineralized; surface soil on the east zone is not expected to be mineralized as the ore is over 1,000' below the surface. Site analytes fell within the previous concentrations with the exception of one or more of the following elevated in 2016: copper, molybdenum, arsenic, silver, and sulfate (Table 8).

Table 8. Soil chemistry. *Soil and drill cuttings samples were compared to USGS soil samples collected in 2007-2008 and to PLP background. The notations "W", E" and "NE" refer to the location on Pebble West, Pebble East, or the northeast area of the deposit (near Upper Talarik). Bold indicates metals more than an order of magnitude above background, elevated sulfate, or low pH. The orange-silty drill cuttings are likely oxidized copper-iron-sulfides; sites with the highest iron concentrations were site DDH 4171, DDH 6355 #1, site DDH 12548, and GH05-60 (not shown). For 2016 soil sample profiles, see Table 5. USGS data is from Fey 2008 and Fey 2009.[12] PLP data is from the 2011 Environmental Baseline Document, Chapter 10 – Trace elements.*

	Sample Description	pH	Sulfate mg/L	Ag mg/kg	As mg/kg	Cu mg/kg	Mo mg/kg	Zn mg/kg
PLP range		--	13-67	<0.2	2-4	9-20	0.4	25-76
Sump overburden cover								
PB197, 2007, NE	Dark brown silty mineral soil	5.0	na	<1	11	20	16	30
DDH 5324, 2016	Sump cover	6.2	1	<5	5	7	0.3	24
PB041, 2007, W	Discovery outcrop	6.0	na	<1	**57**	**1,800**	**24**	118
DDH 11526/11527	Sump cover	5.1	11	<5	4	28	1	28
DDH 12557, W	Sump cover under dead tundra	5.1	1	<5	7	86	3	32
Drill cuttings								
DDH 3129, W	Drill cuttings	**3.2**	**72-546**	<5	**108-175**	**422 – 1,650**	**215-233**	22
DDH 7392	Drill cuttings at outcrop	**3.0**	**109-176**	**9**	13	**1,066**	**334**	10
GH05-60, W	Drill cuttings with soil	**3.5**	25-49	<5	14	**122**	**21**	43
Drill waste discharge areas								
DDH 4171, W		5.7	**223-429**	<5	17	**323-767**	**10-24**	188
GH08-111 area, E		**4.3**	11	**21**	**83**	**615**	**163**	54
DDH 12548 area, W		6.0	**165**	<5	13	**655**	**22**	149
DDH 6355 area 1, E		**2.7**	**535**	**13**	**242**	**4,865**	**645**	242
DDH 6355 area 2, E		6.6	13	**10**	14	**4,143**	**605**	14
DDH 7359 (E)	Soil	5.6	11	**74**	15	**2,928**	**360**	148

All samples collected from overburden covering sump covers fell within background: DDH 11526/11527, DDH 12557, DDH 5324. Soil chemistry from these sites suggests they were not affected by drill cuttings or drilling waste, however groundwater samples could indicate whether contamination exists, since the waste itself is problematic, and the sumps unlined. Samples collected from drill cuttings and areas of drilling discharge waste were uniformly elevated in Cu and Mo, and drill cuttings were acidic (Table 8). Drill cuttings had similar copper concentrations to the USGS discovery outcrop soil sample (PB041), but generally higher molybdenum with lower pH.

[12] Fey, DL, Granitto, M, Giles, SA, Smith, SM, Eppinger, RG, and Kelley, KD. 2009. Geochemical data for samples collected in 2008 near the concealed Pebble porphyry Cu-Au-Mo deposit, southwest Alaska: U.S. Geological Survey Open-File Report 2009-1239, 107 p., http://pubs.usgs.gov/of/2009/1239. Fey, DL, Granitto, M, Giles, SA, Smith, SM, Eppinger, RG, and Kelley, KD. 2008. Geochemical data for samples collected in 2007 near the concealed Pebble porphyry Cu-Au-Mo deposit, southwest Alaska: U.S. Geological Survey Open-File Report 2008-1132, 2008, 154 p., http://pubs.usgs.gov/of/2008/.

Discovery outcrop

Site PB041 is located on the discovery outcrop and was higher in copper and molybdenum than the 2016 CSP2 sump sample (DDH 11526/11527), also near the discovery outcrop. Although USGS notes that no contamination from drilling was evident, this is a highly mineralized location and a mineralized sample was likely collected: *"'total metals soil fraction; 'A' horizon is 3 cm thick; 'B' is brown and clay-rich with a few cobbles up to ~5 cm across; color gets slightly more orange with depth; abundant mud, very few pebbles; soil very moist-but not saturated".*

The 2016 CSP2 sample was from 47" within the cover of a drill sump. From the color and texture it appeared to be B horizon, not sump contents, and would not have represented the A horizon soil. The discovery outcrop soil is more similar to the drill cuttings collected at DDH 7392, in that both have high concentrations of copper, but the drill cuttings are acidic with higher molybdenum.

The site PB041, the discovery outcrop soil sample collected by USGS in 2007, is on a ridge west of and overlooking the main camp (Figure 9). This ridge is the site of at least six former drill sites, and rims a gulley that contains two abandoned drill sites, including DDH 7392 which has an open drill casing and has flushed a thick layer of drill cuttings along the gulley floor (Figure 8).

There is also a ring of dead vegetation several feet above the floor of the gulley (Figure 10). There is no obvious explanation for this, but it is possible that several drill sites disposed of waste in the gulley, affecting vegetation. Based on mapped information, a stream was

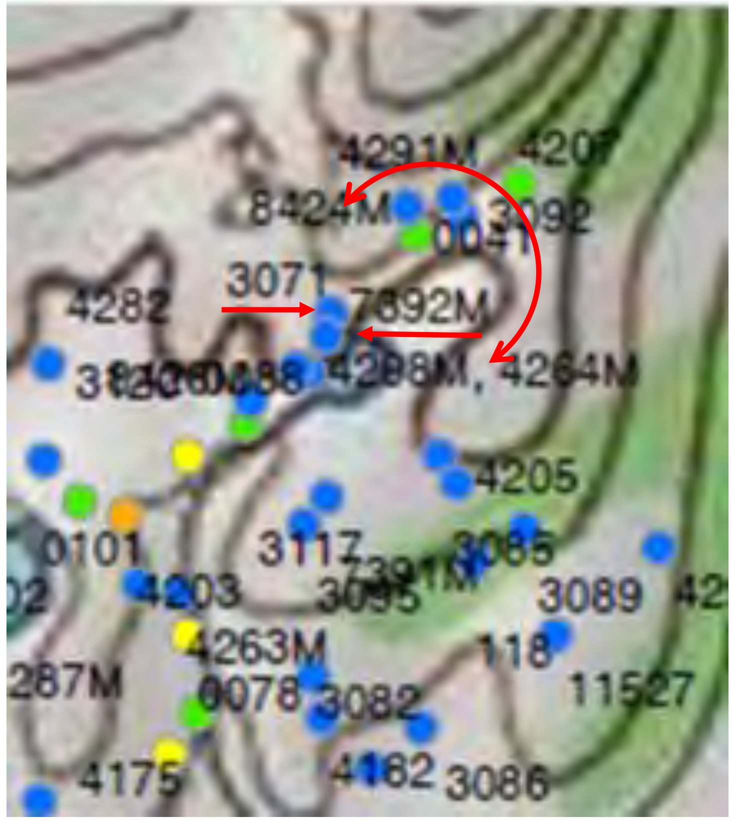


Figure 9. Topographic map of ridge and gulley. *Drill sites 3071 and 7392M are in the bottom of the gulley. Multiple drill sites surround them along a horseshoe shaped ridge.*

Figure 10. Dead vegetation along hillside in gulley. *Acid drill cutting can be seen in the background in the bottom of the gulley, where they have flushed from DDH 7392.*

expected within 30-100’ of DDH 7392 and DDH 3071 (about 40’ away), but no stream was present. Site 3071 was drilled in 2003 to 729 feet; currently an old monument marker remains on site. There is a trail of dead vegetation from the site, but no apparent drill cuttings. Site DDH 7392 was drilled in 2007 to 1,250 feet. Both are categorized as “3E” (stable and fully reclaimed) by PLP.

Petroleum

Soil or sediment from six sites, water from two sites, and a sample of sump material were submitted for analysis of diesel range organics (DRO) and residual range organics (RRO). Soil duplicates were collected at two sites and water duplicates were collected at one site. All but one sample also had general chemistry analysis performed on samples.

The laboratory ran the analyses with and without silica gel cleanup. They provided chromatograms of petroleum markers and chromatograms, DRO concentrations, and RRO concentrations for all samples. Positive identification of petroleum contamination was determined by high concentrations of DRO and RRO, and by comparing site chromatograms with chromatograms of petroleum biomarkers cetane, pristine, and phytane.

PLP recorded petroleum in soil at ranges of 12 mg/kg – 1,300 mg/kg for DRO and 33 mg/kg to 12,300 mg/kg for RRO, and notes this is unusually high for background.[13] Mean concentrations were 209 mg/kg for DRO and 2028 mg/kg for RRO, indicating that the high end range was represented by a small number of the 23 samples tested. The two soil samples that CSP2 identified as contaminated had DRO concentrations of 2,890 - 3,470 mg/kg and RRO of 6,470 – 12,800 mg/kg; the DRO was higher than any background concentrations recorded, and one of the RRO samples exceeded known background (Table 9). They were significantly higher than average background concentrations. The specific locations of soil samples collected by PLP were not provided so CSP2 does not have a direct comparison with earlier soil samples, but the concentration and chromatograms provide sufficient evidence of contamination.

Table 9. Petroleum in soil and sediment. *Data are compared to the mean of 23 soil samples and the single sediment sample analyzed by PLP for DRO and RRO. The number of water samples tested by PLP is not known, but all were below the method reporting limits. Bold represents high concentrations. PLP data is from the 2011 Environmental Baseline Document, Chapter 9 – Water Quality and Chapter 10 – Trace elements, tables 10.1-5 and 10.2-3.*

Sample ID	Matrix	Units	DRO	RRO
PLP mean	Soil	mg/kg	209	2,028
PLP mean	Sediment	mg/kg	14	49
PLP, mean	Water			
DDH 7382	Grout material	mg/kg	42	45
	wetland sediment	mg/kg	**2890**	**6,470**
	wetland water	mg/L	2	6
DDH 7359	Soil	mg/kg	**3470**	**12,800**

[13] Pebble Environmental Baseline Document, 2011. Chapter 10 – Trace elements. Section, page 10.1-14.

