Surface and Groundwater Quality Technical Working Group
Pebble Project
January 8, 2008
Minutes Recorded by Charlotte MacCay/Bristol

Present:
Jim Vohden/ADNR
David Johnson/ADEC
Scott Mclean/ADNR/OHMP
Julie Woodke/USACE
Jason Mouw/ADF&G
Tammie Massie/ADF&G
Cindi Godsey/EPA
Andrea Meyer/ADNR
Andra Love/HDR
Hugh McCready/WMC
Dennis Deans/PLP
Jane Whitsett/Shaw
Charlotte MacCay/Bristol

As with all Technical Working Group (TWG) Meetings, the minutes reflect discussion of suggestions and concerns raised by individuals. Discussion does not reflect any decision making or consensus from the group (with the exception of electing a lead).

Administrative Issues

- Jim Vohden was chosen as lead for the Surface and Groundwater Technical Working Group.
- The U.S. Environmental Protection Agency (EPA) addresses discharge aspects in particular.
- Alaska Department of Environmental Conservation (ADEC) addresses broader range aspects of water quality.

General Comments

- More access to data may result in the need for changes to the program that are not apparent at this stage of review.
- Sampling design is a best guess until a mine design is proposed, there may need to be adjustments to the program once the mine design is decided.

Data Requests

- There is a request for an updated groundwater sampling site map, with station numbers on it to be distributed with the minutes.
- The TWG would like to review the water quality data.

- Results of the comparison of various cyanide analyses and labs.
- Water quality data that will help evaluate if odd results are event related. Box and whisker plot data can help address this evaluation.

Pebble Limited Partnership (PLP) Surface Water Sampling Program
Presentation and Discussion

Sample Sites

- Maps of the drainages and sampling sites were distributed.
- A review of the sampling study plans was presented by Andra Love of HDR.
- The sampling program addresses the North and South Fork Koktuli Drainage and the Upper Talarik Drainage, as well as one site in the Kaskanak Drainage.
- Studies have been extended from stream sampling to include seeps, ponds, and lakes.
- Stream sampling sites chosen to address the following:
  - Geochemical parameters
  - Baseline water chemistry
  - Support data for fisheries studies
  - Document water quality for water supply to the project
  - Document constituents that are naturally elevated above water quality criteria.
    - There are some parameters that are naturally elevated above water quality criteria in all drainages. At some point naturally elevated constituents will need to be addressed.
    - Natural background site-specific criteria require 20 data points. If the site-specific criteria are seasonal, then 20 points per season are required.
    - Additional data could help identify stream stretches that require individual site-specific criteria.
  - Characterize natural statistical variance or naturally occurring parameter concentrations.
  - Characterize water quality under a range of hydrologic conditions and seasonal changes.
- Stream sampling site locations were based on the following criteria:
  - Upstream and downstream of the Pebble Deposit (as known in 2004)
  - Upstream and downstream of potential development concepts (as developed in 2004)
  - Side drainages
  - Sites historically sampled by Cominco
  - Areas where there is flow gain or loss.

- A few sites have been dropped since the program began, such as the one to the north in Chulitna River that was deemed out of the potential project impact area.
- Sites are located by Global Positioning System (GPS). Pilots are also very familiar with the site locations. There is a map of all sites with GPS coordinates listed on it.
- Discussion on reference sites was deferred to a future (not yet formed) Monitoring TWG.
  - Ideally some sites already being used could be used as reference sites, and this appears to be applicable in this case.
  - It can be difficult to compare water quality from a mineralized area to water quality from a non-mineralized area.
  - Reference sites to track changes before and after the project need to be based on an area outside of the project design. This issue needs to wait for a project design to be proposed to be addressed.
  - Time will need to be allotted after the project is designed to collect an adequate period of data.
- There is a dense network of sampling sites.
- The fish and water quality teams flew the area together to select integrated sites.
- Could ponds being sampled have been impacted by drilling activity? Some ponds were near drilling activity. Drilling programs are designed to discharge to the tundra, not to ponds. Some discharge to ponds was thought to have been noted during inspections and will be investigated.
- It was agreed that without seeing the analytical data it is difficult to determine if the location and number of sampling sites is adequate.
- Sample Frequency
- Sampling frequency started out at monthly May through September, and twice in the winter, and evolved to monthly sampling year-round at 35 sites.
- Red Dog Mine is required to do twice-monthly sampling in their monitoring program, as compared to the PLP study frequency of once a month. Red Dog Mine's program is a monitoring program whereas PLP's program objective is to characterize baseline. Red Dog is monitoring for fluctuations in treated process water discharges for general plan performance, whereas PLP studies are measuring for natural and seasonal fluctuations. Some baseline programs that are only planned for one year will sometimes do more than one sample per month in order to make up for a short sampling period. However, the PLP studies have monthly sampling over several years to characterize these natural fluctuations.
- It would be ideal to sample on the same day of the month each time, but that is not readily feasible due to the number of sites, field conditions, and weather conditions. However, all sampling is targeted for mid-month.

