MEMO

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Subject	Mount Nansen Remediation Project 2013 Site Investigation Plan – Rev 1		

1.0 INTRODUCTION

AMEC Environment and Infrastructure, in association with Associated Engineering, has been retained by the Yukon Government, Department of Energy, Mines and Resources - Assessment and Abandoned Mines (AAM) to carry out the detailed design of the Mount Nansen Remediation Project (MNRP). Early design tasks for the MNRP were authorized under Task Authorizations AMEC-001 and AMEC-002 and included the preparation of three memorandums: a data gap analysis, a site investigation (SI) plan to address the data gaps, and a Design Basis Memorandum (DBM) for design. These documents were intended as planning tools to identify the information considered necessary to support the design process and YESAA application.

The data gap memorandum and SI plan memorandum are closely related and the reader is encouraged to read these two documents together to provide a clear and consistent understanding of the project status. To that end, only the items identified in the data gap analysis as requiring specific site investigation actions for 2013 have been included herein and reference to the relevant data gap item is provided in the appended tables. Data Gap items that have been flagged for follow-up discussion without specific SI requirements for 2013 have not been tabulated herein.

2.0 DOCUMENT ORGANIZATION

The preliminary 2013 SI plan is broken down into the following disciplines:

Table 1.1: Geotechnical
Table 1.2: Hydrology
Table 1.3: Hydrogeology
Table 1.4: Surface Water Quality
Table 1.5: Infrastructure, Landforms and Revegetation
Table 1.6: Site Characterization

Tables 1.1 through 1.6 organize the data gap items by the identification numbers utilized in the data gap analysis in ascending order.

Proposed SI locations are shown on Figures 1 and 2; Figure 1 shows invasive investigations (i.e., drilling and test pitting) for geotechnical, hydrogeological and site characterization, while Figure 2 depicts sampling and surveying investigations for hydrological, surface water quality, and site characterization.

Table 1.7 provides an overall summary of the scope of the 2013 site investigation program regarding the executable field component (i.e., drilling, test pitting, surveying and sampling, etc.) to satisfy the various data gap items presented in the preceding tables. The outlined SI program is preliminary at this time and will be revisited once driller and other contractor pricing has been received and the total cost of the program is better defined. During detailed planning of the site investigation program, priorities will be established based on what information is most critical to the design process and which investigations will provide the greatest benefit with regards to reducing uncertainty. This will require that the purpose of each investigation location be well understood.

3.0 SUMMARY OF GEOTECHNICAL SITE INVESTIGATIONS

From the data gaps identified to date, the geotechnical SI plan for 2013 is comprised of the following key items:

- general site reconnaissance in tailings area (including the two dams and the tailings deposit), Open Pit, waste dump, mill site, camp site, potential borrow areas, and any areas along the access road where geotechnical input is required;
- site wide reconnaissance for geohazards;
- in-situ testing, sampling and installation of piezometers to characterize the tailings and, in select locations, advanced into underlying native materials to investigate the depth and thickness of permafrost soils;
- observation of tailings response to equipment traffic and excavation to characterize behaviour under truck and shovel relocation methods. Depending on the observed behaviour and the recommended relocation methods a larger trial may be part of a subsequent design phase or part of the project execution plan;
- test pitting to observe waste rock characteristics and provide samples for testing of finer grained portions. Geotechnical logging of boreholes drilled for geochemical characterization (see Section 8.0) will also be carried out mainly to confirm thickness of waste rock and foundation conditions;
- review of existing instrumentation and water levels with additional reads conducted as required;
- measurement of current thermal regime at the Open Pit including temperature measurements in existing wells and installation of new measurement wells;

- in conjunction with investigations required by other disciplines, geotechnical observation of drilling and test pitting within the waste rock area, dam fills, borrow areas, and other areas where site characterization will be completed (mill, roadways, etc.);
- general site reconnaissance around Open Pit as the currently preferred location for development of a new landfill if required;
- observation and mapping of pit walls and the potential abutment location at the south end of the pit;
- assessment of Pony Creek adit (and others as required); and
- test pitting in potential borrow areas inside and outside the site boundaries to characterize and delineate available material.

The key locations for the geotechnical SI plan are shown in the attached Figure 1.

4.0 SUMMARY OF HYDROLOGICAL SITE INVESTIGATIONS

From the data gaps identified to date, the hydrotechnical SI plan for 2013 comprises the following key items:

- general site reconnaissance during site visit including observations during the freshet;
- ground reconnaissance along the whole alignment of Dome Creek (including tailings and mill areas) and the section of Pony Creek close to the pit, during spring runoff:
  - identifying flow patterns and paths of the creeks (concentrated or braided flow);
  - estimation and measurement of flow at different locations; and
  - identification and estimation of groundwater discharge/springs and tributaries contributing to surface flow.
- sampling of bottom soils/sediments along Dome Creek upstream (500 m) and downstream (500 m) of the tailings impoundment area;
- detailed survey of the Dome Creek channel upstream (500 m) and downstream (500 m) of the tailings impoundment area; and
- identification of alluvial (if required) and riprap borrow areas.

The key locations for the hydrological SI plan are shown in the attached Figure 2.

5.0 SUMMARY OF HYDROGEOLOGICAL SITE INVESTIGATIONS

From the data gaps identified to date, the hydrogeological site investigation plan for 2013 will comprise the following key tasks:

- quantifying baseline groundwater pathways and quality below the Open Pit and hydraulically down gradient from Open Pit, i.e., northeast, southwest, south and southeast of Open Pit boundary;

- characterizing the connectivity of Open Pit adit(s) with respect to the pit containment integrity and the impact of lower elevation adits on implementation of Closure Option 4;
- identifying long-term Open Pit water levels for design of Closure Option 4, with the objective of minimizing contact between stored tailings and pond water at the bottom of the pit;
- quantifying groundwater-surface water interaction along Dome Creek, Pony Creek and Back Creek, to establish groundwater flow and quality components to overall surface water quality compliance;
- quantifying groundwater flow and quality in the uppermost area of the Dome Creek watershed and the influence of adit drainage (Huestis and Webber Deposit areas, as applicable to OIC boundary); and
- decommissioning the former water supply well(s) at Victoria Creek.

The key locations for the hydrogeological SI plan are shown in the attached Figure 2.

6.0 SUMMARY OF SURFACE WATER QUALITY SITE INVESTIGATIONS

From the data gaps identified to date, the surface water quality SI plan for 2013 is comprised of the following key items:

- area reconnaissance of the tailings storage area, water ponds, Open Pit, waste rock area, mill site, camp site, and potential borrow areas looking for surface and subsurface seepage towards streams and intermittent flow passes;
- site wide water quality reconnaissance for spatial heterogeneity of water chemistry in streams and ponds;
- in-situ testing and sampling to characterize the water quality in pit lake, adit drainage, tailings seepage and ponds as well as adjacent streams;
- flow measurements at water quality sampling sites during sampling (coordinated with the Hydrology programs outlined in Section 4.0); and
- check of drainage pattern and comparison with existing watersheds delineation.

The key locations for the surface water quality site investigation will be determined after a reconnaissance has been completed during the April kickoff meeting.

Note that the adequacy of the existing water quality monitoring program being executed by Environmental Dynamics Inc. (EDI) with respect to the data gap analysis will be reviewed and considered in the finalization of the SI program scope.

7.0 SUMMARY OF INFRASTRUCTURE, LANDFORMS AND REVEGETATION SITE INVESTIGATIONS

From the data gaps identified to date, the infrastructure SI plan for 2013 is comprised of the following key items:

- site assessments ("ground truthing") and inventories for:
  - landforms: this will include taking a photo inventory of the site and surrounding lands, documenting the macro strikes and dips of valleys and mountains as well as micro landform such as stream banks, ravines, and gullies;
  - borrow requirements: observation of site conditions to identify grading and other borrow needs for common fill, riprap, granular material, and topsoil. Quantification of the amount of borrow needed will be as part of the design stage and will be an iterative process based on what materials are available. Borrow investigations, with the exception of topsoil, will be undertaken by the Geotechnical discipline;
  - underground utilities: such as waterlines, storage and septic tanks, pipelines;
  - building and infrastructure: such as mill buildings, bunkhouse, power lines;
  - clearings and trenches;
  - drainage structures: such as existing culverts and bridges; and
  - vegetation: surveys to determine plant community types and species lists within those community types.

The site investigation requirements will largely comprise site visits to make detailed observation of the existing conditions. Through detailed observation and measurement where required, inventories of the materials and structures on-site will be created that will allow the type and amount of demolition material to be calculated. Site visits will also allow designers to become familiar with the project area, site constraints, and surrounding conditions. This information will be used to create the initial landform concept and associated grading and revegetation plans.

8.0 SUMMARY OF SITE CHARACTERIZATION INVESTIGATIONS

From the data gaps identified to date, the site characterization SI plan for 2013 is comprised of the following key items:

- Additional sample collection and static testing of waste rock materials in some sectors of the McDade waste rock pile.
- Additional sample collection and static testing of ore contaminated materials at the upper mill platform area.
- Sample collection and analysis of native soils, tailings dam material, and potential borrow materials from the tailings storage facility area.

