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**NORTHERN DYNASTY MINES INC.**

**DRAFT ENVIRONMENTAL BASELINE STUDIES  
PROPOSED 2007 STUDY PLANS**

**CHAPTER 10.  
WETLANDS**

***DRAFT***

**SEPTEMBER 2007**

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## 10. WETLANDS

Three Parameters Plus, Inc., will lead the wetlands study in 2007, with support from Dr. Mark Rains of Coshow Environmental, Inc., for the small pools study. The objectives and process for the 2007 wetlands study are the same as described in the 2005 and 2006 study plans, except as noted below. Work for the wetlands study in 2004 through 2007 is summarized in Table 10-1.

With the exception of adding more area to the mine study area, the overall scope of the wetland study has not changed substantially. Digital mapping of areas visited in 2004, 2005, and 2006 is still underway.

Changes in scope since 2006 include the following:

- Installation of up to an additional 28 shallow groundwater monitoring wells by SLR Alaska to support expansion of the small pools study designed by hydrology professor Dr. Mark Rains. The purpose of this study is to test the hypothesis that certain characteristics of the ponds and adjacent vegetation, which are observable on the aerial photography, can typically distinguish those that are hydrologically isolated from the regional groundwater table from those that are consistently fed by groundwater. The new wells will be installed in the Upper Talarik Creek and North Fork Koktuli watersheds. The objectives of this study are described below.
- To support this study, and to provide a more complete inventory of these small pools for the functional assessment mapping efforts, field crews will continue photographing, collecting water pH readings, and water conductivity (EC) readings at most, if not all, waterbodies that will be mapped in the mine study area.
- Prior plant-species observation data will be reviewed, and species of interest to the Alaska Natural Heritage Program will be flagged for review and, where appropriate, revisits. If species of interest are found at the time of the revisit, voucher specimens will be collected, mounted, and submitted to the University of Alaska Fairbanks herbarium for concurrence.

The main objective of the small pools study is to verify the hypothesis that there are two types of pools present—perched precipitation pools and groundwater flow-through pools. The primary sources of water to each of the pools will be determined by comparing the geochemical characteristics of the surface waters to that of the precipitation and groundwater characteristics in the surrounding area. The local precipitation and groundwater each have very different geochemical signatures and the resulting surface water signature should reflect these variances. The hydrodynamic studies (monitoring stage and hydraulic heads in the deposits on which the pools occur) will allow a determination of whether the pools are perched on the surface; connected to a shallow, perched aquifer; or connected to a deep, regional aquifer. The specific goals of the study are as follows:

- Characterization of two proposed pool types: perched precipitation pools and groundwater flow-through pools.
- Collection of stage and hydraulic head measurements to evaluate pool hydrodynamics.

- Collection of surface and groundwater samples for analysis of chemical composition, including stable isotopes and major ions, to evaluate pool water sources and pool and underlying aquifer connectivity.

The field data collection and mapping area for the wetlands study is now approximately 247,997 acres in size, including the segment of the possible access road from the mine site to the Newhalen River. However, in 61,202 acres of this revised study area, typically only those wetlands and waters within recognized floodplains will be delineated.

The following changes in the mine study area have been made since the 2006 study plan was prepared:

- Addition of the lower reaches of the Upper Talarik Creek watershed as well as additional acres in the upper reaches of the watershed.
- Addition of the lower portion of the South Fork Koktuli watershed to its confluence with the North Fork Koktuli.
- Addition of most of the North Fork Koktuli watershed to its confluence with the South Fork Koktuli.

Figure 10-1 shows the current mine study area, including the area to be examined in 2007.

The study area for the transportation corridor has not changed. The study area is the same as was shown on Figure 10-2 in the 2005 study plan.

