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Final
Field Sampling Plan
2010 Limited Sampling Effort,
Red Devil Mine, Alaska

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Prepared for:

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List of Abbreviations and Acronyms

°C	degrees Celsius
ARARs	Applicable and Relevant or Appropriate Requirements
As	arsenic
ASTM	American Society for Testing and Materials
ATV	all-terrain vehicle
BLM	Bureau of Land Management
Br	bromine
BTEX	benzene, toluene, ethylbenzene, and xylenes
Cl	chlorine
COC	chain-of-custody
COPCs	contaminants of potential concern
DOT	Department of Transportation
DRO	diesel range organics
EPA	Environmental Protection Agency
FSP	Field Sampling Plan
GPS	global positioning system
HCl	hydrochloric acid
Hg	mercury
HNO_3	nitric acid
IATA	International Air Transportation Association
IDW	investigation-derived waste
L	liter
mL	milliliter
MS/MSD	Matrix Spike/Matrix Spike Duplicates
Pb	lead
QAPP	Quality Assurance Project Plan
QA/QC	quality assurance/quality control
QC	field quality control
RCRA	Resource Conservation and Recovery Act
RDM	Red Devil Mine
RI/FS	Remedial Investigation/Feasibility Study
RRO	residual range organics
Sb	antimony
SOPs	Standard Operating Procedures
SPLP	synthetic precipitation leaching procedure
SSE	selective sequential extraction
TAL	target analyte list
TCLP	toxicity characteristic leaching procedure
TDS	total dissolved solids
TSS	total suspended solids

List of Abbreviations and Acronyms (cont.)

USCS	United Soil Classification System
XRF	X-ray fluorescence spectrometer

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Introduction

This document is a Field Sampling Plan (FSP) to be used for a limited sampling effort to be conducted during the 2010 summer field season at the Red Devil Mine (RDM) site. The RDM site is an abandoned mercury mine and ore processing site on the south bank of the Kuskokwim River in a remote area of Alaska, approximately 250 air miles west of Anchorage and 75 air miles northeast of the village of Aniak. The site is on public lands managed by the Department of the Interior Bureau of Land Management (BLM).

The 2010 limited sampling effort is being performed in support of a Remedial Investigation/Feasibility Study (RI/FS) at the RDM site. A draft RI/FS Work Plan was submitted to BLM on August 18, 2010. The draft RI/FS Work Plan details the site setting, site history, previous investigations, data quality objectives, and Applicable and Relevant or Appropriate Requirements (ARARs) for the site. Information in the draft RI/FS Work Plan is not repeated in the FSP. This FSP is intended to be used as a streamlined guide for the field investigation team.

The purpose of this FSP is to provide specific methodology for the sampling and analysis at the RDM site. The results of the activities performed under this FSP will be used in support of the RI/FS to characterize the nature and extent and fate and transport of contaminants of potential concern (COPCs) at and near the site, to provide data for human health and ecological risk assessments, and to provide data and information for use in the analysis of remedial alternatives.

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Sample Locations, Types, and Rationale

This section describes the study design for each component of the 2010 limited sampling effort at RDM. The study area for the 2010 limited sampling effort includes the Main Processing Area, where ore processing operations were conducted, and areas outside of the Main Processing Area where additional potential contaminant sources may exist and/or where site-related contamination may be present (see Figures 1-2 and 1-3 in the draft RI/FS Work Plan). The draft RI/FS Work Plan details the contaminant sources associated with the site and the COPCs associated with these sources.

The study design is biased to target locations that are potential and/or known sources of COPCs and locations and media potentially impacted by migration of COPCs at the site. Some sample locations have also been selected to verify historical sample results or to provide new data because site conditions have changed since previous sampling events (e.g., movement of soil, construction activities associated with mine operations or cleanup actions, and vehicle traffic).

The study design incorporates both field screening and fixed laboratory analyses. Field screening will provide real-time data to inform decisions about subsequent sample locations and selection of samples for laboratory analysis, as well as providing a large data set to delineate the areal distribution of tailings and waste rock. As discussed in the draft RI/FS Work Plan, available information does not clearly indicate the locations at which the waste rock generated during all mining operations was disposed of. The waste rock is likely mixed with tailings locally, and waste rock may be difficult to distinguish from thermally processed tailings. Therefore, unless indicated otherwise, the term “tailings” is used in this document to refer to tailings and/or waste rock. Flotation tailings are readily distinguishable from the tailings/waste rock and were disposed of in the settling ponds. The historical and present channel and delta of Red Devil Creek likely consist of tailings/waste rock mixed with native alluvial material.

2.1 Surface Soil

Surface soils will be characterized using a combination of visual observations, field screening methods, and fixed laboratory analyses. To evaluate the presence and areal extent of tailings at the RDM site, information regarding waste disposal during mine operations will be verified and supplemented in the field using a combination of visual observations (see Section 2.1.1) and in situ field screening for total metals using a portable X-ray fluorescence spectrometer (XRF) (see Section 2.1.2). Visual inspection and XRF field screening also will be performed at locations where soil samples are collected for laboratory analysis (see Section 2.1.3).

2.1.1 Visual Inspection

Based on a review of historical aerial and other photographs, the extent of tailings during the period of mining operations is expected to include much of the Main Processing Area and areas within the Red Devil Creek drainage downstream of the Main Processing Area. Tailings were disposed of in the Red Devil Creek drainage, and piles of tailings along the banks of Red Devil Creek are subject to erosion by the creek. As such, tailings are expected to be mixed with alluvial materials within the Red Devil Creek drainage and its delta into the Kuskokwim River. The extent of the areas where tailings/waste rock and flotation tailings were disposed of during subsequent to mine operations is illustrated in Figure 2-2 of the draft RI/FS Work Plan.

Review of recent photographs indicates that some of the areas where tailings have historically been located still likely have tailings at the surface. At other locations, tailings may have been redistributed, covered by soil, and/or vegetated. Based on historical photographs and lithological descriptions of tailings provided in soil boring logs (Wilder/HLA 2001), thermally processed tailings at the site are expected to consist of mixtures of gravel, sand, and silt-sized material, with at least some of the gravel comprising angular shale fragments. Some tailings material is expected to be largely gray to black with some brown, and other tailings material is expected to be rusty brown. Flotation tailings in the settling ponds are expected to consist predominantly of silt-sized and fine sand–sized particles. Physical characteristics of possible tailings will be recorded during the visual inspection, as summarized in Section 4.1.1.

Locations where visual inspection will be performed are discussed in Section 2.1.2.

2.1.2 In Situ XRF Field Screening

Areas where tailings could be present at the surface based on historical data will be evaluated using visual observations and XRF field screening during the 2010 field event to determine the presence of tailings. Visual observations and XRF field screening will be used to delineate the lateral extent of tailings. Based on available historical data, tailings are generally expected to contain the key metals antimony (Sb), arsenic (As), and mercury (Hg) at concentrations significantly higher than in the native soil materials at most locations at the site. XRF field screening concentrations of these and other metals in soils will be recorded and used in conjunction with other data to support the determination of whether tailings are present.

Early in the 2010 field event, visual observation and XRF field screening will be performed in areas where historical information (see draft RI/FS Work Plan Figure 2-2) and visual observations indicate that tailings are likely present. The initial area of field screening for tailings is illustrated in FSP Figure 2-1. A square grid with 100-foot spacing was established within the area expected to contain tailings. One location within each grid square (FSP Figure 2-1) will be field screened for the presence of tailings. Field screening will be performed as near as feasible to the field screening locations illustrated in FSP Figure 2-1. A total of approximately 45 field screening locations are expected to be evaluated. At each location, visual observations of soil characteristics and XRF field screening data will be recorded.

Field screening will commence in the areas of the site where tailings are known to exist at the surface (e.g., the area between the Post-1955 Retort building and Red Devil Creek). Visual soil characteristics and XRF concentrations of the key metals in these tailings materials will be used as a guide to identify tailings at other areas of the site where the presence of tailings is not as readily observed.

Subsequent field screening will be conducted in areas where tailings are suspected based on historical photographs, but where the surface is presently vegetated and/or modified by subsequent construction activities (e.g., within the Red Devil Creek drainage downstream of the Main Processing Area). The possible presence of tailings at these locations will be assessed based on comparison of visual characteristics and XRF concentrations at these locations with those at locations where tailings have been documented (e.g., Main Processing Area). As noted above, the Red Devil Creek alluvial deposits downstream of the Main Processing Area are expected to consist of a mixture of tailings and native alluvial materials, and, as such, concentrations of the key metals are expected to be somewhat less than the concentrations in unmixed tailings. At these locations, identification of tailings will necessitate careful visual identification of tailings material as well as careful consideration of XRF field screening data. Where tailings material may lie adjacent to heavily mineralized native material, such as the area northwest of the Pre-1955 Rotary Furnace, it is possible that both the tailings and the native materials may exhibit fairly high concentrations of the key metals. Here, also, identification of tailings will necessitate careful visual observations of soil materials and consideration of XRF data.

The lateral extent of tailings will be delineated by performing field screening at locations in the vicinity of the expected edge of tailings. Transect lines oriented perpendicular to the expected edge of tailings have been established at 33 locations along the expected lateral limit of tailings/waste rock (see FSP Figure 2-1). Each transect line segment straddles the expected lateral limit of tailings, with the starting point lying 15 feet inside of the expected lateral limit (Proposed Transect Station A) and the endpoint located 25 feet outside of the expected lateral limit (Proposed Transect Station B). Initially, field screening will be performed at Station A and Station B along each transect. If tailings materials are identified at the Station B location along any transect, the transect line will be extended outward to an additional station 25 feet from Station B (to Station C) and the soil will be evaluated at Station C for the presence of tailings. This process will be repeated until the lateral extent of tailings at that transect location is identified. Similarly, if it appears that tailings are not present at the Station A position along a given transect, the transect line will be extended inward approximately 25 feet from Station A (to Station AA). This process will be repeated until the lateral extent of tailings at that transect location is identified.

Based on the available information regarding site operational history, it is expected that tailings are locally present on roadways where these materials have been used as ballast or surface material. However, the identity of the roads on which tailings were used for such purposes is not known. The locations of roads developed during mining operations that have been identified based on review of historical information and photographs are shown in Figure 2-2 of the draft RI/FS Work Plan. Portions of some of these roads are illustrated in FSP Figure 2-1. These roads will be evaluated for the presence of tailings by performing visual observations and XRF field screening. Field screening will be performed at positions located approximately every 300 feet along each road, commencing at the expected lateral extent of tailings/waste rock (as shown in FSP Figure 2-1) and progressing outward from there.

XRF field screening will be performed in situ (on the soil surface) after removal of any surficial detritus that may exist. XRF field screening procedures are discussed further in Chapter 4. The lateral coordinates of each field screening location will be surveyed with global positioning system (GPS) instrumentation, as described in Chapter 8.

2.1.3 Laboratory Analytical Sampling

Surface soil samples will be collected for laboratory analysis. Surface soil sample results will be used as follows:

- Characterization of the nature and extent of COPCs in surface soil
- Provision of data supporting the delineation of the areal extent of tailings on the ground surface
- Identification and characterization of possible tailings at the reservoir dam
- Characterization of the soils within the area of surface mining and exploration
- Characterization of soil characteristics that may affect contaminant fate, transport, and bioavailability
- Characterization of chemical and physical characteristics of soils in background areas
- Provision of data for the human health risk assessment to assess potential exposure to COPCs through direct contact, inhalation, and incidental ingestion
- Provision of data to be used in support of the ecological risk assessment to assess potential exposure of biota to COPCs through direct contact and ingestion

- Characterization of geotechnical properties of tailings and soils that may be subject to excavation
- Characterization of geotechnical properties of soils at a potential site for an on-site waste repository located within the area of surface mining approximately 700 feet north of the Dolly Shaft Collar (see draft RI/FS Work Plan Figure 2-1)

Proposed surface soil sample locations are illustrated in FSP Figures 2-2, 2-3, and 2-4. Positions of these sample locations are approximate. Final sample locations will be refined during field sampling based on actual conditions encountered in the field.

Surface soil samples will be collected from 0 to 6 inches below ground surface following removal of any surficial detritus that may exist on the ground surface. Specific sampling methodologies are provided in Chapter 4 of this FSP.

All the surface soil samples will be analyzed for target analyte list (TAL) inorganic elements. A subset of these samples will be selected for analysis for mercury selective sequential extraction (SSE), arsenic speciation, synthetic precipitation leaching procedure (SPLP) TAL metals, toxicity characteristic leaching procedure (TCLP) Resource Conservation and Recovery Act (RCRA) metals, semi-volatile organic compounds (SVOCs), diesel range organics (DRO), and residual range organics (RRO). In addition, selected soil samples will be analyzed for geotechnical parameters including grain size/Atterburg limits, moisture content, compaction, direct shear, and permeability. In general, samples will be selected for the additional analyses to obtain the following:

- Broad areal distribution of data
- Data for different tailings types (e.g., flotation tailings versus thermally processed tailings, including pre-1955 thermally processed tailings and post-1955 thermally processed tailings) that may be discernable based on chemical or physical characteristics and/or geographic position
- Data on disturbed soils within the area of surface mining
- Data for anticipated background locations

Table 2-1 summarizes the planned surface soil samples by geographic area and/or source area to be evaluated, the proposed numbers of samples to be collected for selected analyses, and the criteria for selecting samples for laboratory analyses. Additional detail of the planned sampling of background soil is provided below.

Each surface soil sample collected for laboratory analysis will be field screened with an XRF, as described in Section 4 and in accordance with the XRF standard operating procedures (SOP). The XRF results will be used in the field to select samples for selected laboratory analyses, as described in Table 2-1. Results of the XRF field screening will be correlated to laboratory total metals results to assess the effectiveness of the XRF field screening.