- Additional geochemical sampling and testing of water and sediments from historical ponds and riparian areas since the previous sediment sampling was conducted on pond shoreline deposits only.
- Water sampling from the lower Huestis and Webber Adits as it may be contributing significant metal loads to Dome Creek.
- Additional testing of geochemical samples from the haul road near the mill site.
- A compilation and confirmation of all hazardous materials should be completed. Where environmental contamination is identified, full delineation of the impact should be completed.
- Delineation of contamination of the areas of known releases of hazardous materials is required. Specific releases noted include: metals contamination in wood chips in the educor area, metals contaminated sediment across the mill complex, cyanide slurry release in 1996, antifreeze release in 1998, and metals contaminated soil in the mill, SAG, polish pond and Ketza areas.
- Characterization and potential delineation of hydrocarbon contaminated material near the former Ketza Shop, for two reported historical spills, along site roads, adjacent to transformer storage, in front of the Generator Building, material near the AST in the Warehouse Building, near the waste oil barrel, adjacent to the Diesel Containment, stained soil on the Upper Road to the SAG Building.
- Delineation of hydrocarbon contaminated material adjacent to drums in the Warehouse and oil sludge in the Mill Building.
- Characterization and potential delineation of hydrocarbon contaminated material from three sumps inside the Generator Building and from the basin within the Upper Mill Building.
- Identification and characterization of potential landfill contaminant plumes.

The key locations for site characterization site investigation are shown in Figures 1 and 2.

TABLES

Table 1.1: Geotechnical Site Investigations

Data Gap ID #	Data Gap as Described in Data Gap Analysis	Design Data Objective	Field Work Scope	Methods Proposed	Comments
G02 G04 G05 G08 G12 G18 G25 G35 G36	Geotechnical and thermal characterization of tailings.	Define the design properties for the tailings (current in-situ and long-term backfilled).	Drilling and test pitting of tailings deposit with in-situ testing and recovery of soil samples for subsequent lab testing.	Cone penetration testing (CPT), rotary borings and test pitting. Laboratory testing will be prioritized based on the design issues associated with the relocation methods identified, and may include: • mineralogy; • particle size distribution (PSD); • moisture content; • Atterberg limits; • consistency; • consolidation; • hydraulic conductivity; • moisture retention; • thermal conductivity; • specific heat; • specific gravity; • moisture – density relationship; and • strength testing.	Initial investigation using CPT on a regular grid to assess spatial variability of the tailings deposit. Based on collected CPT data, rotary borings and test pits would be performed to recover samples for subsequent laboratory testing. Test pits would be used to recover larger samples required for larger scale lab testing. Rotary drilling would target samples in the deeper portions of the tailings deposit and advance several metres into native materials to assess permafrost conditions. Observation of material drainage, dewatering potential and trafficability will be made during excavation of test pits. Some test pits may be left open to assess longer term excavation stability (wall sloughing) and desaturation (changes in moisture content) over time of excavation spoil piles.
G02 G07	Define and quantify material to be relocated.	Identify volume, type and characteristics of material to be relocated in tailings area (includes tailings, dams fill and underlying affected materials), mill site (tailings and waste rock) and waste rock areas.	Refer to Table 1.7 for site characterization and geochemical requirements.	Refer to Table 1.6 S01, S02, S03, S04, and S05 for site characterization and geochemical requirements.	This will be mainly a geochemical exercise; however, geotechnical logging and observations will be completed in conjunction with these investigations.
G03 G27	Quantify storage volume available in the pit and possibly surrounding area.	Develop contours of pit below existing water level to supplement LiDAR data.	Survey of pit bottom.	Sonar survey from boat.	
G05 G18 G25	Tailings trafficability and response to excavation.	Assess ability of equipment to traffic the area during removal operations.	Site observations of access during site investigation program.	Observation of equipment type, size, speed, bearing pressure, location and distance to pond, resulting deformation and performance in comparison with in-situ testing (CPT) data.	Observation of wall stability and stand-up time will also be made during excavation of test pits.

Table 1.1: Geotechnical Site Investigations

Data Gap ID #	Data Gap as Described in Data Gap Analysis	Design Data Objective	Field Work Scope	Methods Proposed	Comments
G07 G20	Characterize tailings in the mill area, including riparian areas if/as indicated by site observation.	Define state of tailings, PSD, moisture content, consistency plasticity and quantity.	Observe and sample tailings.	Refer to Table 1.6 for site characterization and geochemical requirements.	The methods will be largely driven by geochemical sampling requirements. Because of the small volume of tailings, the geotechnical parameters are less critical to the overall design although basic properties must be understood to identify appropriate relocation methods. Geotechnical logging and observations will be completed in conjunction with the geochemical investigation requirements.
G10 G26	Characterize materials in Main Tailings Dam.	Confirm reported conditions.	Drilling and test pitting in tailings dam shell, visual observation, review readings of existing thermistors and piezometers, collect new data if required. Note that the instruments are monitored monthly by the care and maintenance operator.	Rotary borings and test pitting with subsequent laboratory index testing of collected soil samples.	Advance rotary boring into native materials below dam fill to assess permafrost conditions and depth to bedrock (depending on depth to bedrock). Samples will also be collected for geochemical characterization.
G11	Characterize materials in Seepage Collection Dam.	Confirm reported conditions.	Visual observation, review readings of existing thermistors and piezometers, collect new data if required.	Visual observation and instrumentation data review.	This will be mainly a geochemical exercise; however, geotechnical logging and observations will be completed in conjunction with these investigations.
G23	Assess haul road configurations (including bridges and culverts) to assess effects and considerations for relocation methods.	Current road widths, conditions and grades.	Site reconnaissance.	Visual observation.	This would include assessment of perceived equipment productivities and logistics based on observed site conditions.
G24	Geohazard assessment.	Identify any fatal flaws from a geohazards perspective.	Site reconnaissance.	Visual observation in conjunction with air photo interpretation.	
G09 G27 G28 G30	Waste rock characterization (geotechnical).	Determine design properties for relocation and use as a construction material.	Test pitting and sampling for subsequent laboratory testing.	Borehole drilling and/or test pitting with sampling for PSD of finer fractions and visual estimate of oversize material. Potential for Atterberg Limits testing on ground rock to characterize properties of fine particles. Other tests such as organic content, specific gravity, durability may be required depending on desired use of waste rock as a borrow material.	Waste rock sampling to be coordinated with geochemical and site characterization programs.
G29	Condition of pit wall with regards to stability and interaction with backfill, particularly in any “abutments” at the south end of the Open Pit.	Rock condition, particularly with regards to potential seepage flow paths.	Visual observation and mapping of pit walls and surrounding area.	Visual observation of exposed bedrock including rock mass classification and mapping of structural geology.	Emphasis on identification of conductive features.

Table 1.1: Geotechnical Site Investigations

Data Gap ID #	Data Gap as Described in Data Gap Analysis	Design Data Objective	Field Work Scope	Methods Proposed	Comments
G30	Current stability of the waste rock piles.	Assess current slopes and performance.	Site Reconnaissance.	Observation of existing waste dumps including measurement of existing slope angles.	Emphasis on identifying and assessing slopes where surplus material will remain.
G30	Foundation conditions of the waste rock piles.	Assess foundation conditions.	Site Reconnaissance.	Observation of surrounding ground conditions to infer conditions under waste rock.	If geochemical testing requires drilling, holes could be advanced through the near surface soils and rock to confirm conditions.
G31	Borrow characterization for cover materials (pit, landfill, waste rock), erosion protection (Dome Creek remediation), and general site regrading.	Identify borrow locations and characterize physical properties of borrow materials.	Field truthing of areas identified in previous studies (i.e., R106) including test pitting and sampling for subsequent laboratory testing.	Visual observation and test pitting with laboratory testing to include: • particle size distribution, • moisture content, • Atterberg limits, and • moisture density relationship (Proctor test) depending on borrow needs.	A potential fine grained borrow material site was identified in a previous study by EBA (R106) which is located approximately 25 km east of the site along the Mount Nansen Road between km 26 and km 32 and 2 km off the road (see Figure 3). Per the report recommendations, test pitting will be performed in this area to confirm material properties which will require permitting as this is outside the OIC boundary. An air photo assessment will be completed to confirm if there are any other off-site potential borrow areas that should be investigated.
G32	Foundation conditions in potential area of new landfill.	General characterization of subsurface soils.	Site reconnaissance of area around Open Pit to assess foundation conditions supplemented by drilling and/or test pitting in conjunction with waste rock characterization.	Visual observation and test pitting.	
G33 G35	Current pit wall condition.	Confirm and/or update recommendations with regards to mitigation required for pit wall stability during backfilling.	Reconnaissance at Open Pit.	Visual observation of existing pit wall conditions with mapping of structural geology where warranted.	
G34	Stability of adit surroundings.	Confirm the reported conditions of the Pony Creek adit and possibly other adits in the Open Pit as required / possible.	Reconnaissance.	Visual observation of existing conditions with mapping of structural geology where warranted coordinated in conjunction with hydrogeological survey programs (i.e., HG01).	
G37	Assessment of thermal regime at the Open Pit.	Provide boundary conditions for thermal assessment and understand the extent of influence of the Open Pit.	Temperature measurements below and at some distance from the Open Pit.	Rotary borings to install PVC casings for temperature measurement below and away from the Open Pit.	Measurements in newly installed wells and casing to be performed once conditions within the well reach equilibrium (typically requires 1 to 4 weeks) after installation.

