

**DRAFT ENVIRONMENTAL BASELINE STUDIES  
2005 FIELD SAMPLING PLAN**

**CHAPTER 11. FISH & AQUATIC HABITAT**

**NOVEMBER 2005**

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## ACRONYMS

ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
ASCI	Alaska Stream Condition Index
CAS	Columbia Analytical Services
COC	chain-of-custody
DI	deionized
EPA	U.S. Environmental Protection Agency
GPS	global positioning system
µm	micrometer
NDM	Northern Dynasty Mines Inc.
QA	quality assurance
QC	quality control
RBP	rapid bioassessment protocol

## 1. PROJECT BACKGROUND

Northern Dynasty Mines Inc. (NDM) is proposing an open-pit mining operation in southwestern Alaska. The prospect contains gold, copper, molybdenum, and silver deposits. The site is located approximately 15 miles north of Lake Iliamna in the eastern drainage of the Mulchatna River. It is on the divide separating the watersheds of Upper Talarik Creek and of the South Fork of the Koktuli River. NDM has launched extensive programs to collect data on engineering, environmental, and socioeconomic aspects in preparation for the permit-application process.

## 2. STUDY SCOPE AND OBJECTIVES

The overall objective of the fish and aquatic-resources studies is to document the distribution and relative abundance of aquatic resources within the project area in sufficient detail to provide information required for impact assessment and mitigation planning. A predevelopment baseline will be determined for post-development monitoring.

## 3. FISH-TISSUE SAMPLING

### 3.1 Introduction

This field sampling plan provides the protocol that is followed by all fisheries field crews for the Pebble Project. This plan describes in detail the methods for all the fish-tissue collection and handling procedures including dissection, preservation, and shipping. The same procedures used for the 2004 fish-tissue collection effort will be followed in 2005.

### 3.2 Purpose and Scope

A series of biological sample sites was established in 2004 within and adjacent to the project area to determine baseline conditions and to provide a basis for detecting potential changes within the surrounding waterbodies. These collection sites were established and sampled in 2004 and will continue to be used in 2005 for water-quality and hydrology monitoring, fish-abundance index sampling, macroinvertebrate and periphyton sampling, and fish-tissue collection. It should be noted that two additional lakes will be sampled during 2005 as part of the fish-tissue collection program (Figure 11-1).

Fish-tissue samples will be collected at 20 sites in the mine area and at five locations along the proposed road alignment. Depending on the specific task, fish will be collected using baited minnow traps, electrofisher, gill-nets, or seines (see *Draft Environmental Baseline Studies, Proposed 2005 Study Plan, Fish and Aquatic Habitat* [NDM, in press]). A variety of species will be used for tissue analysis including northern pike, arctic grayling, whitefish, Dolly Varden, and juvenile salmon.

### 3.3 Site Description

The sampling sites are located primarily within a 10-mile radius of the ore body (Figure 11-1) and along the proposed road alignment (Figure 11-2). There are also sites located on the Kaskanak River and downstream of the 10-mile radius on the north and south forks of the Kaktuli River. In addition to Frying Pan Lake and Big Wiggly Lake, two additional lake sites will be selected: one lake in the North Fork Kaktuli drainage (i.e., Black Lake) and an additional lake located in either the South Fork Kaktuli or the Lower Talarik drainage.

### 3.4 Objectives

The objectives of the fish-tissue analysis are to determine if migratory and resident fish contain specific metals within their tissues. The baseline data will provide documentation of the natural levels of trace elements within the fish tissue prior to the commencement of mining operations. Fish tissues will be analyzed for a suite of trace metals including Sb (Antimony), As (Arsenic), Be (beryllium), Cd (cadmium), Cr (chromium), Cu (copper), Pb (lead), Mo (molybdenum), Ni (nickel), Se (selenium), Ag (silver), Zn (zinc), Tl (thallium), and total Hg (total mercury). A variety of fish species will be collected for tissue samples. Due to their position as an apex predator, northern pike will be used for tissue samples in areas where enough are captured.

### 3.5 Sample Analysis Summary

Collected samples will be analyzed by Columbia Analytical Services, Inc. (CAS) for the parameters that are defined for fish tissue in the *Draft Environmental Baseline Studies, Proposed 2005 Quality Assurance Project Plan*. or QAPP (NDM, 2005). Reports will be sent to the quality assurance (QA)/quality control (QC) manager and NDM by CAS.

### 3.6 Study Organization and Responsibility

The fish-tissue study will be organized by the senior fisheries biologists: Paul McLarnon of HDR Alaska, Inc., and John Morsell of Northern Ecological Services. They will be responsible for assigning tasks and ensuring that protocols are followed. Shaw Environmental Inc. will be responsible for filling out electronic chain-of-custody forms (e-Chain) for fish-tissue samples that will be sent to CAS for analysis.

### 3.7 Field Activities

Field activities involved with the fish-tissue collection will include collection of fish using baited minnow traps and/or electrofishing at stream sites and angling and/or gill nets at lake sites. Electrofishing will be used in place of, or as a supplement to, minnow traps when insufficient fish are collected by traps alone. Collection efforts will take place at each of the selected locations as described in Table 1.