Background Soil

Background soil sample locations were selected based on review of historical aerial photographs, records of mine operations, and available analytical data. The extent of mine-related impacts, including those stemming from underground mining, surface mining, and ore processing and waste disposal practices, is summarized in Chapter 2 and illustrated in Figures 2-1 and 2-2 of the draft RI/FS Work Plan. Available information regarding the nature of native soils is summarized in Chapter 2 and Figure 2-3 of the draft RI/FS Work Plan. Results of air modeling to identify the areas that may have been impacted by aerial emissions from thermal ore processing at the mine are summarized in Appendix E of the draft RI/FS Work Plan.

Based on available information on surficial geology (Mackevett and Berg 1963; see draft RI/FS Work Plan Figure 2-3), three types of native soil exist at the site: alluvium associated with Red Devil Creek; loess; and soil derived from the Kuskokwim group bedrock. The existing surficial geologic map (Mackevett and Berg 1963) appears to include little of the area lying outside of the influence of the mine-related impacts. Nonetheless, it is expected that native soils lying a short distance outside of the area of mining impacts will include each of these three soil types. Each soil type will be targeted for background soil characterization. Ten grab surface soil samples from each of these three types of soil are planned, for a total of 30 grab samples. Background soil characterization is summarized in Table 2-1 and discussed further below.

The alluvial materials targeted for background characterization lie within the Red Devil Creek drainage upstream of the Main Processing Area. Based on a historical aerial photograph that appears to show that soil was bulldozed from the adjacent hillside down to the reservoir dam, it is suspected that the reservoir dam is composed of nearby native soils rather than tailings. This will be confirmed with sampling conducted as part of the 2010 sampling event. For the purpose of identifying preliminary background locations in alluvial materials, it is assumed that the dam is not composed of tailings. Several proposed surface soil sample locations lie downstream of the dam (locations 10RD10 through 10RD13, FSP Figure 2-4), and the rest lie upstream of the dam (locations 10RD14 through 10RD19, FSP Figure 2-4).

The general area of proposed background sampling for soils derived from loess and Kuskokwim group bedrock is located in the upland area generally west of the Main Processing Area and the area of surface mining (see “Area of Upland Samples (10UP01 - 10UP20)” in FSP Figure 2-4). As indicated above, available geologic mapping (Mackevett and Berg 1963) does not indicate the areal extent of the loess and Kuskokwim group bedrock-derived soils within this area. Therefore, it is not possible to identify specific sample locations prior to performing field work. The specific locations of these soil types within the proposed upland soil background area will be determined during the 2010 sampling event by a project geologist based on field observations of soil characteristics. It is expected that 10 surface soil samples (locations 10UP01 through 10UP10) will be collected from soil derived from Kuskokwim group bedrock and 10 surface soil samples (locations 10UP11 through 10UP20) will be collected from soil derived from loess.

2.2 Subsurface Soil

Subsurface soil samples will be collected from soil borings to be installed during the RI/FS. No subsurface soil sampling will occur during the 2010 field event; it is expected that subsurface soil sampling will be performed during the 2011 RI/FS field activities. The subsurface soil sampling program will be revised as appropriate based on data gathered during the 2010 sampling event in addition to existing data. The revised subsurface soil sampling program will be described under separate cover.

2.3 Groundwater

Groundwater samples will be collected from existing monitoring wells for laboratory analyses during the 2010 field event. No new monitoring wells will be installed during the 2010 field event. It is expected that installation and sampling of new monitoring wells will be performed during the 2011 RI/FS field activities. The expected 2011 groundwater sampling program will be informed by data gathered during the 2010 sampling event in addition to existing data. The proposed 2011 groundwater sampling program will be described under separate cover.

Groundwater monitoring results will be used for:

- Characterization of the nature and extent of COPCs in groundwater
- Characterization of the cation-anion signature of the groundwater to assess potential sources and migration patterns of groundwater and COPCs
- Characterization of groundwater depth, flow direction, gradient, and migration patterns of COPCs
- Assessment of groundwater-surface water interactions, including the potential for COPCs in groundwater to enter surface water
- Provision of data for the human health risk assessment to assess potential exposure to COPCs through ingestion of drinking water

Groundwater samples will be collected from monitoring wells using a low-flow sampling technique, if feasible. If it is not possible to sample using the low-flow technique, alternative technique(s) will be employed. Specific sampling methodologies are described in Chapter 4 of this FSP.

At the beginning of the field event, a round of static water level measurement will be conducted at all existing wells. Following the completion of groundwater sampling near the end of the sampling event, another round of static water level gauging will be conducted. The static water levels will be measured during each round within the shortest time period possible.

All the groundwater samples will be analyzed for total TAL inorganic elements, dissolved TAL inorganic elements, total low-level mercury, dissolved low-level mercury, methyl mercury, inorganic ions, nitrate/nitrite, carbonate/bicarbonate, total dissolved solids (TDS), and total suspended solids (TSS). Several groundwater samples also will be analyzed for arsenic speciation, SVOCs, DRO, RRO, and gasoline range hydrocarbons (GRO) and benzene, toluene, ethylbenzene, and xylenes (BTEX). The groundwater samples from existing monitoring well MW-1 will be analyzed for BTEX to evaluate the potential presence of benzene in groundwater based on historical sample results of benzene in soil at the Gravel Pad.

Field measurements of pH, temperature, specific conductance, oxidation-reduction potential, dissolved oxygen, and turbidity will be collected for each groundwater sample.

Table 2-2 summarizes the planned groundwater samples by geographic area and/or source area evaluated and the proposed numbers of samples to be collected for selected laboratory analyses. FSP Figure 2-5 illustrates the locations of existing monitoring wells planned for sampling in 2010.

2.4 Red Devil Creek Surface Water and Sediment

Surface water and surface sediment grab samples will be collected from nine locations along Red Devil Creek between the creek’s mouth at the Kuskokwim River and a point upstream of the reservoir south of the Main Processing Area (FSP Figure 2-6). Surface sediment and surface water sample locations between the Kuskokwim River and the reservoir are intended to characterize the contribution of COPCs from overland runoff from tailings and/or contaminated soil and from groundwater contribution. One surface sediment and surface water sample will be collected upstream of the reservoir. Sample results will be used for:

- Characterization of the nature and extent of COPCs in creek sediment and water
- Characterization of the cation-anion signature of the surface water to assess contribution from groundwater sources
- Characterization of chemical attributes affecting contaminant fate and transport of COPCs in surface water and sediment
- Characterization of grain size distribution of sediment
- Provision of data for the human health risk assessment to assess potential exposure to COPCs through direct contact and incidental ingestion
- Provision of data for the ecological risk assessment to assess potential exposure of creek biota to COPCs through direct contact and ingestion

It is anticipated that the creek will be shallow at most sample locations. To the extent feasible, surface water samples will be collected from mid-depth water in the creek. Surface sediment samples will be collected from the top 10 centimeters of the sediment bed. Specific sampling methodologies are summarized in Chapter 4 of this FSP.

All of the Red Devil Creek surface water samples will be analyzed for total TAL inorganic elements, dissolved TAL inorganic elements, methyl mercury, low-level total mercury, low-level dissolved mercury, inorganic ions, nitrate/nitrite, carbonate/bicarbonate, TDS, and TSS. Selected surface water samples will also be analyzed for arsenic speciation and SVOCs. Field measurements for pH, temperature, specific conductance, oxidation-reduction potential, dissolved oxygen, and turbidity will be collected at each sample station.

All of the Red Devil Creek sediment samples will be analyzed for total TAL inorganic elements, methyl mercury, arsenic speciation, grain size, and total organic carbon. Selected sediment samples also will be analyzed for mercury SSE.

Tables 2-3 and 2-4 summarize the proposed numbers of surface water and sediment samples to be collected for selected laboratory analyses.

2.5 Kuskokwim River Sediment

A total of approximately 11 surface sediment grab samples will be collected for laboratory analyses in the Kuskokwim River between a point approximately 900 feet up-river of the mouth of Red Devil Creek and a point approximately 800 feet down-river of the Dolly Sluice delta (FSP Figure 2-7). The surface sediment sample locations down-river of the mouth of Red Devil Creek are intended to provide information regarding the migration of COPCs from Red Devil Creek in the Kuskokwim River. Sample results will be used for:

- Characterization of the nature and extent of COPCs in river sediment
- Characterization of chemical attributes affecting fate and transport of COPCs
- Provision of data for the human health risk assessment to assess potential exposure to COPCs through direct contact, incidental ingestion, and consumption of fish
- Provision of data for the ecological risk assessment to assess potential exposure of river biota to COPCs through direct contact and ingestion

The surface sediment samples up-river of the mouth of Red Devil Creek are intended as reference samples to be used to infer the contribution of COPCs from Red Devil Creek to the Kuskokwim River.

Surface sediment samples will be collected from the top 10 centimeters of the sediment bed. The sediment samples will be collected beneath moving river water within 1 meter of the wetted edge of the river. Specific sampling methodologies are summarized in Chapter 4 of this FSP.

All of the Kuskokwim River sediment samples will be analyzed for total TAL inorganic elements, methyl mercury, arsenic speciation, grain size, and total organic carbon. Selected sediment samples also will be analyzed for mercury SSE.

Table 2-4 summarizes the proposed numbers of sediment samples to be collected for selected laboratory analyses.

2.6 Quality Control Samples

Following the requirements specified in the draft RI/FS Quality Assurance Project Plan (QAPP), included in the draft RI/FS Work Plan, field quality control (QC) samples will be collected for all matrices and analytes (except soil samples collected for XRF field screening, grain size, and geotechnical parameters). QC samples will be:

- Field Duplicates – One field duplicate will be collected for every 10 field samples of each matrix collected
- Matrix Spike/Matrix Spike Duplicates (MS/MSD) – One MS/MSD will be collected for every 20 field samples of each matrix collected
- Rinsate Blanks – One rinsate blank will be collected from each piece of non-dedicated sampling equipment for every 20 field samples collected
- Trip Blanks – One trip blank will be collected for every shipment of samples collected for BTEX analysis.

Table 2-1 Summary of Surface Soil Samples

General Geographic Area	Source Area / Other Area	Sub-Area	Location Description	Sample Location ID	Number of Samples / Selection Criteria											
					Total TAL Metals	Mercury SSE	Arsenic Speciation	SPLP TAL Metals	TCLP RCRA Metals[a]	SVOCs[3]	DRO/RRO	Grain Size / Moisture Content	Compaction	Direct Shear	Permeability	Comment
Main Processing Area	East of Red Devil Creek	Area of Monofill #2 / Post-1955 Retort Building	Surface of Monofill#2	10MP03	1			1	1							Collect composite sample for SPLP metals, with subsample from each location. Collect composite sample for TCLP RCRA metals, with subsample from each location.
				10MP04	1											
				10MP05	1											
			Slope Below Perimeter of Monofill #2 / Post-1955 Retort Building	10MP06	1			1	1							Collect composite sample for SPLP metals, with subsample from each location. Collect composite sample for TCLP RCRA metals, with subsample from each location.
				10MP07	1											
				10MP08	1											
				10MP09	1											
			Road below Monofill #2 / Post-1955 Retort Building	10MP11	1											Clean road surface material has been added since Monofill #2 construction.
				10MP12	1											
				10MP13	1											
				10MP14	1											
				10MP15	1											
				10MP18	1											
			North of Monofill #2 / Post-1955 Retort Building / Drum Storage Area	10MP10	1					1	1					
				10MP19	1					1	1					
		Area Upgradient of Monofill #2 / Post-1955 Retort Building	Upgradient Area	10MP01	1	1	1	1								
			Ore Pile upgradient from the Ore Hopper	10MP02	1			1								
		General, Tailings	Tailings borrow area, near former chute	10MP16	1	1	1	1	1							
			Tailings borrow area	10MP17	1	1	1	1	1			1	1			
				10MP27	1	1	1	1	1							
			Tailings	10MP26	1	2	2	2	2							Select discrete samples for Hg SSE from the locations that exhibit the highest XRF concentrations for mercury. Select discrete samples for arsenic speciation from the locations that exhibit the highest XRF concentrations for arsenic. Select discrete samples for SPLP TAL metals and TCLP RCRA metals from locations that exhibit the highest XRF concentrations for mercury and arsenic.
				10MP28	1											
				10MP29	1							1	1		1	
				10MP30	1											
				10MP67	1											
		Gravel Pad	Gravel Pad	10MP23	1	1	1	1	1							Select discrete sample for Hg SSE from the location that exhibits the highest XRF concentration for mercury. Select discrete sample for arsenic speciation from the location that exhibits the highest XRF concentrations for arsenic. Select discrete sample for SPLP TAL metals metals from location that exhibit the highest XRF concentrations for mercury. Select discrete sample for TCLP RCRA metals from location that exhibit the highest XRF concentration for lead.
				10MP24	1											
				10MP25	1											
		Monofill #3 Area	Monofill #3 Area/ Tailings	10MP22	1											
		Power Plant / Former Drum Storage Area	Power Plant / Former Drum Storage Area	10MP20	1					1	1					
				10MP21	1					1	1					
		Settling Pond Area	Upgradient of Settling Pond #1	10MP31	1											
			Flotation Tailings, Settling Pond #1	10MP32	1	1	1	1	1	1	1	1	1	1	1	Collect direct shear sample and permeability sample from above water table.
			Upgradient of Settling Ponds #2 and #3	10MP33	1											
			Flotation Tailings, Settling Pond #2	10MP34	1	1	1	1	1	1	1	1	1	1		Collect direct shear sample from above water table.
			Berm of Settling Pond #2	10MP35	1											
			Flotation Tailings, Settling Pond #3	10MP36	1	1	1	1	1	1	1	1	1			
			Berm of Settling Pond #3	10MP37	1											
				10MP68	1											
			Between Settling Ponds #1 and Red Devil Creek	10MP38	1											
			Between Settling Ponds #2 and Red Devil Creek	10MP39	1											
			Between Settling Ponds #3 and Red Devil Creek	10MP40	1											
	West of Red Devil Creek	Area East of Pre-1955 Processing Facilities	Near spring in Red Devil Creek / Downgradient of former mine openings / Tailings	10MP60	1							1	1		1	
		Area East of Pre-1955 Processing Facilities	Area between Pre-1955 Retort and Red Devil Creek	10MP63	1											
			Area between mine access road and Red Devil Creek	10MP64	1											
			Area between mine access road and Red Devil Creek	10MP65	1											
			Mine Access Road / Downgradient of Pre-1955 Processing Area	10MP66	1											
		Monofill #1 / Former Shop Buildings / Tailings	Surface of Monofill #1	10MP42	1			1	1							Collect composite sample for SPLP metals, with subsample from each location. Collect composite sample for TCLP RCRA metals, with subsample from each location.
				10MP43	1											
				10MP44	1											
			Area near Monofill #1 / Former Shop Pad / Tailings	10MP45	1					1	1					
				10MP46	1					1	1					
				10MP47	1					1	1					
			Area near Monofill #1 / Shop Pad A / Tailings	10MP48	1											
				10MP49	1											