Table 1.1: Geotechnical Site Investigations

Data Gap ID #	Data Gap as Described in Data Gap Analysis	Design Data Objective	Field Work Scope	Methods Proposed	Comments
G38 G39 G40	Thermal characterization of native materials in Dome Creek.	Investigate current depths to permafrost in impacted area and non-impacted area of Dome Creek. Confirmation of current ground temperatures.	Drilling and test pitting as part of other programs (i.e., tailings impoundment and dam) combined with general reconnaissance and review of readings of existing thermistors and piezometers (collect new data if required).	Drilling, test pitting, visual observation of ground conditions and review of instrumentation data. Coordinate with investigation of tailings dam and impoundment to investigate native soils and bedrock thermal properties.	Drilling will be advanced into permafrost, competent material, and/or bedrock to a sufficient depth so that the thermal regime can be characterized and understood.

Table 1.2: Hydrological Site Investigations

Data Gap ID #	Data Gap as Described in Data Gap Analysis	Design Data Objective	Field Work Scope	Methods Proposed	Comments
HT01	Site overall drainage (flow paths through the site).	Spring flows characteristics for Dome Creek and Pony Creek and all tributaries. Identification and estimates of groundwater/surface water discharge.	Walk channels during spring runoff. Measure flows at selected locations, in Dome and Pony Creeks. Document changing channel characteristics, single channel versus braided channels. Identify springs, tributaries and estimate flows.	Measure flow in creeks, tributaries and springs using swoffer/flowmeter. Photo and visual documentation of changing characteristics of the creek.	Site visit should be conducted during spring runoff in May.
HT02	Restoration of Dome Creek. Channel forming soils and sediments characteristics. Upstream and downstream channel characteristics (assume that location of the tailings has similar characteristics). Slopes, cross-section and natural features.	Soil characteristics in the channel and sediment aggradations or degradations. Detailed cross-section and channel alignment survey of upstream and downstream.	Sampling of channel bottom soils: • Walk channel alignment during site visit. • Select upstream and downstream channel segment which will required detailed surveying and evaluating channel characteristics.	Bottom soil sampling every 100 m over the two channel segments upstream and downstream of the tailings impoundment for a total distance of 1,000 m, resulting in 20 soil/sediment samples. The sediment samples will be sent for gradation analysis to estimate the particular size distribution of the sediments. Detailed x-section survey every 50 m over the two segments upstream and downstream of the tailings impoundment area for a total distance of 1,000 m, resulting in 20 cross-section surveys. The surveys should be done at an interval of 0.1 metre, or less.	Upstream and downstream of the tailings are being assessed for sediments, because it is assumed that it has similar characteristics as the tailings site. Also, the soils underneath the tailings will be evaluated as part of the geotechnical investigation of the tailings facility. Sampling and surveys will be coordinated with other water quality and hydrogeology surveys in the area (W04, W06, HG02 and HG05).
HT03	Pit Area Drainage Availability and suitability of alluvial and riprap for erosion control.	Alluvial and riprap borrow area.	Consultation during field trip. Need to confirm geochemical suitability.	Test pits will be excavated, if required in coordination with geotechnical borrow investigation activities (G31).	Coordinate with geochemical investigations of borrow areas.

Table 1.3: Hydrogeological Site Investigations

Data Gap ID #	Data Gap as Described in Data Gap Analysis	Design Data Objective	Field Work Scope	Methods Proposed	Comments
HG01	Open Pit baseline groundwater flow and quality. Open Pit adit integrity and sealing (if required for closure Option 4).	Quantification of groundwater rate and quality leaving the Open Pit via pit floor. Determination of whether major faults intersecting the Open Pit act as groundwater conduits. Characterization of Open Pit adit(s), if required.	Bedrock drilling program, involving: two (2) locations, to maximum of 50 metres depth (TBC). Bedrock fractured rock assessment. Groundwater baseline quality program. Adit connectivity assessment. Sampling of new existing well for groundwater quality (at time of investigation in early summer and in fall before freeze up).	Rotary drilling, NQ-size, using biodegradable drilling fluids. Acoustic televiewer survey of borehole walls to characterize fracture and joint sets, in terms of orientation, frequency and aperture. Flow meter survey of major groundwater pathways identified from televiewer survey. Packer (permeability) testing of major groundwater pathways identified from televiewer and flow meter survey. Installation of multi-level (three levels) groundwater monitoring wells into each borehole, for shallow, intermediate and deeper groundwater monitoring, sampling and analyses. Groundwater sampling and analyses. Surveying location and elevation of iron-stained pit wall fractures. Possible water tracer assessment of Open Pit adit(s) that 'daylight' outside the Open Pit boundary.	Two bedrock boreholes proposed inside the Open Pit boundary. One vertical to assess deeper groundwater flow and quality. Second, inclined to intercept footwall fault, along east side of Open Pit. Monitoring wells constructed as temporary installations (up to five years) and decommissioned prior to implementation of closure Option 4.
HG02	Pony Creek recharge to shallow groundwater entering the Open Pit.	Quantification of Pony Creek water contribution to Open Pit.	Pony Creek channel elevation survey, along stage adjacent to Open Pit. Groundwater-surface water interaction assessment.	Elevation survey of channel centreline, banks and flood-line. Creek bed testing at 250 metre creek intervals, including: seepage meter testing, manometer testing and temporary installation of dual-level mini-piezometers in adjacent creek bank.	Temporary installation of mini-piezometers carried out manually to enable three sets of readings in 2013. To be removed end of 2013.
HG03	Open Pit long-term pond water level.	Evaluate long-term pit water level(s) for Option 4 design use (preliminary waste rock platform El. 1190 m consistent with the maximum measured pit lake elevation of 1185 m).	Update and revision to existing Open Pit water balance analysis (AECOM 2010).	Joint hydrology-hydrogeology update and revision to existing Excel-based water balance analysis. New inputs to include closure Option 4 design parameters.	

Table 1.3: Hydrogeological Site Investigations

Data Gap ID #	Data Gap as Described in Data Gap Analysis	Design Data Objective	Field Work Scope	Methods Proposed	Comments
HG04	Baseline groundwater flow and quality hydraulically down gradient of Open Pit. Protective groundwater quality monitoring.	Quantification of groundwater moving hydraulically down gradient of Open Pit. Long-term groundwater quality.	Bedrock drilling program, involving: four (4) locations, to maximum of 50 metres depth (TBC). Bedrock fractured rock assessment. Groundwater baseline quality program.	Rotary drilling, NQ-size, using biodegradable drilling fluids. Acoustic televiewer survey of borehole walls to characterize fracture and joint sets, in terms of orientation, frequency and aperture. Flow meter survey of major groundwater pathways identified from televiewer survey. Packer (permeability) testing of major groundwater pathways identified from televiewer and flow meter survey. Installation of multi-level (three levels) groundwater monitoring wells into each borehole, for shallow, intermediate and deeper groundwater monitoring, sampling and analyses. Groundwater sampling and analyses.	Four bedrock boreholes proposed hydraulically down gradient of Open Pit, northeast, southwest, south and southeast. Monitoring wells constructed as permanent installations, as a protective groundwater quality measure. It is envisioned that these wells could be integrated into long term monitoring during and post remediation, likely supplemented by other wells installed as part of the remediation work.
HG05	Groundwater-surface water interaction along creeks inside and adjacent to the OIC boundary.	Long-term general groundwater quality entering Dome and Pony/Back Creeks.	Dome Creek, Pony/Back Creek channel elevation survey. Groundwater-surface water interaction assessment. Groundwater baseline quality program.	Elevation survey of channel centreline, banks and flood-line. Creek bed testing at 250 metre creek intervals, including: seepage meter testing, manometer testing and temporary installation of dual-level mini-piezometers in adjacent creek bank. Groundwater sampling and analyses.	Temporary installation of mini-piezometers, to enable three sets of readings in 2013. To be removed end of 2013.
HG06	Groundwater flow and quality in uppermost area of the Dome Creek watershed from adit drainage (Huestis and Webber Deposit areas, as applicable to OIC boundary), plus historic landfill, new landfill and mill areas.	Long-term point-source groundwater quality entering Dome Creek from adit drainage (lower Huestis adit).	Adit field survey to locate entrances, drainage rates and quality. Groundwater baseline quality program.	Historical aerial photo assessment. Test pits by backhoe to locate adit entrances, access and safety permitting. Possible temporary weir construction to measure adit flow and sample. Installation of single-level, well points, using backhoe at old landfill, mill and new landfill areas. Groundwater sampling and analyses.	Well points constructed as temporary installations (up to five years) and decommissioned prior to implementation of closure Option 4.
HG07	Water supply well(s) construction and water low (artesian) details.	Water supply well(s) at Victoria Creek.	Water well field survey.	Well survey, including total depth, artesian flow rate.	