# TABLE

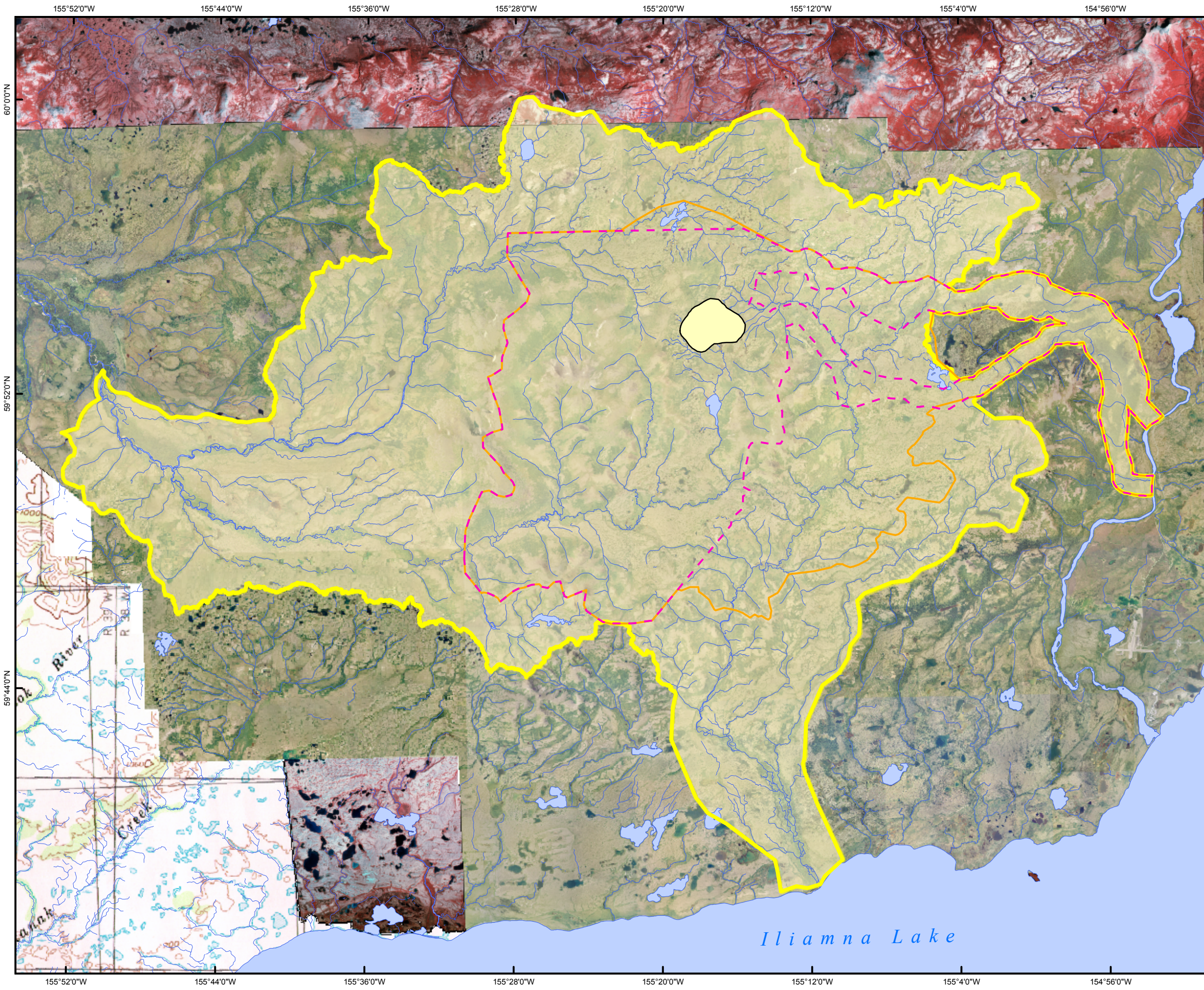
**TABLE 10-1**  
**Pebble Project Environmental Studies**  
**Study Summary for Wetlands, 2004-2007**  
**Consultants: Three Parameters Plus, Inc., and HDR Alaska, Inc.**

