Memo

To:	Josée Perron, P.Eng.		
From:	Serge Chevrier, P.Eng.	**Reviewed By:**	Brian Geddes
Tel:	604-294-3811	**AMEC File No.**	VM00605.TAR2.2160
Email:	serge.chevrier@amec.com	**cc**	Patricia Randell
Date:	31 July 2013		Steven Bartsch
Subject:	Mount Nansen Remediation Project – Preliminary Design Basis Memorandum		

1.0 INTRODUCTION

AMEC Environment & 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.

This memorandum outlines the preliminary DBM and provides an overview of the closure objectives and design criteria for the Mount Nansen site. It also provides comments on input conditions and parameters to be used for the design work. This document is considered an evolving document and will be amended as the project proceeds and new information/assessment results become known.

2.0 PROJECT OVERVIEW

The Mount Nansen site is located approximately 45 km east of Carmacks, in the Yukon Territory. The Mount Nansen site consists of the Brown-McDade Open Pit and associated adjacent waste rock pile; the tailings containment system area and tailings pond dam area with an engineered creek diversion; the mill site buildings and infrastructure with an industrial waste and settling pond and the smaller Mill Site waste rock pile; the Pony Creek adit portal area, the Huetis and Webber adits, and core shack; the camp/office building (lower bench) and kitchen building area and former camp buildings area; derelict equipment and materials storage sites; and multiple access roads and borrow areas. The site covers approximately 1,200 hectares in area and is accessible year-round by an all-weather road from Carmacks, Yukon.

3.0 SCOPE OF DESIGN BASIS MEMORANDUM

- To identify the overall project design objectives.
- To present design concepts with regards to works to be implemented at the site.

- To set out design standards for the overall project.
- To identify what criteria need to be established for each discipline. During the 30% design stage, the actual value of the criteria will be developed.

4.0 DESIGN OBJECTIVES

The closure goals for the site remediation include the following objectives:

- protect human health and safety;
- protect and restore the environment including land, air, water, as well as fish and wildlife and their habitats;
- return the mine site to an acceptable state that reflects original, traditional, and pre-mining land use;
- maximize local, Yukon and First Nation benefits; and
- manage risk in a cost effective manner.

The principal design objectives for the Mount Nansen site are as follows:

1. Mitigate/minimize physical health and safety hazards.
    a. Mitigate on-site fall hazards (e.g., Brown McDade Pit, exploration trenches) by backfilling and/or grading.
    b. Mitigate tailings dam stability/permeability issues by moving tailings from existing storage areas and decommissioning the dam.
    c. Remove site infrastructure.
    d. Seal Open Pit adit(s), if needed for Closure Option 4. Mitigate drainage from other adits outside Open Pit (Huestis, Webber), if needed for surface water remediation.
2. Mitigate risk of exposure to contaminated materials.
    a. Placement of the tailings and waste rock within the Brown McDade Pit and encapsulate with an engineered cover.
    b. Design mitigation and/or remedial programs to address or prevent impacts to groundwater and surface water from historical site uses or during remedial construction.
    c. Assessment, removal and disposal of hazardous materials and petroleum hydrocarbons (liquids or contaminated soil and/or groundwater).
3. Undertake closure measures that will not adversely affect local environmental quality.
    a. Manage surface water and groundwater such that water quality is maintained to regulatory standards (see Section 6.3) at the entry point to the environment (Pony creek and the confluence of Back Creek and Dome Creek with Victoria Creek).
    b. Manage acid rock drainage (ARD) and metal leaching (ML) potential that could have adverse affects on the environment.

c. Rehabilitate surface and watercourse conditions of the tailings facility area to conditions equivalent to the pre-development environment.

d. Improve landforms and general site conditions (i.e., consistent with the general objective of returning the site to conditions that reflect original, traditional and pre-mining land use).

All objectives represent the required steps to place the Mount Nansen site in a *Closed* mine status.

5.0 CONCEPTUAL DESIGN RECOMMENDATIONS

The remedial design will be based on assessment of site data and will recommend the optimum course of action for the following activities as part of the overall remediation project:

Tailings Storage Facility Area

1. Options and reclamation target criteria for the excavation and relocation of approximately 300,000 m^3 of tailings, potentially contaminated soil and portions of the dam to the Open Pit.
2. Options for the removal of tailings in dry, wet and/or frozen conditions.
3. Potential for the relocation of the remaining part of the dam to the Open Pit, adjacent borrow areas, or other fill location on-site.
4. Options for the removal and/or dismantling of the seepage pond dam and associated/proximate infrastructure (e.g., instrumentation, thermosyphons).
5. Restoration, armouring, and revegetation methods for the Dome Creek channel in the area of the former tailings facility and determination of the availability of sources of non-acid generating (NAG) borrow sources and sediment control procedures during construction.
6. Management plan for monitoring and treating (if necessary) water quality during construction.

