MEMO

To	Josée Perron, P.Eng.		
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Date	24 July 2013		

Subject **Mount Nansen Remediation Project**
Freshet Site Visits 16 and 21 to 23 May 2013
Final – Revision 1

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). This memorandum summarizes the findings of tasks conducted during a recent site visit, undertaken on 16 and 17 May and 21 to 24 May 2013, with objectives and a work scope as defined in Task Authorization Request TAR #3 (Freshet, Modeling, Ongoing Tasks, TAR Support). The purpose of TAR #3 is to allow the execution of time sensitive tasks, including freshet conditions on the project site during May 2013.

2.0 BACKGROUND

A site visit coinciding with near peak freshet conditions was discussed at project meetings with AAM, held in Whitehorse on 11 April 2013. A four person team was selected on the basis of disciplines and specializations closely associated with water flow and quality, including: hydrology, hydrogeology, environmental site characterization and also permafrost conditions.

One team member conducted field work during 16 May 2013, to coincide with the peak freshet period, as quantified by the monitored flow rate at the tailings seepage pond, which had 'spiked' to 350 Lpm (Denison Environmental Services data). Three other team members conducted field work during 21 to 23 May, 2013, inclusive. The main tasks and team member roles are summarized in the following Table 1.

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Table 1: Freshet Site Visit Team

Team Member	Site Visit Dates	Role on the Freshet Team	Tasks Conducted
Paul Morton	22 and 23 May	Lead Hydrogeologist and Freshet Team Lead	Reconnaissance of: - candidate hydrogeology borehole locations; - Dome Creek and Pony Creek streambeds; - area west and south of mine camp for signs of former adits. Downloaded dataloggers (Barologger and Leveloggers). Measured groundwater levels and checked total depths in non-frozen wells. Reviewed Victoria Creek water supply well (flow rate only).
Robyn Andrishak	22 and 23 May	Hydrologist	Reconnaissance of Dome Creek and Pony Creek streambeds and culverts. Reviewed active channels at high creek flows. Measured surface flow rates at key water course locations.
Nicole Jacques	16 May, and 21 – 23 May, incl.	Lead Site Characterization	Sampled surface water at: - ore ramp; - mill area (2 samples); - West Lower Waste Rock Dump; - lysimeter (L2); - leachate in field bin test; - runoff from exploration trenches (2 samples); and - runoff from downstream of waste rock pile (DES Seeps). Groundwater sampling of: - MW09-02; and - MW09-15. Measured groundwater levels check well conditions.
Alex Tchekhovski	21 – 23 May, incl.	Permafrost Specialist	Reconnaissance of: - open pit and vicinity; - Dome Creek and Pony Creek water sheds; - Victoria Creek pumphouse area.

The addition of a permafrost specialist was discussed with AAM with objectives of reviewing terrain to identify permafrost-related factors at an early stage, prior to finalizing 2013 site investigation plans.

3.0 SCOPE OF WORK

As shown Table 1, four senior project team leads visited the site in May 2013 for the purposes of witnessing freshet conditions and to understand local permafrost conditions. Of the disciplines and specializations associated with water flow and quality, the more time-dependent technical focus for the site visit was hydrology, notably to observe and conduct some quantification of active surface water channels and flow rates. For safety reasons, the period immediately following (i.e., the week after) peak freshet conditions was preferred for the hydrology measurements and for the reconnaissance of the main creeks.

The scope of work, as described in TAR#3 for the four disciplines and specializations associated with water, are summarized below.

3.1 HYDROLOGY

For an understanding of the overall site drainage and water flow paths, the following hydrological items were included:

- Identify and describe flow patterns and paths of the site surface drainage.
- Identify and describe groundwater discharge/springs to surface flow. If possible, measure the flow.
- Flow characteristics of Dome Creek and Pony Creek and all tributaries. Measure flows at key locations in Dome and Pony Creek using a Swoffer/flowmeter. Document the changing channel characteristics, i.e., single versus braided channels.
- Measure flow at one or more locations in the diversion channel surrounding the tailings impoundment.
- Estimate the pond water elevation in the pit, noting any visible discharges into the pit.
- Estimate water elevation in the tailings pond and seepage collection pond.
- Note any surface water flow around the waste rock dumps.

3.2 HYDROGEOLOGY

The site visit was an opportunity to download water level data from existing on-site instrumentation, last performed in June 2012. The accessibility to proposed drill rig equipment and manual probe surveys was also reviewed, as follows:

- Open pit, interior - review accessibility to drill rig and candidate locations for two (2) boreholes.

- Open pit, interior - download groundwater level data from two loggers (Solinst Barologger and Levelogger) housed in monitoring well (GLL07-03) and one data logger (Solinst Levelogger) installed within the pit pond, using existing direct-read cables.
- Open pit, exterior north area - review accessibility to drill rig and candidate location for one (1) borehole.
- Open pit, exterior north area - download groundwater level data from one logger (Solinst Levelogger) housed in monitoring well (GLL07-01), using existing direct-read cable.
- Open pit, exterior south area - review accessibility to drill rig and candidate locations for three (3) boreholes.
- Dome Creek and Pony Creek – observe creek bed conditions for manometer and seepage meter manual probe surveys, plus creek bank conditions for temporary mini-piezometer installations.
- Huestis Zone area, west of site camp – if observed, record GPS coordinates of signs of mine adit drainage, i.e., active surface seeps.
- Victoria Creek water supply well – measure total well depth and artesian flow rate.
- In-service and accessible groundwater monitoring wells – measure static water level, or top of frozen water, as applicable. Update the general well condition status which was last checked in 2012 (EBA, 1 to 5 June 2012).