- There are rotating teams of water quality samplers. There is always at least one person on the team that is familiar with the site. Each two-person field team is made up of a water quality and a hydrology sampler. In the winter, there is a third team for augering holes in the ice.
- Daylight limits sampling in the winter. All sampling done between 10 a.m. – 3 p.m. It takes 5 – 7 days to complete one round of water quality sampling.

Parameters and Lab Methods

- The full suite of parameters measured was provided.
- Hexavalent chromium analysis was to be conducted only if total chromium levels were above the water quality criteria. This was problematic to do because there is a very short holding time for this analysis, and the analysis was dropped in 2005. However, very seldom are total chromium concentrations above the water quality criteria, so there was not much need for this analysis.
- Orthophosphate and a separate analysis for nitrate and nitrite were added in 2006 to supply data of interest to the geochemistry group. The geochemistry team did not find a need to continue gathering this data and the analyses were dropped from the program in 2007.
- While only the 2007 Study Plan lists the field parameters being measured (pH, conductivity, temperature, dissolved oxygen, oxidation/reduction potential and turbidity), these data were being collected as part of the program since its inception in 2004.
- There is no Study Plan currently ready for 2008 – expect to generally proceed as was done in 2007. Perhaps some changes will need to be made to address the East Zone if needed.
- Cyanide is occasionally detectable, and because the detection limit and water quality criteria are so close, it is usually above the water quality criterion.
- To confirm the unexpected detection of cyanide, the laboratories have done minimum reporting level (MRL) studies and the PLP has done additional site-specific MRL studies. All confirm the presence of naturally occurring cyanide.
- Both total and weak acid dissociable (WAD) cyanide methods are used. Starting in 2006, when there was a detectable occurrence of cyanide, a duplicate sample was also sent to Frontier Geosciences, Inc., laboratory for a special EPA-approved low-level cyanide test (OIA-1667) where the MRL is 10X lower than the usual cyanide tests. The test results between the laboratories show close agreement. The TWG requested that the PLP send out the comparison of the various cyanide methods and results.
- Dissolved organic carbon (DOC) was added as a new parameter for water quality samples in 2007.

Field Methods

- Use depth-integrated samplers.

- Use Alconox® in summer to decontaminate the sampler (problematic to use Alconox in winter, as it doesn't readily rinse off when it's cold).
- Alconox could add sodium to the sample – field blanks for sodium concentrations can help establish if this is occurring.
- Deionized water is also used for rinsing equipment.
- A DH48 sampler was used in 2004, but the paint coating tended to chip; switched to the unpainted DH81 model in 2005.
- Depth integrated samples are composited in clean buckets and poured into sample bottles. Mercury samples are taken as a grab sample directly from the stream to avoid specific contamination issues associated with this test.
- To ensure composite samples are mixed in the 5-gallon bucket, HDR used the swish and pour method. ADEC stated that this is considered an acceptable method. At some ADNR projects, a churn splitter is used. Swish and pour usually works and this could just be an extra step.
- Samples are taken to a field laboratory building where samples are filtered for dissolved metals analyses.
- Chains of Custody and shipping paperwork are generated by a sample handler, and samples are packed on ice and shipped to the appropriate laboratory.
- Stream discharge is measured at each site.
- Some sites have continuous stage data loggers, samplers will continue to take instantaneous flow at these sites until a good rating curve is established.