Table 1.4: Water Quality Site Investigations

Data Gap ID #	Data Gap as Described in Data Gap Analysis	Design Data Objective	Field Work Scope	Methods Proposed	Comments
W01 W02	Pit lake: water quality data limited by parameters at top, middle, bottom layers, no details by depth.	Data on detailed water quality profiles and volumes required for selection of treatment options.	Determine vertical distribution of water quality parameters.	Sampling and “in-situ” parameters vertical profiling. Bathymetric survey of pit lake.	
W03	Pore water quality data within the tailings is not available.	Provide input to water quality model through assessment of potential water seepage. Pore water quality data required.	Test pore water quality before and after tailings relocation.	Field sampling and lab testing of tailings pore water prior to relocation for baseline conditions and design using existing wells.	Comments to be provided on current EDI sampling under separate cover.
W04	Flow data in creeks at the sampling events.	Site water quality mass balance modelling. Loadings calculations required flow data.	Measure discharges at sampling events in creeks.	Standard hydrometric methods of flow measurements (in cooperation with hydrotechnical tasks).	Comments to be provided regarding current EDI sampling under separate cover. Additional sampling and surveys will be coordinated with other hydrology and hydrogeology surveys in the area (HT01, HG02 and HG05). Reports R53 and R54 were provided on April 19 and have not yet been reviewed in detail. This will be done prior to the field program to assess if additional sediment sampling is required.
W05	Insufficient data on surface runoff and quality in the mill area, waste rock dump, tailings.	Site water balance and quality model input and output data.	Collect data on water quality in creeks and affected areas.	Field survey, in-site measurements, sampling, lab analysis on 250 m intervals.	
W05	No data on bottom sediments in streams at potential deposition / erosion reaches.	Water quality management and protection plans.	Collect bottom sediments quality data.	Bottom sediments sampling, chemical analysis in the laboratory on 250 m intervals.	

Table 1.5: Infrastructure / Structural / Landform Site Investigations

Data Gap ID #	Data Gap as Described in Data Gap Analysis	Design Data Objective	Field Work Scope	Methods Proposed	Comments
L01	Ground truthing of underground utilities; septic field, areas obscured by water; road/trail culverts or drainage structures; areas obscured by vegetation.	Site grading. Characterization and quantification of materials requiring removal and/or on-site landfilling.	This may include ground truthing particular areas compared with the LiDAR/survey data provided. Create an inventory of trails, culverts, utilities, pipelines, etc.	Field review of site.	Additional survey requirements may be identified in consultation with other project disciplines.
L02	Inventory and characterization of road network.	Closure of site roads.	Field confirm roads to be closed/ decommissioned, and those to remain for construction and monitoring of the site.	Field review of site.	Will require site characterization input regarding material classification, or contamination and geotechnical input on slope stability.
L03	Inventory and characterization of trail network.	Closure of site trails.	Field confirm trails to be closed.	Field review of site.	Trails are minor and likely will be only revegetated.
L04	Inventory and characterization of exploration trenches.	Reclamation of exploration trenches.	Confirm trench locations, lengths, and depths.	Field review of site.	Some areas of remediation should be compared to access requirements.
L05	Complete inventory of underground and surface features including septic tank, pipeline, power lines, fuel systems, etc.	Characterize type and quantity of miscellaneous Infrastructure.	Prepare an inventory of the existing miscellaneous infrastructure through site visit. Pictures, field notes, and possibly additional survey.	Field review of site.	Should be completed through site visit.
L06	Inventory clearing locations.	Miscellaneous clearings.	Confirm clearing locations requiring regrading/revegetation.	Field review of site.	Field confirmation.
L08	Characterization of the landscape. Organic material characterizations and sources, vegetation data.	Reclaiming the landscape to its original form and traditional land use and natural appearance.	Identify organic material characterization and vegetation types.	Field review of site.	The landform engineer's work relies on field conformation of topography to develop sketches of desired landform shape that characterizes the greater landscape. This will provide a target form for the final "aesthetic" of the site.
L09	Building inventory.	Provided data to develop building demolition plan. Identify what buildings may be useful to maintain throughout remediation work.	Investigate and characterize buildings on- site.	Field review of site to verify information (record drawings, building dimensions & quantities, construction type and materials description, potential hazardous materials) and augment data as required. Complete a summary report for each building including photo record.	Site visit required.
L10	Total volume and type of demolition and waste/debris to be landfilled, removed from site or recycled.	Assess volume and type of material to be landfilled on-site and removed from site.	Develop detailed and complete inventories of on-site structures, infrastructure, etc. (see Items L05 and L09).	Field review of site (as detailed in L05 and L09).	Site visit required.

Table 1.5: Infrastructure / Structural / Landform Site Investigations

Data Gap ID #	Data Gap as Described in Data Gap Analysis	Design Data Objective	Field Work Scope	Methods Proposed	Comments
L11	Location and configuration of new landfill including quantity and type of material to be stored.	New landfill development.	Confirm location and existing conditions at new landfill site. Note this is not a geotechnical characterization of the site but a review to grades, topography and conditions that would influence landfilling operations.	Requires site visit and possible investigation depending on design developed.	Input may be required from geotechnical and site characterization disciplines depending on the materials to be stored and the location selected. Consideration will be given to locating the new landfill in an area of existing disturbance, possibly near the Open Pit. This would allow the pit cover to be extended over the landfill if required and may allow the pit backfill and new landfill to create a single landform integrated with the existing landscape.
L12	Limited pre-disturbance species lists and ecological community classification.	Pre-disturbance and adjacent ecology.	See L14.	See L14 which will be applied to adjacent ecology. The number of plots will be dependent on replication of community types, i.e., plots will not be repeated more than necessary in the same community type.	This is necessary to determine what the potential of the site is, what wildlife use is in the area, and sources of natural vegetation colonization, which will influence revegetation planning.
L13	Delineation of substrate characterization or vegetation cover on the site or adjacent area.	Baseline Mapping.	This will not require a site visit.	Complete preliminary mapping of the nine disturbance sites and adjacent areas. This will entail polygon delineation based on terrain, dominant vegetation cover, nature of mining disturbance, water features, and existing soil substrate characterization including physical attributes (parent material characterization). Attribute polygons with available data from existing mapping sources and orthophoto interpretation.	Preliminary mapping of the site is important for assessing baseline conditions to estimate parent material available, to estimate erosion potential, and revegetation potential. Parent material characterization will guide the development of the remediation plan as soil properties determine which vegetation species will be appropriate for planting at specific sites.

Table 1.5: Infrastructure / Structural / Landform Site Investigations

Data Gap ID #	Data Gap as Described in Data Gap Analysis	Design Data Objective	Field Work Scope	Methods Proposed	Comments
L14	Species lists and community composition adjacent to the disturbance units and within the disturbance. Wildlife presence/absence and level of use within and adjacent to the site. Soil depth, location and quality. Vegetation metal uptake.	Vegetation, soils and wildlife baseline.	Completing terrestrial ecological classification surveys targeting vegetation, wildlife and soils components on the site and in adjacent areas.	Design field program including stratification of plot locations based on preliminary mapping. Plot locations will include the nine disturbance sites and sampling adjacent to each of these nine sites. To achieve the appropriate level of representative samples and spatial distribution, stratification will consider the following: wildlife use, soil parent material characterization, and revegetation objectives. Complete site visit to refine polygon attribute typing. Level of detail will follow the BC Methods for Describing Terrestrial Ecosystems in the Field (Land Management Handbook 25; BC Ministry of Forests and Range and BC Ministry of Environment, 2010).	The vegetation, soils and wildlife baseline will form the basis for all the remediation recommendations. Detailed knowledge of the site, how the wildlife are using the site, how vegetation is currently colonizing different substrates on the site, which vegetation species are currently colonizing the site, and how the land is responding in general to the site disturbance will form the basis for remediation planning.
L15	Detailed substrate drainage definition for pre and post remediation.	Topography and substrate drainage.	See L13.	Topography will be recorded at each plot location. In the event that there is no soil present, substrate drainage will be recorded according to defined standards.	This is required to determine what revegetation is possible by classifying substrates and their drainage potential, this will be used as the drainage classification when the substrates are re-contoured. This information can be used to determine Reclamation Treatment Units (RTUs).
L16	Detailed material characterization including chemistry and physical characteristics.	Surficial materials characteristics.	Surface material physical and chemical characterization.	Surface material characterization will be sampled during the baseline field trip. Methods for sampling physical and chemical attributes will follow those methods used in the Brown McDade Waste Rock Ecological Restoration Strategy (R114 Altura 2009).	This information will help to determine RTUs, which will be used to prescribe specific revegetation treatments on-site.
L17	Spatial distribution of vegetation available for revegetation of the entire site.	Seed and plant source material.	Species lists adjacent to disturbance sites.	See L14.	This information would be taken from the baseline survey, which would produce a map specific to locations of desirable species to be used as source plant material (for both passive and active revegetation). Species lists and reference community types are limited in spatial extent (to the Brown McDade waste rock pile and to some extent at the Huestis Portal).