TABLE 1: Fish Tissue Sample Sites

Location	Fish Species	No. of Primary Samples	No. of QC Samples	Analytes
Frying Pan Lake	Northern Pike	10 fish, 20 samples: 10 liver, 10 muscle	1 fish, 2 samples: 1 liver, 1 muscle (split of homogenate)	Ag, As, Be, Cd, Cr, Cu, Mo, Pb, Ni, Se, Sb, Tl, Zn, Total Hg,
Big Wiggly Lake	Northern Pike	10 fish, 20 samples: 10 liver, 10 muscle	1 fish, 2 samples: 1 liver, 1 muscle (split of homogenate)	Same as above
2 additional lakes (Black Lake and a lake to be determined)	Northern Pike (if present)	20 fish, 40 samples: 20 liver, 20 muscle	2 fish, 4 samples: 2 liver, 2 muscle (split of homogenate)	Same as above
same 2 lakes as above	Grayling (if present)	10 whole body	Split of Homogenate (1 fish)	Same as above
same 2 lakes as above	Whitefish (if present)	10 whole body	Split of Homogenate (1 fish)	Same as above
SK100A	Juvenile salmon	10 whole body	Split of Homogenate (1 fish)	Same as above
SK100B	Juvenile salmon	10 whole body	Split of Homogenate (1 fish)	Same as above
SK119A	Juvenile salmon	10 whole body	Split of Homogenate (1 fish)	Same as above
SK100C	Juvenile salmon	10 whole body	Split of Homogenate (1 fish)	Same as above
SK100F	Juvenile northern pike and grayling	20 whole body	Split of Homogenate (1 fish)	Same as above
SK100G	Arctic grayling	10 whole body	Split of Homogenate (1 fish)	Same as above
KC100A	Juvenile salmon	10 whole body	Split of Homogenate (1 fish)	Same as above
NK100A	Juvenile salmon	10 whole body	Split of Homogenate (1 fish)	Same as above
NK100B	Juvenile salmon	10 whole body	Split of Homogenate (1 fish)	Same as above
NK100C	Juvenile salmon	10 whole body	Split of Homogenate (1 fish)	Same as above
NK119A	Dolly Varden	10 whole body	Split of Homogenate (1 fish)	Same as above
UT119A	Dolly Varden	10 whole body	Split of Homogenate (1 fish)	Same as above
UT100B	Juvenile salmon	10 whole body	Split of Homogenate (1 fish)	Same as above

Location	Fish Species	No. of Primary Samples	No. of QC Samples	Analytes
UT100C	Juvenile salmon	10 whole body	Split of Homogenate (1 fish)	Same as above
UT100D	Juvenile salmon	10 whole body	Split of Homogenate (1 fish)	Same as above
UT100E	Dolly Varden	10 whole body	Split of Homogenate (1 fish)	Same as above
Ursa 100B	Dolly Varden	10 whole body	Split of Homogenate (1 fish)	Same as above
UT138	Juvenile salmon	10 whole body	Split of Homogenate (1 fish)	Same as above
Bear Den Creek	Juvenile salmon	10 whole body	Split of Homogenate (1 fish)	Same as above
Y Creek	Juvenile salmon	10 whole body	Split of Homogenate (1 fish)	Same as above
Red Creek	Juvenile salmon	10 whole body	Split of Homogenate (1 fish)	Same as above

## 3.8 Fish-tissue Sampling Protocols

### 3.8.1 Sampling Procedures

Processing of fish for tissue samples, subsequent handling, chain-of-custody, and transport to the analytical laboratory will follow procedures outlined in the QAPP (NDM, 2005).

#### 3.8.1.1 Fish Sampling

##### *Stream Sample Sites*

At the stream sampling sites, one or more key fish species will be selected for each monitoring site and will be sampled for tissue metals analysis. In most cases, juvenile salmonid species will be selected as key species based on abundance and catchability. A total of 10 discrete whole-body samples will be collected for individual analysis at each site to provide an adequate measure of variability. Individual fish will be a minimum of 25 grams or about 50 millimeters in length to provide adequate tissue mass to complete the required analyses. Length to weight relationships will be verified in the field.

Each fish will be placed into an individual plastic bag and immediately placed on ice in a clean cooler. Samples will be returned to Iliamna and frozen as soon as possible, but within 12 hours of capture. Collection personnel will use powder-free surgical gloves to handle fish samples. Handling of fish will be minimized to the extent possible. Fish will be measured inside the collection bag. A field blank will be prepared for each collection day by rinsing an empty sample bag with deionized (DI) water in the field and collecting the rinsate in an acid-preserved sample jar.



### *Lake Sample Sites*

Large fish from lake samples will be placed in clean plastic bags and put on ice immediately after capture. Dissection of liver and muscle tissues will be conducted in a clean indoor location on an uncontaminated surface. Tissue samples will be placed in individually labeled plastic bags and frozen as soon as possible. Procedures for sample labeling, washing tools and work surfaces, and preparing QC equipment blanks will follow the QAPP (NDM, 2005). Specific steps to be taken in processing the dissected samples are as follows:

- Immediately upon capture, fish will be placed in a clean plastic bag (heavy-duty trash-compactor type) and placed on ice in a freshly washed cooler.
- Dissection will take place as soon as possible on the same day as capture at a selected indoor location in Iliamna.
- Prior to dissection the fish will be measured to fork length, weighed, and a scale sample obtained. Scale samples will be placed on gum cards provided by the Alaska Department of Fish and Game (ADF&G).
- The cutting surface will be washed with soap and water, rinsed with hot tap water followed by DI water, and covered with heavy-duty aluminum foil. The aluminum-foil cutting surface will be replaced after each dissection.
- Stainless steel, disposable scalpels and/or high-quality stainless steel knives will be used for dissection.
- Knives will be washed with soap and water and rinsed with DI water between uses. If scalpels are used, a new blade will be used for each fish dissected.
- Personnel handling or dissecting fish will wear powder-free surgical gloves, and the gloves will be changed after each dissection.
- Fish undergoing field dissection will be photographed with a visible sample identification number prior to and after dissection.
- Samples of liver and muscle tissue will be extracted from each fish and placed in an individually labeled Ziploc bag. The label will include the sample ID and a suffix of “M” for muscle and “L” for liver tissue. Where possible, each sample will consist of a minimum of 50 grams of tissue.
- Bagged tissue samples will immediately be placed in a freezer
- A composite equipment blank will be prepared before each set of dissections by rinsing the foil cutting surface and the stainless steel knives (if used) with DI water and collecting the rinsate in an acid-preserved sample jar. DI water for use in blanks will be provided by the analytical laboratory.
- Frozen tissue samples will be packed in a cooler and sent to the laboratory within 24 hours using packaging recommendations provided by the lab.
- A field blank will be prepared for each sample day at the field collection site by rinsing an empty plastic fish bag with DI water and collecting the rinsate in an acid-preserved sample jar.
- Chain-of-custody procedures will be followed.

### 3.8.2 Sampling Equipment Decontamination

Where stainless steel, disposable scalpels are used for dissection, a fresh scalpel blade will be used for each fish. All stainless steel knives used will be washed with soap and water and rinsed with DI water between uses. All cutting surfaces will be washed with soap and water, rinsed with hot tap water and DI water, and covered with heavy-duty aluminum foil.

### 3.8.3 Sample Handling

#### 3.8.3.1 Sample Containers

Sampling containers will consist of clean Ziploc bags for all whole-body and tissue samples. The preservation method will be to keep samples frozen at below 0°C. The hold time is six months, but samples will be sent to the laboratory for analysis within 24 hours of collection.