QA/QC

- There is a primary laboratory and a QA laboratory.
- Ten percent of the samples, opportunistically taken where there is adequate flow, also go to the QA laboratory to check on the primary laboratory.
- The primary laboratory also gets duplicates every 10 samples.
- All equipment is rinsed between sites.
- Gloves are used and changed between sites.
- Split duplicates are taken every 20 samples.
- Laboratories also have their own QA protocol.
- Shaw conducts a field audit program with each field crew following a checklist procedure.
- For 2006 and 2007, prepared samples of known concentrations were sent through the field and laboratory handling process, and then sent to the labs to check on accuracy and precision.

Miscellaneous Discussion on Surface Water Quality

- The TWG would like to review the water quality data.
- Some seeps were flowing when they were surveyed in March, but not all.
- There is interest in looking at the data to determine if odd results are event related. Box and whisker plot data can help address this evaluation.
- To help relate events to data, the nearest meteorological stations are located near the old mine concept mill station, and 2 more near water quality stations SK100D – one is on the knoll and one is in the valley.

PLP Sediment Study

- Sediment is sampled when there is enough sediment available at the site. This can vary between visits.

PLP Pond Studies

- Ponds are studies within the North Fork Koktuli, South Fork Koktuli, and Talarik drainages.
- Studies look at the interrelation between water quality, sediment chemistry, and, in some cases, trace elements in vegetation.

PLP Groundwater Studies

Sample Sites

- The sample sites are intended to characterize groundwater quality prior to mining.
- The groundwater sites are distributed upgradient and downgradient of the mineralized zone in all three watersheds (North Fork Koktuli, South Fork Koktuli, Upper Talarik).
- New monitoring wells and piezometers have been installed every year. In recent years, additional sites were added in Upper Talarik to better characterize conditions near the East Deposit and in the upper North Fork Koktuli to provide information for potential alternative tailings sites.
- Wells are drilled in clusters, with each well in the cluster drilled to a different depth.
- There are a total of 35 groundwater monitoring wells located in clusters at 15 – 16 sites.
- There is a request for an updated groundwater sampling site map, with station numbers on it to be distributed with the minutes.

Methods

- Try to capture high and low events in the groundwater system.
- Piezometers provide information on groundwater levels and hydraulic conductivity.

- Monitoring wells provide information on groundwater level and water chemistry and hydraulic conductivity.
- Wells have dedicated pumps to prevent cross-contamination.
- The pumps are submersible pumps that push water up the line. Pushing water up the line instead of sucking water up a line has less potential for degasification. The pumps have a very smooth pumping action, which is less likely to agitate gases or stir things up.
- The pumps are low-flow pumps with adjustments for rate of pumping.
- Pumps are purposely positioned just above the screen.
- Water level is measured each time a sample is taken.
- Groundwater wells show a range of 0-100 feet. All depths to water are <100 feet.
- Twenty-five percent of the wells go into bedrock.
- One Westbay multi-port system has been installed within the mineralized zone to monitor to depths of about 4,000 feet. Typically, these systems have 20 or more monitoring zones. A tube goes into the monitoring zone, opens a port, and allows the sampler to measure water pressures and sample water from each zone. The current Westbay installation was not appropriate for water quality samples to be collected; future Westbay installations are being considered at the site and will be carried out such that water quality information can be collected.

Parameters

- Generally, follow same list of parameters as the surface water program.
- Turbidity data was gathered in 2005, then dropped from the program; it's not really a parameter for groundwater characterization.
- Dissolved oxygen and pH measurements need to be done on water that is kept isolated from the atmosphere. Therefore, a flow–through cell is incorporated into the sampling apparatus to accomplish this.
- There have been a few naturally occurring cyanide hits in the groundwater samples.
- Organics were measured once as a reconnaissance sample. They were not detectable and were, therefore, not included in the ongoing program. There was no reason to expect organics to be present; they are not very widespread in Alaska, as they usually originate from industrial solvents. A point was made to consider the possibility of an annual sample or a quarterly sample for a year. There could be a possible variation related to temperature.
- Biogenics were also sampled once as a reconnaissance measure in surface water. None were found in the surface water.
- Biogenics have been sampled at other mine sites, none have been found and the sampling is usually discontinued after a while.
- Most wells show groundwater with characteristic low total dissolved solids (TDS), and high DO.