Table 2-1 Summary of Surface Soil Samples

General Geographic Area	Source Area / Other Area	Sub-Area	Location Description	Sample Location ID	Number of Samples / Selection Criteria Total TAL Metals	Mercury SSE	Arsenic Speciation	SPLP TAL Metals	TCLP RCRA Metals[a]	SVOCs[3]	DRO/RRO	Grain Size / Moisture Content	Compaction	Direct Shear	Permeability	Comment
		Pre-1955 Retort	Area of Pre-1955 Retort Building	10MP55	1	1	1	1	1							Select discrete sample for Hg SSE from the location that exhibits the highest XRF concentrations for mercury. Select discrete sample for arsenic speciation from the location that exhibits the highest XRF concentrations for arsenic. Collect composite sample for SPLP metals, with subsample from each location. Collect composite sample for TCLP RCRA metals, with subsample from each location.
				10MP56	1											
				10MP57	1											
				10MP58	1											
			Burnt Ore near Pre-1955 Retort	10MP59	1	1	1	1	1			1	1		1	
			Area between Pre-1955 Retort and Red Devil Creek	10MP61	1											
			Area between Pre-1955 Retort and Red Devil Creek / Pre-1955 Rotary Furnace Burnt Ore Disposal Pile	10MP62	1							1				
		Pre-1955 Rotary Furnace Building / Tailings	Area of Pre-1955 Furnace Building / Tailings	10MP50	1	1	1	1	1							Select discrete sample for Hg SSE from the location that exhibits the highest XRF concentrations for mercury. Select discrete sample for arsenic speciation from the location that exhibits the highest XRF concentrations for arsenic. Collect composite sample for SPLP metals, with subsample from each location. Collect composite sample for TCLP RCRA metals, with subsample from each location.
				10MP51	1											
				10MP52	1											
				10MP53	1											
				10MP54	1											
		Upslope of Pre-1955 processing facilities and Monofill #1	Upslope of Pre-1955 processing facilities and Monofill #1	10MP41	1	1	1	1								
Surface Mining / Exploration Area	Central Surface Mined Area	Central Surface Mined Area	Central Surface Mined Area	10SM20	1	1	1	1								Select discrete sample for Hg SSE from the location that exhibits the highest XRF concentrations for mercury. Select discrete sample for arsenic speciation from the location that exhibits the highest XRF concentrations for arsenic. Select discrete sample for SPLP TAL metals from location that exhibit the highest XRF concentrations for mercury.
				10SM21	1											
	Northern Surface Mined Area	Northern Surface Mined Area	Northern Surface Mined Area	10SM22	1	1	1	1								Select discrete sample for Hg SSE from the location that exhibits the highest XRF concentration for mercury. Select discrete sample for arsenic speciation from the location that exhibits the highest XRF concentrations for arsenic. Select discrete sample for SPLP TAL metals from location that exhibit the highest XRF concentrations for mercury.
				10SM23	1											
	Sluiced Areas	Dolly Sluice Area	Dolly Sluice Delta	10DS01	1	1	1	1								Select discrete sample for Hg SSE from the location that exhibits the highest XRF concentration for mercury. Select discrete sample for arsenic speciation from the location that exhibits the highest XRF concentrations for arsenic. Select discrete sample for SPLP TAL metals from location that exhibit the highest XRF concentrations for mercury.
				10DS02	1											
			Gulley	10DS03	1											
		Possible Rice Sluice Area	Rice Delta	10RS01	1	1	1	1								Select discrete sample for Hg SSE from the location that exhibits the highest XRF concentration for mercury. Select discrete sample for arsenic speciation from the location that exhibits the highest XRF concentrations for arsenic. Select discrete sample for SPLP TAL metals from location that exhibit the highest XRF concentrations for mercury.
				10RS02	1											
			Gulley	10RS03	1											
	Southern Surface-Mined Area	Bulldozed Area Away from Known Ore Trend	Potential Site of On-Site Repository / Bulldozed Area Away from Known Ore Trend	10SM10	1	1	1	1				1	1		1	Select discrete sample for Hg SSE from the location that exhibits the highest XRF concentration for mercury. Select discrete sample for arsenic speciation from the location that exhibits the highest XRF concentrations for arsenic. Select discrete sample for SPLP TAL metals from location that exhibit the highest XRF concentrations for mercury.
				10SM11	1							1	1		1	
				10SM12	1							1	1			
			Bulldozed Area Away from Known Ore Trend	10SM13	1	3	3	3								Select discrete samples for Hg SSE from the locations that exhibit the highest XRF concentrations for mercury. Select discrete samples for arsenic speciation from the locations that exhibit the highest XRF concentrations for arsenic. Select discrete samples for SPLP TAL metals from locations that exhibit the highest XRF concentrations for mercury, arsenic, and antimony.
				10SM14	1											
				10SM15	1											
				10SM16	1											
				10SM17	1											
				10SM18	1											
				10SM19	1											
		Dolly Ore Zone Area	Dolly Ore Zone	10SM04	1	1	1	1								Select discrete sample for Hg SSE from the location that exhibits the highest XRF concentration for mercury. Select discrete sample for arsenic speciation from the location that exhibits the highest XRF concentrations for arsenic. Select discrete sample for SPLP TAL metals from location that exhibit the highest XRF concentrations for mercury.
				10SM05	1											
				10SM06	1											
		Originally Mined Ore Zone Area	Originally Mined Ore Zone	10SM01	1	1	1	1								Select discrete sample for Hg SSE from the location that exhibits the highest XRF concentration for mercury. Select discrete sample for arsenic speciation from the location that exhibits the highest XRF concentrations for arsenic. Select discrete sample for SPLP TAL metals from location that exhibit the highest XRF concentrations for mercury.
				10SM02	1											
				10SM03	1											
		Rice Ore Zone Area	Rice Ore Zone	10SM07	1	1	1	1								Select discrete sample for Hg SSE from the location that exhibits the highest XRF concentration for mercury. Select discrete sample for arsenic speciation from the location that exhibits the highest XRF concentrations for arsenic. Select discrete sample for SPLP TAL metals from location that exhibit the highest XRF concentrations for mercury.
				10SM08	1											
				10SM09	1											
	Trenches	Trenched Area West of Bulldozed Area	Trenched Area West of Bulldozed Area	10SM24	1	1	1	1								Select discrete sample for Hg SSE from the location that exhibits the highest XRF concentration for mercury. Select discrete sample for arsenic speciation from the location that exhibits the highest XRF concentrations for arsenic. Select discrete sample for SPLP TAL metals from location that exhibit the highest XRF concentrations for mercury.
				10SM25	1											
				10SM26	1											
				10SM27	1											
		Trenched Area West of Residential Structures	Trenched Area West of Residential Structures	10SM28	1	1	1	1								Select discrete sample for Hg SSE from the location that exhibits the highest XRF concentration for mercury. Select discrete sample for arsenic speciation from the location that exhibits the highest XRF concentrations for arsenic. Select discrete sample for SPLP TAL metals from location that exhibit the highest XRF concentrations for mercury.
				10SM29	1											
				10SM30	1											

Table 2-1 Summary of Surface Soil Samples

General Geographic Area	Source Area / Other Area	Sub-Area	Location Description	Sample Location ID	Total TAL Metals	Mercury SSE	Arsenic Speciation	SPLP TAL Metals	TCLP RCRA Metals[a]	SVOCs[3]	DRO/RRO	Grain Size / Moisture Content	Compaction	Direct Shear	Permeability	Comment
					Number of Samples / Selection Criteria											
Outside of Main Processing Area and Area of Surface Mining / Exploration	Dam / Upgradient from Main Processing Area	Dam	Dam	10RD08	1	1	1	1								Select discrete sample for Hg SSE from the location that exhibits the highest XRF concentration for mercury. Select discrete sample for arsenic speciation from the location that exhibits the highest XRF concentrations for arsenic. Select discrete sample for SPLP TAL metals from location that exhibit the highest XRF concentrations for mercury.
				10RD09	1											
	Red Devil Creek Alluvial Deposits and/or Soil Downstream of Main Processing Area	Red Devil Creek Alluvial Deposits Between Main Processing Area and delta	Red Devil Creek Alluvial Deposits and/or Soil	10RD05	1	1	1	1								Select discrete sample for Hg SSE from the location that exhibits the highest XRF concentration for mercury. Select discrete sample for arsenic speciation from the location that exhibits the highest XRF concentrations for arsenic. Select discrete sample for SPLP TAL metals from location that exhibit the highest XRF concentrations for mercury.
				10RD06	1											
				10RD07	1											
				10RD20	1											
		Red Devil Creek Delta	Red Devil Creek Delta	10RD01	1	1	1	1								Select discrete sample for Hg SSE from the location that exhibits the highest XRF concentration for mercury. Select discrete sample for arsenic speciation from the location that exhibits the highest XRF concentrations for arsenic. Select discrete sample for SPLP TAL metals from location that exhibit the highest XRF concentrations for mercury.
				10RD02	1											
				10RD03	1											
				10RD04	1											
	Background Alluvial Deposits: Red Devil Creek Alluvial Deposits Upstream of Main Processing Area	Red Devil Creek Alluvial Deposits Between Dam and Main Processing Area	Red Devil Creek Alluvial Deposits Between Dam and Main Processing Area	10RD10	1	2	2	2								Select discrete samples for Hg SSE from the locations that exhibit the highest XRF concentrations for mercury. Select discrete samples for arsenic speciation from the locations that exhibit the highest XRF concentrations for arsenic. Select discrete samples for SPLP TAL metals from locations that exhibit the highest XRF concentrations for mercury and arsenic.
				10RD11	1											
				10RD12	1											
				10RD13	1											
		Red Devil Creek Alluvial Deposits Upstream of Dam	Red Devil Creek Alluvial Deposits Upstream of Dam	10RD14	1	2	2	2								Select discrete samples for Hg SSE from the locations that exhibit the highest XRF concentrations for mercury. Select discrete samples for arsenic speciation from the locations that exhibit the highest XRF concentrations for arsenic. Select discrete samples for SPLP TAL metals from locations that exhibit the highest XRF concentrations for mercury and arsenic.
				10RD15	1											
				10RD16	1											
				10RD17	1											
				10RD18	1											
				10RD19	1											
	Background Upland Soils: Upland Area Apparently Upgradient of Mine Impacts	Soil derived from bedrock (Kuskokwim Group)	Specific sample locations to be identified in the field based on lithological characteristics	10UP01	1	2	2	2								Select discrete samples for Hg SSE from the locations that exhibit the highest XRF concentrations for mercury. Select discrete samples for arsenic speciation from the locations that exhibit the highest XRF concentrations for arsenic. Select discrete samples for SPLP TAL metals from locations that exhibit the highest XRF concentrations for mercury and arsenic.
				10UP02	1											
				10UP03	1											
				10UP04	1											
				10UP05	1											
				10UP06	1											
				10UP07	1											
				10UP08	1											
				10UP09	1											
				10UP10	1											
		Soil derived from loess.	Specific sample locations to be identified in the field based on lithological characteristics	10UP11	1	2	2	2								Select discrete samples for Hg SSE from the locations that exhibit the highest XRF concentrations for mercury. Select discrete samples for arsenic speciation from the locations that exhibit the highest XRF concentrations for arsenic. Select discrete samples for SPLP TAL metals from locations that exhibit the highest XRF concentrations for mercury and arsenic.
				10UP12	1											
				10UP13	1											
				10UP14	1											
				10UP15	1											
				10UP16	1											
				10UP17	1											
				10UP18	1											
				10UP19	1											
				10UP20	1											
				Total	**144**	**38**	**38**	**42**	**15**	**10**	**10**	**11**	**10**	**2**	**6**	

Notes:

a - Aliquots for TCLP RCRA metals analysis will be collected as indicated and submitted to the laboratory. The laboratory will be directed to perform the analysis only if total metal concentrations exceed the theoretical TCLP RCRA limits.

