Pebble Project

NORTHERN DYNASTY MINES INC.

ENVIRONMENTAL BASELINE STUDIES

PRELIMINARY SUMMARY
STUDIES PERFORMED BY HDR, ALASKA INC.
MACROINVERTEBRATE AND PERIPHYTON STUDIES

1. MINE STUDY AREA

Macroinvertebrates are invertebrates that are large enough to see with the naked eye and spend a portion of their life in the aquatic environment. "Periphyton" is loosely defined as attached algae. The potential for effects on populations of aquatic life is a concern when development projects are considered. Adequate baseline data are needed to assess such project effects. Sampling for macroinvertebrates in the area of the Pebble Project was conducted using protocols from the U.S. Environmental Protection Agency (EPA) that have been modified for the Alaskan environment (referred to as the Alaska Stream Condition Index, or ASCI) and standard surber and drift net methods. Periphyton (algae) sampling methods were drafted from the EPA protocols for collecting and identifying diatoms (one-celled organisms that make up algae) and the Alaska Department of Fish and Game's methods for collecting and assessing the concentrations of chlorophyll-a. Specific objectives for this work are as follows:

- Collect baseline (predevelopment) data to evaluate the distribution, abundance, and density of macroinvertebrates in the mine-area streams.
- Collect baseline data on periphyton communities to assess the productivity of the mine-area streams.
- Identify macroinvertebrate genera in collected fish stomachs.
- Compare in situ water-quality data with macroinvertebrate and periphyton communities.
- Conduct a review of existing literature.

1.1 MACROINVERTEBRATE SAMPLING

Macroinvertebrates are commonly studied because they are good long-term indicators of water quality and habitat change. They also are the main source of food for many fish species. Sampling for macroinvertebrates can be conducted in many ways depending on the goals of the project.

The ASCI protocols are methods for collecting invertebrates from a variety of habitats within a stream. As part of this protocol for Pebble Project, 20 subsamples from varied habitats such as riffles, snags and undercut banks were collected at each of 16 sites and were later sorted and identified to genus. The diversity and number of genera correlated with stream habitat health gives a score that can be compared through the years at a given site and between sites to assess changes in the health and compare different locations of a stream system.

The Alaska Department of Fish and Game (ADF&G) suggested that collection methods for this project should include drift net sampling and surber sampling. Drift net sampling is done by setting a series of equal-sized nets across the streams to capture organisms moving in the water column. The nets are placed in the stream for a given length of time and flow velocity is measured so a total volume of water moving through the nets can be calculated. The organisms are then collected from the net, and later sorted and identified to genus. The density of drifting macroinvertebrates can be calculated and used to monitor for seasonal changes as well as changes over years.

Surber sampling protocols are used to assess the density of macroinvertebrates in the streambed of a specific habitat type (e.g., riffles) within a stream. A surber net is a fine mesh net with a square frame attached at a 90-degree angle to the net. For Pebble Project, five surber samples were collected at each of five sites in the mine study area by placing the frame on the stream bottom with the water current flowing into the net. The streambed area within the frame was scrubbed clean of macroinvertebrates to the extent possible. The loose macroinvertebrates were captured in the net and later sorted and identified to genus by HDR scientists. This method allows more precise density and interannual variability measurements than the ASCI method, which is generally geared toward establishing a picture of which invertebrates are present at a site and which are noticeably not present.

Analysis of stomach contents of fish was added on the North Fork of the Koktuli in 2006. An electro-fisher was used to capture fish in three sites along the North Fork of the Koktuli while nets were set for drift invertebrates at those sites. Organisms collected from the fish stomachs will help identify what the fish are eating. The organisms will be sorted from the stomachs and identified to genus when possible.

Horizontal plankton tows were collected at Black Lake, Lake #2, Frying Pan Lake, and Big Wiggly Lake in 2006. Sample processing will occur during late 2006.

1.2 PERIPHYTON SAMPLING

Studying periphyton growth in streams is an additional way of monitoring the health of the stream system. Two methods were employed on this project. The EPA protocols for rapid bioassessment were used in 2005 to assess diversity and abundance. ADF&G methods were used in 2006 to assess chlorophyll-a concentrations.

The EPA methods involve collecting a series of rocks from the substrate of a stream. A flexible sampling strap with a defined opening is wrapped around the rock. The periphyton is then scrubbed from the rock and rinsed into a container for laboratory processing. The material is then digested in acid to clean the single-cell diatoms of any organic material. What is left is a silicon "shell" that can be identified using a compound microscope. The density and diversity of these diatoms can then be used to compare sites and monitor changes through the years.

The ADF&G methods use a similar collection method except that the material cleaned from the rocks is then filtered through a very fine mesh filter. This filter is preserved and sent to a laboratory for analysis of chlorophyll-a. The amount of chlorophyll-a can be used to assess changes in primary productivity among sites or over time.

1.3 SAMPLING SITES AND DATES

Macroinvertebrate and periphyton studies began in 2004 using the ASCI methods for collecting macroinvertebrates and periphyton. Additionally, drift net samples were collected. Samples were collected from 16 sites in the mine study area in June and August 2004. These sites were collocated with data collection sites for fish, hydrology, and water quality (Figure HDR-1).

In 2005 ADF&G protocols were used as a response to agency comments on the program. The number of sites in the mine study area was reduced to five and sampling was conducted in June.

In 2006 three sites on the North Fork Koktuli River were sampled in August for fish stomachs. Drift net samples also were collected for comparison. Black Lake, Lake #2, Frying Pan Lake, and Big Wiggly Lake were sampled for zooplankton in August. Sample processing will occur during late 2006.

2. TRANSPORTATION CORRIDOR

The objectives and methods for the sampling macroinvertebrates and periphyton in the transportation corridor are similar to those for the mine study area. The transportation corridor includes a wide variety of stream types and sizes. Stream sampling sites were selected based on size, type, location, and relative importance as fish-rearing habitat.

2.1 MACROINVERTEBRATE SAMPLING

Macroinvertebrates were collected in streams (Figure HDR-4) very similar in nature to the mine-area streams as well as in streams that vary greatly from the mine-area streams. The location of the proposed transportation corridor changed during 2004, so a site that was studied early on was discontinued and a new site was established along the new alignment (Y Valley Creek). The sampling methods were the same as those used in the mine study area, as were the changes in the sampling protocol from 2004 to 2005. No sampling occurred in 2006 along the transportation corridor.

2.2 PERIPHYTON SAMPLING

The periphyton sampling occurred at the same time as the macroinvertebrate sampling for all of the transportation corridor sites as well as for the mine study-area sites. Sampling procedures were identical to those used in the mine study area, as were the changes to sampling protocol from 2004 to 2005.

2.3 SAMPLING SITES AND DATES

Five sampling sites were located for study (Figure HDR-4). During the summer of 2004 the proposed alignment for the transportation corridor shifted to the degree that a site that was sampled early in the summer no longer fell within the study area. A new site was established within the new study area, and the old site was no longer sampled. In 2005 the five sites, including the new site, were sampled one time during the summer. No sampling was done along the transportation corridor in 2006.