Comparison to 2011 investigation

In 2011, water at site DDH 11540 was sampled at the drill sump and in a wetland pool and spring downgradient.[14] In 2016 sump material, a wetland spring (Figure 11), and wetland sediment were sampled. The sump material was collected as a core with 1 inch of overburden and 6 inches of a blue-grey material (sump pit contents) that swelled when removed from the pipe. The wetland spring was a small, clear spring downgradient of the sump site, in heavy brush and slightly to the southeast about 80 feet (estimated). The 2011 spring is described as 98 feet downgradient.

Figure 11. Wetland spring sampled in 2016.

The wetland spring in 2016 had the same pH and conductivity as the 2011 sample, but was elevated in minor and trace elements relative to the 2011 sample, although lower in concentrations than the 2011 wetland pool sample. Concentrations of cadmium (not shown), barium (not shown), and zinc were similar to 2011, but copper, molybdenum, aluminum, iron, manganese were higher than in the 2011 spring sample and higher than ponds 715' and 915' upgradient (USGS 2008) (Table 10).

Table 10. Wetland spring, 2011 and 2016. *PB159 and PB161 are ponds sampled for water and sediment in 2008 (Fey et al. 2009). The 2011 data is from Woody et al. 2012. Bold indicates concentrations an order of magnitude above nearby sites or prior measurements.*

		Field & Lab pH	**Field & lab SC µS/cm**	**Al mg/L**	**As µg/L**	**Cu µg/L**	**Fe mg/L**	**Mn µg/L**	**Mo µg/L**	**Zn µg/L**
2008	PB159 water	6.2	29	--	0.3	1.4	0.13	10	0.4	3
2008	PB161 water	5.9	63	--	0.3	1.4	0.39	25	0.4	3
Water										
2016	Wetland spring	6.5	97	0.23	0.7	1.8	**7**	**336**	2	4
2011	Wetland spring	6.6-7	66-100	0.02-0.04	<0.15	0.25	0.09	6	na	2-3
2011	Wetland pool	5.4-7.7	249-305	16-28	5-8	71-137	13-21	383-490	na	72-85
2011	Sump water	8.1	310	56	15	435	61	865	na	116
Sediment and sump material				**Al mg/kg**	**As mg/kg**	**Cu mg/kg**	**Fe mg/kg**	**Mn mg/kg**	**Mo mg/kg**	**Zn mg/kg**
2016	Sump material	6.3	**1,150**	10,000	4	**475**	20,000	233	**38**	33
2008	PB159 sed.	--	**--**	86,000	19	218	56,000	616	9	102
2008	PB161 sed.	--	**--**	82,000	11	109	45,000	978	5	91

[14] Woody et al. 2012. Water quality at Pebble prospect drill rig #6, South Fork Koktuli River, Bristol Bay, Alaska.

Only a small sample of sump material was retrieved and analyzed. Based on this, copper and molybdenum were elevated relative to nearby sediment but aluminum, iron, and manganese were not. CSP2 cannot be certain that the same spring was sampled in 2011 and 2016, but the water chemistry suggests potential mobilization of Cu and Mo from the sump into the wetland.

Comparison of DNR and CSP2 2016 reclamation inspections

In 2016, DNR and CSP2 both visited 23 drill sites, 16 of which had no previously recorded state inspections. In general, the visits differed in that CSP2 spent more time at each site and collected data to determine if, or better indicate why, sites were impacted (Table 11).

CSP2 physically landed at all but two of the 107 sites visited over one week; at GH06-72 (inspected by both DNR and CSP2), the helicopter kept the rotors going to keep from sinking into the wetland, so CSP2 was on site only long enough to photograph it and take notes, and at site DDH 10511, in a dry area, CSP2 inspected from the air.

DNR visited 134 sites in 2 days. Like CSP2, they prioritized sites and opportunistically visited more as time allowed. DNR priorities were to inspect sites that did not have an "E" (stable, reclaimed") rating. Their schedule implies that many sites were only viewed from the air. DNR noted only 9 sites with issues out of 134 drill sites visited; CSP2 noted only 36 fully reclaimed sites out of 107, and 44 that had environmental issues (Table 3).

Impacts noted by DNR were potential subsidence and artesian flows. CSP2 noted layers of fine-grained, oxidized drill cuttings, representing past or periodic flushing that may represent drill holes with insufficient cement and grouting. CSP2 also noted where drilling muds had been discharged over wide areas, whether sites had discharge sumps or not, and the condition of vegetation at both. Collecting samples provided information on how the environment was impacted, e.g. whether sump overburden material was preventing revegetation. Some impacts were observed only on close inspection. For example, CSP2 observed a milky liquid in the gravel at the base of casing DDH 7382 and, inspecting downgradient, found it had entered a wetland; wetland sediment was determined to be elevated in petroleum and wetland water was elevated in copper and other trace metals. DNR listed the site as one they inspected but they made no notes, just grouping it in with the "107 boreholes…observed to be in stable condition". At other sites, such as the drill casings DDH 4202 and DDH 5330, water sampling could determine the origin of standing water.

A detailed account comparing observations is available in Appendix D.

Table 11. Chemistry at sites visited by CSP2 and DNR. *Of 23 sites inspected by both DNR and CSP2, four – all artesian or leaking – had samples submitted by CSP2 for chemical analysis. The PLP reclamation status rating categories are shown. "1" is an active well and "2" is inactive. "D" is a reclaimed and stable site that has had past issues and may need high maintenance or was recently repaired. "C" is a site that needs routine maintenance.*

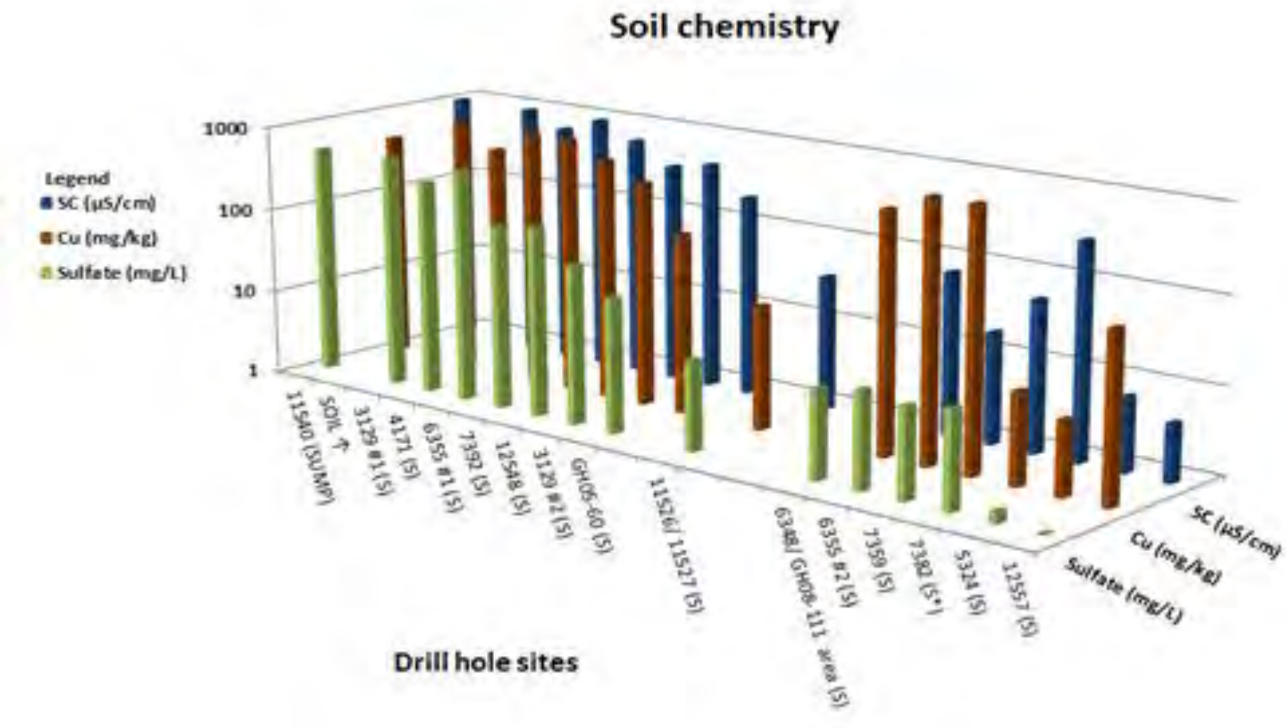
General Chemistry					
Site	**pH**	**Sulfate mg/L**	**Copper mg/kg or µg/L**	**Other analytes of interest**	**PLP rating**
DDH 5330					1D
Sediment	6.2	15	621 mg/kg	Zn	
Water @ casing base	6.8	5	< 0.4 ug/L	-	
DDH 7365					1C
Standpipe water	7.0	11	15 ug/L	Na, Fe, Mn, Pb	
Pond water	6.3	0.4	0.9 ug/L	-	
DDH 7382					2D
Gravel @ casing base	9.5	13	11 mg/kg	Na, Th, U	
Sediment, wetland	6.3	10	186 mg/kg	Petroleum	
Water, wetland	na	7	215 ug/L	Al, V, Mn, Fe, Zn, As, Ag, Cd, Ba, Pb	
DDH 9475 (BH17)					1D
Artesian water (duplicates)	6.9-7.4	700	< 2 ug/L	SC 1500 µS/cm, Na 195 mg/L; Mg, Al, Ca, Mn, As	

Discussion

A significant amount of reclamation work remains to be done. In addition to many drill casings that need to be removed, drill casings with evidence of flushed drill cuttings should be inspected to determine if the cement and grouting are sufficient. The inspection noted that there are recurring issues with efforts to reclaim some artesian sites, and long-term issues with vegetation failing to thrive.

Drill cuttings and drilling discharge

Historically, drilling muds, including cuttings, were disposed of on land even after sumps went into use in about 2003. Drill muds were not always discharged near the drill hole, but could be pumped hundreds of feet away, including upslope. As sumps came into regular use, sump wastewater continued to be discharged on the tundra, with the presumption that metals settled out with the cuttings. In 2016, there were sites with evidence of drilling waste disposal over large areas, accompanied by areas of dead vegetation; soils ranged from acidic to neutral. Soils at both types of sites were elevated in copper, molybdenum, sulfate, and specific conductance (Figure 12). Drilling discharges would have occurred at least several years ago. These sites were in contrast to drill casings with layers of flushed cuttings running downgradient; the soil at these sites was acidic and the flushing may not be historical, it may be continuing on a periodic basis.