Open Pit and Waste Rock Areas

1. Management plan for the pit groundwater quality during construction and a management plan for post-construction (including a description of any water treatment requirements).
2. Construction design for the placement of approximately 344,000 m^3 of waste rock to the Open Pit in such a manner as to initially provide a surface above the water table for the tailings placement and subsequently stabilize (if necessary) by placing waste rock in a fashion that prevents tailings from migrating out of the southern portion of the pit.
3. Construction design for the placement of approximately 300,000 m^3 of tailings, reactive ore, and contaminated soil (if applicable) to the pit.

4. Plan for the plugging of the Pony Creek adit to prevent seepage (if necessary to maintain acceptable surface water quality) from the backfilled Open Pit to Pony Creek.
5. Characterization of the proposed borrow material sources in terms of quantity and quality for the low permeability cover and design criteria in which the conversion to a geosynthetic based cover is warranted based on considerations of potential future settlement and maintaining relative impermeability to keep the tailings dry.
6. Design to encapsulate all pit backfill with low-permeability cover (e.g., Vegetated “store-release-divert” low infiltration cover or other options such as synthetic covers).
7. Grading design of the backfilled pit in order to route runoff flows to Pony Creek and Dome Creek.
8. Characterize the PAG (Potentially Acid Generating) and NAG materials at the former waste rock dump areas in terms of quantity, quality and "spatial" distributions.
9. Re-contouring and revegetation plan for the former waste rock areas.
10. Long-term management plan with regards to the inspection of the backfilled pit cover and a failure modes analysis with regards to all aspects of the site where remediation takes place (e.g., pit cover, backfilled material in pit, Dome Creek Valley, landfill, etc.).
11. Long-term and during construction management plan for monitoring the tailings and pit seepage water quality.

Mill and Camp Area

1. Site selection and design for a waste disposal area with regard to the estimated quantities and qualities to dispose of demolition wastes.
2. Disposal plan/design (e.g., recycling, salvaging, and/or landfilling on-site) for the demolition/deconstruction of buildings and facilities.
3. Plan to address fuel or chemical storage equipment (e.g., tanks and rail car), and associated contaminated soil and concrete.
4. Assessment, characterization and removal of hazardous and contaminated products and media (soil/groundwater).
5. Design of surface water flow controls in the Mill disturbance area.
6. Removal plan for reactive rock fill from the old ore transfer site, as well as the mine waste and historic tailings from riparian areas.
7. Decommissioning design of the various storage ponds (Ponds #1 to #3), including:
    a. Characterization of any accumulated solids at pond bottom.
    b. Dewatering of impoundments, removal of accumulated tailings fines, removal and disposal of the liner, assessing pond to identify any remaining tailings.
    c. Re-contouring to ensure no water is being accumulated in the future.
    d. Restoration of watercourse and revegetation.

8. Restoration of Upper Dome Creek watercourse.
9. Re-contouring and revegetating the Mill disturbance area.

Additional Works Designs

1. Reclaim exploration trenches within the Order-in-Council (OIC) boundary using existing available side-cast material, contour to integrate with surrounding terrain, disperse coarse woody material, control drainage, prevent erosion and promote natural revegetation.
2. Decommissioning of non-public exploration and site roads within the OIC boundary that are not required for long term monitoring (e.g., de-compaction and re-contouring).
3. Disposal or salvage of miscellaneous buildings throughout the site.
4. Deactivation of power lines and removal of cables, poles, switchgear and transformers.
5. Disposal of above surface pipelines and insulation debris.
6. Decommissioning and sealing of the artesian well, and removal of the pump house.
7. Disposal of miscellaneous concrete foundations.
8. Delineation and assessment of the historic landfill using AANDC protocols.
9. Development of landfill on-site.
10. Investigate necessity and options for remediation of adits (note: the development of closure/remediation plans for adits will be an integrated effort of the geotechnical and hydrogeological disciplines).