Table 1.5: Infrastructure / Structural / Landform Site Investigations

Data Gap ID #	Data Gap as Described in Data Gap Analysis	Design Data Objective	Field Work Scope	Methods Proposed	Comments
L18	Success of planting trials at Mount Nansen.	Revegetation techniques for the Yukon.	Assess previously revegetated areas as part of past trials at Mount Nansen and collect tissue samples.	Survey all revegetated areas (Huestis Portal, Tailings, Dome Creek, Pony Creek). Survey previously established monitoring plots and establish new plots where not documented. At each plot document species presence, abundance and vigour, planting technique, site amendments, exposed soil and depth of soil and tissue sampling.	This will help define a successful approach to planting and species selection for each RTU, and provide some level of monitoring to use in an adaptive management strategy. Knowledge that can be collected from historical revegetation programs will be instrumental to the success of the revegetation program for Mount Nansen.

Table 1.6: Site Characterization Site Investigations

Data Gap ID #	Data Gap as Described in Data Gap Analysis	Design Data Objective	Field Work Scope	Methods Proposed	Comments
S01	Geochemical characterization of waste rock materials at some sectors of McDade waste rock pile.	Locate and characterize waste rock.	Materials sampling with subsequent laboratory testing.	Collect samples from drilling materials with subsequent laboratory testing.	
S02	Geochemical characterization of ore contaminated materials at the upper mill platform.	Locate and characterize ore contaminated material.	Materials sampling with subsequent laboratory testing.	Collect samples from test pits with subsequent laboratory testing.	The south end of McDade pit was already sampled and tested by Altura in 2009. Altura completed 10 test pits and collected nine samples for the geochemistry testing (see S2 at Data Gap Memo). Lorax also collected bulk samples from this area and used these samples for the field bin testing. Data quality and coverage are sufficient to characterize ARD/ML potential of ore materials at the south end of the Brown McDade pit.
S03	Geochemical characterization of native soils underneath tailings at the tailings impoundment, materials of tailings dam, seepage pond materials, and other potential borrow materials near the tailings storage facility area.	Characterize native soils; tailings dam material and potential borrow materials for cover.	Materials sampling with subsequent laboratory testing.	Collect samples to characterize native soils, tailings dam material, seepage pond material, and potential borrow materials at the tailings storage facility with subsequent laboratory testing.	
S04	Geochemical characterization of historical ponds and riparian areas with water quality from Huestis and Weber Adits.	Locate and characterize waste rock and tailings.	Materials sampling with subsequent laboratory testing.	Collect solid and water samples from historical ponds, riparian areas and water samples from Huestis and Webber Adits with subsequent laboratory testing.	

Table 1.6: Site Characterization Site Investigations

Data Gap ID #	Data Gap as Described in Data Gap Analysis	Design Data Objective	Field Work Scope	Methods Proposed	Comments
S05	Geochemical characterization of waste rock materials from haul road near mill area.	Locate and characterize waste rock and ore previously used for road construction.	Materials sampling with subsequent laboratory testing.	Collect samples from test pits with subsequent laboratory static testing.	We acknowledge that the geochemical characterization of rock materials from the haul road from Pit to Mill was performed, but ABA testing was performed only to limited number of samples. We propose to conduct only the static testing such as ABA and metal testing for these samples, and leachable metal testing for selected samples. The long test (i.e., 52 weeks) is for the kinetic testing such as humidity cell testing. The ABA testing and metal testing should be completed in 6 to 8 weeks. The leachable metal testing will be conducted on selected samples based on the ABA and metal testing results. It will take around 6 to 8 weeks to complete the leachable metal testing.

Table 1.6: Site Characterization Site Investigations

Data Gap ID #	Data Gap as Described in Data Gap Analysis	Design Data Objective	Field Work Scope	Methods Proposed	Comments
S06	A reliable and complete hazardous materials inventory is lacking. Once that is complete, a sampling work plan will be completed.	Complete a reliable hazardous materials inventory.	A site inspection is required prior to finalizing the scope of the hazardous material management work plan. Areas of interest include: • Crusher buildings; • Generator room; • Former Ketza shop area; • Laboratory; • Mill Buildings; • Mill Boneyard; • Mill Scrapyard; • Shop; • Tarped Stockpile; • Tailings Pond; and • Warehouse. This will focus on the labelling and volume of the following Hazardous Materials: • Lubricants; • Process chemicals; • Hazardous building materials (asbestos, lead paint, mercury, ozone-depleting substances, PCBs); • Storage containers (including tanks and drums); • Unknown materials; • Batteries; and • Buried debris.	Compile all hazardous material inventories from previous reports into a single database. Complete a site inspection to confirm the characterization and volume estimates of the compiled inventory and collect characterization samples where material composition is uncertain. From this, a hazardous materials sampling work plan will be completed. It will include, as a minimum, the sampling of sediments in 21 tanks and analyzing them through Toxicity Characteristic Leaching Procedure (TCLP).	

Table 1.6: Site Characterization Site Investigations

Data Gap ID #	Data Gap as Described in Data Gap Analysis	Design Data Objective	Field Work Scope	Methods Proposed	Comments
S07	Contamination extents in the areas of known releases have not been determined. Presence/absence characterization data is required for the cyanide slurry or antifreeze releases. Leachable metals results are needed for metals impacted soils in the mill, SAG and polish pond.	Characterization and delineation of contamination from hazardous material releases.	The environmental quality needs to be determined at the areas of known releases of hazardous materials; and the vertical and horizontal extent of any noted contaminated areas needs to be delineated. Known release areas include: • Metals contamination in wood chips in the educor area (R130) • Metals contaminated sediment across the mill complex (R130) • Cyanide slurry release to mill yard in 1996 (R63) • Antifreeze release in front of mill powerhouse in 1998 (R63) • Metals contaminated soil in the mill, SAG, polish pond and Ketza areas (R07)	Soil sampling and analyses for parameters of potential environmental concern to determine the presence and absence of contamination at all noted spill areas. The analyses will include TCLP for leachable metals for materials in the mill, SAG and polish pond.	
S08	Hazardous material analytical results adjacent to the former landfill near the mill building.	Identification off-site contaminant migration from the former landfill near the mill building.	Collect and analyze a minimum of soil samples from beyond the footprint of the former landfill. The results of these samples will be used to characterize the material. If a sample has compounds in exceedance of the applicable standards, then collect and analyze samples to delineate the contamination.	Samples will be collected at various depths using a drill. In addition to the typical testing completed, they will be analyzed for parameters of concern associated with the identified waste in the landfill (including fridges, freezers, batteries and waste oil).	
S09	There is no characterization data or delineation data for staining in two locations outside of the Ketza Shop.	Characterization and potential delineation of hydrocarbon contaminated material near the former Ketza Shop.	Collect and analyze a minimum of four soil samples from areas of staining beyond the footprint of the former Ketza Shop. The results of these samples will be used to characterize the material. If a sample has hydrocarbon compounds in exceedance of the applicable standards, then collect and analyze samples to delineate the contamination.	Characterizations samples will be collected from the surface using hand-held equipment. Delineation samples may require the use of a drill (or at least a backhoe).	

Table 1.6: Site Characterization Site Investigations

Data Gap ID #	Data Gap as Described in Data Gap Analysis	Design Data Objective	Field Work Scope	Methods Proposed	Comments
S10	Re-characterization and potential delineation of hydrocarbon contaminated materials from two reported hydrocarbon spill locations is required.	Characterization and potential delineation of hydrocarbon contaminated materials for two reported historical spills.	Review spill record reports from YG-Environment and Environment Canada to determine spill locations. Collect and analyze a minimum of two soil samples from these locations. The results of these samples will be used to characterize the material. If a sample has hydrocarbon compounds in exceedance of the applicable standards, then collect and analyze samples to delineate the contamination.	Review YG and Environment Canada spill reports. Characterizations samples will be collected from the surface using hand-held equipment. Delineation samples may require the use of a drill (or at least a backhoe). Excess excavated material will be replaced after samples are collected.	
S11	Characterization and potential delineation of hydrocarbon contamination on the roads.	Characterization and potential delineation of hydrocarbon contaminated soil along site roads.	Collect and analyze a minimum of four soil samples from strategic locations on the site Haul Road. These will include the locations near the mill, near the camp, near the former Ketza Shop and beyond the pit. The results of these samples will be used to characterize the material. If a sample has hydrocarbon compounds in exceedance of the applicable standards, then collect and analyze samples to delineate the contamination.	Characterizations samples will be collected from the surface using hand-held equipment. Delineation samples may require the use of a drill (or at least a backhoe).	
S12	Characterization and delineation sample results are required for the stained soil beneath the transformer storage area in front of the mill in the scrap yard.	Characterization and delineation of hydrocarbon contaminated material adjacent to the transformer storage.	Confirm the location of the transformer storage through interviews and maps. Collect and analyze a minimum of one soil sample from the stained soil near the transformer storage. The results of this sample will be used to characterize the material. If the sample has hydrocarbon compounds in exceedance of the applicable standards, then collect and analyze samples to delineate the contamination.	The characterizations sample will be collected from the surface using hand-held equipment. Delineation samples may require the use of a drill (or at least a backhoe).	