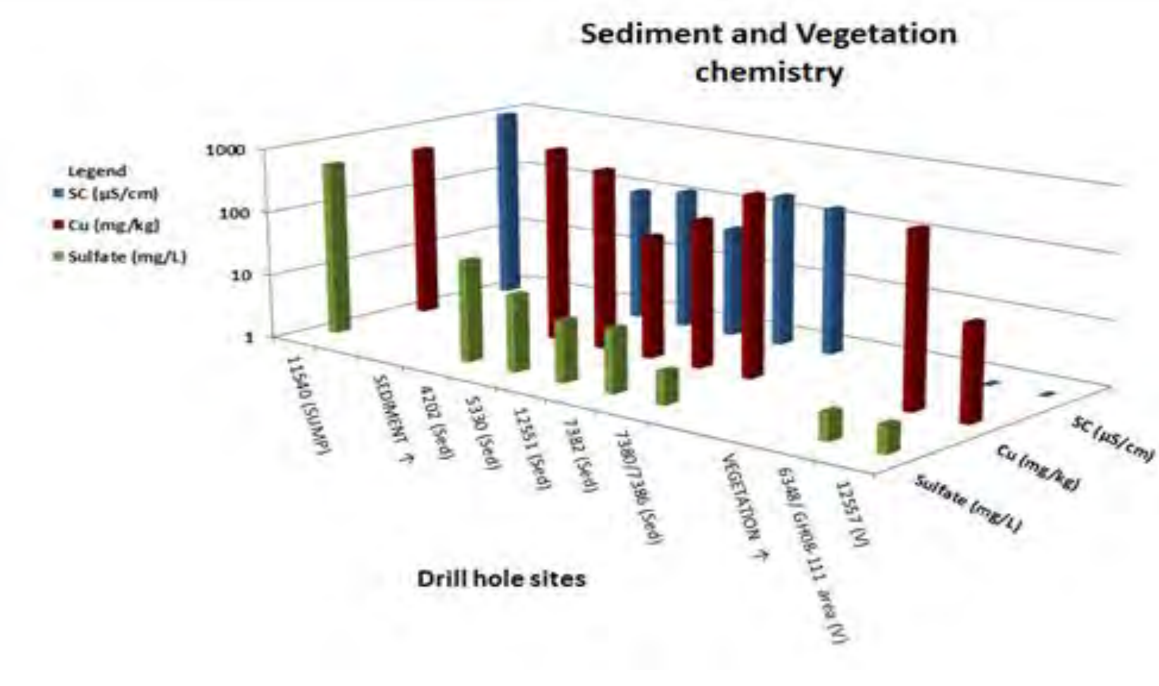


Figure 12. Soil, sediment, and vegetation chemistry. *The chemistry associated with drill cuttings can be represented by the pattern of the drill sump material. (Top, label furthest to the left) Drill pit sump material is elevated in sulfate, copper, and specific conductance. Sites with drill cuttings have similar chemistry. The most dissimilar are sites on the far right. The sample of the upper 2" of soil from site DDH 6355 had a different profile than the sample from the upper 4". Site GH08-111, although in an area of drilling discharge, was a sample of grey material. The profile of sediment and vegetation (bottom), not impacted by drill cuttings, is different from soil in the upper figure. Drill sump material is shown on the far left of both charts for comparison.*

Both types of drill waste areas are in contrast to sites with drill sumps; although vegetation failed to thrive on several sumps, it was not due to poor soil chemistry. CSP2 consistently observed sites from 4 to 13 years old at which natural vegetation had not re-established. Re-seeding these with "squirrel grass" [15] (Kentucky Bluegrass) is not in line with good reclamation practices that or the MLUP permits which encourage measures such as reshaping, providing organic material, "reseeding to encourage natural revegetation of the sites" and stabilizing to provide sufficient moisture.

Tundra mats have not re-established where they have been placed over trenches and sump pits at some locations. State field inspections have noted sites that were not reclaimed in the same year they were drilled, tundra mats that were desiccated and flaking apart, and tundra mats and soil that were stored in manners that caused them to lose their essential biological components.

Reclamation could be enhanced at future sites by putting in place policies that require drill sumps, do not allow drilling discharge onto the landscape, and require best practices for storage of tundra mats and revegetation.

Water quality

Acid drainage water was not observed. In general, water in ponds was good, and had not changed from 2008. Many drill sites did not have water on them. However, drill sites were leaching trace elements, particularly copper, where there was active upwelling and artesian conditions. Additionally, water quality at the only spring at which CSP2 collected water chemistry suggests that a drill site had caused increased in copper, aluminum, iron, and manganese; however, this is a tentative conclusion.

Artesian waters had neutral pH and no consistent pattern in water chemistry (Table 12). There was no consistent pattern of metals in water sequestering in sediment, or metals in sediment releasing into the water column. Vegetation was in generally good condition. However, copper concentrations indicate water is being impacted in at least localized areas, but the extent to which copper is moving into fish-bearing waters is not known.

Sediment chemistry did provide information on the origin of standing water around the drill casings at DDH 4202 and DDH 5330, where it was not evident from observation whether the sites were artesian. Water surrounding the base of the DDH 4202 casing was elevated in aluminum, iron, manganese and copper and sediment copper and molybdenum were well above background and above concentrations in the pond a few feet away. The water at DDH 5330 did not show any elevated analytes, but sediment was elevated in copper and molybdenum, although to a lesser degree than DDH 4202. This suggests that DDH 4202 is leaking artesian water and DDH 5330 had artesian conditions in the past but is not currently artesian.

[15] DNR field inspection report August 2010

Table 12. Artesian water and sediment. *Four artesian sites with water and sediment chemistry. DDH 5330 and DDH 4202 are open drill casings in standing water. DDH 7382 is a closed drill casing with an upwelling of milky fluid around the casing. DDH 7380/7386 was artesian flow from where a drill casing had been removed. Artesian water from sites DDH 7365, DDH 9475 and an unidentified drill casing are not included, as sediment was not collected. PLP pond water is based on n=2 at one pond (site 335133). PLP sediment is based on sites near the artesian areas. PLP. 2011. Environmental Baseline Document. Chapter 9 – Water quality and Chapter 10 – Trace elements.*

General Chemistry						
Site	**pH**	**Sulfate**	**Copper**	**Molybdenum**	**Other analytes of interest**	**PLP rating**
		mg/L	mg/kg or µg/L	mg/kg or µg/L		
PLP pond water, ug/L	7.2-7.6	<0.5	1-3	30-36	-	-
PLP sediment, mg/kg	-	13-67	9-20	<0.4	-	-
DDH 5330						1D
Sediment @ casing base	6.2	15	**621** mg/kg	**78** mg/kg	Zn	
Water @ casing base	6.8	5	< 0.4 ug/L	<LOD	-	
DDH 4202						1C
Sediment @ casing base	5.0	38	**1,892** mg/kg	**246** mg/kg	-	
Water @ casing base	6.2	36	7 ug/L	4 ug/L	Al, Fe, Mn	
DDH 7382						2D
Gravel @ casing	9.5	13	11 mg/kg	1 mg/kg	Na, Th, U	
Sediment, wetland	6.3	10	**186** mg/kg	**37** mg/kg	Petroleum	
Water, wetland	na	7	**215** ug/L	10 ug/L	Al, V, Mn, Fe, Zn, As, Ag, Cd, Ba, Pb	
DDH 7380/7386						
Sediment	6.3	3	**599** mg/kg	**43** mg/kg	Na	
Artesian water	na	8	**76** ug/L	1 ug/L	Al, Fe, Mn, K, Ca, As, Zn, Ag, Cd, Pb, Th, U,	

Risk factors

Initial site prioritization attempted to determine whether specific factors such as depth, age or history of artesian upwellings could locate higher risk drill holes.

Due to the practice of disposing of drill waste in uplands and depressions up to 1,000 feet from the original drill site, it is not possible to determine which drill sites contributed to some types of observed impacts. Sites with chemical impacts (elevated metals or acidic soils) were mostly deep holes (over 1,000'), and many were old; the two sites that were neither deep nor old were artesian. Similarly, most of the sites with dead vegetation were near deep holes. The depth of the hole appeared to be a more important factor than the age. The lithology – understanding what percent of the hole is sulfide minerals, would be useful, but the data was not available.

Many drill holes are located in wetlands and artesian areas. This has caused recurring problems with attempting to fully reclaim drill holes.

Conclusions

Although there is no widespread contamination, there are localized areas with elevated copper and other elements in soil and water. The inspection provided insight into earlier events that can guide better state policy on exploration, as well as information on existing risks. About 10% of the sites inspected had fine-grained, oxidized drill cuttings around the casing or leading in a trail away from the casing. If these are flushing periodically, this suggests that either the holes were not cemented, or the cement has failed.

Allowing drill waste to be placed directly on the tundra, where it is exposed to oxygen and water, has led to acid generation in the waste. This is not only a demonstrated source of contamination at Pebble, but it should be obvious that allowing this practice to continue at any mineralized drilling site could result in similar contamination. DNR should not allow drill waste to be placed on the ground surface.

The impacts of placing drill waste into kettle ponds, and unlined waste pits covered with overburden, is less clear. A single sump sample was not acidic, but sump contents could turn acidic if the ability of cuttings to generate acid exceeds the ability of buffer possibly provided by drill mud. Sump contents should be sampled to determine if chemistry is changing, and groundwater downgradient from several sumps should be checked to see if it is impacting groundwater. Drill waste has been observed in kettle ponds, but these ponds flush annually, and additional water quality and sediment monitoring would be required to determine if there are impacts to aquatic organisms.

At least some sites were improperly classified. For example, DDH 9475 is an artesian site near Upper Talarik. PLP categorizes it as "converted to active" – although there is no drill casing, only water upwelling from a hole – and as "1D" "active well, reclaimed and stable recently repaired or with past issues or with high maintenance needs". DDH 5330, a leaning, rusted casing standing in water, is also classified as "converted to active" and the artesian site DDH 7380 is classified as "plugged, fully reclaimed, and stable".