Key:

DRO = diesel range organics
RCRA = Resource Conservation Recovery Act
RRO = residual range organics
SPLP = synthetic precipitation leaching procedure
SSE = selective sequential extraction
SVOC = semivolatile organic compound
TAL = Target Analyte List
TCLP = toxicity characteristic leaching procedure

Table 2-2 Summary of Groundwater Samples

					Number of Samples													
General Geographic Area	**Source Area / Other Area**	**Sub-Area**	**Location Description**	**Sample Location ID**	**Total TAL Metals**	**Dissolved TAL Metals with Silicon**	**Total Low Level Mercury**	**Dissolved Low Level Mercury**	**Methyl Mercury**	**Arsenic Speciation**	**Inorganic Ions (Cl, F, SO4)**	**Total Dissolved Solids**	**Total Suspended Solids**	**Nitrate/Nitrite**	**Carbonate, Bicarbonate**	**SVOCs with TICs**	**DRO / RRO**	**GRO/ BTEX**
Main Processing Area	East of Red Devil Creek	Gravel Pad / Monofill #3 Area	Gravel Pad / Downgradient from Monofill #3	MW01 (existing well previously referred to as MW-1)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		Power Plant / Former Drum Storage Area	Downgradient from Power Plant / Former Drum Storage Area	MW07 (existing well previously referred to as MW-7)	1	1	1	1	1		1	1	1	1	1			
		Settling Pond Area	Berm of Settling Pond #1 / Downgradient of Settling Pond #1 Tailings	MW03 (existing well previously referred to as MW-3)	1	1	1	1	1		1	1	1	1	1			
	West of Red Devil Creek	Mine Openings / Monofill #1 / Former Shop Buildings / Tailings	Downgradient of Former Shop Pad	MW04 (existing well previously referred to as MW-4)	1	1	1	1	1		1	1	1	1	1	1	1	
		Pre-1955 Retort Area	Possibly downdradient of Pre-1955 Retort Area	MW06 (existing well previously referred to as MW-6)	1	1	1	1	1		1	1	1	1	1			
				Total	**5**	**5**	**5**	**5**	**5**	**1**	**5**	**5**	**5**	**5**	**5**	**2**	**2**	**1**

Key:

BTEX = benzene, toluene, ethylbenzene, and xylenes
DRO = diesel range organics
GRO = gasoline range organics
Hg = mercury
RRO = residual range organics
SVOC = semivolatile organic compound
TAL = Target Analyte List
TIC = tentatively identified compounds
TAL = Target Analyte List

Table 2-3 Summary of Surface Water Samples

General Geographic Area	Sub-Area	Location Description	Sample Location ID	Number of Samples											
				Total TAL Metals	Dissolved TAL Metals	Methyl Mercury	Arsenic Speciation	Inorganic Ions (Cl, F, SO4)	Total Low-Level Hg	Dissolved Low-Level Hg	Total Dissolved Solids	Total Suspended Solids	Nitrate/Nitrite	SVOCs with TICs	Carbonate, Bicarbonate
Red Devil Creek Area	Upstream from Main Processing Area	50 feet upstream from reservoir	10RD01	1	1	1	1	1	1	1	1	1	1		1
		50 feet downstream from reservoir dam	10RD02	1	1	1	1	1	1	1	1	1	1		1
		Approximately 300 feet upstream from the Main Processing Area	10RD03	1	1	1		1	1	1	1	1	1	1	1
	Main Processing Area	10 feet upstream from where the access road crosses Red Devil Creek	10RD04	1	1	1	1	1	1	1	1	1	1	1	1
		Seep on Left Bank of Red Devil Creek	10RD05	1	1	1	1	1	1	1	1	1	1	1	1
		Near Settling Pond #2	10RD09	1	1	1		1	1	1	1	1	1	1	1
		Near Settling Pond #3	10RD06	1	1	1	1	1	1	1	1	1	1	1	1
	Downstream from Main Processing Area	250 feet upstream from confluence with Kuskokwim River	10RD07	1	1	1		1	1	1	1	1	1	1	1
		Confluence of Red Devil Creek and Kuskokwim River	10RD08	1	1	1	1	1	1	1	1	1	1	1	1
			Total	**9**	**9**	**9**	**6**	**9**	**9**	**9**	**9**	**9**	**9**	**7**	**9**

Key:

Hg = mercury
SVOC = semivolatile organic compound
TAL = Target Analyte List
TIC = tentatively identified compounds

Table 2-4 Summary of Sediment Samples

General Geographic Area	Sub-Area	Location Description	Sample Location ID	Number of Samples					
				Total TAL Metals	Methyl Mercury	Arsenic Speciation	Mercury SSE	Grain Size	Total Organic Carbon
Red Devil Creek Area	Upstream from Main Processing Area	50 feet upstream from reservoir	10RD01	1	1	1	1	1	1
		50 feet downstream from reservoir dam	10RD02	1	1	1		1	1
		Approximately 300 feet upstream from the Main Processing Area	10RD03	1	1	1	1	1	1
	Main Processing Area	10 feet upstream from where the access road crosses Red Devil Creek	10RD04	1	1	1	1	1	1
		Seep on Left Bank of Red Devil Creek	10RD05	1	1	1	1	1	1
		Near Settling Pond #2	10RD09	1	1	1		1	1
		Near Settling Pond #3	10RD06	1	1	1	1	1	1
	Downstream from Main Processing Area	250 feet upstream from confluence with Kuskokwim River	10RD07	1	1	1		1	1
		Confluence of Red Devil Creek and Kuskokwim River	10RD08	1	1	1	1	1	1
Kuskokwim River Area	Upriver from Red Devil Creek	850 feet upriver from Red Devil Creek	10KR01	1	1	1		1	1
		750 feet upriver from Red Devil Creek	10KR12	1	1	1	1	1	1
		650 feet upriver from Red Devil Creek	10KR13	1	1	1		1	1
	Downriver from Red Devil Creek	50 feet downriver from Red Devil Creek	10KR02	1	1	1	1	1	1
		250 feet downriver from Red Devil Creek	10KR03	1	1	1		1	1
		"Rice Sluice" delta	10KR04	1	1	1	1	1	1
		200 feet downriver from "Rice Sluice" delta	10KR05	1	1	1		1	1
		200 feet upriver from Dolly Sluice Delta	10KR06	1	1	1		1	1
		Dolly Sluice Delta	10KR07	1	1	1	1	1	1
		200 feet downriver from Dolly Sluice Delta	10KR08	1	1	1	1	1	1
		400 feet downriver from Dolly Sluice Delta	10KR09	1	1	1		1	1
		600 feet downriver from Dolly Sluice Delta	10KR10	1	1	1		1	1
		800 feet downriver from Dolly Sluice Delta	10KR11	1	1	1	1	1	1
			Total	**22**	**22**	**22**	**12**	**22**	**22**

Key:

SSE = selective sequential extraction
TAL = Target Analyte List

3

Sample Identification

Each sample collected for during the 2010 sampling event will be assigned a unique alphanumeric code. Sample codes will be recorded in field logbooks, on sample containers, and on chain-of-custody (COC) forms. The field team leader will be responsible for maintaining a master database or spreadsheet of samples to be collected and samples obtained to ensure that all planned samples are collected during the field investigation, sample designation codes are not used twice for different locations, and the correct analytical parameters are identified on laboratory documentation.

Tables 3-1 through 3-4 describe the sample coding system.

Table 3-1 Location Identification Coding System – In Situ Surface Soil Tailings Delineation XRF Field Screening

Characters	Purpose	Code	Description
1–2	Sample year	10	Last two digits of year
3	XRF Unit ID	N or I	N = Niton I = Innov-X
4–7	Location ID or Transect/Station ID	**For Point Locations:** PXXX **For Transect Locations:** TXXY	**For Point Locations:** PXXX, where: P signifies “Location” and XXX = Consecutive numerical characters identifying location (e.g., 001, 002, etc.) **For Transect Locations:** TXXY, where: T signifies “Transect”; XX = Consecutive numerical characters identifying transect (e.g., 01, 02, etc.); and Y = alpha character identifying station on transect (e.g., A, B, C, AA)

Example sample code for XRF surface soil screening:

- 10NP002 – The second point location screened with the Niton XRF unit.
- 10IT03A – Station A along Transect 3, screened with the Innov-X XRF unit.

Surface soil samples collected for laboratory analysis will be assigned sample identifiers as specified in Table 3-2. Pre-assigned sample location identifiers for proposed surface soil samples are presented in Tables 2-1 and FSP Figures 2-2 through 2-4.

Table 3-2 Sample Identification Coding System – Surface Soil Samples

Characters	Purpose	Code	Description
1–2	Sample date	10	Last two digits of year
3–4	Area/Location	MP	Main Processing Area
		RD	Red Devil Creek area (including area along creek and on delta in Kuskokwim River)
		SM	Surface-mined area
		DS	Dolly Sluice delta area
		RS	Possible Rice Sluice area
		UP	Upland area west of Main Processing Area and area of surface mining and exploration
5–6	Location number	01, 02, etc.	Consecutive number within area/location
7–8	Matrix	SS	Surface soil

Surface soil samples collected for laboratory analysis will be field screened using an XRF analyzer. The sample coding described in Table 3-2 for laboratory samples will be used to identify samples field screened with the XRF.

Field duplicate samples for surface soil samples will be identified by selecting a unique location number not used for the regular sample or any subsequent samples. All surface soil samples will be cross-referenced in the field logbooks and in the sample master database to sample locations.

Example sample codes for surface soil:

- 10MP04SS – The regular surface soil sample collected from the fourth surface soil/subsurface soil sampling station in the Main Processing Area
- 10MP80SS – The field duplicate surface soil sample collected from the fourth surface soil/subsurface soil sample location in the Main Processing Area

Groundwater samples will be collected for laboratory analyses from existing monitoring wells during the 2010 sampling event. No new monitoring wells will be installed during the 2010 field event. Groundwater samples will be collected from the wells shown in FSP Figure 2-5 and will be assigned sample identifiers as specified in Table 3-3.

Table 3-3 Sample Identification Coding System – Groundwater Samples

Characters	Purpose	Code	Description
1–2	Sample date	10	Last two digits of year
3–4	Monitoring well	MW	Existing monitoring wells installed in 2001
5–6	Monitoring well identification Number	01, 02, etc.	Consecutive number. For existing monitoring wells installed in 2001, MW-01 corresponds to MW-1, MW-02 corresponds to MW-2, etc.
7–8	Matrix	GW	Groundwater

Field duplicate samples for groundwater samples will be identified by selecting a unique monitoring well identification number not used for the regular sample or any subsequent samples. All groundwater samples will be cross-referenced in the field logbooks and in the sample master database to monitoring well designations.

Example sample codes for groundwater:

- 10MW03GW – The regular groundwater sample collected from existing monitoring well MW-3.
- 10MW40GW – The field duplicate groundwater sample collected from existing monitoring well MW-3.

Surface water and sediment samples will be assigned sample identifiers as specified in Table 3-4. Pre-assigned sample location identifiers for proposed surface water and sediment samples are presented in Table 2-3 (surface water) and 2-4 (sediment) and FSP Figures 2-6 and 2-7.

Table 3-4 Sample Identification Coding System – Surface Water and Sediment Samples

Characters	Purpose	Code	Description
1–2	Sample date	10	Last two digits of year
3–4	Area/location	RD	Red Devil Creek area (including creek and delta in Kuskokwim River; surface water and sediment)
		KR	Kuskokwim River (locations along Kuskokwim river; sediment only)
5–6	Location number	01, 02, etc.	Consecutive number within area/location
7–8	Matrix	SD	Sediment
		SW	Surface water

Field duplicate samples for surface water and sediment samples will be identified by selecting a unique location number not used for the regular sample or any subsequent samples. All surface water and sediment samples will be cross-referenced in the field logbooks and in the sample master database to sample locations.

Example sample codes for surface water and sediment:

- 10RD06SW – The regular surface water sample collected from the sixth surface water/sediment sampling station in Red Devil Creek.
- 10RD06SD – The regular surface sediment sample collected from the sixth surface water/sediment sampling station in Red Devil Creek.
- 10RD20SW – The field duplicate surface water sample collected from the sixth surface water/sediment sampling station in Red Devil Creek.
- 10RD20SD – The field duplicate surface sediment sample collected from the sixth surface water/sediment sampling station in Red Devil Creek.

4

Sampling and other Field Procedures

This chapter describes the procedures and equipment to be used in the collection of samples and collection of observations during the 2010 field activities. E & E SOPs are referred to in this chapter and subsequent chapters. A copy of all applicable E & E SOPs will be on site during the implementation of the 2010 field work.

All surface water and groundwater sampling conducted for the 2010 field event will be conducted using ultraclean sampling methods (EPA Method 1669). In summary, ultraclean sampling methods involve the following procedures:

- Sampling equipment and containers are obtained from the laboratory that have been cleaned using detergent, mineral acids, and reagent water, filled with weak acid solution, and individually double bagged for storage and shipment.
- On site, one member of the two-person sampling team is designated as “dirty hands”; the second member is designated as “clean hands.” All operations involving contact with the sample container and transfer of the sample from the sample collection device to the sample container are handled by the individual designated as “clean hands.”
- A new pair of 8-mile nitrile gloves will be worn during each sample collection.
- All sampling equipment and sample containers used will be non-metallic and free from any material that may contain metals.
- Sampling personnel will wear clean, non-talc gloves when handling sampling equipment and sample containers.
- Surface water samples will be collected facing upstream and upwind (when possible) to minimize introduction of contamination.
- Acid preservatives will be placed in sample containers in a clean area prior to sample collection.

4.1 Surface Soil Characterization

Surface soil samples will be collected for laboratory analysis at all soil boring locations and additional locations as described in Section 2. Field screening for total metals using an XRF will be performed at each of these locations in addition to the field screening locations to delineate the areal extent of tailings. Specific procedures to perform these activities are described below.

4.1.1 Surface Visual Inspection

The areal extent of tailings will be delineated using visual observations and field screening for total metals using a portable XRF. As detailed in Chapter 2, based on a review of historical aerial and other photographs and reports, the extent of tailings has historically included much of the Main Processing Area, the bed, banks, and adjacent alluvial deposits of Red Devil Creek, and the delta of Red Devil Creek in the Kuskokwim River.