#### 3.8.3.2 Sample Volumes, Containers, and Preservation

Sample volume will be made up of the whole body for fish less than 6 inches in length or the combined volume of muscle sample and liver tissue from fish longer than 6 inches. Approximately 25 grams (3x3x1 inches) of liver and 25 grams of muscle will be collected from each fish. Tissue and whole-body samples will be stored in plastic Ziploc bags and preserved through freezing.

#### 3.8.3.3 Field Data Forms and Document Management

A field data sheet (Appendix A) will be completed for each fish collected at each location where whole-body samples are collected. A data sheet also will be completed for each fish dissected. Data sheets will be completed in the field at each location where whole-body samples are collected.

All data sheets will be printed on write-in-the-rain paper and will be completed using waterproof ink. At the end of each working day completed field data sheets will be turned over to John Morsell or Paul McLarnon. All photographs will be downloaded to a field laptop computer once all field activities are completed.

#### 3.8.3.4 Sample Identification

Each sample will be labeled individually with a waterproof label listing the following information:

- Project name: Pebble Project.
- Date: month/day/year.
- Time.
- Preservation method: Keep Frozen.
- Sample code (example: 0605UT100ETF001).

- Analysis.
- Sampler's initials.

The sampler will identify each sampling location on the field form. The sample identification format is as follows:

Example: 0605UT100ETF001

Where:

*0605* is the date as month and year. If sampling begun in a given month carries over into the next month, samples are still labeled according to the month during which the sampling event began. For example, the last few samples for the June collection may be taken in early July, but the sample date will still read "0605."

*UT100E* is the location ID.

*TF* is the matrix code for fish tissue.

*001* is a sequential sample number.

201 = sequential sample number for field duplicates.

301 = sequential sample number for field triplicates.

401 = sequential sample number for field equipment blanks.

501 = sequential sample number for DI water blanks.

For analysis conducted on muscle or liver tissue an "M" or "L," respectively, will be placed at the end of the sample identification number:

Example: 0605UT100ETF001L

### 3.8.4 Sample Custody

Chain-of-custody (COC) information will be completed by a Shaw Environmental employee in the field at the time the sample is collected. All COC information will be entered in an e-Chain database.

The COC information for the fish-tissue samples will, at a minimum, include the following information:

- Sample identification code: TF (fish tissue).
- Signature of sampler.
- Date of collection: month/day/year.
- Time of collection.
- Project name: Pebble Project.
- Type of sample: "M" for muscle, "L" for liver, or whole body.
- Number and type of containers:   x   Ziploc bags.

- Sample preservation: Keep Frozen.
- Sample analysis requested: e.g., suite of trace metals.
- Inclusive dates of possession.
- Signature of receiver.

Also included on the COC form will be the following:

- HDR Alaska, Inc.  
2525 C Street Suite 305  
Anchorage, Alaska 99503  
(907) 644-2000.
- Instructions to laboratory to invoice Northern Dynasty Mines Inc. and to mail reports to:  
Jane Whitsett  
Shaw Environmental, Inc.  
2000 West International Airport Road, Suite A11  
Anchorage, Alaska 99502

### 3.8.5 Field Quality Control Samples

#### 3.8.5.1 Equipment Blank

Equipment blanks will be prepared after each set of dissections by rinsing the cutting surface with DI water and collecting the rinsate in an acid-preserved jar. Equipment blanks should occur at a frequency of 5 percent or one per day, whichever is greater.

#### 3.8.5.2 Field Duplicates

Field duplicates will be a split of homogenate prepared by CAS.

#### 3.8.5.3 Field Triplicates

Field triplicates will be a split of homogenate prepared by CAS and analyzed by the QA laboratory (North Creek Analytical).

## 4. MACROINVERTEBRATE AND PERIPHYTON SAMPLING

### 4.1 Introduction

This field sampling plan provides the protocol that is followed by all macroinvertebrate and periphyton field crews for the Pebble Project. This plan describes in detail the methods for all the macroinvertebrate and chlorophyll-*a,b,c* (periphyton) collection, and handling procedures including sampling, preservation, and shipping. The same procedures used for the 2004 macroinvertebrate collection will be followed in 2005. Also, an additional method (ADF&G, 1998) that provides more quantitative population information will be used. This method was

successfully tested by the Alaska Department of Fish and Game (ADF&G) and has been used by the Alaska Department of Natural Resources (ADNR) for sampling macroinvertebrates and periphyton.

## 4.2 Purpose and Scope

A series of collection sites was established in 2004 within and adjacent to the project area to determine baseline conditions. The baseline will provide a basis for detecting potential changes within the waterbodies. These collection sites were established and used in 2004, and many will continue to be used in 2005 for macroinvertebrate and periphyton sampling.

Macroinvertebrate and periphyton samples will be collected at seven sites in the mine area (including two lake sites) and at five locations along the proposed road alignment and at the proposed port location.

## 4.3 Site Description

The sampling sites are located primarily within a 10-mile radius of the ore body (Figure 11-1) and along the proposed road alignment (Figure 11-2). Specific study sites, as described below, have been selected to characterize macroinvertebrate and periphyton populations upstream and downstream of proposed project facilities. Macroinvertebrate and periphyton studies will not be required at all of the biological sampling sites designated for hydrology, water-quality, and fisheries studies. Mine-area study sites will be located on the north and south forks of Koktuli River, on Upper Talarik Creek, and at two lake sites (Frying Pan Lake and Big Wiggly Lake) (Figure 11-1). There will be four road-corridor sites and one port site (Figure 11-2).

## 4.4 Objectives

Macroinvertebrate and periphyton populations are effective indicators of water quality, productivity, and habitat health. The varied life histories and contaminant tolerances of indicator species integrate both short- and long-term environmental changes. The objective of the macroinvertebrate and periphyton study is to characterize baseline populations and habitat conditions. The preliminary results from the data collected in 2004 helped in refining the 2005 sampling effort.

## 4.5 Sample Analysis Summary

Macroinvertebrate samples will be processed (sorted) and identified in the HDR laboratory by HDR personnel. Periphyton samples will be sent to the Alaska Department of Natural Resources (ADNR) laboratory in Fairbanks for analysis of chlorophyll-*a, b, c* using ultraviolet and visible spectrophotometry.