DNR prioritized inspecting sites categorized by PLP as having less than a fully reclaimed status, and added a randomly selected site of sites for spot-checking. Random spot-checking needs to be pursued more frequently. This would maintain a regularly updated status of site classification. DNR focused the most recent investigation on drill sites with potential subsidence and artesian sites. However, the question of the competency of the reclamation of drill holes that have flushed, or are flushing, cuttings should be investigated as they may represent ongoing environmental and potentially financial risks with respect to fully reclaiming the sites.

It is evident that there may be long-term reclamation and maintenance issues. Currently DNR requires no reclamation plan, and has exempted PLP from reclamation bond.[16] It is obvious that the amount required to properly reclaim the well sites is significant. If PLP were to go bankrupt, taxpayers would be liable for the costs of this reclamation.

[16] 2014-2016 MLUP, http://dnr.alaska.gov/mlw/mining/largemine/pebble/pdf/a156118permit.pdf

Appendices

Appendix A: PLP Mineral Claims Map

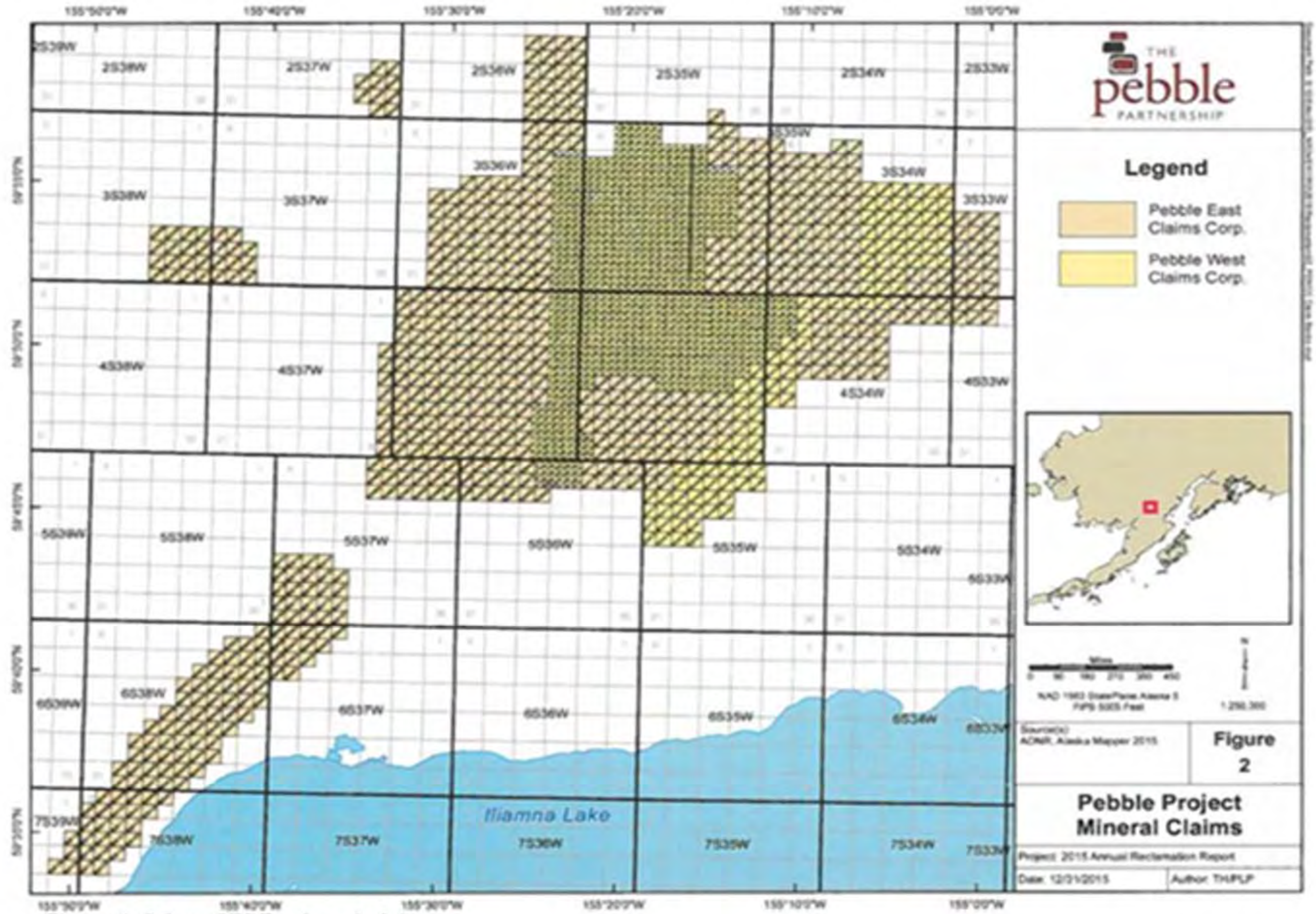


Figure 1. Map of PLP mineral claims.

Appendix B: PLP reclamation status codes

PLP Reclamation Status sample codes

			# of drill holes
1- Active monitoring wells or boreholes maintained as water sources. Not plugged (no grout, cement, bentonite) but may have mechanical plug or cap			
1	A	A- Site of concern; significant repairs needed.	0
1	B	B - needs repair that requires more than one person, but not at risk of further degradation.	1
1	C	C - Routine maintenance needed or conditions not confirmed and needs further inspection.	6
1	D	D - Needs frequent inspection. Reclaimed and stable but had past issues or known to have high maintenance needs or recently repaired.	28
1	E	E - fully stable and reclaimed with no history of leaks, upwellings, staining and not in a wetland or artesian area. Only minimal inspection needed.	576
2 - Inactive but might be used in future so aboveground caps/casing/valves remain.			
2	A	A - site of concern, significant repairs needed	0
2	B	B - needs major repair but not unstable	0
2	C	C - Routine maintenance or unconfirmed condition; needs further inspection.	1
2	D	D - Reclaimed, stable, but had past issues so needs frequent inspection.	10
2	E	Inactive, fully reclaimed.	122
3 - abandoned, decommissioned, plugged, all structures removed but may have wood post with ID			
3	A	A - site of concern, significant repairs needed.	0
3	B	B - significant repairs needed but not unstable	2
3	C	C - Routine maintenance or need to confirm condition.	7
3	D	D - Reclaimed and stable but had past issues, needs frequent inspection.	8
3	E	E - Fully stable and reclaimed with no issues.	553

No information
2 NDM monitoring holes drilled 2004; remainder exploration holes drilled 1988-1989 except two drilled by PLP same as 4251 and 4225

Appendix C: Photos of significance, CSP2 2016

DDH 3129

Drill cuttings flushed from this low, cut off, open casing towards a pond. A thick layer of cuttings is shown in the photos. Cuttings were acidic with elevated sulfate, arsenic, copper, and molybdenum. Pond water did not have high concentrations of analytes; pond sediment was not collected.

The pond downgradient from DDH 3129 did not have elevated metal concentrations, with the exception of slightly elevated aluminum. Sediment was not collected.

DDH 4145

This site is one of at least six within walking distance of each other. It is a good example of cuttings flushed from a drill casing.

DDH 4202

This site is located in a wetland on the edge of a beaver pond. You can see the weathered orange snowpole marking the site in the picture on the left. To the right, outside of the picture, is a wetland pond that had iron staining. Water directly around the drill casing at DDH 4202 also had iron-stained water and a sheen. This is not uncommon in wetlands, so we collected water and sediment samples at the base of the casing. Iron and sulfate were elevated in water samples above water quality criteria and above water samples collected in the pond in 2008 (sulfate at 35 mg/L vs 11 mg/L and iron at 2.7 mg/L vs 0.6 mg/L). Sediment was very high in copper (1,892 mg/kg) and molybdenum (246 mg/kg). This information suggests that the standing water around the drill casing is artesian flow from water passing over mineralized ore in the drill hole, rather than natural wetland water.

DDH 5330

DDH 5330 is in a wetland and surrounded by standing water. Water and sediment samples indicated that water is coming up from the casing. Although water was low in copper, sediment had elevated copper at 621 mg/kg; the highest background sediment copper in the mine area was 200 mg/kg, with nearby sites less than 20 mg/kg. Sediment was also enriched in molybdenum (98 mg/kg vs a maximum of 22 mg/kg in mine area sediment). This site was listed as a drillhole "converted to active" well although there are no indications that it could be used as a water source.

DDH 7365

The entire plateau where this drill site is located is wet with springs. The drill site has a history of artesian conditions; USGS observed free-flowing water from the drill stem – and collected a sample – in 2008. The casing currently has a valve on it, but this will require regular maintenance. A similar site, DDH 7379, had a broken valve and artesian water. DDH 7365 is near a pond (to the middle left of the photo). Standpipe (also called drill stem) water was collected by opening the valve. It is elevated in sulfate, sodium, copper, iron, manganese, and lead (report Table 11 and unpublished).

DDH 7367

One of many examples of an open casing.

DDH 7380 & DDH 7386

These should be separate locations, and have two different reclamation classifications. DDH 7380 is classified as fully reclaimed and stable (3E) and DDH 7386 is classified as inactive and stable (2E). Monument markers for both posts were lying next to an artesian flow upwelling from where a drill casing had been removed. There is no record of DDH 7380 having been inspected by the State, and DDH 7386 appears to have been last inspected in October 2007.

This site is an example of wetland contamination and of the need to inspect and correctly classify drill sites.

These should be separate locations, and have two different reclamation classifications. DDH 7380 is classified as fully reclaimed and stable (3E) and DDH 7386 is classified as inactive and stable (2E). Monument markers for both posts were lying next to an artesian flow upwelling from where a drill casing had been removed. There is no record of DDH 7380 having been inspected by the State, and DDH 7386 appears to have been last inspected in October 2007.