Review of recent photographs indicates that some of the areas where tailings have historically been located still likely have tailings at the surface. At other locations, tailings may have been redistributed, covered by soil, and/or vegetated.

The visual inspection to delineate the areal extent of tailings will be performed in conjunction with XFR field screening for total metals. At each inspection location, any vegetation and organic detritus will be removed with a trowel or shovel to expose underlying tailings or mineral soil. Observations of the soil will be recorded in the field logbook, and will include:

- Soil type
- United Soil Classification System (USCS) soil group classification
- Color
- Odor
- Grain size range and distribution
- Soil particle mineralogy and lithology (e.g., greywacke or argillite of Kuskokwim group)
- Stratigraphy
- Plasticity
- Moisture content
- Observations of gross contamination, including sheen or staining and elemental mercury
- Mineralization, including sulfides (e.g., cinnabar, stibnite, and realgar, orpiment) and iron staining
- Observations of non-native materials (e.g., brick, wood, metal or other debris)

4.1.2 In Situ XRF Field Screening

At each field screening location that will be evaluated for the presence of tailings, the XRF will be used to field screen surface soils in-situ. Samples will not be extracted from the sampling station or containerized. The XRF readings of the key metals (Hg, As, and Sb) will be recorded in the field logbook. XRF concentrations of these and other metals analyzed also will be recorded digitally by the XRF units. A rented Innov-X Alpha 4000 and/or BLM-owned Niton XL3t XRF device will be used. Operation of the XRF units will be in accordance with manufacturer specifications and the XRF Standard Operating Procedure (SOP). A copy of the XRF SOP is attached at the end of this plan. The lateral coordinates of the field screening location will be recorded using GPS instrumentation.

4.1.3 Surface Soil Sampling for Laboratory Analysis

Surface soil samples for laboratory analysis will be collected from 0 to 6 inches below ground surface at each sample location. Large rocks, cobbles, and organic detritus will be removed from the sampling site prior to sample collection.

The sample will be collected by excavating a hole to a depth of 6 inches below the ground surface after surficial detritus has been removed. The sampling team will excavate each hole with a dedicated durable plastic scoop, if possible. It is anticipated that, at some sample locations, the targeted soil material may be too coarse and/or compacted to effectively excavate the hole with a plastic scoop. In the event that it is not possible or practical to excavate a hole with the plastic scoop, a clean stainless steel trowel and/or rock hammer pick will be used to excavate a ‘pilot hole’ to 6 inches below the surface. Subsequently, a dedicated durable plastic scoop will be used to remove the soil from the surface of the sidewall of the ‘pilot hole’ (by prying and undermining) that may have been in contact with the trowel or rock hammer pick. This material will be discarded. A dedicated durable plastic scoop will then be used to collect sample material from the newly exposed sidewall of the ‘pilot hole’ (by prying and undermining) from 0 to 6 inches below the surface. Collection of sample material for various laboratory analyses will be performed as described below.

For those sample locations where the sample may be selected for mercury SSE analysis (see Table 2-1), an aliquot of the soil for mercury SSE analysis will be collected by placing sample material directly into the appropriate sample container. The material will be placed directly into the container without homogenizing, thereby reducing potential volatilization of any elemental mercury that could be present in the material.

Sample material for other inorganic analyses will be placed into a clean dedicated re-sealable plastic bag. The bag will be sealed and the material will be homogenized by working the material manually within the sealed bag. This material will subsequently be field screened with an XRF by testing the soil material directly through the bag. XRF field screening will be performed in accordance with the XRF SOP. XRF field screening results will be recorded and used for the selection of samples for additional laboratory analyses as indicated in Table 2-1. Material for these analyses will be transferred from the plastic bag into the appropriate pre-cleaned sample containers using a dedicated plastic scoop.

For those sample locations selected for analysis for DRO, RRO, and SVOCs, following collection of material for all the inorganic analyses, sample material will be collected with a dedicated stainless steel spoon and placed into a dedicated stainless steel bowl and thoroughly homogenized. The homogenized material will be placed into the appropriate pre-cleaned sample containers.

Sample locations will be recorded with a GPS unit and marked with survey flagging.

4.2 Subsurface Soil Sampling

Subsurface soil samples will be collected from soil borings installed during the RI/FS. No subsurface soil sampling will be conducted during the 2010 field event; it is expected that subsurface soil sampling will be performed during the 2011 RI/FS field event. The proposed subsurface soil sampling program will be described under separate cover.

4.3 Monitoring Well Installation, Construction, and Development

Groundwater samples will be collected for laboratory analyses during the RI/FS from existing and new monitoring wells. No new monitoring wells will be installed during the 2010 field event; it is expected that installation and sampling of new monitoring wells will be performed during the 2011 RI/FS field event. The proposed 2011 monitoring well installation program will be described under separate cover.

4.4 Groundwater Sampling

During the 2010 sampling event, groundwater samples will be collected from all existing monitoring wells within the Main Processing Area. To the extent practicable, groundwater sampling will occur in a progression from the least to the most contaminated wells, based on existing groundwater sample data.

Prior to sample collection, each well will be sounded with a decontaminated electronic water level meter to determine the static water level, measured to the nearest 0.01 feet. The water level measurements will be used to determine groundwater elevation and to estimate the standing water volume contained within the well. The measurement will also be used to determine the depth of the pump intake and to monitor water drawdown during low-flow purging and sampling, as described below.

If feasible, each well will be purged and sampled using a low-flow purging and sampling technique following the United States Environmental Protection Agency’s (EPA’s) Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures, EPA/540/S-95/504, dated April 1996. A battery-operated peristaltic pump outfitted with dedicated Teflon-lined tubing will be used to purge and sample the monitoring wells. The tubing will be lowered into the well to the targeted sample point at the middle of the water column within the screen interval. The well will be purged at a target rate of less than 0.5 liter/minute. During purging, the water level will be monitored with the water level indicator to measure well drawdown and to guide the adjustment of purge rate to minimize drawdown while purging. The sampling team will attempt to maintain less than 0.1 meter of drawdown during purging.

During purging, field water quality parameters, including pH, temperature, specific conductance, oxidation-reduction potential, dissolved oxygen, and turbidity, will be measured to determine when stabilization of the groundwater is achieved. Water quality parameters will be measured using an in-line water quality meter (e.g., Horiba U50 or similar equipment) and recorded in the field logbook. Field parameters will be measured every 3 to 5 minutes during purging. Field parameters will be considered stabilized after all parameters have stabilized for three successive readings. Criteria for stabilization are three successive readings within the following limits:

- pH: ±0.1 pH units
- Temperature: ±1 degree Celsius (°C)
- Conductivity: ±3%
- Turbidity: ±10%
- Dissolved oxygen: ±10%

Upon stabilization of field parameters, groundwater samples will be collected directly into the appropriate (pre-preserved, as applicable) sample containers. Dissolved metals aliquots will be collected following collection of the other aliquots using a dedicated in-line 0.45-micrometer filter. The filter will be inserted into the end of the sample tubing while the pump is still running in order to maintain a steady flow of water, minimizing potential disturbance of formation groundwater. Following installation of the filter, the dissolved water aliquot will be collected directly into the appropriate sample container.

The use of peristaltic pumps to collect groundwater samples is limited by the ability of peristaltic pumps to draw water from depths of greater than approximately 25 feet. If it is not possible to collect a groundwater sample from a given well using a peristaltic pump, the sampling team will attempt to use a decontaminated positive pressure pump (e.g., Grundfos Redi-Flo or similar pump) to purge and sample the well using low-flow techniques. If neither of these approaches is successful at a given well, the well will be purged and sampled with a clean, disposable Teflon-lined polyethylene bailer. For wells that are not sampled using low-flow techniques, each well will be purged of a minimum of three well volumes prior to sample collection. During purging, field water quality parameters will measured as described above. It may not be possible to achieve the stabilization criteria outlined above using a bailer to purge the well. In this case, sample collection will occur after six well volumes have been purged from the well. Samples collected by bailer will be poured directly into the appropriate pre-cleaned sample containers. Dissolved metals samples will be collected by pouring water from the bailer into a dedicated transfer container and pumping the water into the sample container using a peristaltic pump outfitted with dedicated tubing and in-line 0.45-micrometer filter.

For those wells sampled for BTEX, if a positive pressure pump is not used to purge and sample the well, the aliquot for BTEX will be collected with a bailer following collection of all other aliquots.

4.5 Surface Water Sampling

At each surface water and sediment sampling location, the surface water sample will be collected prior to the sediment sample. Surface water samples from Red Devil Creek will be collected first from near the confluence of Red Devil Creek and the Kuskokwim River. Sampling will proceed upstream to avoid disturbing sediments that could impact turbidity and contaminant concentrations in downstream locations.

Samples will be collected using a battery-operated peristaltic pump outfitted with dedicated silicone tubing. The water sample will be collected from a single location within the middle of the stream channel at the mid-depth water level. Dissolved metals aliquots will be collected following collection of the other aliquots using a dedicated in-line 0.45-micrometer filter.

In the event that it is not possible to collect the water samples using a peristaltic pump, the samples will be collected by hand-dipping the sample container directly into the creek water or. For sample containers that have been pre-preserved, a separate dedicated bottle may be used as a transfer container.

Following sample collection at each location, field parameters for pH, temperature, specific conductance, oxidation-reduction potential, dissolved oxygen, and turbidity will be measured using a water quality meter and recorded in the field logbook.

4.6 Sediment Sampling

For those locations where both a surface water sample and a sediment sample are planned, following collection of the surface water sample the sediment sample will be collected. Sediment samples will be collected from the most downstream locations first, with work progressing upstream to avoid disturbing sediments that could impact downstream sample locations. Accordingly, the following sequence for sediment samples will be followed:

- Collect most down-river sample on Kuskokwim River first
- Collect Kuskokwim River samples sequentially, moving up-river to Red Devil Creek
- Collect Kuskokwim River sample up-river of Red Devil Creek
- Collect Red Devil Creek sample near confluence of Kuskokwim River
- Collect Red Devil Creek samples sequentially, moving upstream to the background sample location

Sediment sample locations illustrated in Figures 2-6 and 2-7 are approximate locations. Actual sample locations will be established in sediment depositional areas where fine-grained material is expected to accumulate. Areas containing a rocky substrate will be avoided. All sediment samples will be collected from below the water line.

Sediment samples will be collected from the top 10 centimeters (0 to 4 inches) of the bed sediments. Any organic debris that may be present will be removed from the sampling location prior to sample collection. The aliquot of sediment collected for laboratory analysis for mercury SSE will be placed directly into the sample container using a dedicated plastic scoop. This material will not be homogenized, thus reducing potential volatilization of any elemental mercury that could be present in the sediment material. Sediment to be analyzed for the other laboratory analyses will be placed into a dedicated plastic bowl using a dedicated plastic scoop. The collected sediment will be thoroughly homogenized, and placed into pre-cleaned sample containers.

At each sediment sample location, physical characteristics of the sediment material will be observed and recorded. Specific characteristics that will be documented are:

- Color
- Odor
- Grain size range and distribution
- Sediment particle mineralogy and lithology (e.g., greywacke or argillite of Kuskokwim group)
- Stratigraphy
- Observations of gross contamination, including sheen or staining and elemental mercury
- Mineralization, including sulfides (e.g., cinnabar, stibnite, and realgar, orpiment) and iron staining
- Observations of non-native materials (e.g., brick, wood, metal or other debris)

5

Sample Analytical Methods

Sample analytical methods, including holding times and method detection limits, are presented in the QAPP (Appendix C of the draft RI/FS Work Plan). For reference, Table 5-1 summarizes the sample analytical methods.