## 4.6 Study Organization and Responsibility

The macroinvertebrate and periphyton study will be organized by the senior macroinvertebrate biologists: Andra Love of HDR Alaska, Inc., and Sally Morsell of Northern Ecological Services. They will be responsible for assigning tasks and ensuring that protocols are followed.

## 4.7 Field Activities

The methods used in 2004 to characterize the macroinvertebrate and periphyton populations within the proposed mine and road corridor study areas followed those outlined in the *Alaska Stream Condition Index (ASCI): A Modification of the USEPA Rapid Bioassessment Protocols* (Major and Barbour, 1997).

Two study approaches have been adopted for 2005. The ADNR Office of Habitat Management and Permitting (OHMP) has used methods for sampling macroinvertebrates and periphyton that are intended to provide more quantitative population information (ADF&G, 1998). These methods call for collection of a minimum of five replicate macroinvertebrate samples and 10 periphyton samples from a specific habitat type (riffles) and location that can be resampled in successive years. In 2005, an ASCI macroinvertebrate sample will again be collected at each site; however an additional five macroinvertebrate samples will be collected at each site in accordance with the ADNR methodology for comparison. The methods in the rapid bioassessment protocols (RBPs) for collection and processing of diatom (periphyton) data will not be used in 2005. Instead, the periphyton data collection will consist of 10 periphyton samples collected in each riffle location in accordance with the ADNR methods. Samples will be analyzed for chlorophyll-*a,b,c* and, the data will be used to assess productivity at each site.

Seven sites in the proposed mine area will be sampled and have been selected to collect information upstream and downstream of proposed facilities. (Because of hydrological limitations, only a downstream site can be used on the South Fork of Kaktuli River.) The sampling effort will take place in early June at the seven sites shown in Figure 11-1 and listed in Table 2.

TABLE 2: Sampling Sites for Macroinvertebrate and Periphyton Samples

Location	Sampling Method/Type	No. of Samples	No. of QC Samples	Total No. of Samples
<b>Sampling Sites for Mine Area</b>				
Frying Pan Lake	Modified ASCI, dredge	1	1 for ASCI samples	83 Total: 82 primary samples and 1 QC sample
Big Wiggly Lake	Modified ASCI, dredge	1		
SK100B	ASCI, Surber, Chlorophyll- <i>a,b,c</i>	16		
NK100A	ASCI, Surber, Chlorophyll- <i>a,b,c</i>	16		
NK100C	ASCI, Surber, Chlorophyll- <i>a,b,c</i>	16		
UT100B	ASCI, Surber, Chlorophyll- <i>a,b,c</i>	16		
UT100D	ASCI, Surber, Chlorophyll- <i>a,b,c</i>	16		
<b>Sampling Sites for Proposed Road Corridor and Port Location</b>				
Ursa 100B	ASCI, Surber, Chlorophyll- <i>a,b,c</i>	16	1 for ASCI samples	81 Total: 80 primary samples and 1 QC sample
UT138	ASCI, Surber, Chlorophyll- <i>a,b,c</i>	16		
Bear Den Creek	ASCI, Surber, Chlorophyll- <i>a,b,c</i>	16		
Red Creek	ASCI, Surber, Chlorophyll- <i>a,b,c</i>	16		
Y Valley Creek	ASCI, Surber, Chlorophyll- <i>a,b,c</i>	16		

## 4.8 Environmental Sampling Protocols

This section includes information about the macroinvertebrate and periphyton sampling procedures. It also includes information about equipment maintenance and sample handling.

### 4.8.1 Field Sampling Procedures

The ASCI sampling protocol (Major and Barbour, 1997) includes the methods used in 2004 for macroinvertebrate and periphyton samples. The same methods will be used in 2005 for macroinvertebrate sampling; however ADNR methods (ADF&G, 1998) will be used in collecting additional macroinvertebrate samples and in collecting periphyton samples.

#### 4.8.1.1 ASCI and Modified ASCI Methods

The ASCI protocols require 20 “jabs or kicks” with a D-frame, 363-micrometer-mesh kick net, resulting in approximately three square meters of habitat being sampled. Kick nets are used by disturbing or kicking the substrate upstream of the net so that organisms and debris flow into the net and are trapped. The jabs or kicks are partitioned proportionally between habitat types in the 100-meter reach, and the collected macroinvertebrates and debris are composited into one sample. The samples will be preserved with alcohol and labeled for later sorting and identification in the laboratory.

In addition to sampling the macroinvertebrate population, a visual aquatic and riparian habitat assessment will be completed and ambient water-quality data will be recorded on field data sheets such as those presented in Major and Barbour (1997) and those found in Appendix B. The visual

assessment of aquatic and riparian habitat is an integral part of the bioassessment process and considers the following habitat parameters:

- Epifaunal substrate/available cover.
- Embeddedness.
- Velocity/depth combinations.
- Sediment deposition.,
- Channel flow status.
- Channel alteration.
- Channel sinuosity.
- Bank stability.
- Bank vegetative protection.
- Riparian-zone vegetation width.

Dissolved oxygen, ph, conductivity, temperature, and oxidation reduction potential will be measured using a YSI 556 MPS multiprobe. The probe will be calibrated each morning before sampling begins.

Two lakes in the mine area, Big Wiggly and Frying Pan, will be sampled once using a modified ASCI approach and again using an Ekman dredge. The ASCI approach described above will be modified primarily to account for the lack of flowing water. Instead of placing the D-frame net in a stationary position, organisms will be collected by dragging the net through the habitat substrate. The habitat substrate may be disturbed beforehand, depending on substrate material, so that organisms enter the net.

#### **4.8.1.2 ADNR Surber-Sampler Methods**

Use of a Surber sampler is a semi-quantitative method to determine the density and composition of macroinvertebrate populations on stream-bottom habitats. The sampler is constructed of a rectangular frame net of 363-micrometer mesh size. Attached to the bottom of the net frame and oriented upstream is a metal frame that delineates the area of substrate to be sampled. The substrate within the frame is disturbed and cobbles are “scrubbed” clean of debris and organisms. The debris and organisms then flow into the net and are trapped.

Five samples will be collected with a Surber sampler from a selected riffle/cobble area at each sampling site. The sampling site will be documented using a global positioning system (GPS) and will be flagged to ensure that any subsequent sampling will occur in the same area. Samples will be placed in separate containers and preserved with alcohol.