Discipline	2004 Data Collected or Tasks	2005 Data Collected or Tasks	2006 Data Collected or Tasks	2007 Tasks to be Completed
<b>Wetlands</b>	<b>Mine Study Area</b>			
	Information Gathering			
	Scope, Schedule, Field Sampling Plan	Scope, Schedule, Field Sampling Plan	Scope, Schedule, Field Sampling Plan	Scope, Schedule, Field Sampling Plan
	2004 Study Plan	2005 Study Plan	2006 Study Plan Summary	2007 Study Plan Summary
	With RDI, Initial Design and Testing of Wetlands Application in the NDM Database	With RDI, Design and Testing of Reports and QC Tools in Wetlands Application of the NDM Database.	With RDI, Design New Forms Related to New Alaska Delineation Manual, and Test Wetland Application in the NDM Database	
	With RDI, Initial Design and Layout of Project GIS and Data Management Procedures	GIS and Data Management Coordination	GIS and Data Management Coordination	GIS and Data Management Coordination
	Preliminary Wetland Impact Analysis Using Historical Data Sources and NDM Mine Development Concept Footprints	Preliminary Wetland Impact Analysis Using Historical Data Sources and NDM Mine Development Concept Footprints	Preliminary Wetland Impact Analysis Using Historical Data Sources and NDM Mine Development Concept Footprints	
	Jurisdictional Wetland Determinations Using the 1987 Corps of Engineers Manual (Portions of the South Fork Koktuli, North Fork Koktuli, Upper Talarik, and Newhalen Watersheds)	Jurisdictional Wetland Determinations Using the 1987 Corps Manual (Same Area as 2004)	Jurisdictional Wetland Determinations Using the 1987 Corps Manual and the 2006 Alaska Delineation Manual (Upper Talarik Watershed)	Jurisdictional Wetland Determinations Using the 1987 Corps Manual and the 2006 Alaska Delineation Manual or Equivalent (Predominantly Upper Talarik & North Fork Koktuli Watersheds)
	Rapid Wetland Functional Assessments Using the Magee/Hollands Method	Rapid Wetland Functional Assessments Using the Magee/Hollands Method	Rapid Wetland Functional Assessments Using the Magee/Hollands Method	Rapid Wetland Functional Assessments Using the Magee/Hollands Method
	Photo Documentation of Streams, Various Habitat Features, Representative Wetlands and Uplands	Photo Documentation of Streams, Various Habitat Features, Representative Wetlands and Uplands	Photo Documentation of Streams, Various Habitat Features, Representative Wetlands and Uplands	Photo Documentation of Streams, Various Habitat Features, Representative Wetlands and Uplands
		Two-Day Work Plan/Database Overview with Corps and EPA Project Staff		
		Initial SWANCC Field Review with Corps and EPA Staff		
		Problem Soil Evaluations with Joe Moore of NRCS and Chien-Lu Ping of UAA		
		Small Pools Study Design & Piezometer Installation (Dr. Mark Rains)	Small Pools Study Implementation (Dr. Mark Rains)	Small Pools Study Continuation (South Fork Koktuli) and Expansion into the Upper Talarik and North Fork Koktuli (Dr. Mark Rains)
		Water Body Evaluations with Photos and pH and EC Data to Support Small Pools Study.	Water Body Evaluations with Photos and pH and EC Data to Support Small Pools Study.	Water Body Evaluations with Photos and pH and EC Data to Support Small Pools Study.
		Rapid Evaluations of Willow and Mixed Willow/Alder Shrub Thickets to Support Jurisdictional Mapping Work	Rapid Evaluations of Willow and Mixed Willow/Alder Shrub Thickets to Support Jurisdictional Mapping Work	Rapid Evaluations of Willow and Mixed Willow/Alder Shrub Thickets to Support Jurisdictional Mapping Work
	Data Entry and QC	Data Entry and QC	Data Entry and QC	Data Entry and QC
	Digital Mapping of Jurisdictional Wetland Boundaries, HGM Type, Vegetation Type, and Existing Disturbance	Digital Mapping of Jurisdictional Wetland Boundaries, HGM Type, Vegetation Type, and Existing Disturbance	Digital Mapping of Jurisdictional Wetland Boundaries, HGM Type, Vegetation Type, and Existing Disturbance	Digital Mapping of Jurisdictional Wetland Boundaries, HGM Type, Vegetation Type, and Existing Disturbance
		Develop Basic Mitigation Concepts with Other Study Leaders	Basic Abandoned Mine Database/GIS Evaluations and Search for Compensatory Mitigation Opportunities	Basic Abandoned Mine Database/GIS Evaluations and Search for Compensatory Mitigation Opportunities
	Coordination with NDM & Agencies	Coordination with NDM & Agencies, Monthly Reporting, Fall Agency Summary Presentation	Coordination with NDM, agency meetings, and monthly reporting	Coordination with NDM, agency meetings, and monthly reporting
	2004 Progress Report			
			Review plant species data collected to date, revisit field sites with potential species of interest to the Alaska Natural Heritage Program. Collect voucher specimens where appropriate.	

