Pebble Project

NORTHERN DYNASTY MINES INC.

ENVIRONMENTAL BASELINE STUDIES

PRELIMINARY SUMMARY
STUDIES PERFORMED BY ABR, INC.
SNOW SURVEYS, MINE STUDY AREA

As part of the study of surface-water hydrology in the area of the proposed Pebble Mine, spring snow surveys are being conducted to provide data for calibrating snow-distribution models and calculations of ablation (melting) rates. This study is designed to characterize the distribution, snow/water equivalent (SWE), and ablation rates of late-season (pre-breakup) snow across the landscape of the mine region. This information on winter precipitation and its contribution to surface water in the area will be critical for the design of tailings-storage areas and water-management plans for the proposed mine. Specific objectives of this study include the following:

- Produce a map of late-season snow distribution using data from field surveys, terrain characteristics, and MODIS (moderate resolution imaging spectroradiometer) satellite imagery.
- Produce a map of snowpack ablation rates from field-survey data, terrain characteristics, and climate data.
- Provide paired field measures of snow depths and densities at meteorological stations to compare with automated precipitation-gauge measures.
- Evaluate records from proximal snow-survey sites administered by the Natural Resources Conservation Service (NRCS) and Federal Aviation Administration (FAA) as appropriate proxies for historical snowpack data.

Field snow surveys have been conducted in three major drainage basins in the mine study area (Figure ABR-1). The approach to mapping spring snow distribution involves a combination of field surveys and a terrain model that incorporates the predominant variables that influence snow accumulation (elevation, aspect, slope, and vegetation-canopy and wind-shelter indices). To determine the spring snow distribution across the study area, snow depths and density have been measured along 14 slope/aspect transects and two permanent snow courses. Sampling along the slope/aspect transects extended from ridge tops to valley bottoms with snow depths and densities measured at 30-meter-elevation intervals. At each measurement location, snow/water equivalent was determined from three replicate measures of snow

depth and snow density using a standard federal snow sampling tube and scale. Percent snow cover was visually estimated at each measurement site. Slope and aspect also were measured at each sample site for use in the snow-distribution model. Additional field measurements were made at the proposed location of meteorological stations. At each of these locations, snow depth and density were measured at five locations situated in a 3-meter radius around the proposed station location.

Two permanent snow courses were located to provide data suitable for comparison with existing NRCS snow-course sites and to provide precise inter- and intra-annual comparison of snow/water equivalent. One snow course was located at 2,000 feet elevation on a shoulder of Groundhog Mountain and the other was at 1,200 feet elevation on an isolated hill in the headwaters of Upper Talarik Creek. Each snow course comprised a 1.6- to 3.2-kilometer circuit around a small ridge or knob with 10 to 16 stations that covered all slope aspects. Repeated measures of snow depth and density were performed along the two snow-course transects to provide estimates on spring snowpack-ablation rates. Results from additional spring field surveys will be used with calibrated MODIS snow data to estimate snowpack ablation and to provide runoff estimates.

Snow survey studies have been performed each year from 2004 through 2006. This work entails the following activities:

- Perform spring snow-distribution surveys (mid to late April) and snow-ablation surveys (mid to late May) to obtain concurrent meteorological and ground-truth data.
- Produce a snow-distribution map (and refine this map by integrating real-time meteorological data and plant-canopy maps when they become available).
- Estimate ablation rates across the landscape through the combination of periodic spring field surveys, analysis of MODIS satellite imagery, and stream discharge measurements (data collected by HDR Alaska, Inc.).
- Compile the three years of survey data (2004, 2005, and 2006) to produce a normalized snow-distribution map for the mine study area.