#### **4.8.1.3 ADNR Modified Periphyton Methods**

At each sampling site, ten periphyton samples will be collected within the same riffle/cobble area from which macroinvertebrate samples are collected by the Surber sampler. The periphyton



sampling area will be flagged, and a GPS location will be recorded so that any future samples can be collected in the same place for continuity and comparison.

At each sampling site, periphyton will be removed from 10 cobbles from a riffle/cobble area that will not be disturbed by macroinvertebrate sampling. The sampling protocol that will be used to collect periphyton samples (ADF&G, 1998) has been used by ADNR on other Alaska projects. A square of high-density foam that is five square centimeters will be placed on each cobble. All material surrounding the foam square will be removed by scrubbing the cobble with a clean toothbrush. This area will then be rinsed clean. The area under the foam square then will be brushed with another clean toothbrush and rinsed clean onto a 45-micrometer glass fiber filter attached to a hand vacuum pump. Most of the water will be extracted and one milliliter of saturated magnesium carbonate solution will be added to the filter as a preservative. The remaining water will be extracted. The damp filter will be wrapped in a clean, large coffee filter (to absorb any additional water), labeled, placed in a Ziploc bag, and packed over silica gel desiccant. This process will be repeated so that ten discrete periphyton samples (one sample per cobble) will be collected from each sampling station. Filters will be frozen in a lightproof container with desiccant for shipment to the laboratory.

#### 4.8.2 Sampling-Equipment Maintenance

Before the field-sampling trip the nets will be examined for damage which may cause loss of organisms. Repairs or replacements will be made as needed. In the field the nets used for macroinvertebrate sampling will be rinsed with ambient water and examined for clinging organisms and debris after each sample collection. When sampling is completed at each stream site, the nets will again be rinsed and examined.

Sampling equipment for periphyton will not be reused between samples collected on the same day. The toothbrushes used to scrub the rocks of material will be placed in a Ziploc bag for the remainder of the field day. Upon returning from the field sampling each day, the dirty toothbrushes will be thoroughly cleaned using denatured alcohol. The foam squares will be placed in a Ziploc bag and cleaned upon returning from each field-sampling day.

The YSI 556 water-quality meters will be calibrated before the field-sampling event. Calibration will occur as needed during the field sampling to maintain the accuracy of the meters. Each meter will have a manual explaining the steps for calibration. Fresh calibration standards will be used during each calibration. The calibration menu for each parameter can be reached through the main menu of the meter. To calibrate the meter for a given parameter, the steps on the meter and in the manual will be followed and the proper levels for the solution being used will be entered.

A spare set of meters and nets will be taken on the field-sampling trip as a backup in case replacement of equipment is necessary. Extra sample bottles will also be taken on the sampling trip.

### 4.8.3 Sample Handling

#### 4.8.3.1 Sample Containers and Preservation

Macroinvertebrate sample containers will be one-liter Nalgene bottles. Each sample will be stored in a separate bottle. Some samples will require multiple bottles due to the amount of material collected in the nets. The bottles will be labeled accordingly to clarify how many bottles each sample comprises and which sampling method was used (ASCI or Surber). These samples will be stored in a cooler during the field day. Upon returning from the field-sampling day, the bottles will be filled with denatured alcohol. Labels will be examined, samples will be logged on a sample-tracking form, and all bottles will be stored in coolers for transport back to the lab.

Sampling containers for all periphyton samples will consist of clean Ziploc bags. All the sample bags will be clearly labeled. The preservation method will be to keep samples frozen at below 0°C and stored in light-proof containers. The periphyton samples will be sent to the laboratory for analysis immediately upon returning from the field-sampling trip.

#### 4.8.3.2 Sample Identification

Each sample will be labeled individually with a waterproof marker listing the following information:

- Project Name: Pebble Project.
- Date: month/day/year.
- Sample Site ID.
- Sample Type: macroinvertebrate or periphyton.
- Sample Method and/or Number Code: e.g., Surber 1 = macroinvertebrate Surber-sample #1.
- Bottle Number (if one sample needs more than one bottle): e.g., 1 of 3 (macroinvertebrate)
- Preservation Method: Keep Frozen (periphyton)
- Duplicate (if applicable).

### 4.8.4 Sample Custody

The macroinvertebrate samples will be sorted and identified by HDR employees so no custody forms will be necessary; however, all samples will be logged in using the Macroinvertebrate Sample Login Sheet (Appendix B). Periphyton samples will be recorded on the Periphyton Sample Login and Shipment Tracking Sheet. This sheet includes the following:

- Site identification and sample number.
- Stream name.

- GPS coordinates.
- Date and time of collection.
- Samplers' initials.
- Shipping date.
- Shipper's initials.

Periphyton samples will be shipped to Bill Morris of the ADNR Office of Habitat Management and Permitting for laboratory analysis of chlorophyll-*a,b,c* concentrations.

#### 4.8.5 Field Quality Control Samples

Field duplicates are the quality control samples. These will occur at a frequency of 10 percent for the ASCI samples. There will be one duplicate macroinvertebrate ASCI sample collected at the mine area and an additional duplicate macroinvertebrate ASCI sample collected at one of the road-corridor sites. These samples will be placed in separate bottles and labeled "duplicate" at the bottom of the label.

## 5. REFERENCES

- Alaska Department of Fish and Game (ADF&G). 1998. Methods for Aquatic Life Monitoring to Satisfy Requirements under 1998 NPDES Permit: NPDES AK-003865-2, Red Dog Mine Site. ADF&G, Division of Habitat and Restoration, Fairbanks, Alaska.
- Major, E.B., and M.T. Barbour. 1997. The Alaska Stream Condition Index (ASCI): A Modification of the USEPA Rapid Bioassessment Protocols. Prepared for Alaska Department of Environmental Conservation, Anchorage, Alaska.
- Northern Dynasty Mines Inc. (NDM). In press. Pebble Project, Draft Environmental Baseline Studies, Proposed 2005 Study Plan, Fish and Aquatic Habitat. Prepared by HDR Alaska, Inc.
- . 2005. Pebble Project, Environmental Baseline Studies, 2005 Final Quality Assurance Project Plan.