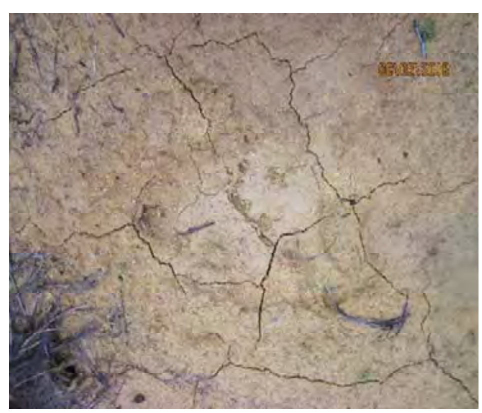
At this site, clear water bubbled up through milky material, possibly cement. The site had a slightly alkaline pH (7.8) and was elevated in copper, aluminum, iron, and manganese, and several other elements, including thorium and uranium (report Table 6). Only DDH 7382 and DDH 7380/7386 are elevated in thorium and uranium; it is possible that both are moving through alkaline material. There were several patches of dead vegetation in the general area.

DDH 7382

This site was visited during a rainstorm. Gravel was packed around the casing, which was unusual, and a milky fluid was welling up from around the casing in the gravel. It was observed moving into a wetland. Samples from material around the casing, wetland water, and wetland sediment were submitted for laboratory analysis. The wetland sediment was contaminated with petroleum; it was one of only two samples that had petroleum contamination. Possibly the petroleum came from the material packing around the casing. Wetland water and sediment were elevated in copper; water was also elevated in several different metals (report, Table 11). Photos show the casing and the trail into the wetland.

DDH 7392

To the west of the discovery outcrop is a horseshoe-shaped rim of hills around a gulley. Around the rim are several old drill sites, with sites DDH 3071 and DDH 7392 in the gulley about 20 feet apart A thick layer of drill cuttings (bottom right) ran from the open casing at DDH 7392 for well over 100' (bottom left). No water was present at the site, but given the path of the cuttings it is feasible that rainwater or snowmelt is moving the cuttings. The cuttings were light colored and about 4 inches deep, covering vegetative mat. The material was acidic (pH 3.0), with elevated specific conductance, sulfate, copper, and molybdenum (Report Table 8).



DDH 8410

This site represents one of several casings with a variety of bolts and plugs, possibly to contain artesian conditions.

DDH 9452

This is an example of a fully reclaimed site with no apparent issues. No water was on the site.

DDH 12548

Patches of drill waste in small depressions

This is an example of one of three sites where drilling waste was disposed of over a large area in the past. Patches were located between DDH 12548 and DDH 4171. Vegetation was not growing on the drill sump pits at DDH 12548. Samples of soil with drill waste material were neutral pH but elevated in sulfate, copper, molybdenum and zinc (report Table 8).

Main camp

The main camp contains drill pipe, buildings, tanks, and other supplies.

Appendix D: Comparison of Field Inspections, 2016

Comparison of comments at sites. DNR specifically notes that none of the sites, including the 9 that need monitoring or repair, are environmental or compliance risks.

Site	CSP2 Observations & Samples	DNR Recommendations	PLP rating
DDH 3127 or 3131	CSP2 notes this in a site sketch when visiting Site DDH 11529 but has no notes about the site. DNR notes that DDH 3127 was reseeded in 2016 and grass species are growing in discontinuous tufts. DNR lists DDH 3131 as, by default, one of the sties in stable condition with the caveat that repairing 3131 in the fall may have caused an issue at DDH 3132.	None for sites 3127 or 3131	1C, 2D
DDH 5330	DNR noted that high artesian conditions had been repaired earlier in 2016. They have an aerial photo of the site, and note that ponded water may be precipitation or shallow groundwater. It is not clear if they landed. CSP2 at the site, which is next to a pond with a beaver house, noted a rusted, open casing. The pooled water had a sheen. Samples show the water quality is consistent with natural wetland water, but sediment is somewhat elevated in copper and zinc. There is some – but not conclusive – evidence of petroleum contamination.	DNR recommends re-inspection in 2016 to verify the artesian fix holds. CSP2 would agree.	1D
DDH 5332	DNR noted a small flow coming from the well in an area of known artesian conditions. CSP2 found a monument marker post down in the grass and no casing; no water was seen at the marker, although the general area was wet. No drill sumps were present. No samples were taken.	DNR requests a workplan from PLP; CSP2 has no recommendations	3C
DDH 6343, DDH 8423	DDH 6343 and DDH 8423 are drill holes about 15 feet apart that were repaired in 2015 with new Margo plugs. DNR noted the 6343 casing was sealed and wrapped, the 8423 casing was spray-foamed, and there was good vegetative growth. CSP2 noted the "seal" was a Ziploc bag duct-taped over the top of the casing. They did not appear to be leaking. DDH 6343 was identified by foam-paint on a post and 8423 had no ID.	DNR had no recommendation; CSP2 notes that the temporary placement of a Ziploc bag over the hole will need a more permanent solution.	2D, 2D
DDH 6348	DNR lists this as a site visited but has no notes; CSP2 has it in a site sketch but has not notes.	No recommendations	2C

Site	CSP2 Observations & Samples	DNR Recommendations	PLP rating
DDH 7365	DNR lists this as a site visited but has no notes. CSP2 noted a ball valve holding in artesian water. The artesian water and a nearby pond were sampled. The water was elevated in conductivity, sodium, and trace elements very similar to the chemistry of the pond in 2008 when artesian water from the drillhole was not contained. Pond water is good in 2016.	DNR had no recommendations but CSP2 notes that the valve will need maintenance and artesian water from the site did, in the past, change water quality in a nearby pond.	1C
DDH 7382	DNR makes no notes on this site; by default it is one considered in stable condition. CSP2 determined that an alkaline material was flowing from or around the casing and impacting a wetland with high copper and other metals.	DNR had no recommendations, but CSP2 recommends this site be re-inspected.	2D
DDH 8413	DNR has no notes, indicating it is a stable site. CSP2 notes duct tape and spray foam around the cap and water pooled at the base, but did not take samples.	DNR has no recommendations but CSP2 recommends re-inspection and water/sediment samples should be collected to determine the level of copper.	2D
DDH 8417	DNR has no notes, indicating it is a stable site. CSP2 notes that the site is fully reclaimed, and there is a mix of live and dead vegetation on the sump.	DNR has no recommendations. CSP2 recommends monitoring the success of vegetation.	3E
DDH 9475	DNR notes the drill hole continues to produce water outside of the casing despite efforts in 2015. In September 2015, PLP grouted the casing at a depth of 40' on one side and 80' on the other using a mixture of sand, cement and bentonite. Water flows downhill to the west approximately 132' into the surrounding vegetation. The water catchment trench and sump were successfully reclaimed in 2015 and reseeding efforts appear to be successful. CSP2 noted that it was unusual to have an artesian hole on a topographically high elevation. At the artesian hole (no casing), there was a grey clay-like substance under about 1" of red surface soil at the posthole. A drill sump was present. A water sample was collected about 20 feet downgradient from the artesian hole, in the runoff flow. The water was neutral pH but with very high sulfate (700 mg/L), very high sodium (190 mg/L), and elevated in some trace metals. It was unusually low in copper (less than 2 μg/L).	DNR recommends PLP "continue to investigate a resolution" and monitor vegetation. CSP2 notes that PLP categorizes the site as "converted to active". Since there is no casing, only an artesian hole, this should be reclassified. CSP2 recommends the site be re-inspected regularly. This site is near a tributary of the Upper Talarik and should be closely monitored.	1D

Site	CSP2 Observations & Samples	DNR Recommendations	PLP rating
DDH 10481	DNR has no notes, indicating it is a stable site. CSP2 noted it was reclaimed and there was no water on site, but there was little to no vegetation on the trench or sumps.	DNR made no recommendations. CSP2 recommends that vegetation reclamation work be done.	3E
GH06-72	DNR noted a minor upwelling of less than 0.5 gpm at this site, located in a marsh, possibly due to a rusty Margo plug. They noticed that a sheen on the water dissipated and was likely bacterial, not petroleum. CSP2 noted the site was so wet that the helicopter needed to keep the rotors going to prevent sinking. Only photos, not samples, were taken. The site is in a marsh just north of Frying Pan lake and may be hydrologically connected when the water table is high.	DNR recommended that the site rating be changed from 1D to 1B until repairs were made. CSP2 recommends taking water and sediment samples to determine if copper is entering the wetland, and continue to monitor the site.	1D
GH11-270S	DNR has no notes, indicating it is a stable site. CSP2 also notes it is reclaimed with good vegetation and the cap secured on the casing.	DNR makes no recommendations. CSP2 recommends the casing be removed if not needed.	1C
MW05-13D MW05-13S	DNR has no notes, indicating it is a stable site. CSP2 notes that it is a reclaimed monitoring well site.	No recommendations	1E
P05-30D, P05-30S	DNR has no notes, indicating it is a stable site. CSP2 notes that it is a reclaimed site with no issues.	No recommendations	1E
P05-36D, P05-36M, P05-36S	DNR has no notes, indicating it is a stable site. CSP2 notes that it is a reclaimed site of three nested wells and has no issues, other than plastic tubing trash littered around it.	DNR makes no recommendations. CSP2 recommends removing litter.	1E
SRK5D, SRK5M, SRK5S	DNR notes that SRK5D was reseeded or repaired earlier in the year. CSP2 noted the area was reclaimed but casings were frost-jacking, particularly SRK5S.	DNR recommends monitoring continue. CSP2 recommends PLP provide a solution to prevent further frost-jacking at the site.	1B, 1E, 1E
Main Camp	DNR and CSP2 noted the site was generally orderly without spills.		
Geochemistry Barrels	DNR and CSP2 noted the site had no leaks. CSP2 noted that the barrels did not appear to be in use, and therefore were missing an opportunity for long term testing of waste rock material.	DNR recommends solid lids for the barrels. CSP2 recommends that geochemistry testing continue.	

Appendix E: List of site inspections, 2016

Site chemistry issues

The following sites were noted by CSP2 to have acid soil or elevated metals. "Rec. code" refers to the PLP reclamation status code (see Appendix B). Bold are sites inspected by CSP2 and DNR in 2016. Bold are sites visited by CSP2 and DNR. Dark shaded cells are one of the 9 sites DNR that required follow up.