6.0 PROJECT DESIGN CRITERIA

The project will be complying with the [Yukon] *Waters Act*, the *Yukon Environment Act*, and any other acts or regulations found to be relevant to the proposed works. The challenges, constraints and important design considerations and methodologies to address each component will rely on assessment to augment or reconfirm data previously collected to form the basis of an effectively designed program, which will translate to a more efficient implementation of the remedial works.

The following sections outline the criteria for the various disciplines or activities to be implemented in the assessment or design phase.

6.1 Geotechnical Design Criteria

The geotechnical design components of the project will include:

- remediation method and objectives for tailings and Open Pit;
- layout of backfilled pit;

- tailings relocation;
- cover performance and robustness;
- stability of backfilled Open Pit;
- design for earthquake;
- waste rock areas and Open Pit stability;
- stability of slopes included in final reclaimed landscape consideration of current climate and effects of climate change;
- borrow sources; and
- material balance.

Details regarding the geotechnical design issues are summarized in the following table:

Item	Value/Description	Source/Comment
Closure method and objectives for tailings and Open Pit	The tailings facility will be removed and relocated to the Open Pit. The Open Pit will be backfilled with waste rock and tailings. The backfilled pit, including the low grade ore pile will be covered with an engineered cover to limit infiltration. Key objectives are to: • provide a tailings deposit that will meet water quality objectives. The Option 4 concept is intended to achieve this by: o minimizing contact between the tailings and water; and o achieving “dry” tailings in the long term. • provide physical stability for the tailings; and • avoid creating a structure classified as a dam if possible. Waste rock will be placed in the pit bottom so that the tailings can be placed above the water level. Waste rock will be placed above the tailings and the existing low grade ore for physical stabilization and to provide suitable topography for surface drainage and end land use. A low permeability, potentially synthetic cover will be constructed over the backfilled pit area.	Lorax 2011.

Item	Value/Description	Source/Comment
Layout and configuration of backfilled pit	The final configuration of the backfilled pit will aim to avoid creating a structure that would be classified as a dam. Consideration will be given to potentially providing an underdrain system that could be monitored to limit the potential liquid impoundment in the pit. This could also be used as a contingency measure to remove/treat impacted water from the tailings during and immediately following the construction period (or any other time) if necessary. The final configuration of Open Pit containment structure will be established giving due consideration to the volumes of tailings, waste rock and contaminated soil that must be placed in the structures, and on the methods used to complete the relocation of these materials.	Lorax 2011.
Tailings relocation	The tailings relocation method will be determined in consideration of: • The design objective of achieving dry tailings in the long term. • Ability to provide a stable long-term foundation for a low infiltration cover. • Current state of the tailings. • Local experience and expertise available. • Cost effectiveness. • Safety considerations during removal operations.	Identification of an optimal method for relocating the tailings and the priorities of competing objectives in this regard is a significant data gap. Assessments (including considerations of past tailings reclamation/ relocation studies) and possibly a trade off study are still required.
Temporary slopes	Temporary slopes will be designed to provide a safe working environment.	Slopes required for safety will depend significantly on the relocation methods employed.
Cover footprint	The geometry of the Open Pit containment structure and its cover will be configured to avoid encroaching on the public road at the north end of the Open Pit that will remain post closure.	
Cover performance	The cover will be designed to limit infiltration to that required for acceptable water quality. The current design basis is that infiltration be limited to 5% mean annual infiltration. The cover design will take into account the expected long term movement (settlement or heave) of the material underlying the cover.	Lorax 2011.

Item	Value/Description	Source/Comment
Cover robustness	The cover will be designed to provide long term control of infiltration. This will include a long term management plan.	Lorax 2011 includes a geosynthetic liner as the most viable cover design. Detailed design will consider the inclusion of geosynthetic elements (e.g., geomembrane, geosynthetic clay liner) that would meet design infiltration rates and promote durability and increased design life of the cover.
Stability of backfilled Open Pit	The backfilled Open Pit will be designed to have acceptable long term stability: • Minimum factor of safety with respect to long term stability of 1.5. • Minimum factor of safety under design earthquake loading of 1.1. Best efforts will be made to design a backfilled pit that does not require a dam. It is noted that should a dam be required, CDA guidelines would apply.	CDA if applicable.
Design earthquake	Will be determined based on the design element being considered. • For slopes, a return period of 1 in 475 or 1 in 2,475 will be used as appropriate. • If the backfilled Open Pit is considered a dam then the guidelines from the Canadian Dam Association will be followed.	CDA or building codes as appropriate.
Waste rock areas	All remaining waste rock areas will have slopes that provide adequate factors of safety with regard to stability (as described above), allow revegetation, and are consistent with the desired end land use. The specific locations of stabilized waste rock slopes will be influenced by the final details of the Materials Management and Containment Plan.	Design will take into consideration the Yukon Mine Site and Remediation Closure Policy, Technical Guidelines and the Interim Guidelines of the British Columbia Mine Waste Rock Pile Research Committee.
Slopes	All slopes that will form part of the remediated landscape at the site, including any pit wall slopes that remain exposed, will provide adequate factors of safety with regards to stability (as described above). Final slopes will also be established considering reclamation and safety requirements and/or constraints (e.g., vegetation and surface drainage plans, falling hazards for areas that are accessible post closure).	