## FIGURES

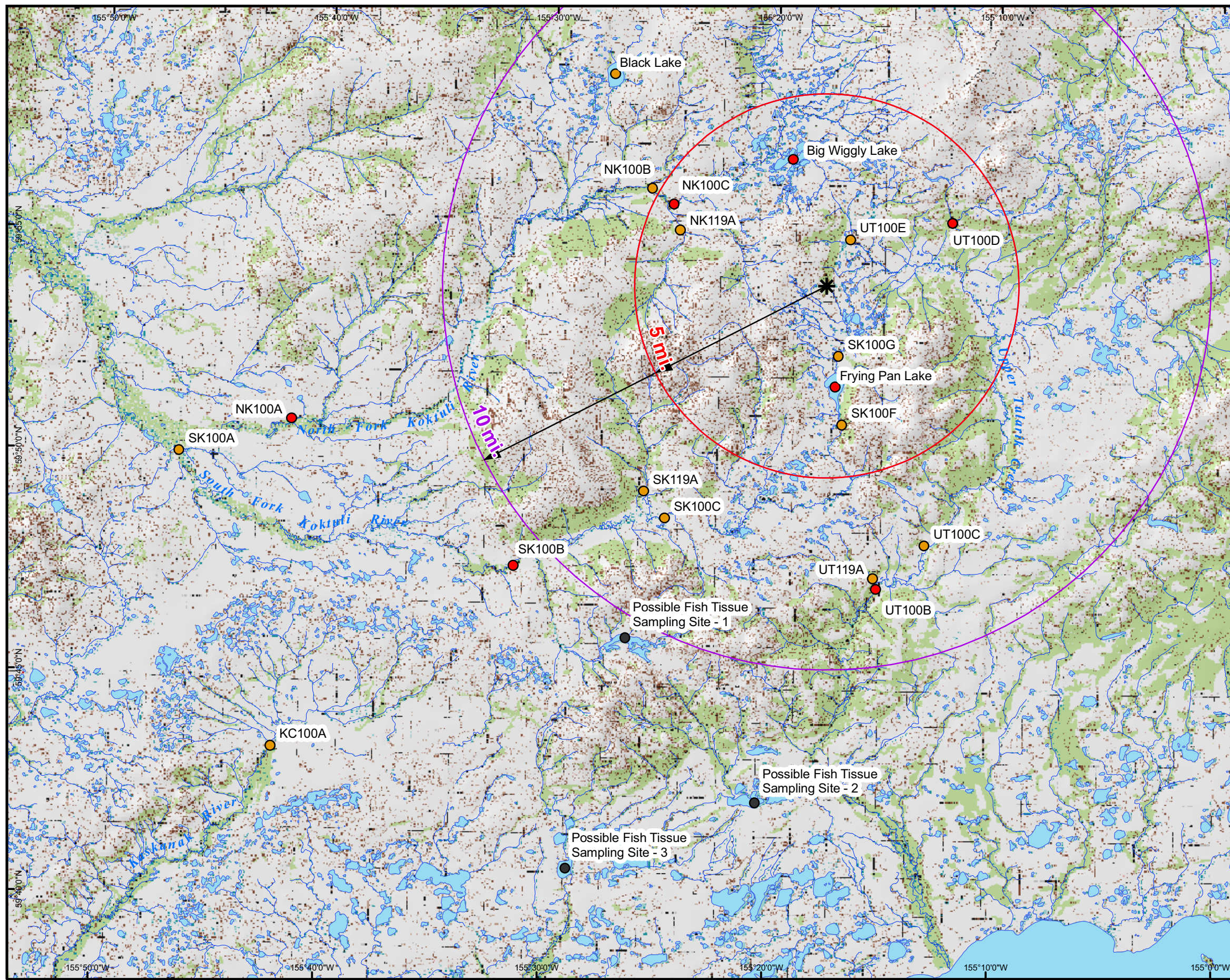


### Pebble Project

Fish and Aquatic Field Sampling Plan  
Fish Tissue, Macroinvertebrate, and  
Periphyton Sampling Sites  
Mine Study Area  
Figure 1

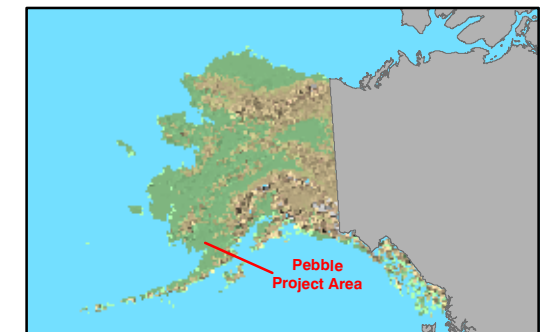
### Legend

- 2005 Sampling Sites (Fish & Macro)
- Fish Tissue Only Sampling Sites
- Possible Fish Tissue Sampling Sites
- ✱ Ore Body
- Inner Mine Area
- Outer Mine Area