Table 1.6: Site Characterization Site Investigations

Data Gap ID #	Data Gap as Described in Data Gap Analysis	Design Data Objective	Field Work Scope	Methods Proposed	Comments
S13	Characterization, delineation and confirmatory sample results are required for the stained soil beneath the waste oil drums in the Warehouse.	Delineation of hydrocarbon contaminated material adjacent to drums in the Warehouse.	Confirm the location of Warehouse drum storage through interviews and maps. Collect and analyze a minimum of one soil sample from the stained soil near the drum storage. The results of this sample will be used to characterize the material. If the sample has hydrocarbon compounds in exceedance of the applicable standards, then collect and analyze samples to delineate the contamination.	The characterizations sample will be collected from the surface using hand-held equipment. Delineation samples may require the use of a drill (or at least a backhoe).	
S14	Characterization and quantification of the contents of the three sumps in the Generator building. Characterization, delineation and confirmatory sample results are required for the stained soil in front of the Generator Building.	Characterization and potential delineation of hydrocarbon contaminated material from three sumps inside the Generator Building and stained soil in front of the Generator Building.	Confirm the location of the Generator Building. Collect and analyze a minimum of one soil sample from the stained soil in front of the Generator Building. The results of this sample will be used to characterize the material. If the sample has hydrocarbon compounds in exceedance of the applicable standards, then collect and analyze samples to delineate the contamination. Collect and analyze three samples (one from each sump within the Generator Building). The results of this sample will be used to characterize the material.	The characterization samples from the stained soil in front of the Generator Building will be collected from the surface using hand-held equipment. Delineation samples may require the use of a drill (or at least a backhoe).	
S15	Characterization, delineation and confirmatory sample results may be required beneath the Warehouse Building's foundation in association with the staining near the AST.	Characterization and potential delineation of hydrocarbon contaminated material near the AST in the Warehouse Building.	N/A	N/A	
S16	Characterization and quantification of the contents of the basin in the Upper Mill Building.	Characterization and potential delineation of hydrocarbon contaminated material from the basin within the Upper Mill Building.	N/A	N/A	
S17	Characterization, delineation and confirmatory sample results are required for area around the stained soil where a waste oil barrel was located next to the diesel containment.	Characterization and potential delineation of hydrocarbon contaminated material near the waste oil barrel, adjacent to the Diesel Containment.	Collect and analyze a minimum of one soil sample from areas of staining beyond near the diesel containment. The results of these samples will be used to characterize the material. If a sample has hydrocarbon compounds in exceedance of the applicable standards, then collect and analyze samples to delineate the contamination.	Characterizations samples will be collected from the surface using hand-held equipment. Delineation samples may require the use of a drill (or at least a backhoe).	

Table 1.6: Site Characterization Site Investigations

Data Gap ID #	Data Gap as Described in Data Gap Analysis	Design Data Objective	Field Work Scope	Methods Proposed	Comments
S18	Characterization, delineation and confirmatory sample results are required for the stained soil on the Upper Mill Road to the SAG Building.	Characterization and potential delineation of stained soil on the Upper Road to the SAG Building.	Collect and analyze a minimum of one soil sample from areas of staining beyond near the diesel containment. The results of these samples will be used to characterize the material. If a sample has hydrocarbon compounds in exceedance of the applicable standards, then collect and analyze samples to delineate the contamination.	Characterizations samples will be collected from the surface using hand-held equipment. Delineation samples may require the use of a drill (or at least a backhoe).	
S19	Characterize and quantify the oil sludge in the mill building, then have that material removed from site.	Characterization and potential delineation of hydrocarbon contaminated material from oil sludge in the Mill Building.	Collect and analyze a minimum of one sludge sample. The results of this sample will be used to characterize the material.	Characterizations samples will be collected from the surface using hand-held equipment.	
S20	The product in all the fuel storage tanks needs to be quantified.	Locate, identify, quantify fuel volumes and plan for the removal of all fuel storage equipment.	Quantify product volumes.	Dip tanks with liquids and use the tank's dimensions to assess the product's volume. Read gauges on tanks containing gases.	
S21	The contents of the rail tanker need to be sampled and quantified by a trained professional. Refer to the Detailed Rail Tanker Assessment Work Plan for the proposed methods.	Assess and plan for the removal of the Rail Tanker and its content.	Sample products. Quantify product volumes. Confirm dimensions.	Refer to the Detailed Rail Tanker Assessment Work Plan for the proposed methods.	

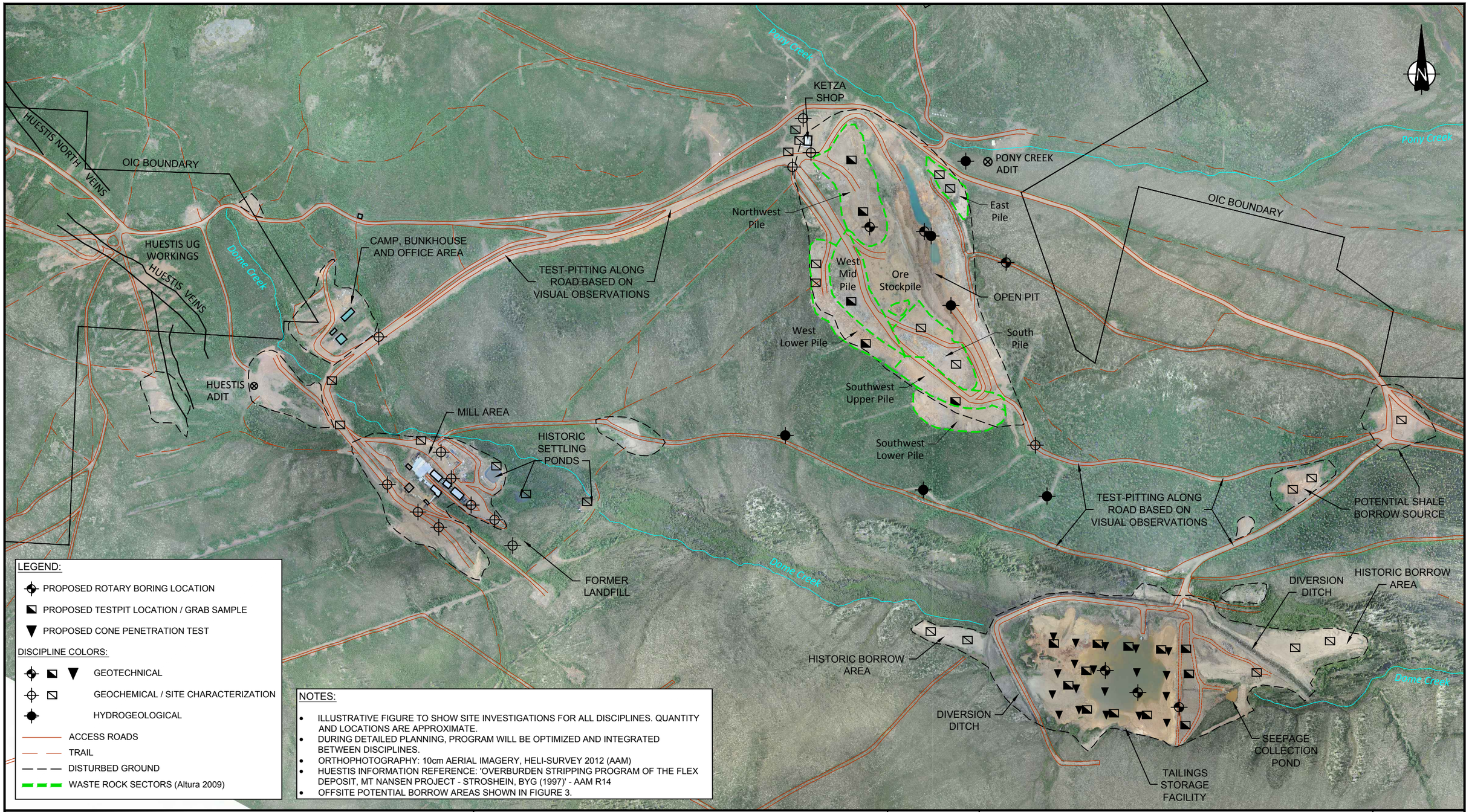
Table 1.7: Summary of 2013 Site Investigation Plan Scope