Item	Value/Description	Source/Comment
Open Pit stability	Procedures and mitigative measures will be confirmed to provide a safe working environment during pit backfilling operations.	Open pit stability is an issue primarily during remediation construction.
Consideration of current climate	The impact of the current climate on the restoration and remediation work will be assessed and mitigative strategies developed as required.	Issues to consider include the potential for thermokarst and thermoerosion in areas that are disturbed and the potential for the formation of adverse conditions in areas material is subjected to freezing.
Consideration of the effects of climate change	The potential impact of climate change on long term performance of remediation measures will be considered.	Assessments will include the findings from the Climate Change and Permafrost Workshop Report and the Canada Country Study, Climate Impacts and Adaptation.
Borrow sources	Local borrow sources will be identified to meet project requirements. In selecting borrow areas, consideration will be given to minimizing the footprint and post-construction reclamation of the impacted areas.	

6.2 Hydrotechnical Design Criteria

The hydrotechnical design at the Mount Nansen site will focus on the following main elements:

- overall site hydrological characterization and analysis;
- restoration of Dome Creek including the tailings area and seepage pond;
- diversion channels around the Brown McDade Pit area (water to be diverted from the cover and any upstream areas to the northwest);
- cover surface drainage and erosion control;
- construction water management plan and erosion and sediment control plan; and
- site water balance modelling.

Details regarding the hydrotechnical design issues are summarized in the following table:

Item	Value/Description	Source/Comment
Overall site hydrological characterization and analysis	Investigation to understand the unique hydrological characteristics of and water flow paths at the site that will affect the remaining and proposed hydrotechnical design features.	Hydrological factors to be evaluated will include: watershed areas and characteristics; climatic factors (such as extreme temperatures, design storms); local and regional watercourses; natural drainage patterns (temporal and spatial); and how watercourses (flow paths) have been affected by the project.

Item	Value/Description	Source/Comment
Restoration of Dome Creek	Two areas of the Dome Creek will require restoration, the area around the mill and the area around the tailings storage facility. The goal of Dome Creek restoration is to establish self-sustaining stream functions. This can be achieved by making its morphologic structure and fluvial function more consistent with that of a dynamically stable natural stream, based on the undisturbed upstream and downstream conditions. It is assumed that the channel will form in natural alluvial material at the bottom of the tailings, if appropriate material is not present, the channel may be lined using granular material.	Preliminary hydraulic analysis will be performed using Mannings equation (Flowmaster) or HEC-RAS (if required). Additionally, an analog approach will be employed, where an upstream or downstream dynamically stable section of the creek will be used as a template for the design. 1 in 2 year return interval (for the regular flow channel). The creek will also be evaluated for the larger storms, 1 in 200 year, 1 in 1000 year, and probable maximum flow.
Diversion channels around Brown McDade Pit area	The diversion channel will be designed around the pit. The objective of the diversion channel is to keep upstream runoff away from the pit area and protect the cover from erosion. On the downstream side of the pit area, diversion channels might also be required to route and collect runoff from the cover.	Sized to route the design storm event (the appropriate return period for this event will be reviewed and defined during the design). A catchment hydrological model such as HEC-HMS will be used to estimate discharge.
Cover surface drainage and erosion control	The purpose of the cover surface drainage and erosion control is to prevent direct precipitation from collecting on the cover and infiltrating through the cover. The cover surface drainage and erosion control will be designed to route flows to Pony Creek for the northern half of the pit area and to Dome Creek for the runoff generated in the southern half of the pit.	The cover will be designed to have a gentle slope to facilitate direct precipitation to shade off the cover to collection ditches (if required), which will route water to the perimeter diversion ditches. The cover will also be designed to minimize erosion of cover material and to route the design storm event (the appropriate return period for this event will be reviewed and defined during the design).