Sites from HDR, file date 01/25/2005

*Privileged and Confidential*

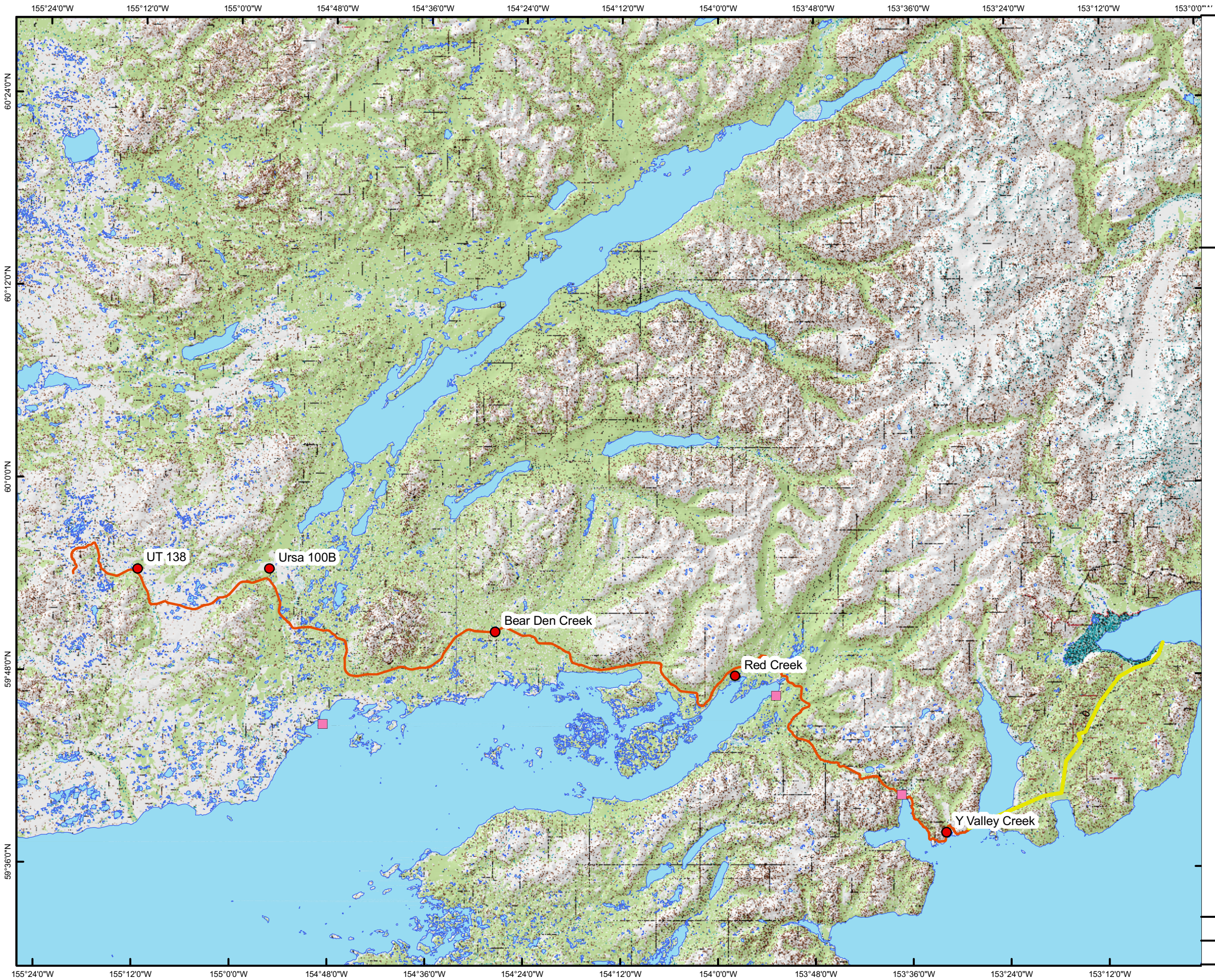


0 0.5 1 2 3 4 5 Miles

0 0.5 1 2 3 4 5 Kilometers

Scale 1:166,756

Alaska State Plane Zone 5 (units feet)  
1983 North American Datum



Northern Dynasty Mines Inc.



**Pebble Project**

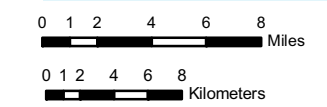
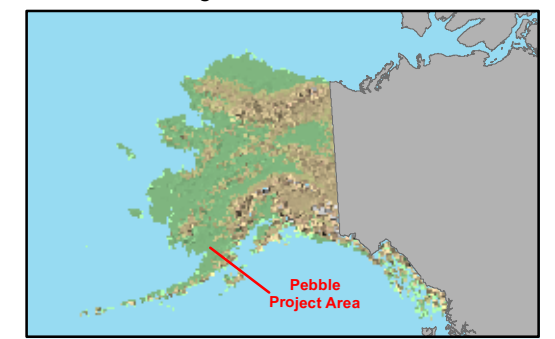
Fish and Aquatic Field Sampling Plan  
 Fish Tissue, Macroinvertebrate, and  
 Periphyton Sampling Sites - Road, Port,  
 and Transmission Line Study Area  
 Figure 2

**Legend**

- 2005 Sampling Sites
- Barge Landing Areas
- Road Corridor
- Transmission Line

Sites from HDR, file date 01/25/2005

*Privileged and Confidential*



Scale 1:445,627

Alaska State Plane Zone 5 (units feet)  
 1983 North American Datum

File: Fig2 Fish_Aquatic_FieldSamplingPlan	Date: March 17, 2005
Version: 1	Author: HDR-DS

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# APPENDIX A

## Fish Tissue Data Sheets

# Fish Tissue Dissection Data Sheet

(Complete a new data sheet for each fish dissected)