Investigator	Site	CSP2 category	CSP2 site notes	Lab chemistry	Metals of interest	DNR notes prior to 2016 visit	DNR notes 2016	Reclamation Code
CSP2	3129	Low	Acid soil, dead vegetation, cuttings flushed from drill hole	soil #1: acid (pH 3.2), metals , sulfate, SC, possible petroleum	Mo	Grouted & plugged		3E
				soil #2: acid (pH 3.2), metals, possible petroleum	Mo			
CSP2	4171	Low-moderate	Dead vegetation, discolored soil, cuttings may be flushing from drill hole	soil: metals, sulfate, SC	Cu, Zn, Pb	Converted to Monitoring Well		1E
CSP2	4202	Moderate	Cap off, iron staining at casing and nearby spring/pool	At base of casing: water: metals, sulfate	Al, Mn, Fe	Past issues, needs frequent inspection; wet area but no upwelling		2D
				sediment: metals, sulfate	Cu, Mo			
CSP2 & DNR	**5330**	Moderate-high	Open casing with pooled water at base, iron stain, sheen	sediment - metals, possible petroleum	Cu, Zn	Active, not plugged; new water valve Sept 2015	photo 28 (aerial). 2015 artesian conditions repaired. Some surface water ponding. New veg growth.	1D
				wetland water: ok, no petroleum	Cu, Zn			
CSP2	6355	Low	Large area of dead vegetation, acid soil	soil #1: acid (pH 2.9), metals, sulfate, SC	Cu, Mo, As, Se	Grouted & plugged		3E
				soil #2: metals	Cu, Mo, Cr			
CSP2	7359	Low	open casing, fuel smell	soil: metals, petroleum	Cu, Zn, Mo, Ag	no notes		2E

Investigator	Site	CSP2 category	CSP2 site notes	Lab chemistry	Metals of interest	DNR notes prior to 2016 visit	DNR notes 2016	Reclamation Code
CSP2	7380/ 7386	7380 – low moderate	artesian: grey liquid flowing out of casing hole, posts down, two posts at one site	water: metals	Al, K, Ca, Fe, Mn, Cu, Zn, As, Ag, Cd, Pb, Th, U	7380 is listed as 3E "grouted & plugged" and 7386 is listed as 2E with no notes, but both are at exact same site. PLP 2016 photo visit.		3E/2E
		7386 - low moderate		sediment: metals, sodium	Cu, Th			
CSP2 & DNR	**7382**	moderate	artesian: grey liquid flowing up from around base of casing	material at base of casing: alkaline (pH 9.8), metals, SC, sodium, no petroleum	Th, U	Inactive, new cap Sept 2015 to control minor leak, reinspect 2016	no notes	2D
				wetland sediment: SC, petreoleum				
				wetland water: metals, no petroleum	Al, Fe, Mn, Ca, Cu, Zn, As, Ag, Cd, Ba, Pb.			
CSP2	7392(M)	low	dead veg, acid soil. Flushing	soil: acid (pH 2.9), metals, sulfate, SC, no petroleum	Cu, Mo	Grouted & plugged		3E
				veg: acid (pH 3.3), metals, sulfate, SC	Cu, Mo			
CSP2 & DNR	**9475**	Moderate-high	Artesian	wetland water: metals, sulfate, sodium, chloride, SC	Mg, Al, Ca, Mn, As	Active, not plugged; **converted to monitoring well,** redrilled and grouted Sept 2015 to controll upwelling; PLP 2016 site visit	Photo. 2015 repairs (grout to 40' on one side, 80' on the other with sand, cement, bentonite) unsuccessful but there is no environmental or compliance risk. Minor iron bacteria growth. Water is coming out of casing and flows downhill 132' into vegetation. Re-seeding was successful. PLP to investigate a resolution and monitor vegetation	1D

Investigator	Site	CSP2 category	CSP2 site notes	Lab chemistry	Metals of interest	DNR notes prior to 2016 visit	DNR notes 2016	Reclamation Code
CSP2	11540	Low	Cap off, dead vegetation	soil: metals; no petroleum	Al, Fe, Mn;	PLP to place snowpole 2016		2E
				Drill core: SC, sulfate, metals, no petroleum	Cu			
CSP2	12548	Low-moderate	Dead vegetation, discolored soil widespread	soil: metals, sulfate, SC	Cu, Zn, Pb	no notes		1E
CSP2	12557	None	Dead vegetation	soil: ok		Grouted & plugged		3E
				vegetation: metals	Zn			
CSP2	GH05-60	High	Open casing, cap off, dead vegetation, cuttings flushed from drill hole	soil: acid, metals	Cu	PLP to place snowpole 2016		1D
				pond water: metals	Fe, Mn, Al			
CSP2	Between 6348, **GH08-11**1	6348 – moderate; GH08-111 - none	large area of drill mud and cuttings in depression	Soil and veg: metals	Cu	na		
CSP2	PB137 (closes pond to 12551)	none	sampled pond near 12557, but map shows none close; PB 137 is 1,000' away	pond water: metals	Al, Cu	no notes		1E
				pond sediment: ok				
CSP2	Unknown, artesian	None	Artesian, casing frost jacked, no ID	drill casing water more alkaline with higher SC than water pooled at base of casing	Zn	na		na

Sites with field-observed issues

Investigator	Site	CSP2 category	CSP2 Field observations	DNR notes prior to 2016 visit	DNR notes 2016	Reclamation Code
CSP2	3071	Low	Dead vegetation; no sample	Grouted & plugged		3E
CSP2	3092	Low	Casing open, no sample	no notes		2E
DNR	3132	Low			Repair of nearby borehole in fall 2015 may have caused this one to weep.	3E
CSP2	4145	None	Dead vegetation, discolored soil, no sample	Grouted & plugged		3E
CSP2	4183	Low	Cap unlocked, no sample	Grouted & plugged		3E
DNR	4224	None			2015 inspection requested minor repairs to valves, caps or plugs	3E
CSP2	4232	None	Dead vegetation, cuttings flushed from drill hole, no sample	Grouted & plugged		3E
DNR	4279	None			In 2015 found to have ponded water of unknown origin. PLP attempted to repair with bentonite in 2016; partial success	3C
CSP2	4291M	Low	Open casing, cap off, no sample	no notes		2E
CSP2	5324	Low-moderate	Open casing, dead vegetation	no notes		1E
CSP2	5326	Low-moderate	Open casing, dead vegetation; no sample	no notes		1E
CSP2 & DNR	**5332**	Moderate	Post down , otherwise site okay; no sample	Grouted & plugged but wet area, source of ponded water unclear, reinspect 2016	photo 14 (aerial). Producing a small flow in a known artesian area, not entering water body, no iron staining. PLP to investigate cause and submit work plan. Upwelling may be from shallow groundwater.	3C
CSP2 & DNR	**6343**	Moderate	Short – term fix; cap bolted on and covered with plastic bag; dead vegetation; no sample	Inactive, new Margo plug Sept 2015; PLP 2016 visit	photo 29 (aerial). 2015 problems repaired with new plug. Casing sealed and wrapped. Grass is well established.	2D
CSP2	6349? 8438?	6349 – Low; 8438 Low-moderate	open casing, jacked casing and PVC, no ID; no sample	(6349 Grouted & plugged with 2016 PLP photo visit; 8438 also has 2016 PLP photo visit)		(6349 is 3E, 8438 is 1E)

Investigator	Site	CSP2 category	CSP2 Field observations	DNR notes prior to 2016 visit	DNR notes 2016	Reclamation Code
CSP2 & DNR	**7365**	High	Short term fix - valve	Active, not plugged; potential water source; PLP to place snowpole 2016	no notes	1C
			Chem - pond water ok; Drill casing Fe, Mn, Cu, Pb but not leaking			
CSP2	7367	Low	open casing, no cap; no sample	PLP 2016 visit to install snowpole		2E
CSP2	7377	Low-moderate	short term fix: cap bolted to casing; no sample	PLP 2016 photo visit		1E
CSP2	7378	Low	dead veg, possibly non-native grass; no sample	Grouted & plugged; PLP 2016 photo visit		3E
CSP2	7379	Low	open casing with broken ball valve, artesian, no ID; no sample	no notes		2E
CSP2	7381	High	cap off; no sample	PLP photo visit 2016		2E
CSP2	7384	Low	dead veg; no sample	Grouted & plugged		3E
CSP2	8410	Low-moderate	Short term fix – plug; no sample	no notes		1E
CSP2 & DNR	**8413**	Moderate	Short term fix – plug; no sample	Inactive, new Margo plug Sept 2015; PLP 2016 visit	2015 inspection requested minor repairs to valves, caps or plugs	2D
CSP2 & DNR	**8417**	Low-moderate	Dead vegetation; no sample	Grouted & plugged; PLP 2016 photo visit	no notes	3E
CSP2	8422	Low-moderate	Non-native grass; no sample	Grouted & plugged		3E
CSP2 & DNR	**8423**	Moderate	Short term fix: bolted cap. Dead veg, no ID; no sample	Inactive, new Margo plug Sept 2015; PLP 2016 visit	photo 30 (prossibly aerial) -- new plug in 2015, casing spray foamed to prevent water penetration, successful repairs, vegetation unaffected; In 2015, cap replaced (may be referring to 8432?)	2D
DNR	8433M	None			Groundwater upwelling where casing removed despite spring 2016 attempts by PLP to pack it with bentonite	3C
CSP2	8424(M)	None	Patches bare of vegetation	Grouted & plugged		3E

Investigator	Site	CSP2 category	CSP2 Field observations	DNR notes prior to 2016 visit	DNR notes 2016	Reclamation Code
CSP2	8441	None	open casing, dead veg, no sample (DMC notes there seems to be periodic flushing, but veg looks fine in photos, no cuttings visible; says you can look 50' down well)	no notes		2E
CSP2	9454	Low	Patches bare of vegetation, post down; no sample	Grouted & plugged; PLP 2016 photo visit		3E
CSP2	9462	Moderate-high	Dead vegetation, non-native grasses; no sample	Inactive reclaimed; repaired in 2013, known artesian area, significant revegetation in 2015		2D
CSP2 & DNR	**10481**	None	Dead vegetation; no sample	Grouted & plugged; 2016 PLP photo visit	no notes	3E
CSP2	10486	None	Dead vegetation, post down; no sample	Grouted & plugged; 2016 PLP photo visit		3E
CSP2	10498	None	Open casing, dead vegetation, post down; no sample	Grouted & plugged; 2016 PLP photo visit		3E
CSP2	10502	None	Dead vegetation, post down; no sample	Grouted & plugged; 2016 PLP photo visit		3E
CSP2	11533	Low	Dead vegetation, non-native grass; no sample	Grouted & plugged		3E
CSP2	11535	Low-moderate	Dead vegetation; no sample	no notes		1E
CSP2	11526/11527	11526 – not a priority; 11527 – Low	Dead vegetation, two names on one post, cuttings flushed from drill casing?. Soil pH	Grouted & plugged		3E
CSP2	12551	Low-moderate	Dead vegetation, discolored soil widespread	no notes		1E
DNR	12561	Moderate	na		Subsidence at casing	3C
CSP2 & DNR	**GH06-72**	Moderate-high	Artesian; no sample – too wet for helicopter to land	Active, not plugged; artesian	photo 9 (ground level). Minor upwelling at casing with small pool at base, rusty plug, sheen present but likely from bacteria. DNR requested PLP upgrade the rating of BH from 1D to 1B until repaired.	1D
CSP2	GH07-105	None	Cap off; no sample	no notes		1E
CSP2	GH08-107	High	Open casing, PVC tube inside casing frost-jacked, no ID; no sample	no notes, inspected Sept 2015		1E
CSP2	GH08-111	None	Open casing, dead vegetation	no notes		1E