Item	Value/Description	Source/Comment
Site and construction water management plan and erosion and sediment control plan	The construction water management plan (CWMP) and erosion and sediment control plan (ESCP) will cover all the areas on site disturbed due to the remediation construction activities. These will include: • Tailings area • Pit area • Mill/Camp area • Backfill trenches • Landfill area • Dome Creek • Borrow area The purpose of the CWMP is to manage runoff and stormwater in a manner that maintains work areas to be in a suitably dewatered condition to allow construction to proceed, and that minimizes non-contact water from entering areas disturbed by construction activities, thus reducing potential erosion and sediment loading. The CWMP will also address the management of any water that may require treatment during and following the construction period and address post closure erosion mitigation and/or control requirements.	Different elements of the water management plan have different design criteria but will be implemented using standard industry elements. Appropriate return periods for design storm events will be reviewed and defined during the design.
Site water balance modeling	The water balance model provides an understanding of total inflow and outflow of water at selected water collection points on the site. The purpose of water balance modelling is to provide an understanding of site average water volumes or quantities over longer periods of time – day, month or year. Water balance analysis is typically evaluated on a monthly or annual basis. At the Mount Nansen site, the objectives of water balance modelling are: • Estimate total water volumes and quality at key water collection points at the site. • Estimate water volumes of different water types on-site, particularly water which might require treatment.	An existing GoldSim site water balance model will be employed and updated as required. The site water balance should be evaluated for an average year, and for a selected dry and wet year (e.g., 1 in 100 year dry and 1 in 200 year wet).

6.3 Hydrogeological Design Criteria

The hydrogeological design at the Mount Nansen site will include the following main elements (note: the associated performance objectives will be monitored post remediation at compliance points that are established during the design):

- maintaining or lowering long-term water levels in the Open Pit;
- maintaining surface water quality – Pony and Back Creeks;
- improving/maintaining surface water quality – Dome Creek;
- improving/maintaining water quality related to historic and new landfills, the Mill area and areas around adits (Huestis and Webber Deposit areas, as applicable to OIC boundary);
- improving/maintaining water quality during implementation and post-construction phases of Closure Option 4; and
- decommissioning former water supply well(s) at Victoria Creek.

Details regarding the hydrogeological design issues are summarized in the following table:

Item	Value/Description	Source/Comment
Brown McDade Pit water levels	As needed for Closure Option 4, the mitigation design will reduce shallow groundwater inflow to Open Pit from Pony Creek, i.e., via shallow, fractured bedrock. Pit water balance update to identify long-term pit water level range and any design needs for pit water lowering To implement Closure Option 4.	Lorax 2011. For Closure Option 4, maintain long-term pit water level below El. 1190 m (TBC), to minimize water contact with tailings.
Pony/Back Creeks water quality – point of compliance near Victoria Creek	Design to maintain water quality in Pony and Back Creeks. Quantification of groundwater-surface water interaction and quality with respect to contaminants from Open Pit moving into Pony Creek watershed during implementation and post-construction phases of Closure Option 4. Definitions of adit modification/management requirements needed to satisfy pit containment performance specifications.	Lorax 2011. Defined by Government of Yukon protocols and Canadian Council of Ministers of the Environment (CCME) freshwater aquatic quality guidelines, adjusted to reference site water quality and compliance with Department of Fisheries and Oceans (DFO) requirements.

Item	Value/Description	Source/Comment
Dome Creek water quality – point of compliance near Victoria Creek	Design to improve/maintain water quality in Dome Creek. Quantification of groundwater-surface water interaction and quality with respect to contaminants from the Open Pit to the Dome Creek watershed during implementation and post-construction. Quantification of groundwater-transported contaminants originating from adit point sources (Huestis and Webber Deposit areas, as applicable to OIC boundary).	Lorax 2011. Defined by Government of Yukon protocols and Canadian Council of Ministers of the Environment (CCME) freshwater aquatic quality guidelines, adjusted to reference site water quality and compliance with Department of Fisheries and Oceans (DFO) requirements.
Former water supply well(s) at Victoria Creek	Conduct existing water well survey of depth and flows for applicable decommissioning design.	R056 Desktop Hydrogeological 2007 GLL. Decommission according to YG protocols and best practice for disused, artesian, water supply wells.