Table 5-1 Summary of Sample Analytical Methods

Subgroup	Analyte	Analytical Method
	Matrix: Soil/Sediment	
Analytical Group: Metals		
Total Metals	Mercury	EPA 7471A
	Mercury (low level)	EPA 1631
	Aluminum	EPA 6010B
	Antimony	EPA 6020A (mass=121)
		EPA 6020A (mass=123)
	Arsenic	EPA 6010B
	Barium	EPA 6020A (mass=135)
		EPA 6020A (mass=137)
	Beryllium	EPA 6020A
	Cadmium	EPA 6020A (mass=111)
		EPA 6020A (mass=114)
	Calcium	EPA 6010B
	Chromium	EPA 6020A (mass=52)
		EPA 6020A (mass=53)
	Cobalt	EPA 6020A
	Copper	EPA 6020A (mass=63)
		EPA 6020A (mass=65)
	Iron	EPA 6010B (mass=54)
		EPA 6010B (mass=57)
	Lead	EPA 6010B
	Magnesium	EPA 6010B
	Manganese	EPA 6020A
	Nickel	EPA 6020A (mass=60)
		EPA 6020A (mass=62)
	Potassium	EPA 6010B
	Selenium	EPA 6020A (mass=82)
		EPA 6020A (mass=78)
	Silver	EPA 6020A
	Sodium	EPA 6010B
	Thallium	EPA 6020A
	Vanadium	EPA 6020A
	Zinc	EPA 6020A (mass=66)
		EPA 6020A (mass=67)
		EPA 6020A (mass=68)
Methyl Mercury	Methyl Mercury	EPA 1630, modified
Mercury Selective Sequential Extraction	Mercury	BRL SOP #BR-0013; Hg 5-step SSE and (www.epa.gov/esd/pdf-ecb/542asd95.pdf)
Arsenic Species	Arsenic Species	EPA 1632, modified As (inorganic)
		EPA 1632, modified As (III)
		EPA 1632, modified As (V)
SPLP Metals	TAL Metals	EPA 1312/6020A/7470A
TCLP Metals	Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, Silver	EPA 1311/6020A/7470A

Table 5-1 Summary of Sample Analytical Methods

▪ Subgroup	▪ Analyte	▪ Analytical Method
▪ ***Analytical Group: Petroleum***		
▪	▪ Diesel Range Organics	▪ AK 102
▪	▪ Residual Range Organics	▪ AK 103
▪	▪ Benzene	▪ EPA 8021B
▪	▪ Toluene	▪ EPA 8021B
▪	▪ Ethylbenzene	▪ EPA 8021B
▪	▪ m/p-Xylene	▪ EPA 8021B
▪	▪ o-Xylene	▪ EPA 8021B
▪		
▪ ***Analytical Group: Conventionals and Geotechnical Parameters***		
▪	▪ Particle Size/Atterberg Limits	▪ ASTM D2487
▪	▪ Total Organic Carbon (TOC) ▪ Moisture Content ▪ Permeability ▪ Compaction	▪ EPA 9060 modified ▪ ASTM D2216 ▪ ASTM D2434 ▪ ASTM D1557 ▪
▪ ***Analytical Group: SVOCs***		
▪	▪ SVOCs + TICs	▪ EPA 8270D
▪	▪	▪
▪ **Matrix: Groundwater/Surface Water**		
▪ ***Analytical Group: Metals***		
▪ **Total and Dissolved Metals**	▪ Total Mercury (low level)	▪ EPA 1631
▪	▪ Aluminum	▪ EPA 6020A
▪	▪ Antimony	▪ EPA 6020A (mass=121)
▪	▪	▪ EPA 6020A (mass=123)
▪	▪ Arsenic	▪ EPA 6020A
▪	▪ Barium	▪ EPA 6020A (mass=135)
▪	▪	▪ EPA 6020A (mass=137)
▪	▪ Beryllium	▪ EPA 6020A
▪	▪ Cadmium	▪ EPA 6020A (mass=111)
▪	▪	▪ EPA 6020A (mass=114)
▪	▪ Calcium	▪ EPA 6020A
▪	▪ Chromium	▪ EPA 6020A (mass=52)
▪	▪	▪ EPA 6020A (mass=53)
▪	▪ Cobalt	▪ EPA 6020A
▪	▪ Copper	▪ EPA 6020A (mass=63)
▪	▪	▪ EPA 6020A (mass=65)
▪	▪ Iron	▪ EPA 6020A (mass=54)
▪	▪	▪ EPA 6020A (mass=57)
▪	▪ Lead	▪ EPA 6020A
▪	▪ Magnesium	▪ EPA 6020A
▪	▪ Manganese	▪ EPA 6020A
▪	▪ Nickel	▪ EPA 6020A (mass=60)
▪	▪	▪ EPA 6020A (mass=62)
▪	▪ Potassium	▪ EPA 6020A
▪	▪ Selenium	▪ EPA 6020A (mass=82)
▪	▪	▪ EPA 6020A (mass=78)
▪	▪ Silver	▪ EPA 6020A
▪	▪ Sodium	▪ EPA 6020A

Table 5-1 Summary of Sample Analytical Methods

■ Subgroup	■ Analyte	■ Analytical Method
■	■ Thallium	■ EPA 6020A
■	■ Vanadium	■ EPA 6020A
■	■ Zinc	■ EPA 6020A (mass=66)
■	■	■ EPA 6020A (mass=67)
■	■	■ EPA 6020A (mass=68)
■ Methyl Mercury	■ Methyl Mercury	■ EPA 1630
■ Arsenic Speciation	■ Arsenic Species	■ EPA 1632, modified As (inorganic)
■	■	■ EPA 1632, modified As (III)
■	■	■ EPA 1632, modified As (V)
■		
■ ***Analytical Group: Petroleum***		
■	■ Diesel Range Organics	■ AK 102
■	■ Residual Range Organics	■ AK 103
■	■ Benzene	■ EPA 8021B (15.0 mL)
■	■	■ EPA 8021B (5.0 mL)
■	■ Toluene	■ EPA 8021B (15.0 mL)
■	■	■ EPA 8021B (5.0 mL)
■	■ Ethylbenzene	■ EPA 8021B (15.0 mL)
■	■	■ EPA 8021B (5.0 mL)
■	■ m/p-Xylene	■ EPA 8021B (15.0 mL)
■	■	■ EPA 8021B (5.0 mL)
■	■ o-Xylene	■ EPA 8021B (15.0 mL)
■	■	■ EPA 8021B (5.0 mL)
■ ***Analytical Group: SVOCs***		
■	■ SVOCs + TICs	■ EPA 8270D
■		
■ ***Analytical Group: Conventionals***		
■	■ Sulfate ■ Chloride ■ Fluoride ■ Nitrate/Nitrite ■ Alkalinity ■ Total Suspended Solids ■ Total Dissolved Solids	■ EPA 300.0 ■ EPA 300.0 ■ EPA 300.0 ■ EPA 353.2 ■ EPA 310.1 ■ EPA 160.1 ■ EPA160.2 ■

- Key:
- EPA = Environmental Protection Agency
- mL = milliliter
- SVOC = Semivolatile Organic Compounds
- SPLP = Synthetic Precipitation Leaching Procedure
- TCLP = Toxicity Characteristic Leaching Procedure
- TICs = Tentatively Identified Compounds

6

Sample Handling, Preservation, and Shipping

Transportation and handling of samples must be accomplished in a manner that not only protects their integrity but also prevents any detrimental unnecessary exposure to sample handlers due to the possibly hazardous nature of the samples.

6.1 Sample Documentation

6.1.1 Sample Labels

Sample labels attached to or fixed around the sample container will be used to identify all samples collected in the field. The sample labels will be placed on bottles so as not to obscure any quality assurance/quality control (QA/QC) lot numbers on the bottles, and sample information will be printed legibly. Field identification will be sufficient to enable cross-reference with the project logbook.

To minimize handling of sample containers, labels will be filled out before sample collection. Each sample label will be written in waterproof ink, attached firmly to the sample containers, and protected with Mylar tape. The sample label will contain the following information:

- Sample designation code
- Date and time of collection
- Analysis required
- pH and preservation (when applicable)

6.1.2 Custody Seals

Custody seals are preprinted, adhesive-backed seals with security slots designed to break if the seals are disturbed. Sample shipping containers (e.g., coolers) will be sealed in as many places as necessary to ensure security. Seals will be signed and dated before use. Upon the containers' arrival at the laboratory, the custodian will check (and certify by completing the package receipt log) that seals are intact.

6.1.3 Chain-of-Custody Records

The COC records will be completed fully, at least in duplicate, by the field technician designated by the site manager as responsible for sample shipment. Information in the COC record will contain the same level of detail found in the site logbook, except that the on-site measurement data will not be recorded. The custody record will include, among other things, the following information:

- Name and company or organization of person collecting the samples
- Date of sample collected
- Matrix of sample collected (soil/water)
- Location of sampling station (using the sample designation code system described in Chapter 3)
- Number and type of containers shipped
- Analysis requested
- Signature of the person relinquishing samples to the transporter, with the date and time of transfer noted, and signature of the designated sample custodian at the receiving facility

If samples require rapid laboratory turnaround, the person completing the COC record will note these or similar requirements in the remarks section of the custody record.

The relinquishing individual will record pertinent shipping data (e.g., air-bill number, organization, time, and date) on the original custody record, which will be transported with the samples to the laboratory and retained in the laboratory's file. Original and duplicate custody records with the air bill or delivery note constitute a complete custody record. The field team leader will ensure that all records are consistent and that they are made part of the permanent job file.

6.1.4 Field Logbooks and Data Forms

Field logbooks (or daily logs) and data forms are necessary to document daily activities and observations. Documentation will be sufficient to enable reconstruction of events that occurred during the project accurately and objectively at a later time. All daily logs will be kept in a bound notebook containing numbered pages, and all entries will be made in waterproof ink, dated, and signed. No pages will be removed for any reason.

Minimum logbook content requirements are described in E & E's SOPs, *Preparation of Field Activities Logbooks*, a copy of which will be kept on site during the field activities. If corrections are necessary, they will be made by drawing a single line through the original entry (so that the original entry is still legible) and writing the corrected entry alongside it. The correction will be initialed and dated. Corrected errors may require a footnote explaining the correction.

6.1.5 Photographs

Photographs will be taken as directed by the team leader. Documentation of a photograph is crucial to ensure its validity as a representation of an existing situation.

The following information on photographs will be noted in field logbooks:

- Date, time, and location photograph was taken
- Weather conditions
- Description of photograph
- Reasons photograph was taken
- Sequential number of photograph
- Direction

After the photographs are processed, the information recorded in the field logbook will be summarized in captions in the digital photo log.

6.1.6 Custody Procedures

The primary objective of COC procedures is to provide an accurate written or computerized record that can be used to trace the possession and handling of a sample from collection to completion of all required analyses. A sample is considered to be in custody if it is:

- In someone’s physical possession
- In someone’s view
- Locked up
- Kept in a secured area that allows authorized personnel only

6.1.6.1 Field Custody Procedures

The following guidance will be used to properly control samples during fieldwork:

- As few people as possible will handle samples
- Coolers or boxes containing cleaned bottles will be sealed with custody tape during transport to the field or while in storage before use. Sample bottles from unsealed coolers or boxes, or bottles that appear to have been tampered with, will not be used
- The sample collector will be responsible for the care and custody of samples until they are transferred to another person or dispatched properly under COC rules
- The sample collector will record sample data in the field logbook
- The site team leader will determine whether proper custody procedures were followed during the fieldwork and decide whether additional samples are required

When custody is transferred (e.g., samples are released to a shipping agent), the following will apply:

- The coolers in which the samples are packed will be sealed and accompanied by two COC records. When transferring samples, the individuals relinquishing and receiving them must sign, date, and note the time on the COC record. This record documents sample custody transfer.
- Samples will be dispatched to the laboratory for analysis with separate COC records accompanying each shipment. Shipping containers will be sealed with custody seals for shipment to the laboratory. The method of shipment, name of courier, and other pertinent information will be entered in the COC record.
- All shipments will be accompanied by COC records identifying their contents. The original record will accompany the shipment. The other copies will be distributed appropriately to the site team leader and site manager.
- If samples are sent by common carrier, a bill of lading will be used. Freight bills and bills of lading will be retained as part of the permanent documentation.

6.1.6.2 Laboratory Custody Procedures

A designated sample custodian at the laboratory will accept custody of the shipped samples from the carrier and enter preliminary information about the package into a package or sample receipt log, including the initials of the person delivering the package and the status of the custody seals on the coolers (e.g., broken versus unbroken). Additional details on laboratory custody procedures are found in the QAPP.

6.2 Sample Containers and Preservation

Sample aliquots submitted to the analytical laboratories will be placed in commercial certified pre-cleaned sample containers and preserved as identified in Table 6-1.

6.3 Sample Shipping

Due to the remote location of the RDM site, sample shipment to the analytical laboratories will require careful logistical planning to ensure sample holding times are not exceeded and that samples arrive at the laboratories in good condition. In general, sample shipping logistics will involve the following:

- The field team leader will keep records of sample collection dates. Based on the dates of samples being held on site and the number of samples ready for shipment, the field team leader will contact E & E’s Anchorage-based sample custodian to notify an aircraft charter service that a sample shipment flight is needed.
- When the sample shipment aircraft arrives at the Red Devil airstrip, the field team leader will relinquish custody of the samples to the pilot.

- When the sample shipment aircraft arrives in Anchorage, E & E’s Anchorage-based sample custodian will assume custody of the samples. The custodian will re-pack all sample shipping containers with fresh ice and relinquish custody of the samples to an overnight delivery service that will ship the samples to the analytical laboratories.
- E & E’s Anchorage-based sample custodian will confirm with the laboratories that all shipped samples have been received.