Date \_\_\_\_\_

Time \_\_\_\_\_

Sample Team Members \_\_\_\_\_  
\_\_\_\_\_

Sample Location \_\_\_\_\_

Capture Method \_\_\_\_\_

Species \_\_\_\_\_

Length \_\_\_\_\_

Weight \_\_\_\_\_

Photo Numbers \_\_\_\_\_

Scale Card Number \_\_\_\_\_ Scale Sample Numbers \_\_\_\_\_

Sample I.D. Number(s) \_\_\_\_\_

Weight of Liver Sample \_\_\_\_\_

Weight of Muscle Sample \_\_\_\_\_

Stomach Contents \_\_\_\_\_  
\_\_\_\_\_

Recapture? Tag No. and Color \_\_\_\_\_

Comments \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



**PEBBLE PROJECT**

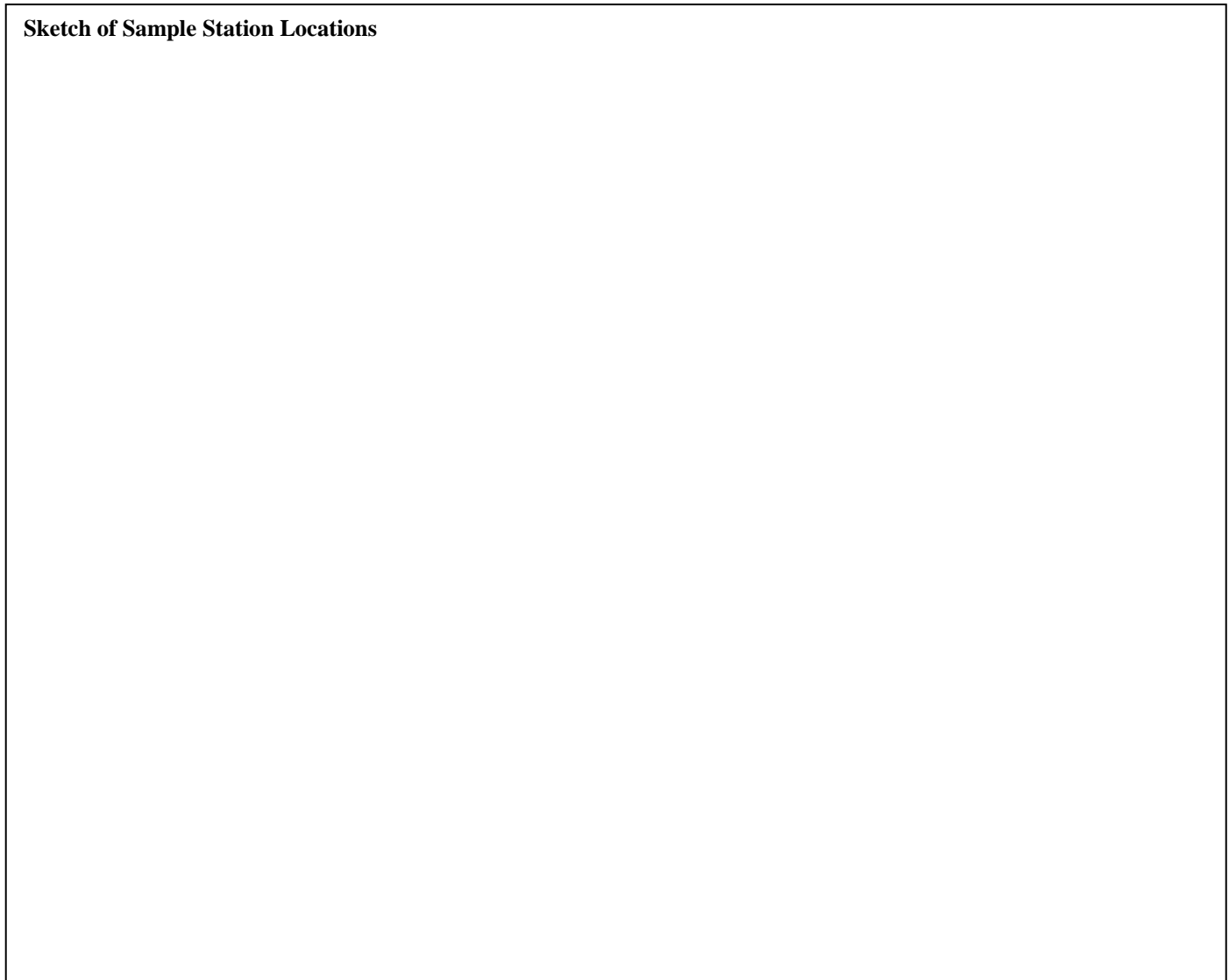
**COLLECTION OF FISH FOR WHOLE BODY TISSUE ANALYSIS AND INDEX SPECIES**

<b>Sample Team</b> _____	<b>Date</b> _____
<b>Stream Name</b> _____	<b>Time</b> _____
<b>Sample Station Code</b> _____	<b>Photo #'s</b> _____
<b>Weather Conditions</b> _____	<b>GPS Waypoint</b> _____
_____	<b>Water Temp</b> _____

**Designated Sample Species – Fish Tissue**\_\_\_\_\_

**Designated Sample Species – Index Sampling**\_\_\_\_\_

**Sketch of Sample Station Locations**







### Fish Retained for Tissue Analysis

<b>Sample Number</b>	<b>Species</b>	<b>Length (mm) must be greater than 75 mm</b>

**General Comments**

**APPENDIX B**  
**Macroinvertebrate and Periphyton Data Sheets**

**Macroinvertebrate/Periphyton/Water Quality  
Field Data Collection Form**

<b>Site Identification:</b>	<b>Date:</b>	<b>Crew Initials:</b>
<b>Site Name:</b>	<b>Time:</b>	
<b>GPS Periphyton Coordinates:</b>		
<b>GPS Surber Coordinates:</b>		
<b>Conditions (Site and Weather):</b>		
<b>Sample Collected:</b>	<b>Type:</b>	
Y      N	Water	Macro – ASCI
	Periphyton	Macro – Surber
	Duplicate	Macro – Modified ASCI
		Macro – Drift
<b>Surber/Periphyton Sample Location Sketch Map</b>	<b>Flow Data:</b>	
	_____	
	_____	
	_____	
	_____	
	_____	
<b>Water Quality Data:</b>		
Temperature C:	DO:	Conductivity:      pH:

Macroinvertebrate and Periphyton Sites: Mine Area

Site ID	Latitude	Longitude	ASCI collected Y/N	Surber collected Y/N	Periphyton collected Y/N
NK100C	N59° 55.822'	W155° 24.595'			
	59.930367	-155.409917			
	2169195.77	1381799.13			
NK100A	N59° 50.584'	W155° 43.136'			
	59.843067	-155.718933			
	2138635.82	1324296.58			
UT100D	N59° 54.481'	W155° 11.995'			
	59.908017	-155.199917			
	2160268.79	1420167.83			
UT100B	N59° 47.215'	W155° 15.215'			
	59.786917	-155.253583			
	2116196.90	1409480.53			
SK100B	N59° 47.591'	W155° 31.452'			
	59.793183	-155.524200			
	2119531.23	1359685.25			
Big Wiggly	N59° 53.334	W155° 16.3619			
	59.8889	-155.2727			
	2153632.73	1406923.30			
Frying Pan	N59° 51.768	W155° 17.214			
	59.8628	-155.2869			
	2144189.11	1403839.67			

Macroinvertebrate and Periphyton Sites: Road/Port Area

Site ID	Latitude	Longitude	ASCI collected Y/N	Surber collected Y/N	Periphyton collected Y/N
UT138	N59° 54.510	W155° 11.430'			
	59.942667	-155.159433			
	1420376.38	2166265.82			
Ursa 100B	N59° 54.5736	W154° 55.6524			
	59.90956	-154.92754			
	2159790.52	1470186.40			
Bear Den Creek	N59° 50.75418	W154° 27.57042			
	59.845903	-154.459507			
	2135881.70	1555859.65			
Red Creek	N59° 48.0468	W153° 57.8304			
	59.80078	-153.96384			
	2118946.29	1647510.10			
Y Valley Creek (Chum)	N59° 56.7162	W153° 31.6614			
	59.94527	-153.52769			
	2062162.86	1728700.44			