6.4 Water Quality Design Criteria

Several water quality design issues have been addressed in the hydrotechnical and hydrogeological sections, but the overall focus of water quality as part of the project will consist of the following components:

- Brown McDade Pit and Tailings Storage Facility water treatment and release to receiving water bodies;
- mine site water quality management during and post remediation (including the consideration of waste rock/water interactions both within and outside the pit containment structure); and
- water quality protection plan and monitoring in streams and water bodies at the site.

Details regarding the water quality design issues are summarized in the following table:

Item	Value/Description	Source/Comment
Brown McDade Pit, tailings area, and small tailings ponds water treatment and release Water quality monitoring during and post construction	Identify volumes of water in the pit and tailings pond qualities considering its vertical heterogeneity and limited mixing. Select treatment methods and suggest any modular/mobile treatment equipment/plant that may be appropriate. Select and suggest receiving environment and allowable discharge rates.	Water quality reports; geotechnical study reports; treatment plant specification. Water quality guidelines for effluent discharges and water quality; available site specific hydrological studies and analysis of seasonal flow pattern in potential effluent receiving creeks.

Item	Value/Description	Source/Comment
Site water quality management (in accordance with Option 4)	Refine and develop site water balance (in cooperation with hydrotechnical and hydrogeology tasks) and water quality model for water management. Site water balance and water quality model, including stream drainages, site facilities (pit, tailings, ponds) seepages and runoffs, surface-groundwater interactions. Model will support remediation (construction phase) for Option 4, mitigation measures, and prospect to post-closure period.	Hydrological and water quality monitoring data in creeks; seepage data and reports on modelling study for the facilities; climate data; geochemical characteristics for pond, waste rock, tailings, mill area. Existing Closure Alternatives Water Balance/Water Quality Model prepared for the site with updates to be developed. Applicable water quality and sediment guidelines. Site specific water quality guidelines to be developed.
Water quality protection plan for Pony Creek, Back Creek, Dome Creek, and Victoria Creek	Suggest and design water quality and sediment quality protection plan during remediation and post-remediation. Develop and conduct water quality monitoring program during remediation/construction phase and post construction. Investigate the site specific efficiency and suggest any required water treatment options for the post-remediation phase. Set water quality objectives during and post construction.	Site specific studies for water quality, bottom sediments, benthos. Existing monitoring programs and reports, list of parameters, detection limits. Drainage structure, remediation plan and schedule. Site specific water quality guidelines (in consideration of existing background water quality and application of CCME Site Specific Application of Water Quality Guidelines and/or BC MoE methodology).

6.5 Infrastructure Design Criteria

Design of infrastructure rehabilitation actions will include:

- demolition/deconstruction of site buildings, equipment, site roads, and storage facilities (note: remediation designs will be developed to avoid encroaching on the public road at the north end of the Open Pit that will remain post closure);
- landform improvements;
- survey for final performance;
- general grading of site and exploration trenches;
- removal and/or remediation of miscellaneous infrastructure;
- considering Energy Balance issues during remediation; and
- considering the infrastructure support requirements during remediation and developing the infrastructure decommissioning sequence accordingly.

Details regarding the infrastructure design issues are summarized in the following table:

Item	Value/Description	Source/Comment
Camp and Mill areas	Identify all structures for demolition/ deconstruction. Include generic structure description, for example 'steel cladded timber framing, and concrete floors.' Identify attached services, pipes, wiring, appliances and equipment content. Identify hazardous materials and location, for each structure. Identify lead paint, PCBs, arsenic, hydrocarbons, etc., Include soil around foundations and under floors. Identify materials for reuse, for recycle, banned, for managed waste or for disposal. Identify receiver agents for hazardous wastes and materials. Develop deconstruction bid specifications, including performance criteria for waste stream diversion; for example, 75% minimum waste diversion; 10% minimum reused.	EBA report, December 2011. Site structure survey.
Miscellaneous tanks and vessels, all areas	Identify all structures for demolition/ deconstruction. Include generic structure description, for example 'steel cladded timber framing, and concrete floors.' Identify attached services, pipes, wiring, appliances and equipment content. Identify hazardous materials and location, for each structure. Identify lead paint, PCBs, arsenic, hydrocarbons, etc., Include soil around foundations and under floors. Identify materials for reuse, for recycle, banned, for managed waste or for disposal. Identify receiver agents for hazardous wastes and materials. Develop deconstruction bid specifications, including performance criteria for waste stream diversion; for example, 75% minimum waste diversion; 10% minimum reused.	EBA report, December 2011. Site structure survey.