Discipline	2004 Data Collected or Tasks	2005 Data Collected or Tasks	2006 Data Collected or Tasks	2007 Tasks to be Completed
Wetlands	<b>Transportation Corridor</b>			
	2004 Study Plan	2005 Study Plan	2006 Study Plan Summary	
		Two Day Work Plan/Database Overview with Corps and EPA Project Staff		
		Initial SWANCC Field Review with Corps and EPA Staff		
	Jurisdictional Wetland Determinations Using the 1987 Corps Manual (including work for minor route variations and for two routes from Pile Bay to Cook Inlet)	Jurisdictional Wetland Determinations Using the 1987 Corps Manual (field work, same area as 2004 plus Y Valley)		
	Rapid Wetland Functional Assessments Using the Magee/Hollands Method	Rapid Wetland Functional Assessments Using the Magee/Hollands Method	Analysis of Wetland Function Data	Analysis of Wetland Function Data
	Photo Documentation of Streams, Various Habitat Features, Representative Wetlands and Uplands	Photo Documentation of Streams, Various Habitat Features, Representative Wetlands and Uplands		
	Data Entry	Data Entry	Data QC and Update	Data QC and Update
	Digital Mapping of Jurisdictional Wetland Boundaries, HGM Type, Vegetation Type, and Existing Disturbance	Digital Mapping of Jurisdictional Wetland Boundaries, HGM Type, Vegetation Type, and Existing Disturbance	Digital Mapping of Jurisdictional Wetland Boundaries, HGM Type, Vegetation Type, and Existing Disturbance	Digital Mapping of Jurisdictional Wetland Boundaries, HGM Type, Vegetation Type, and Existing Disturbance
		Communications w/ Design Team Regarding Constraints		
	2004 Progress Report			
			Review plant species data collected to date, revisit field sites with potential species of interest to the Alaska Natural Heritage Program. Collect voucher specimens where appropriate.	







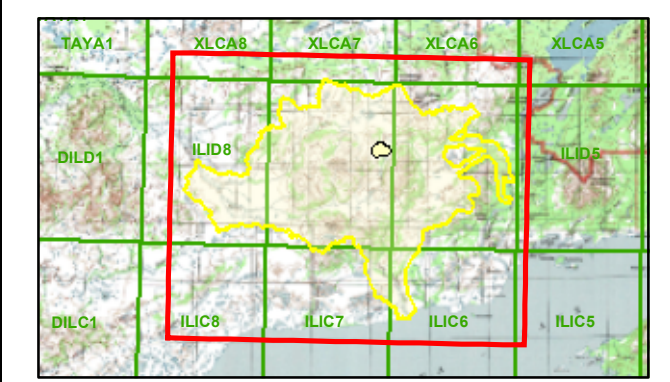
## FIGURE



**Figure 10-1**  
**Wetland Study Area, Mine**  
**DRAFT**

**Legend**

-  General Pit Outline
-  3PPI 2007 Field Study Area
-  3PPI 2006 Field Study Area
-  3PPI 2004/2005 Field Study Area



Miles  
 0 1 2 3 4 5 6  
 Scale 1:190,000  
 Alaska State Plane Zone 5 (units feet)  
 1983 North American Datum

*Iliamna Lake*