Table 6-1 Sample Containers and Preservation

Matrix	Analysis	Maximum Holding Time	Preservation	Sample Containers
Soil/Sediment	TAL Inorganic Elements	6 months (28 days for Hg)	None, 0–4°C	4-oz glass jar
	Methyl Mercury	1 year (if aliquoted, weighed, and frozen ≤ –15°C at lab)	None, 0–4°C (shipment), ≤ –15°C (in lab)	4-oz glass jar
	Low-Level As, Sb, Pb, Hg	6 months (1 year for Low-Level Hg)	None, 0–4°C (None, 0–4°C (shipment), ≤ –15°C (in lab) for Low Level Hg)	4-oz glass jar
	SPLP Metals	6 months	None, 0–4°C	8-oz glass jar
	Mercury SSE	1 year	None, 0–4°C (shipment), ≤ –15°C (in lab)	4-oz glass jar
	Arsenic Speciation	1 year	None, 0–4°C (shipment), ≤ –15°C (in lab)	4-oz glass jar
	TCLP Metals	6 months (28 days for Hg)	None, 0–4°C	8-oz glass jar
	ASTM D2487, Particle Size and determination of Atterberg Limits	None	None	5-gallon bucket
	ASTM D2216 (Moisture Content)	10 days	None, 0–4°C	4-oz glass jar
	ASTM D3080 (Direct Shear Test)	None	None	5-gallon bucket
	ASTM D1557 (Compaction/Modified Proctor Test)	None	None	5-gallon bucket
	ASTM D2434 (Permeability)	None	None	5-gallon bucket
	DRO/RRO (AK102/103)	14 days to extraction, 40 days from extraction to analysis	Cool to < 6°C or freeze to < -18°C.	8 oz. glass jar with Teflon-lined lid
	SVOCs with TICs	14 days to extraction, 40 days from extraction to analysis	Cool to < 6°C or freeze to < -18°C.	8 oz. glass jar with Teflon-lined lid
Water	Total TAL Inorganic Elements	6 months (28 days for Hg)	HNO_3, pH<2, 0–4°C	500-mL plastic bottle
	Dissolved TAL Inorganic Elements	6 months	HNO_3, pH<2, 0–4°C	500-mL plastic bottle
	Methyl Mercury	6 months	0–4°C and dark immediately; HCl, pH<2	250-mL pre-tested fluoropolymer or glass bottle w/fluoropolymer-lined lids (no extra volume needed for MS/MSD)
	Dissolved Low-Level As, Sb, Pb, Hg	6 months (90 days for Low-Level Hg)	HNO_3, pH<2, 0–4°C (BrCl in lab within 28 days of collection for low-level Hg)	500-mL (for MS/MSD sample) or 250-mL plastic bottle; pre-tested fluoropolymer or glass bottle w/fluoropolymer-lined lids

Table 6-1 Sample Containers and Preservation

Matrix	Analysis	Maximum Holding Time	Preservation	Sample Containers
	Arsenic Speciation	28 days	0–4°C and dark immediately; HCl, pH<2	250-mL pre-tested fluoropolymer or glass bottle w/fluoropolymer-lined lids (no extra volume needed for MS/MSD)
	DRO/RRO	7 days for extraction, 40 days after extraction for analysis	None, 0–4°C	1-L amber bottle
	SVOCs with TICs	7 days for extraction, 40 days after extraction for analysis	None, 0–4°C	1-L amber bottle
	GRO and BTEX	14 days preserved, 7 days unpreserved.	HCl to pH <2, cool to 6°C	Four 40-mL amber glass vials, no headspace
	Total suspended solids	7 days	Cool to 6°C	1000 mL HDPE
	Total dissolved solids	7 days	Cool to 6°C	1000 mL HDPE
	Nitrate/Nitrite	28 days	2 mL H_2SO_4 perliter. Cool to 6°C	500 mL or 1-L HDPE
	Alkalinity	14 days	Cool to 6°C	500 mL HDPE

Key:

C	degrees Celsius
s	arsenic
STM	American Society for Testing and Materials
r	bromine
l	chlorine
RO/RRO	diesel range organics/residual range organics
Cl	hydrochloric acid
g	mercury
DPE	high density polyethylene
NO_3	nitric acid
$_2SO_4$	sulfuric acid
	liter
L	milliliter
S/MSD	matrix spike/matrix spike duplicate
)	lead
)	antimony
PLP	synthetic precipitation leaching procedure
SE	selective sequential extraction
VOC	semivolatile organic compound
AL	target analyte list
CLP	toxicity characteristic leaching procedure
IC	tentatively identified compound

6.3.1 Sample Packaging

Samples will be packaged carefully to avoid breakage or contamination and will be shipped to the laboratory at proper temperatures. The following sample package requirements will be followed:

- Sample bottle lids must never be mixed. All sample lids must stay with the original containers
- The sample volume level may be marked by placing the edge of the label at the appropriate sample height or by using a grease pencil. This will help the laboratory determine whether any leakage occurred during shipment. The label should not cover any bottle preparation QA/QC lot numbers
- All sample bottles will be placed in a plastic bag to minimize leakage in case a bottle breaks during shipment
- The samples will be cooled by placing on ice in sealed plastic bags. Ice is not to be used as a substitute for packing materials
- Any remaining space in the sample shipping container should be filled with inert packing material. Under no circumstances should material such as sawdust, newspaper, or sand be used
- The custody record must be sealed in a plastic bag and placed in the shipping container. Custody seals must be affixed to the sample cooler

6.3.2 Shipping Containers

The appropriate shipping container will be determined by Department of Transportation (DOT) or International Air Transportation Association (IATA) regulations for the anticipated level of suspected contaminants. For the RDM 2010 field event, it is anticipated that all sample shipping containers will be commercially available coolers.

Shipping containers will be custody-sealed for shipment as appropriate. The custody seals will be affixed so that access to the container can be gained only by breaking a seal.

Field personnel will arrange transportation of samples to the laboratory. When custody is relinquished to a shipper, field personnel will inform the laboratory sample custodian by telephone of the expected arrival time of the sample shipment and advise him or her of any time constraints on sample analysis.

Suggested guidelines for marking and labeling shipping containers are presented below. In all cases, DOT or IATA regulations will be consulted for appropriate marking and labeling requirements, which include the following:

- Use abbreviations only where specified.

- The words “This End Up” or “This Side Up” must be printed clearly on the top of the outer package. Upward-pointing arrows should be placed on the sides of the package.
- After a shipping container is sealed, two COC seals must be placed on the container, one on the front and one on the back. To protect the seals from accidental damage, clear strapping tape must be placed over them.

7

Decontamination and Management of Investigation-Derived Waste

7.1 Equipment Decontamination Procedures

Dedicated sampling equipment will be used to collect all surface soil, sediment, surface water, and groundwater samples. As indicated in Chapter 4, it may be necessary at some surface soil sample locations to use a stainless steel trowel and/or rock hammer pick to excavate a "pilot hole" as part of the surface soil sampling method. However, in such instances, none of the soil material that may come into contact with the trowel and/or rock hammer pick will be sampled or contacted with the dedicated scoop used to collect the sample. Any material that may be contacted by the trowel or rock hammer pick will be discarded. The sample will be collected using a dedicated plastic scoop or stainless steel spoon. The trowel and/or rock hammer will be cleaned between sample locations by removing visible dirt with a brush and/or wet paper towels.

7.2 Vehicle Decontamination Procedures

Vehicles will be used to facilitate completion of the field activities. During the 2010 field event, vehicle use at the site will be limited to all-terrain vehicles (ATVs) used to transport staff and equipment between Red Devil and the site. It is not expected that the planned use of the vehicles will result in significant contamination of the ATVs. In the event that the ATVs are subjected to significant contamination, they will be decontaminated by scrubbing with a brush and will be rinsing with potable water.

7.3 Investigation-Derived Waste Management

Investigation-derived waste (IDW) that is expected to be generated during the 2010 sampling event includes:

- Monitoring well purge water
- Used dedicated sampling equipment
- Non-dedicated sampling equipment decontamination fluids and used paper towels
- Used personal protective equipment, including gloves and booties

IDW will be managed in accordance with criteria established in the document, Management of Investigation-Derived Wastes During Site Inspections (EPA/540/G-91/009) and guidelines outlined in EPA guidance, Guide to Management of Investigation-Derived Wastes (OSWER Publication 9345.3-03FS).

Based on sample results from groundwater sampling performed at the site in 2009 (E & E 2010), it is expected that purge water generated during sampling of the existing monitoring wells during the 2010 field event would have concentrations of RCRA metals and benzene below the RCRA TCLP limits. As such, purge water from these wells will be disposed of onto the ground at the time of sampling. Disposal of this purge water will be conducted in the area of the well following completion of sampling by pouring slowly onto the ground surface in such a way that the water fully infiltrates into the ground without ponding and does not enter surface water. Disposal will also be conducted in such a way that it does not transport sediment to surface water.

Used dedicated sampling equipment and personal protective equipment will be rinsed if there is visible evidence of contamination, placed in sturdy plastic bags, and shipped off site at the conclusion of the field activities and disposed of at a sanitary landfill in Anchorage.

8

Surveying and Station Positioning

Horizontal coordinates of all tailings field delineation locations, sample locations, and monitoring wells will be surveyed using a mapping grade GPS device. In addition, the lateral extent of Monofill #3 and locations of important site features identified during the field event will be surveyed. Coordinates of planned sample locations will be determined prior to mobilization and programmed into the GPS units as waypoints to facilitate the navigation to planned sample locations.

Coordinates will be recorded using a Trimble GeoXT or GeoXH series or equivalent handheld GPS device. Anticipated horizontal accuracy will be contingent on conditions encountered in the field. GPS data will be differentially corrected as necessary to maximize accuracy. Post-processing of coordinate data may allow sub-meter horizontal accuracy to be achieved.

9

Deviations from the Field Sampling Plan

Deviations from the FSP are inevitable. Deviations may arise from changed field conditions, adjustment of sampling methods, inability to obtain samples from a planned location, and other circumstances. All deviations to the FSP will be carefully documented by the field team leader using the form presented in Figure 9-1. The nature and reason for FSP deviations will be documented in the 2010 sampling event summary report.

Red Devil Mine 2010 Limited Sampling Effort
FSP Deviation Documentation

Date:	Name:
Description of Problem:	
Location of Problem:	
Description of Deviation to Address Problem:	
Other Means Considered but Rejected to Address Problem:	

Figure 9-1 FSP Deviation Documentation Form

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10 References

Ecology and Environment, Inc. (E & E). 2010. Letter report regarding Groundwater and Surface Water Sampling at Red Devil Mine Site, Alaska, October 2009, submitted to Mr. Larry Beck, BLM, March 29, 2010.

MacKevett, E.M. and H.C. Berg. 1963. Geology of the Red Devil Quicksilver Mine, Alaska. Geological Survey Bulletin 1142-G.

Wilder Construction Company and Harding Lawson Associates (Wilder/HLA). 2001. Retort Building Demolition and Limited Site Investigation, Red Devil Mine, Red Devil, Alaska. Prepared for Department of the Interior, Bureau of Land Management, Denver, Colorado. March.

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Figures

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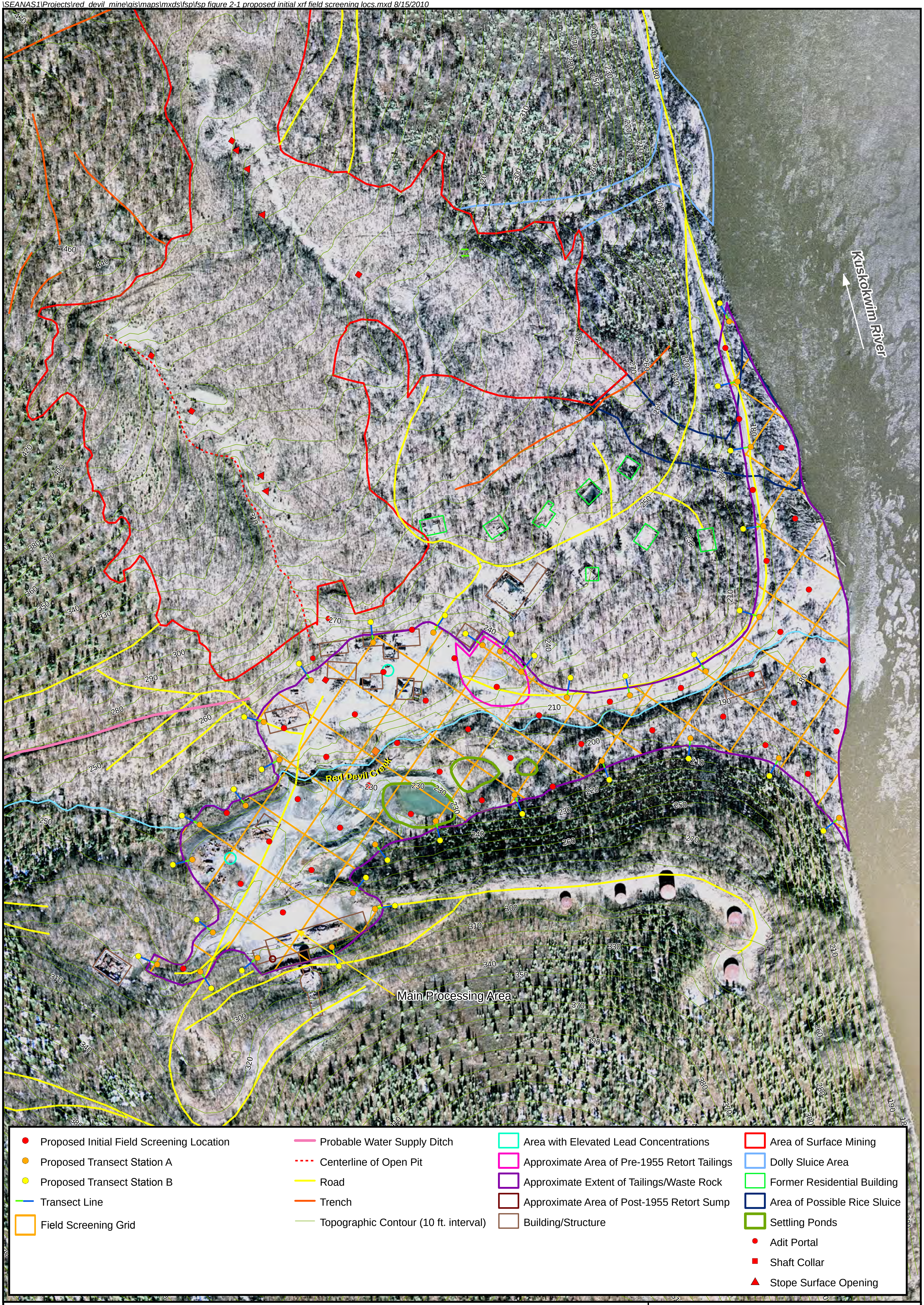
\SEASNAS1\Projects\red_devil_mine\gis\maps\mxds\fsp\fsp figure 2-1 proposed initial xrf field screening locs.mxd 8/15/2010