Investigator	Site	CSP2 category	CSP2 Field observations	DNR notes prior to 2016 visit	DNR notes 2016	Reclamation Code
CSP2	GH08-120	Low-moderate	Open casing, casing and inner PVC tube frost-jacked, standing water; no sample	no notes		1E
DNR	GH08-156	None			Minor upwelling flows 8-10 feet from casing; iron staining	1C
CSP2	GH10-217	None	Dead vegetation; no sample	no notes		1E
CSP2	GH11-231	None	Cap off, inner PVC tube frost jacked out of casing; no sample	no notes		1E
CSP2	GH11-233	None	Cap unlocked; no sample	no notes		1E
DNR	GH11-236	None			Possible subsidence at casing	1D
CSP2	GH11-254S	None	Dead vegetation; no sample	no notes		1E
CSP2	GH11-271	None	Open casing; no sample	no notes		1E
CSP2	P04-04M	Low-moderate	Open casing, cap off, no sample	no notes		2E
CSP2	P04-2D	None	Cap off casing and inner PVC tube; no sample	no notes		1E
CSP2	P04-2M	None	Cap off; no sample			1E
CSP2 & DNR	**P05-36D**	None	Caps unlocked; no sample	no notes	no notes	1E
CSP2 & DNR	**P05-36M**	None	Caps unlocked; no sample	no notes	no notes	1E
CSP2 & DNR	**P05-36S**	None	Caps unlocked; no sample	no notes	no notes	1E
CSP2 & DNR	**SRK5S**	High	Casing frost jacked; no sample	no notes		1E
CSP2	Unknown	None	open casing, no ID	na		na
CSP2	Unknown, may be 6344	None	Short term fix - plug, no ID	(notes for 6344 are "potential water source, PLP 2016 photo visit")		(1E)
CSP2	Unknown, yellow standpipe, may be GH08-119	None	open casing, no ID	(no notes for 08-119)		(1E)

Sites with no issues

DNR visited 134 sites and listed 9 as having follow-up issues; the remainder were considered to not have issues. CSP2 considered 36 sites to be fully reclaimed. There is some overlap. Sites visited by CSP2 and DNR are in bold.

Investigator	Site	CSP2 category	CSP2 Field observations	DNR notes prior to 2016 visit	DNR notes 2016	Reclamation Code
DNR	9	Low-moderate	na		2015 inspection noted surface staining impacting vegetation; request repairs	2E
DNR	40	none			2015 inspection noted surface staining with iron algae in a 120' long channel	3D
DNR	51	none			Reseeded or repaired with Margo plugs or caps spring and early summer 2016	3B
DNR	52	none			no notes	3E
DNR	68	none			no notes	3E
DNR	103	none			no notes	3E
DNR	112	Low	na		Reseeded or repaired with Margo plugs or caps spring and early summer 2016	3C
DNR	122	none			no notes	3E
DNR	2031	none			no notes	3E
DNR	2037	none			no notes	3E
DNR	3072	none			Reseeded or repaired with Margo plugs or caps spring and early summer 2016	3B
CSP2	3089	Low	no sample	no notes		2E
DNR	3093	None			no notes	2E
DNR	3101	Low	na		2015 inspection noted marker needed increased visibility and need to ensure casing is plugged	2E

Investigator	Site	CSP2 category	CSP2 Field observations	DNR notes prior to 2016 visit	DNR notes 2016	Reclamation Code
CSP2 & DNR	**3127**	3127 – Low 3131 – Moderate	Could not determine if site visited was 3127 or 3131; site sketch only	Past issues, needs frequent inspection; redrilled and grouted Sept 2015; PLP 2016 visit	Reseeded or repaired with Margo plugs or caps spring and early summer 2016	1C/2D
DNR/	3131				no notes	2D
DNR	4167	Low	na		no notes	3E
DNR	4169	None			no notes	3E
DNR	4190	None			Reseeded or repaired with Margo plugs or caps spring and early summer 2016	3C
CSP2	4203	Low	No sample	Converted to Monitoring Well		1E
DNR	4215	None			Reseeded or repaired with Margo plugs or caps spring and early summer 2016	3C
DNR	4223	Moderate	na		2015 inspection noted artesian upwelling near drill hole but not from drill hole	3D
DNR	4225	High	na		no notes	1D
DNR	4239	Low-moderate			2015 inspection requested follow up inspections	3D
CSP2	4272	Moderate-high	no sample	Converted to Monitoring Well		1E
DNR	4273	none			no notes	3E
CSP2	4289M	none	no sample	Grouted & plugged		3E
CSP2	4293	Low	ok – vegetation re -establishing	no notes		3E
DNR	4301	None			no notes	3E
DNR	5319M	None			no notes	3E
DNR	5320M	None			no notes	3E
CSP2	5335	Low	No sample	Grouted & plugged; PLP 2016 photo visit		3E
DNR	6340	Low	na		no notes	2E
DNR	7358	Low	na		no notes	3E

Investigator	Site	CSP2 category	CSP2 Field observations	DNR notes prior to 2016 visit	DNR notes 2016	Reclamation Code
DNR	7361	Low	na		no notes	3E
CSP2	7366	Low	No sample	no notes		2E
CSP2	7368	Moderate	Site okay; did not sample	Grouted & plugged		3E
CSP2	7376	Low	Site okay; veg re-establishing			3E
CSP2	7387	Low-moderate	Site okay; did not sample	Grouted & plugged		3E
CSP2	8405	Low	Site okay; did not sample	PLP 2016 photo visit		2E
CSP2	8421	Low	Site okay; did not sample	Grouted & plugged, PLP 2016 photo visit		3E
CSP2	8431	None	Site okay; did not sample	Grouted & plugged		3E
DNR	10509	none			no notes	3E
CSP2	9452	Low	Site okay; did not sample	Grouted & plugged		3E
CSP2	10511	none	Aerial view; site looks okay; no water on site	Grouted & plugged; 2016 PLP photo visit		3E
DNR	11531	Low	na		2015 inspection noted Westbay 4 shed over drill hole site	2E
DNR	12555	Low	na		2015 inspection noted site is stable and vegetation re-establishing	2E
CSP2 & DNR	**Geochemistry Barrel Site**	None	Site ok -- barrels do not appear to be in use		Drums are adequately sealed, no leakage; PLP to replace plastic lids with more durable lids	na
DNR	GH04-016	None			no notes	1E
DNR	GH04-017	None			no notes	1E
DNR	GH04-018	Moderate-high	na		no notes	1E
DNR	GH04-025	None			no notes	1E
DNR	GH04-026	None			no notes	1E

Investigator	Site	CSP2 category	CSP2 Field observations	DNR notes prior to 2016 visit	DNR notes 2016	Reclamation Code
DNR	GH04-028	None			no notes	1E
DNR	GH04-041	None			no notes	1E
DNR	GH05-052	None			no notes	1D
DNR	GH06-079	None			no notes	3E
DNR	GH07-089	None			no notes	1E
DNR	GH07-090	None			no notes	1E
DNR	GH08-163	None			no notes	1E
DNR	GH08-170	None			no notes	1E
DNR	GH10-220	None			no notes	2E
CSP2	GH10-222	None	Site ok – vegetation is re-establishing	no notes		1E
DNR	GH11-248S	None			no notes	1E
DNR	GH11-263S	None			no notes	1E
DNR	GH11-264S	None			no notes	1E
CSP2 & DNR	**GH11-270S**	Moderate-High	Site okay; no sample	Active, not plugged; artesian; PLP 2016 re-inspection	no notes	1C
DNR	GH11-283S	None			no notes	1E
DNR	GH11-289S	None			no notes	1E
DNR	GH11-292S	None			Reseeded or repaired with Margo plugs or caps spring and early summer 2016	1C
DNR	GH11-2989S	?			no notes	
DNR	GH12-297	None			no notes	1E
DNR	GH12-298	None			no notes	1E
DNR	GH12-307	None			no notes	1E
CSP2	GH12-323S	None	Site okay; no sample	no notes		1E
DNR	GH12-335	None			no notes	1E
DNR	GH12-337S	None			no notes	1E

Investigator	Site	CSP2 category	CSP2 Field observations	DNR notes prior to 2016 visit	DNR notes 2016	Reclamation Code
DNR	GH13-369	None			no notes	1E
DNR	GH13-370	None			no notes	1E
DNR	GH13-374	None			no notes	1E
DNR	GH13-375	None			no notes	1E
CSP2 & DNR	**Main Camp**	High	Site okay; no samples		Materials stored in orderly fashion; should be inventoried	na
CSP2 & DNR	**MW05-13D**	None	Site okay; no samples	no notes	no notes	1E
CSP2 & DNR	**MW05-13S**	Moderate-high	Site okay; no samples	no notes	no notes	1E
DNR	P-04-03	None			no notes	1E
DNR	P-05-07D	None			no notes	1E
DNR	P-05-07S	None			no notes	1E
DNR	P-05-08	None			no notes	1E
DNR	P-05-10D	None			no notes	1E
DNR	P-05-10S	None			no notes	1E
DNR	P-05-11D	None			no notes	1E
DNR	P-05-11M	None			no notes	1E
DNR	P-05-11S	None			no notes	1E
DNR	P-05-17D	None			no notes	1E
DNR	P-05-17S	None			no notes	1E
DNR	P-05-27D	None			no notes	1E
DNR	P-05-27M	None			no notes	1E
DNR	P-05-27S	None			no notes	1E
CSP2 & DNR	**P05-30D**	None	Site okay – patches bare of vegetation; no sample	no notes	no notes	1E
CSP2 & DNR	**P05-30S**	None	Site okay – patches bare of vegetation; no sample	no notes	no notes	1E
CSP2 & DNR	**P05-31D**	None	Site okay; no sample	no notes		1E
CSP2 & DNR	**P05-31S**	None	Site okay; no sample			1E