Type/Area	Number of Investigations	Type of Investigation	Average Depth (m)	Total Depth (m)	Sample Type	Sampling Frequency	In-Situ Testing	Installations	Comments
GEOTECHNICAL (Refer to Table 1.1)									
Tailings Impoundment	20	CPT	10	200	N/A	N/A	CPT	N/A	CPTs spaced to provide spatial distribution of geotechnical properties of tailings deposit.
	2	Rotary Drilling	20	40	SPT	3 m	SPT	Monitoring Wells	Holes located in deepest portion of impoundment near the tailings dam to probe tailings deposit and underlying foundation materials. Terminate holes 3 m into permafrost or bedrock. Wells will be standpipe piezometers and will be monitored prior to completion of the investigation program and during any ongoing monitoring efforts.
	10	Test Pits	5	50	Grab	1 m	N/A	N/A	Test pits located adjacent to CPT holes to collect grab samples for correlation of CPT data.
Tailings Dam	1	Rotary Drilling	20	20	SPT	3 m	SPT	N/A	Hole located in middle of dam section to confirm previous investigation data and probe foundation conditions. Terminate 3 m into frozen foundation soils or bedrock.
	3	Test Pits	5	15	Grab	1 m	N/A	N/A	Test pits on dam shell to collect grab samples for lab testing.
Open Pit	2	Rotary Drilling	50	100	N/A	N/A	N/A	PVC Casing	Drilling and installation of well casing to allow temperature measurements once conditions stabilize within drill holes. The program will be optimized as much as possible to allow coordination between the hydrogeology and geotechnical programs.
	1	Survey	N/A	N/A	N/A	N/A	N/A	N/A	Bathymetric survey of pit lake to validate pit storage volume estimates.
Waste Rock	1	Rotary Drilling	10	10	Grab	1.5 m	N/A	N/A	Drilling to investigate the depth of waste rock dumps and assess foundation conditions. Drill cuttings will be used for geochemical characterization.
	11	Test Pits	5	55	Grab	0.5 m	N/A	N/A	Assess particle size distribution of waste rock and collect bulk samples for geochemical testing.
Borrow Areas	8	Test Pits	5	40	Grab	0.5 m	N/A	N/A	Test pitting in the vicinity of the tailings storage area to identify for coarse grained materials.
	5	Test Pits	5	25	Grab	0.5 m	N/A	N/A	Test pitting in an area located approximately 25 km east of the site along the Mount Nansen Road between km 26 and km 32 and 2 km off the road previously defined as a potential borrow source of fine grained material.
HYDROLOGY (Refer to Table 1.2)									
Dome Creek	20	Survey	N/A	N/A	N/A	50 m	N/A	N/A	Perform elevation survey of creek cross sections with flow measurements at 50 m intervals for 500 m upstream and downstream of tailings area.
	20	Sediment	N/A	N/A	Grab	100 m	N/A	N/A	Collect sediment samples from stream bed at survey intervals. Sample locations will coincide with those required for water quality testing.
Borrow Areas	Coordinate sampling of Geotechnical Investigations for identification of erosion protection materials.								
HYDROGEOLOGICAL (Refer to Table 1.3)									
Open Pit	6	Rotary Drilling	50	300	N/A	N/A	N/A	Solinst CMT	Rock mass fracture assessment by drilling open hole with air rotary and log with acoustic televiewer or core hole with NQ size diamond drill. two boreholes performed inside the Open Pit and four boreholes down gradient of the Open Pit. Perform flow-meter survey and packer testing prior to installation of Solinst CMT multilevel monitoring system with three intervals. Perform groundwater sampling and analysis for each interval.
	1	Survey	N/A	N/A	N/A	N/A	N/A	N/A	Survey the pit walls with terrestrial LiDAR or reflectorless total station to identify and map water bearing rock mass discontinuities, iron staining and adits.
Pony Creek	10	Survey	N/A	N/A	Seepage	250 m	N/A	Piezometers	Perform elevation surveys of channel banks and invert centrelines. Coordinate survey, sediment and water quality sampling with Hydrology and Water Quality programs. Manually install multilevel mini piezometers at 250 m intervals.
Dome Creek	20	Survey	N/A	N/A	Seepage	250 m	N/A	Piezometers	

Table 1.7: Summary of 2013 Site Investigation Plan Scope

Type/Area	Number of Investigations	Type of Investigation	Average Depth (m)	Total Depth (m)	Sample Type	Sampling Frequency	In-Situ Testing	Installations	Comments
Site Wide Groundwater Wells	48	Sampling	7-50 m	N/A	Groundwater	N/A	N/A	N/A	Groundwater sampling will be done in the early summer and in the fall before freeze up to assess seasonality.
SURFACE WATER QUALITY (Refer to Table 1.4)									
Open Pit	2	WQ Sampling	N/A	N/A	Grab	0.5 m	N/A	N/A	Perform vertical profiles of water quality in the pit lake. Coordinate with bathymetric surface for volume assessment.
Tailings Area	10	WQ Sampling	N/A	N/A	Grab	TBD	N/A	N/A	Tailings pore water chemistry sampling from existing wells.
Pony Creek	10	WQ Sampling	N/A	N/A	Grab	250 m	N/A	N/A	Surface water quality sampling at 250 m intervals. Program will be coordinated with sediment sampling, surveys and multi-level piezo sites for Hydrology and Hydrogeology programs.
Dome Creek	20	WQ Sampling	N/A	N/A	Grab	250 m	N/A	N/A	
INFRASTRUCTURE AND REVEGETATION (Refer to Table 1.5)									
Overall Site	Field Review (Visual) of Site Conditions.								No invasive investigations or sampling required for general infrastructure review.
	N/A	Survey	N/A	N/A	N/A	N/A	N/A	N/A	Vegetation mapping in the nine disturbed areas with surface material physical and chemical characterization.
	N/A	Survey	N/A	N/A	N/A	N/A	N/A	N/A	Survey of existing revegetated site monitoring plots and establish new plots where not documented.
GEOCHEMICAL AND SITE CHARACTERIZATION (Refer to Table 1.7)									
Mill Site / Former Landfill Area	8	Rotary Drilling	10	80	SPT	0.5 m	N/A	N/A	Collect samples for hydrocarbon, hazardous materials and geochemical characterization.
	4	Test Pits/ Hand Auger	5	20	Grab	0.5 m	N/A	N/A	Collect solids samples from historical ponds and riparian area for subsequent laboratory testing.
	10	Surface Sample	0	0	Grab	N/A	N/A	N/A	Collect samples for hydrocarbon and hazardous materials characterization from noted areas within mill building and warehouse. Should additional staining be observed that warrants sampling, this will be carried out.
Camp Area	1	Rotary Drilling	10	10	SPT	0.5 m	N/A	N/A	Collect samples for hydrocarbon, hazardous materials and geochemical characterization.
	2	Test Pits	5	10	Grab	0.5 m	N/A	N/A	
Ketza Shop	3	Rotary Drilling	10	30	SPT	0.5 m	N/A	N/A	Delineation of potential hydrocarbon stained area outside Ketza Shop.
	3	Test Pits	5	15	Grab	0.5 m	N/A	N/A	
Roads	1	Rotary Drilling	10	10	SPT	0.5 m	N/A	N/A	Collect samples hazardous materials and geochemical characterization in road south of Open Pit.
	TBD	Test pits and/or surface sampling	3-5	TDB	Grab	0.5 m	N/A	N/A	Test pits will be located where warranted based on visual observations of staining on site roads between the mill and pit, south of the Open Pit and elsewhere as needed.
Adits	N/A	WQ Sampling	N/A	N/A	N/A	N/A	N/A	N/A	Collect water samples from Huestis and Weber adits for subsequent laboratory testing.
Tailings Area	Coordinate sampling of Geotechnical Investigations for collection of samples for geochemical characterization.								No additional invasive investigations are required.
Waste Rock									

FIGURES



LEGEND:

- PROPOSED ROTARY BORING LOCATION
- PROPOSED TESTPIT LOCATION / GRAB SAMPLE
- PROPOSED CONE PENETRATION TEST

DISCIPLINE COLORS:

- GEOTECHNICAL
- GEOCHEMICAL / SITE CHARACTERIZATION
- HYDROGEOLOGICAL
- ACCESS ROADS
- TRAIL
- DISTURBED GROUND
- WASTE ROCK SECTORS (Altura 2009)

NOTES:

- ILLUSTRATIVE FIGURE TO SHOW SITE INVESTIGATIONS FOR ALL DISCIPLINES. QUANTITY AND LOCATIONS ARE APPROXIMATE.
- DURING DETAILED PLANNING, PROGRAM WILL BE OPTIMIZED AND INTEGRATED BETWEEN DISCIPLINES.
- ORTHOPHOTOGRAPHY: 10cm AERIAL IMAGERY, HELI-SURVEY 2012 (AAM)
- HUESTIS INFORMATION REFERENCE: 'OVERBURDEN STRIPPING PROGRAM OF THE FLEX DEPOSIT, MT NANSEN PROJECT - STROSHEIN, BYG (1997)' - AAM R14
- OFFSITE POTENTIAL BORROW AREAS SHOWN IN FIGURE 3.

NOTE:
THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE AMEC ENVIRONMENT & INFRASTRUCTURE REPORT No. VM00605 DATED JULY 2013.