RED DEVIL MINE

Red Devil, Alaska

FSP Figure 2-1
Proposed XRF Initial Field Screening Locations

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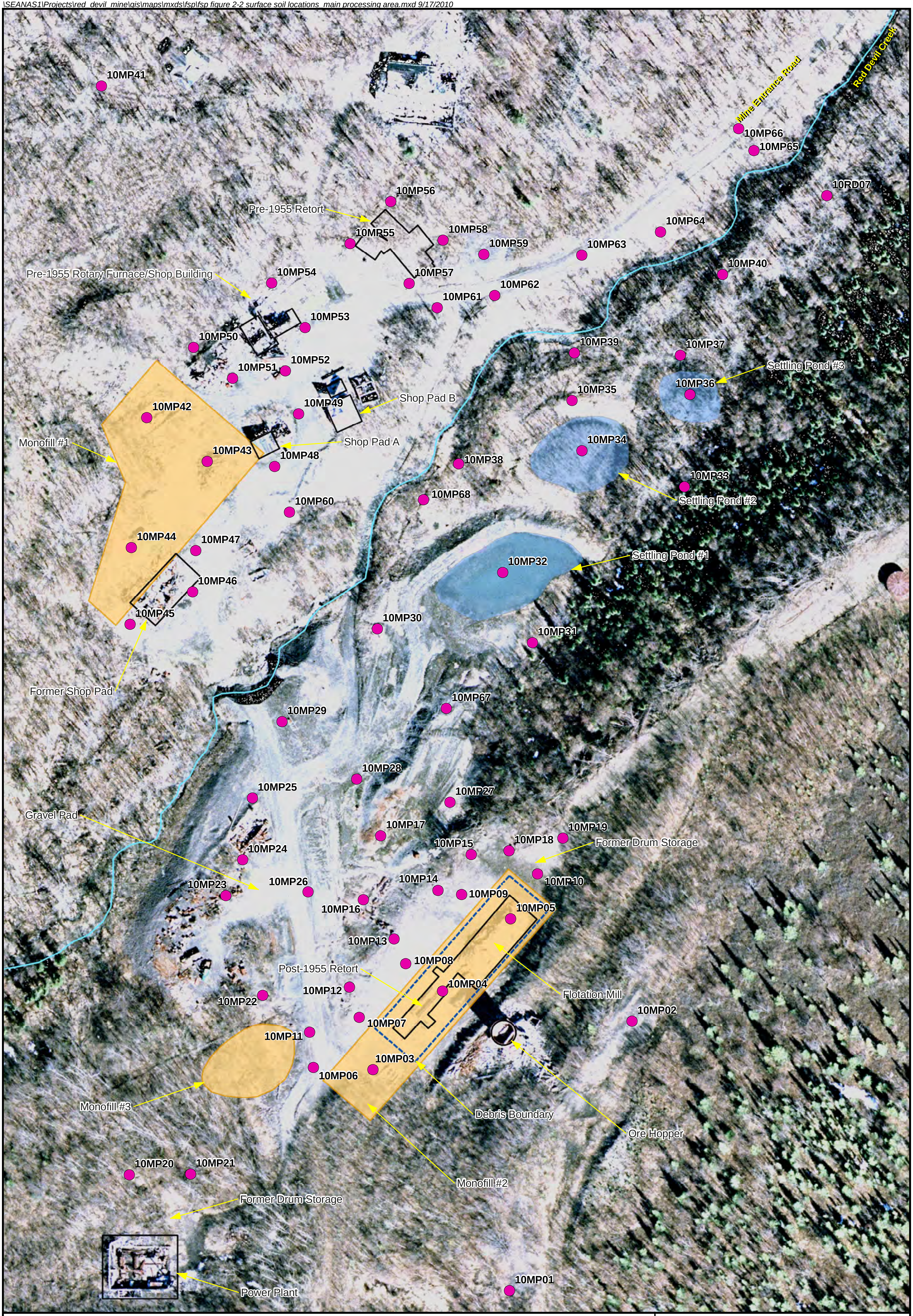
\SEANAS1\Projects\red_devil_mine\gis\maps\mxds\fsp\fsp figure 2-2 surface soil locations_main processing area.mxd 9/17/2010



● Proposed Surface Soil Sample Location
🟦 Settling Pond
🟧 Monofill
☐ Historical Structure

RED DEVIL MINE

Red Devil, Alaska

FSP Figure 2-2
Surface Soil Sample Locations Main Processing Area

0 25 50 100 150
Feet
0 5 10 20 30 40 50
Meters
Scale 1:1,000

N

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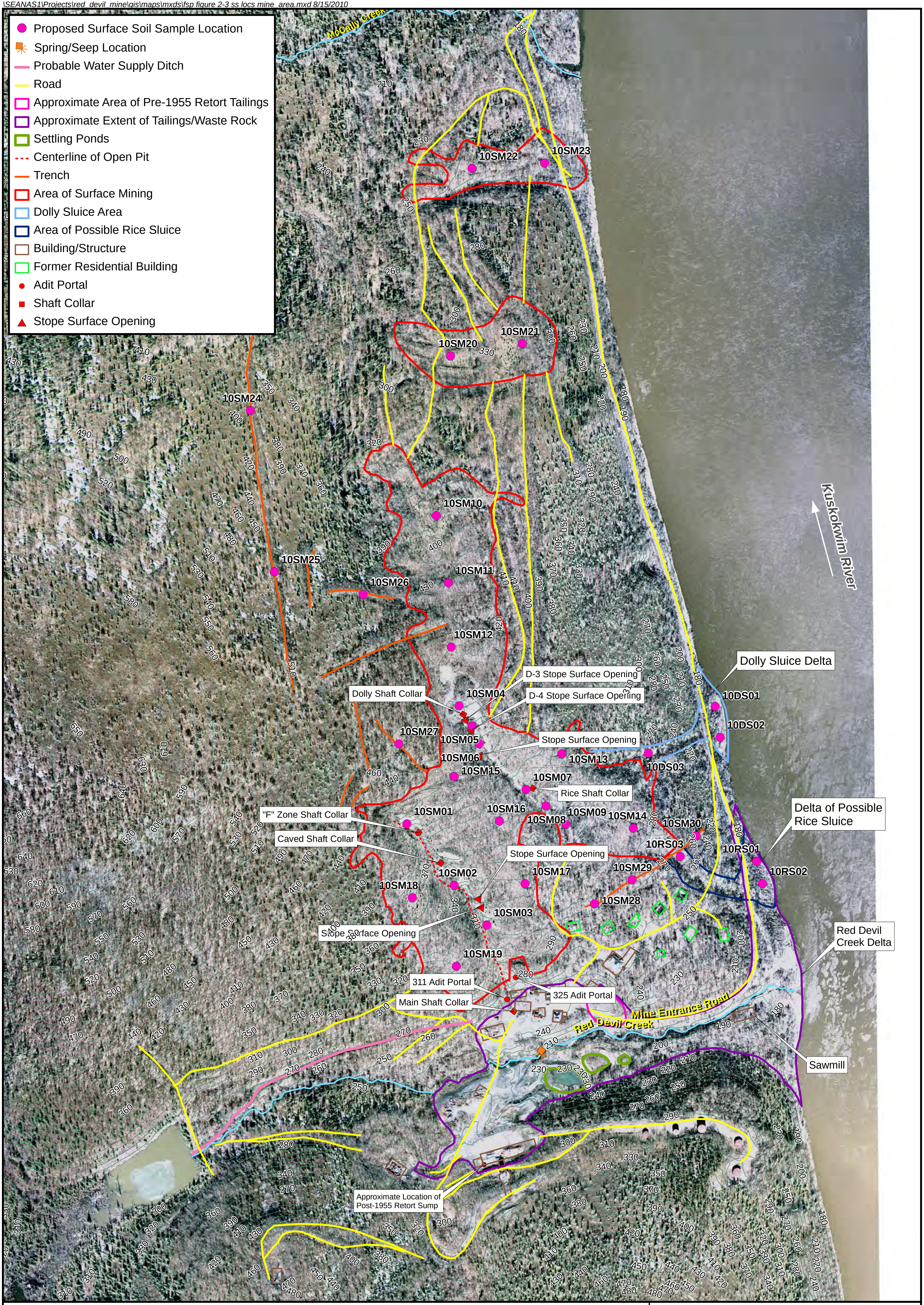
\SEANAS1\Projects\red_devil_mine\gis\maps\mxds\fsp figure 2-3 ss locs mine_area.mxd 8/15/2010



See Figure 1-3 for identification of Main Processing Area buildings/structures.

Aerial Photo Reference:
Aero-Metric, Inc., 5/29/2001.

Topographic Contour Reference:
Aero-Metric, Inc., 5/27/2010.

RED DEVIL MINE

Red Devil, Alaska

FSP Figure 2-3
Surface Soil Sample Locations Area of Surface Mining and Exploration

0 125 250 500 750
Feet
0 25 50 100 150 200
Meters
Scale 1:4,000

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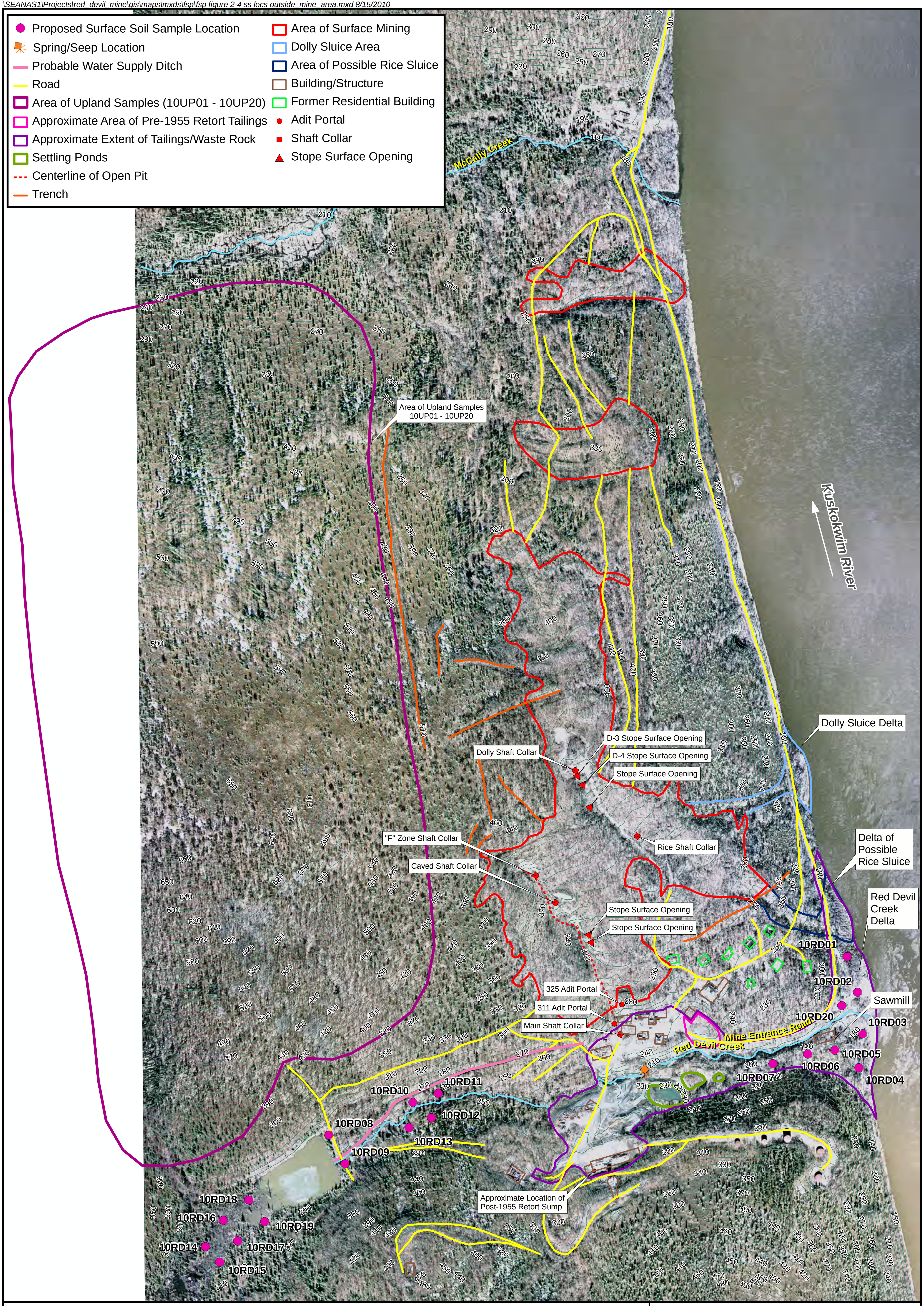

See Figure 1-3 for identification of Main Processing Area buildings/structures.

Aerial Photo Reference:
Aero-Metric, Inc., 5/29/2001.

Topographic Contour Reference:
Aero-Metric, Inc., 5/27/2010.

RED DEVIL MINE

Red Devil, Alaska

FSP Figure 2-4
Surface Soil Sample Locations Outside Main Processing Area and Area of Surface Mining and Exploration

0 130 260 520 780
Feet
0 30 60 120 180 240
Meters
Scale 1:4,500

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- ✦ Existing Monitoring Well Location
- — Topographic Contour (10 ft. interval)
- 🟦 Settling Pond
- 🟧 Monofill
- ☐ Historical Structure

RED DEVIL MINE

Red Devil, Alaska

FSP Figure 2-5
Monitoring Well Locations
Main Processing Area

0 25 50 100 150
Feet
0 5 10 20 30 40 50
Meters
Scale 1:1,000

N

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● RI/FS Surface Sediment and Surface Water Sample

✳ Seep Location

- - - Approximate Location of New Road (2010)

═ New Bridge Location (2010)

— Topographic Contour (10 ft. interval)

RED DEVIL MINE

Red Devil, Alaska

FSP Figure 2-6
Surface Sediment and Surface Water Sample Locations

0 45 90 180 270 360 450
Feet
0 25 50 100 150
Meters
Scale 1:2,800

N

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● River Surface Sediment Sample

RED DEVIL MINE

Red Devil, Alaska

FSP Figure 2-7
Kuskokwim River Sample Locations