Investigator	Site	CSP2 category	CSP2 Field observations	DNR notes prior to 2016 visit	DNR notes 2016	Reclamation Code
DNR	P-05-35	None		no notes		1E
DNR	P-05-36	None		no notes		1E
DNR	P-06-41D	None		no notes		1E
DNR	P-06-41M	None		no notes		1E
DNR	P-06-41S	None		no notes		1E
CSP2	P08-54D	High	Site okay; no sample	no notes for 54D		1E
CSP2	P08-54S	High	Site okay; no sample	54S noted as 1D, active not plugged, needs inspections, wet area but no upwelling		1D
DNR	P-08-60D	None		no notes		1E
DNR	P-08-60S	None		no notes		1E
DNR	P-08-69D	None		no notes		1E
DNR	P-08-69S	None		no notes		1E
DNR	P-08-73D	None		no notes		1E
DNR	P-08-73S	None		no notes		1E
DNR	P-08-74D	None		no notes		1E
DNR	P-08-74S	None		no notes		1E
DNR	P-08-75D	None		no notes		1E
DNR	P-08-75M	None		no notes		1E
DNR	P-08-75S	None		no notes		1E
DNR	P-08-79D	None		no notes		1E
DNR	P-08-79M	None		no notes		1E
DNR	P-08-79S	None		no notes		1E
DNR	P-08-80D	None		no notes		1E
DNR	P-08-80M	None		no notes		1E
DNR	P-08-80S	None		no notes		1E
DNR	P-08-80S	None		no notes		1E
DNR	P-08-81D	None		no notes		1E
DNR	P-08-81S	None		no notes		1E
DNR	P-08-88D	None		no notes		1E
DNR	P-08-88S	None		no notes		1E

Investigator	Site	CSP2 category	CSP2 Field observations	DNR notes prior to 2016 visit	DNR notes 2016	Reclamation Code
DNR	P-08-89D	Moderate-high	na		no notes	1D
DNR	P-08-89M	Moderate-high	na		no notes	1E
DNR	P-08-89S	Moderate-high	na		no notes	1E
CSP2	PB132	High	Chemistry shows slightly elevated Al (84-176 ug/L) but site ok; no petrol; list as "No contam" in report table			
CSP2	PB139	High				na
DNR	Pebble 1 Met	None			Orderly, containers in good condition but contents unknown.	na
DNR	Sill 07	None			no notes	no rating
CSP2	PB203	None		na		na
CSP2 & DNR	**SRK5D**	High		SRK5D requires repairs; artesian overtopping monument (seasonal?) but no evidence of impact; 2016 maintenance scheduled.	One of 8 sites remediated by PLP in 2016, reseeded or repaired. "Positive signs' of grass growth and should continue to be monitored.	1B
CSP2 & DNR	**SRK5M**	High		no notes	no notes	1E
DNR	Watershed	None			In good condition	
DNR	West Bay 1	None			Acceptable condition	
DNR	West Bay 3	None			Acceptable condition	
DNR	West Bay 4	None			Acceptable condition	
DNR	Wiggly Lake Fuel Facility	None			Vegetation growing well, transplanted tundra well-established	

Appendix F: List of drillholes with no history of inspection, 2003-2016

A total of 1,104 sites have no history of inspection by the State of Alaska, based on publically available DNR field inspection reports

0001	0048	0096	2019	2066
0002	0049	0097	2020	2067
0003	0050	0098	2021	2068
0004	0053	0099	2022	3069
0005	0054	0100	2023	3070
0006	0055	0101	2024	3071
0007	0056	0102	2025	3073
0008	0057	0104	2026	3074
0010	0058	0105	2027	3075
0011	0059	0106	2028	3076
0012	0060	0107	2029	3077
0013	0061	0108	2030	3078
0014	0062	0109	2032	3079
0015	0063	0110	2033	3080
0016	0064	0111	2034	3081
0017	0065	0113	2035	3082
0018	0066	0114	2036	3083
0019	0067	0115	2038	3084
0020	0069	0116	2039	3085
0021	0070	0117	2040	3086
0022	0071	0118	2041	3087
0023	0072	0119	2042	3088
0024	0073	0120	2043	3089
0025	0074	0121	2044	3090
0026	0075	0123	2045	3091
0027	0076	0124	2046	3092
0028	0077	0125	2047	3094
0029	0078	2001	2048	3095
0030	0079	2002	2049	3096
0031	0080	2003	2050	3097
0032	0081	2004	2051	3098
0033	0082	2005	2052	3099
0034	0083	2006	2053	3100
0035	0084	2007	2054	3102
0036	0085	2008	2055	3103
0037	0086	2009	2056	3104
0038	0087	2010	2057	3105
0039	0088	2011	2058	3106
0041	0089	2012	2059	3107
0042	0090	2013	2060	3108
0043	0091	2014	2061	3109
0044	0092	2015	2062	3110
0045	0093	2016	2063	3111
0046	0094	2017	2064	3112
0047	0095	2018	2065	3113

3114	4170	4226	4278M	6341
3115	4171	4227	4280	6342
3116	4172	4228	4281	6344
3117	4173	4229	4282	6345
3118	4174	4230	4283	6346
3119	4175	4231	4284	6349
3120	4177	4232	4286M	6352
3121	4178	4233	4287M	6353
3122	4179	4234	4288M	6354
3123	4180	4235	4289M	6356
3124	4181	4236	4290M	7357
3125	4182	4237	4291M	7360
3126	4183	4238	4292	7363
3128	4184	4240	4294	7370
3129	4185	4241	4295M	7371
3130	4186	4242	4296M	7372
3133	4187	4243	4297M	7373
3134	4188	4244	4298M	7375
3135	4189	4245	4299M	7377
4137	4191	4246	4300	7379
4138	4192	4247	4302	7380
4139	4193	4248	4303	7381
4140	4194	4249	4304	7383
4141	4195	4250	4305	7390M
4142	4196	4251	4306M	7391M
4143	4197	4252	4307M	7392M
4144	4198	4253	4308	7393
4145	4199	4254	4309	7395M
4146	4200	4255	5310M	7396M
4147	4201	4256	5311	7397M
4148	4202	4257	5312M	7398M
4149	4203	4258	5313M	7399M
4150	4204	4259	5314M	7400M
4151	4205	4260	5315M	8401
4152	4206	4261	5317M	8404
4153	4207	4262	5318	8406
4154	4208	4263M	5321	8408
4156	4209	4264M	5322M	8409
4157	4210	4265M	5323M	8424M
4158	4211	4266M	5325	8425M
4159	4212	4267M	5327	8426M
4160	4213	4268M	5328	8431M
4161	4216	4269M	5329	8434M
4162	4217	4270M	5333	8435M
4163	4218	4271M	5334	8437M
4164	4219	4272	5335	8439M
4165	4220	4274	5336	8442
4166	4221	4276M	5337	8443
4168	4222	4277M	6339	8444

9446	10524	GH04-032	GH07-082	GH08-134
9447	10525	GH04-033	GH07-083	GH08-135
9449	11526	GH04-034	GH07-084	GH08-136
9456	11527	GH04-035	GH07-085	GH08-137
9457	11528	GH04-036	GH07-086	GH08-138
9458	11529	GH04-037	GH07-087	GH08-139
9459	11530	GH04-038	GH07-088	GH08-140
9460	11532	GH04-039	GH07-091	GH08-141
9461	11535	GH04-040	GH07-092	GH08-142
9465	11536	GH04-040A	GH07-093	GH08-143
9467	11537	GH04-042	GH07-094	GH08-144
9468	11538	GH04-043	GH07-095	GH08-145
9469	11539	GH04-044	GH07-096	GH08-146
9472	11540	GH04-045	GH07-097	GH08-147
9474	11541	GH04-045A	GH07-098	GH08-148
9476	11542	GH04-046	GH07-099	GH08-149
9477	12543	GH04-047	GH07-100	GH08-150
10482	12546	GH04-048	GH07-101	GH08-151
10483	12548	GH04-049	GH07-102	GH08-152
10484	12549	GH04-050	GH07-103	GH08-153
10485	12559	GH05-051	GH07-104	GH08-154
10486	12562	GH05-053	GH07-105	GH08-155
10487	GH04-001	GH05-054	GH07-106	GH08-157
10490	GH04-002	GH05-055	GH08-107	GH08-158
10491	GH04-003	GH05-056	GH08-108	GH08-159
10492	GH04-004	GH05-057	GH08-109	GH08-160
10493	GH04-005	GH05-058	GH08-110	GH08-161
10494	GH04-006	GH05-060	GH08-111	GH08-162
10496	GH04-007	GH05-061	GH08-112	GH08-164
10499	GH04-008	GH05-062	GH08-113	GH08-165
10500	GH04-009	GH05-063	GH08-114	GH08-166
10501	GH04-010	GH05-064	GH08-115	GH08-167
10502	GH04-011	GH05-065	GH08-116	GH08-168
10503	GH04-012	GH06-065	GH08-117	GH08-169
10504	GH04-012A	GH06-066	GH08-118	GH08-171
10505	GH04-013	GH06-067	GH08-119	GH08-172
10510	GH04-014	GH06-068	GH08-120	GH08-173
10511	GH04-015	GH06-069	GH08-121	GH08-174
10512	GH04-019	GH06-070	GH08-122	GH08-175
10513	GH04-020	GH06-071	GH08-124	GH08-176
10514	GH04-021	GH06-071A	GH08-125	GH08-177
10516	GH04-022	GH06-073	GH08-126	GH08-178
10517	GH04-023	GH06-074	GH08-127	GH08-179
10518	GH04-024	GH06-075	GH08-128	GH08-180
10519	GH04-027	GH06-076	GH08-129	GH08-181
10520	GH04-029	GH06-077	GH08-130	GH08-182
10521	GH04-029A	GH06-078	GH08-131	GH08-183
10522	GH04-030	GH06-080	GH08-132	GH08-184
10523	GH04-031	GH07-081	GH08-133	GH08-185

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