Pebble Project

NORTHERN DYNASTY MINES INC.

ENVIRONMENTAL BASELINE STUDIES

PRELIMINARY SUMMARY
WETLAND STUDIES PERFORMED BY THREE PARAMETERS PLUS, INC.
FOR THE MINE STUDY AREA

The Pebble Project wetlands study was initiated in April of 2004 when Northern Dynasty Mines Inc. (NDM) contracted with Three Parameters Plus (3PP) of Palmer, Alaska, to perform studies of the area surrounding the potential mine location and with HDR Alaska Inc. (HDR) of Anchorage to perform studies of the potential transportation corridor. To help ensure consistency across the two wetlands study areas, 3PP developed the methods and support tools that both 3PP and HDR use. The studies for the transportation corridor are described in a separate summary prepared by HDR.

Studies in the vicinity of the mine are focused on those portions of the South Fork Koktuli, North Fork Koktuli, Upper Talarik, and Newhalen watersheds that surround the two Pebble deposits and their most logical access corridors from the city of Iliamna. The mine study area currently encompasses approximately 104,000 acres (see attached Figure 3PP-1).

The Pebble Project wetlands study has grown to be the largest detailed wetland mapping and functional assessment mapping project ever undertaken in Alaska. The study has many components, several of which have been initiated due to the complexity of the glacial terrain and the complex systems of shallow and deep groundwater aquifers that exist around the mine site. The primary components of the wetlands study are described below.

1. MAPPING OF JURISDICTIONAL WETLANDS, VEGETATION, AND HYDROGEOMORPHIC CLASS

Pebble Project wetland scientists are preparing a detailed basemap layer in the project geographical information system (GIS) by delineating major vegetation types on a digital ortho-rectified, true-color aerial photography base. Each polygon of vegetation that is delineated is assigned codes which reflect its regulatory status under the Clean Water Act, its vegetation type according to the Alaska vegetation classification system, its wetland hydrogeomorphic (HGM) class, and its wetland Cowardin class. This

GIS layer, when completed, is expected to have literally tens of thousands of polygons, because of the complexity of the terrain and the mosaic nature of the vegetation in this area of Alaska.

2. FIELD DATA COLLECTION AND MAP VERIFICATION

Each summer since the program began, two-person teams consisting of wetland scientists (including specialists in the fields of botany, soil science, and hydrology) and field technicians have collected site-specific data across a variety of vegetation types and landforms across the project study area. While a number of different types of evaluations or plot types are used, most areas sampled yield the following types of data:

- Vegetation composition—detailed lists of plants found, percent cover estimates.
- Soil descriptions—soil-survey type detail for the top 20 to 24 inches of soil.
- Hydrologic observations—indicators of flooding, saturation, etc.
- Wildlife observations—trails, sign, direct observations.
- Engineering concerns—thixotropic soils, steep grades, organic soils, etc.
- Wetland status according to the 1987 Corps of Engineers manual and, for areas evaluated during the 2006 field season, wetland status according to both the 1987 and 2006 Alaska Interim Regional Supplement delineation manuals.
- Photographs of vegetation, soils, and where present, hydrologic features.
- For areas that meet the regulatory definition of a wetland, additional data are collected related to the primary functions that the wetland provides. These include classifying the wetland according to it hydrogeomorphic class, water pH data, and in the mine study area, specific conductivity of water to document its source.

3. INTEGRATED RELATIONAL DATABASE APPLICATION

Data collected as part of the Pebble Project wetlands study are entered into a web-based relational database, which is integrated with other project data. The wetlands application will ultimately provide regulators and other project data reviewers with an efficient platform to evaluate and query the thousands of field data forms and tens of thousands of site photographs. Currently, data in the database are extracted to support the GIS mapping work and analysis; however, in time, the two may be more directly integrated. However, all wetland scientists working on the mapping effort have direct access to field photographs and the basic data about each site at their fingertips during the mapping process.

4. QUANTITATIVE FUNCTIONAL ASSESSMENT

Wetland functional assessment data are being collected using a methodology proposed by the NDM team and approved for use by the Corps of Engineers project manager. The method being used is based on each wetlands hydrogeomorphic classification and evaluates the degree to which each wetland evaluated currently contributes to eight individual functions with which wetlands in glacial terrain are typically associated. Each wetland evaluated receives a rating for the associated function, also called the functional capacity index, which can then be multiplied by the size of the wetland to get a total “score” for that

function. Site-specific data will not be collected in every wetland in the mapping area; however, every wetland will be rated and scored by extrapolating results from field-evaluated areas to areas with the same HGM class, vegetation type, landform, and other site-specific characteristics. In the event a particular wetland would be lost due to mine development, compensatory mitigation, typically in the form of the specific function lost, will ultimately be proposed to offset that loss. This undertaking, while only in its beginning stages, is referred to as the project's compensatory mitigation plan.

5. SMALL POOLS STUDY

To better understand the hydrology of the numerous ponds and shallow lakes that exist in the mine study area, a series of detailed water chemistry evaluations, shallow piezometer installations (see summary for hydrogeology studies performed by Water Management Consultants), and precipitation gauges have been installed at representative types of ponds in the mine study area. Similar studies will likely be implemented in representative wetland types once the mapping effort is more complete and the proposed mine footprint is better understood. Such sites may become long-term monitoring stations for representative wetlands in each potentially affected watershed.