Item	Value/Description	Source/Comment
Site wide landform	Improve aesthetics of landforms. Prepare a design for the reclaimed landscape. Outline techniques for creating mining landforms.	G. McKenna *et al*. Buchko and Hitch (2010) McKenna G. (2009) As a recent adjunct to the mine remediation process there are no standards in so far as quantifying aesthetics is not an exact science. There is a link between form and function that suggests the finished landscape should look natural as such is a valid component of the process.
Survey	Current LiDAR data has perceived accuracies of 15 - 30 cm. Ground truthing or additional survey may be required.	BGC Engineering LiDAR data.
General site grading	Prepare plan for general site grading to include remediation of pits, tailings areas, mill/camp areas and roads. Determine grades using best management practices to prevent ongoing erosion. Coordinate with revegetation and landform engineering.	Lorax 2011.
Roads	Assess grading and decompaction requirements needed to restore road alignments to conditions compatible with reclamation objectives.	
Exploration trenches	Assess historical trenches across the property ranging from 1 to 3 m deep. As warranted, prepare grading plan to meet natural slope and general area. Revegetate graded trenches as appropriate.	Lorax 2011.
Miscellaneous infrastructure	Assess power infrastructure, pipelines, minor structures, core storage areas. Prepare general disposal plan through Best Management Practices and local regulations if deemed hazardous.	Lorax 2011. Additional information required. EBA report, December 2011.

6.6 Site Characterization

The site characterization for the remedial design at the Mount Nansen site will focus on the following main elements:

- ARD and Metal Leaching (ARD/ML);
- Soil Hydrocarbon Concentrations;

- Groundwater and Surface Water Hydrocarbon Concentrations; and
- Characterization of the contents of tanks identified under the infrastructure scope as potentially containing hazardous and/or dangerous materials (including assessment of the Fuel Storage Tank and Rail Tanker).

Details regarding the site characterization issues are summarized in the following table:

Item	Value/Description	Source/Comment
ARD and Metal Leaching (ARD/ML)	ARD/ML risk from the pit, waste rock dump, ore stockpiles, tailings storage facility, and the other project locations should be assessed and minimized during the closure. The assessment on ARD/ML risk will require sufficient geochemical characterization and ARD/ML prediction information from the affected geologic material of the project site.	Reports of previous ARD/ML studies at Mount Nansen including Lorax 2011, Altura 2010, Altura 2009a, Altura 2009b, Altura 2009c, Lorax 2008, CANMET 2002. Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials (MEND 2009).
Soil, groundwater and surface water hydrocarbon concentrations	Soil, groundwater and surface water hydrocarbon contamination on-site will be assessed. If contamination is identified, a remedial plan will be designed to remove and/or remediate the contaminated materials.	Lorax 2010, Conor Pacific 2000, Kearah & Weri 2006, EBA 2011, Kearah 2008 Canadian Environmental Quality Guidelines 1999 (updates to 2013) and the Yukon Contaminated Sites Regulation 2002.
Hazardous materials	Hazardous materials will undergo assessment/ delineation and individual abatement/ remediation plans will be developed.	Conor Pacific 2000, Strathcona Mineral Services 2000, SENES 2003, Kearah & Weri 2006, Kearah & Weri 2008, and EBA 2011.
Fuel storage tanks	Fuel storage tanks will be emptied, steam cleaned and removed from site for either recycling or waste. Their contents and steam clean product will be relocated off-site for recycling or disposal in accordance with applicable regulations.	EBA Engineering 2011. Kearah Environmental 2008. Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations 2008.

Item	Value/Description	Source/Comment
Rail tanker removal	The rail tanker will be emptied, steam cleaned and removed from site for either recycling or waste. Its contents and steam clean product will be relocated off-site for recycling or disposal in accordance with applicable regulations.	Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations (SOR/ 2005-149). *Canadian Environmental Protection Act* 1999. *Transportation of Dangerous Goods Act* 1992 (c. 34) updated 2012.12.05. Transportation of Dangerous Goods Regulations (SOR/2001-286). *Occupational Health and Safety Act* Chapter 159. Occupational Health and Safety Regulations, O.I.C. 2006/178. Workplace Hazardous Materials Information System Regulations, O.I.C. 1988/107.

6.7 Drafting Design Criteria

All components of the design assessment will be georeferenced to UTM coordinates (NAD83/UTM zone 8N) for implementation of the design. Drafting will be conducted in AutoCAD™ and GIS work will be completed using ArcGIS. These formats are consistent with the data provided by AAM and will allow transition between AMEC and Associated Engineering offices as well as other project partners.