- There is so much DO that it appears there are no oxygen consumers like solid organics.
- The low TDS is probably partly due to the relatively fast groundwater velocities through the permeable materials.

Flow-related Discussion

- Out of the 600+ exploration drill holes that have been drilled, very few have encountered artesian flow.
- The Water Management Consultants' scope includes determining generally where groundwater is discharging to the surface.
- Some of the monitoring wells and piezometers are intended to provide data for mining and pit dewatering management.
- The effect of groundwater quality on streams can be estimated by sampling within, or downstream of, upwelling zones. Upstream of SK100C, the stream is typically dry during the summer and much of the flow downstream of SK100C is representative of the upwelling.
- The water quality in a stream is determined by groundwater quality when surface runoff is not occurring. Mini-piezometer stand-pipes could be placed in the streambed to directly measure the water quality where redds are. It's important to have good water quality data where eggs hatch. These mini-piezometers could help determine if it is river water or groundwater at that site. These mini-piezometers would be impossible to maintain year-round. The water quality in shallow standpipes installed adjacent to a stream would likely have water quality very similar to mini-piezometers installed within the redds.
- Temperature data will also help to determine upwelling areas.
- Flow has to come from the basin based on the amount of water coming up, sometimes 40 to 50 cubic feet per second (cfs); there's not that much lateral flow available at most sites.
- The PLP is conducting studies to determine if groundwater used by a mining operation would interfere with the upwelling into the streams.
- Groundwater may be flowing from the upper North Fork Koktuli River into the Upper Talarik, and is known to be flowing from part way down the South Fork Koktuli into the Upper Talarik (UT190).
- The South Fork Koktuli drainage below SK100C has the most noticeable upwelling within the project area. However, groundwater and surface water interaction is important throughout the study area.
- HDR is measuring stream flow late in the winter to estimate rates of groundwater discharge (called the low-flow stream flow program). Rates of upwelling in streams are estimated by measuring stream flow at multiple sites along each major stream 9NFK, SFK, and UT) during late winter when the flow is due to groundwater discharge only.

- Temperature signatures from Frying Pan Lake do not show up in the monitoring well downstream of the lake. There is too much distance between the sites, and the temperature would attenuate over that distance.

Other Groundwater Issues

- Discussion on groundwater quality influences on fish spawning are covered within the hydrology and fish TWGs.

PLP Seep Program

- Seeps in the PLP Program are considered to be groundwater discharges to land – not streams.
- The base program of sampling 26 seeps has evolved into a program that samples 100 seeps.
- Seeps were aerially inventoried with a GPS.
- Most seeps are sampled 3 times a year, but the sampling frequency ranges from 2-5 times a year.
- The same parameters are analyzed as in the surface water programs, with the exception that DOC is not analyzed in the seeps. DOC analysis is needed to address bioavailability of metals in fish studies, and fish are not present in seeps.
- There were some other one-time samples of seeps at the mine site taken to look for precipitates, but there were none seen.
- Samples were collected for ferrous iron in 2006 at the request of the geochemistry team. It showed nothing of interest and was dropped from the program in 2007.
- Criteria for choosing which seeps to sample included geographic distribution, largest flows and any that had unusual water quality or obvious color (there was only one site with obvious color).
- Depending on factors such as the number of sampling teams, time of year, and the weather, a seeps sampling/inventory event may take about 2 weeks.
- Methodology is a direct grab sample.
- V-notch weirs may be used to measure flow.
- Weirs are set up and removed as needed. There are three different sizes of weirs.
- There are approximately 3000 seeps cataloged; approximately 100 of these are sampled five times per year.
- No seeps were sampled in the Kaskanak drainage.
- Upwelling: Standpipes are used in upwelling areas of streambeds to compare to well samples. It was suggested that sampling should be more frequent during the time when surface water is primarily groundwater fed. Upwelling is on the order of 40-50cfs coming from the entire basin.

Closing:

- Next meeting to be held after 2008 Study Plans are submitted.

- In future, stream segment determination should be looked at for various site specific criteria which may be applied for, given that Mine Design Concept 25 has no discharge planned at this time.

- Deliverables as a result of this meeting: minutes will be sent out for review and then finalized for posting on the website; cyanide analysis comparison data will be sent out to TWG members, digital copy of stream sampling sites map will be sent out to TWG members.