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DRAFT

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DWN BY:	TH
CHK'D BY:	AW / RW
DATUM:	NAD 83
PROJECTION:	UTM Zone 8
SCALE:	AS SHOWN

PROJECT: MOUNT NANSEN REMEDIATION PROJECT
CONCEPTUAL SITE INVESTIGATION PLAN

TITLE: GEOTECHNICAL, HYDROGEOLOGICAL, GEOCHEMICAL AND SITE CHARACTERIZATION DRILLING AND TESTPIT PLAN

DATE:	JULY 2013
PROJECT NO:	VM00605
REV. NO:	A
FIGURE NO:	1

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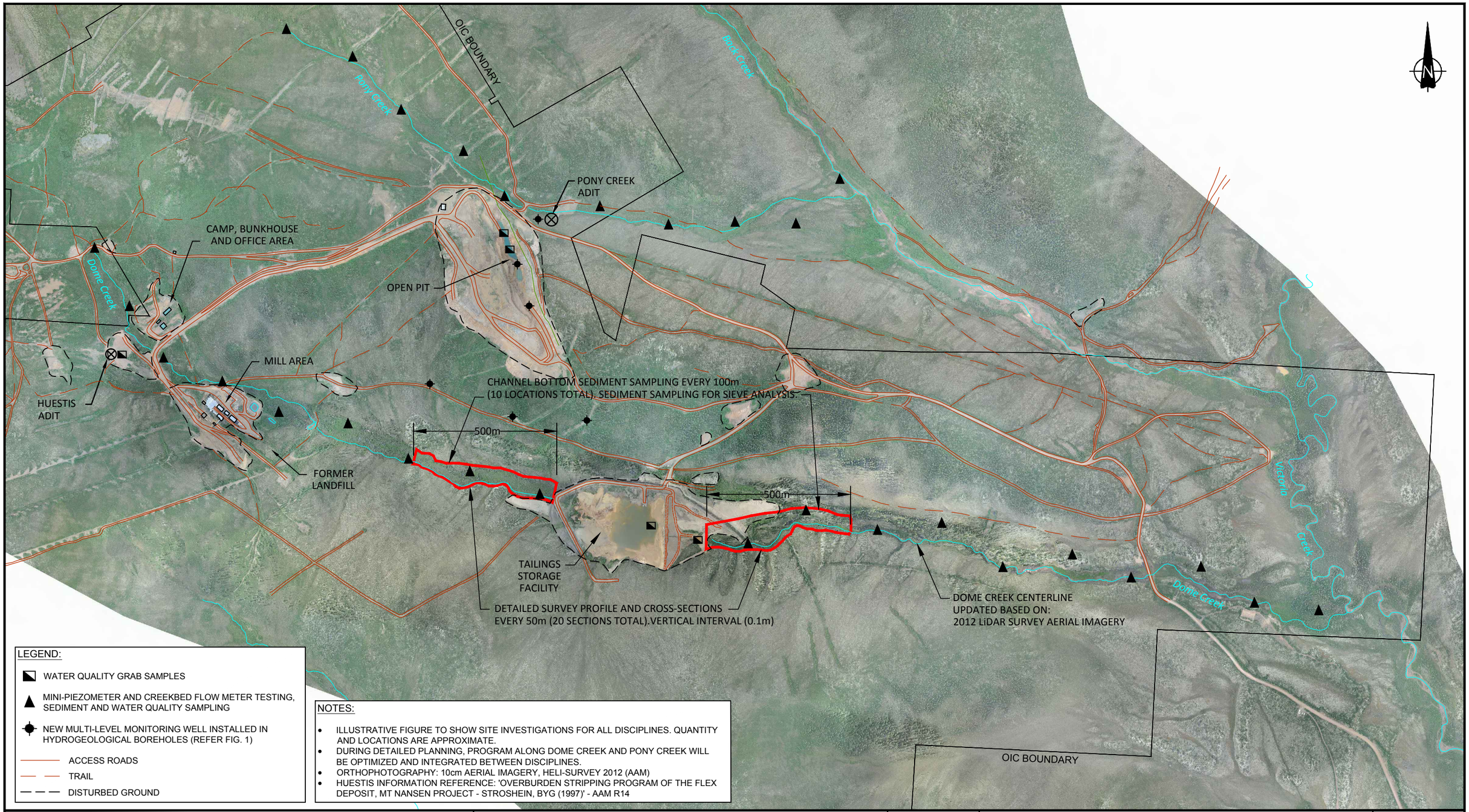

LEGEND:

- WATER QUALITY GRAB SAMPLES
- MINI-PIEZOMETER AND CREEKBED FLOW METER TESTING, SEDIMENT AND WATER QUALITY SAMPLING
- NEW MULTI-LEVEL MONITORING WELL INSTALLED IN HYDROGEOLOGICAL BOREHOLES (REFER FIG. 1)
- ACCESS ROADS
- TRAIL
- DISTURBED GROUND

NOTES:

- ILLUSTRATIVE FIGURE TO SHOW SITE INVESTIGATIONS FOR ALL DISCIPLINES. QUANTITY AND LOCATIONS ARE APPROXIMATE.
- DURING DETAILED PLANNING, PROGRAM ALONG DOME CREEK AND PONY CREEK WILL BE OPTIMIZED AND INTEGRATED BETWEEN DISCIPLINES.
- ORTHOPHOTOGRAPHY: 10cm AERIAL IMAGERY, HELI-SURVEY 2012 (AAM)
- HUESTIS INFORMATION REFERENCE: 'OVERBURDEN STRIPPING PROGRAM OF THE FLEX DEPOSIT, MT NANSEN PROJECT - STROSHEIN, BYG (1997)' - AAM R14

NOTE:
THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE AMEC ENVIRONMENT & INFRASTRUCTURE REPORT No. VM00605 DATED JULY 2013.

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DRAFT

CLIENT: Yukon Energy, Mines and Resources

AMEC Environment & Infrastructure
Suite 600 - 4445 Lougheed Highway
Burnaby, BC V5C 0E4
Tel. 604-294-3811 Fax 604-294-4664

Associated Engineering | GLOBAL PERSPECTIVE. LOCAL FOCUS. | amec

DWN BY:	TH
CHK'D BY:	AW / CM
DATUM:	NAD 83
PROJECTION:	UTM Zone 8
SCALE:	AS SHOWN

PROJECT: MOUNT NANSEN REMEDIATION PROJECT
CONCEPTUAL SITE INVESTIGATION PLAN

TITLE: HYDROLOGY, HYDROGEOLOGY and WATER QUALITY SURVEY, SAMPLING AND INSTALLATION PLAN

DATE:	JULY 2013
PROJECT NO:	VM00605
REV. NO:	A
FIGURE NO:	2

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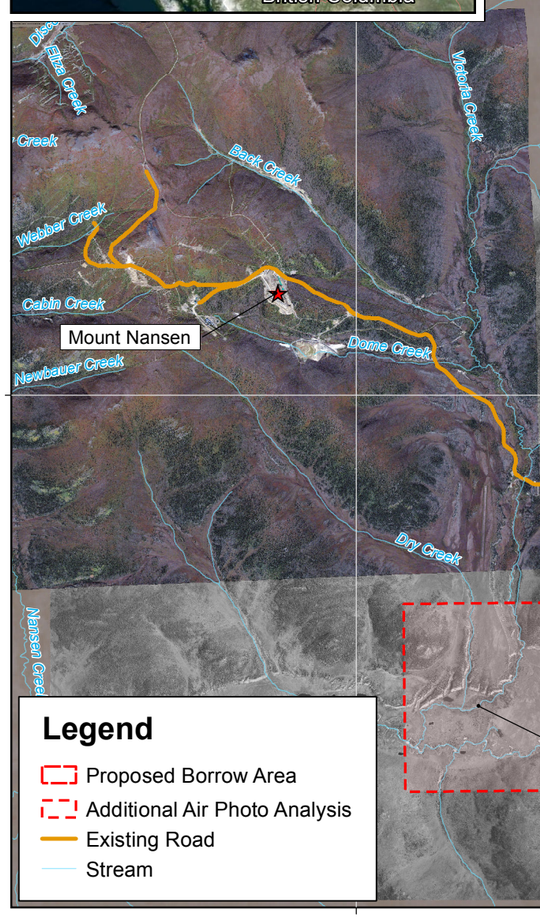

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Access Road to Mount Nansen

Access to Borrow Area 1 (Detailed alignment to be confirmed)

Proposed Borrow Area 1

Fowlinson Creek

Access to Borrow Area 2 (Detailed alignment to be confirmed)

Proposed Borrow Area 2

Fowlinson Creek

Approximate area for additional air photo analysis

Access Road to Mount Nansen

Nisling River

Approximate area for additional air photo analysis

Nisling River

Legend

- Proposed Borrow Area
- Additional Air Photo Analysis
- Existing Road
- Stream

DRAFT

NOTE:
THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE AMEC ENVIRONMENT & INFRASTRUCTURE MEMO NO. VM00605 DATED JULY 2013.

FIRST NATIONS LAND CLAIMS AND QUARTZ CLAIMS WILL BE CONSIDERED PRIOR TO SELECTING ANY POTENTIAL AREAS FOR INVESTIGATION.

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Associated Engineering
amec

DRAWN BY	KC
CHECKED BY	RW
DATUM	NAD83
PROJECTION	UTM Zone 8
SCALE	1:85,000

PROJECT
MOUNT NANSEN REMEDIATION PROJECT
CONCEPTUAL SITE INVESTIGATION PLAN

TITLE
POTENTIAL OFFSITE BORROW AREAS

DATE	JULY 2013
PROJECT NO	VM00605
REV. NO	A
FIGURE NO	3

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23/07/2013