7.0 REFERENCES

Altura Environmental Consulting, *Brown McDade Waste Rock Pile Mount Nansen Mine Site, Yukon, Geochemical Characterization*, 2009a.

Altura Environmental Consulting, *Brown McDade Waste Rock Pile Mount Nansen Mine Site, Yukon, Summary of 2009 Work Program*, 2009c.

Altura Environmental Consulting, *Mount Nansen Mine Closure: Mill Area Geochemical Characterization, Summary of 2010 Field Investigation*, 2010.

Altura Environmental Consulting, *Mount Nansen Mine Closure: Mine to Mill Haul Road Summary of Rock Characterization Studies*, 2009b.

BC Ministry of Environment, Water Stewardship Division, *Approved Water Quality Guidelines*, 2006.

BGC Engineering Inc., *LiDAR Acquisition at Nansen Mine Complex*, Prepared for Yukon Government, EMR, AAM Branch, 2013.

British Columbia Mine Waste Rock Pile Research Committee, *Interim Guidelines*, 1992.

Buchko, J. and M. Hitch, *Designing the Reclaimed Landscape — Integrating Landscape Architecture into the Mining Process*. Proceedings: Fifth International Conference on Mine Closure, 2010.

Canada, Government of, *Hazardous Products* Act*. c. H-3*, 1985 (amendments in 2011).

Canada, Government of, *Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations*, SOR/2008-197. 2008.

Canada, Government of, *The Canadian Environmental Protection Act. c. 33*, 1999.

Canada, Government of, *Transportation of Dangerous Goods Act and Regulations. c. 34,* 1992 (amendments in 2011 and 2012).

Canadian Council of Ministers of the Environment (CCME), *Canadian Environmental Quality Guidelines*. 1999 (updates to 2013).

Canadian Dam Association, *Dam Safety Guidelines*. 2007.

CANMET Mining Lab, *Assessment of Chemical Stability of Impounded Tailings*, 2002.

Conor Pacific, *Historical Review, Site Assessment and Field Program Version 2 Final Report*, 2000.

EBA Engineering Consultants Ltd., *Hazardous Materials Classification, Mt. Nansen Minesite, Yukon*, Prepared for Yukon Energy Mines and Resources Assessment and Abandoned Mines, 2011.

Health Canada, *Guidelines for Canadian Drinking Water Quality*, Water, Air and Climate Change Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario, 2012.

Kearah & Weri. *Hazardous Materials Inventory and Site Assessment*, 2006.

Kearah Environmental, *Limited Phase 2 Environmental Site Assessment draft rev 2,* 2008.

Lorax Environmental Services Ltd., *Mount Nansen – Options for Closure*. Prepared for Assessment and Abandoned Mines Branch, Department of Energy, Mines, and Resources; Government of Yukon, 2011.

Lorax Environmental Services Ltd., *Mt Nansen Tailings Porewater Assessment*, 2008.

Lorax. Environmental Services Ltd., *Mount Nansen Closure Plan Options Evaluation, Draft*, 2010.

McKenna, G. et al., *Aesthetics for Mine Closure*. Mine Closure 2011, Alberta, Canada, 2011.

McKenna, G., *Techniques for Creating Mining Landforms with Natural Appearance*. Proceedings of Tailings and Mine Waste '09 Conference, 2009.

MEND. *Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials.* Natural Resources Canada, 2009.

Saskatchewan, Government of, *The Mineral Industry Environmental Protection Regulations. Chapter E-10.2 Reg 7, The Environmental Management and Protection Act,* 1996.

SENES Consultants. *Human Health Screening Level Risk Assessment*, 2003.

Strathcona Mineral Services Ltd. *Review of the Mt Nansen Property*, 2000a.

Yukon, Government of, *An Act to Amend the Quartz Mining Act. Statutes of the Yukon, S.Y., c.19*, 2008.

Yukon, Government of, *Contaminated Sites Regulation. Statutes of the Yukon, OIC 2002/17*.

Yukon, Government of, Energy, Mines & Resources, *Yukon Mine Site Reclamation and Closure Policy*, ISBN 1-55362-273-1, Whitehorse, YK, 2006.

Yukon, Government of, *Environment Act. Statutes of the Yukon, R.S.Y., c.76,* 2002.

Yukon, Government of, *Quartz Mining Act. Statutes of the Yukon, S.Y., c.14,* 2003.

Yukon, Government of, *The Yukon Environmental and Socio-economic Assessment Act. S.C., c. 7*, 2003.