3.3 WATER QUALITY/GEOCHEMISTRY

Surface water samples will be collected at key runoff locations. The proposed sampling locations include:

- Groundwater wells located at tailings pond dam and downgradient.
- Waste rock pile runoff and lower slope seeps.
- Dome Creek, Pony Creek and possibly tributaries.

The selected groundwater sampling will be conducted close to the peak freshet period, with other tasks following shortly afterwards. In addition, the site visit will provide an opportunity to review the condition of the field bin testing and sample the leachates.

3.4 PERMAFROST

A site reconnaissance-level site visit will be conducted as an initial assessment of permafrost conditions at the site. The following field observations will be carried out:

- Determination of vegetative indicators for frozen and unfrozen terrain units.
- Estimation of permafrost conditions in the open pit.
- Estimation for initial frozen/unfrozen conditions of terrain units over the present tailings and waste rock stockpile.

- Assessment of permafrost conditions for the Dome Creek valley, within the present tailings, based on conditions of the creek valley upstream and downstream from the tailings.
- Visual observation of erosion parameters for granular/cohesive overburden which would be required to calculate/predict erosion and thermoerosion within the portion of the Dome Creek valley to be re-engineered and restored.
- Assessment of permafrost extent across the remainder of the site.

4.0 FIELD ('RAW') DATA

The following 11 data files accompany this 24 July 2013 memorandum. As requested by AAM (18 July 2013), this information is provided as 'raw data' without interpretation.

(a) Monitor wells - groundwater manual levels, field notes and comments. Excel field file:
- *MNRP - Freshet Gw Field Data - May 2013.xlsx*

(b) Monitor wells - groundwater logger levels. Solinst Levelogger data files:
- *Logger - GLL07-03 Pit Well 2010-08-11 to 2013-06-14.csv*
- *Logger - MW09-03 2011-10-17 to 2012-10-15.csv*
- *Logger - MW09-04 2011-10-17 to 2012-10-15.csv*
- *Logger - MW09-15 2009-07-19 to 2013-06-14.csv*

(c) Monitor wells - groundwater chemistry at MW09-02, MW09-24. ALS laboratory report files:
- *Lab Report L1303472_COA.PDF*
- *Lab Report L1303472_XLR.xls*

(d) Open pit - pond water levels. Solinst Levelogger data files:
- *Logger - Mt Nansen Pit Baro 2010-08-11 to 2013-06-14.csv*
- *Logger - Mt Nansen Pit Pond 2010-08-04 to 2013-06-14.csv*

(e) Surface water - water chemistry at Ore Ramp Waste Rock, Pile 01, Lower Platform, Upper Platform. ALS laboratory report file:
- *L1303465_COA.PDF*

(f) Surface water - water chemistry at L2 (Lysimeter), Tailings Sand (Humidity Cell), Trench Above Mill Road 01, Trench Above Mill Road 02, DES-03. ALS laboratory report file:
- *L1307027_COA.PDF*

5.0 WHITEHORSE MEETING

A meeting with Associated Engineering staff in Whitehorse was proposed in TAR#3. This was effectively completed during the site field work, as AMEC and Associated Engineering senior staff representatives attended the freshet site visit.

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TABLE

Table 2: Summary of Freshet Site Visit Findings and Recommendations

Discipline/ Specialization	Freshet Site Visit Item	Findings	Implications for 2013 Site Investigation	Comments and Recommendations (If Applicable)
Hydrology	1 – Dome Creek.	Channel has been modified in the upper reaches and the natural channel is poorly defined within a wide valley bottom covered by low-lying vegetation and spongy mosses. Water percolates slowly through this plant material and braid or meander very irregularly.	Verify observation as part 2013 SI program.	
		Strong influence of ice was noted along Dome Creek, where the channel is more 'natural'. There were various meltwater channels cut into the ice cover and runoff was being conveyed through that system.		
		The stream was braiding through ice meltwater channels both above and below the diversion channel. The reach immediately downstream of the seepage pond outlet was the only segment that was somewhat confined to a more typical channel, but this is likely due to encroachment of the valley bottom on the north side of the creek in this roughly 500 metres reach.	Compare spring time braided channels in ice and summer braided channels in soil. And see if there is any similarity in alignment.	
		Select flow measurements were performed in the diversion channel (Q=0.111 m^3/s) and near the mill building (Q=0.016 m^3/s). Runoff was observed around and below the mine mill building that would enter Dome Creek below the upstream measurement site. The middle pond below the mill was full to crest and over-spilling its outlet. The discharge there could not be measured.	Conduct flow measurement in similar locations during the 2013 for comparison.	
		There was also a significant ice sheet that would have been melting and adding flow along the reach immediately upstream of the diversion channel, below where the upstream measurement was taken.		

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	2 - Pony Creek.	This channel is incised within its local valley at the upper reaches and approximately 500 metres before the confluence with Back Creek. At that point, it splits into two or three channels. The dominant channels were to the north; the southern most were not flowing at the time of the site visit, but there was evidence that these channels flow during the peak event.		
Hydrogeology	1 - Open pit, interior - review accessibility to drill rig and candidate locations for two (2) boreholes.	Freshet site visit observations appear to have coincided with the annual peak for minor rock movement, caused by snow and ice melt, plus diurnal temperature changes. Rockfall and debris slides from the west pit wall have blocked drill rig access to the central area of the open pit, i.e., between the two pit ponds. There is drill rig access to the area immediately at the ramp base at the pit floor elevation, i.e., adjacent to existing shallow monitoring well (GLL07-03).	The proposed open pit borehole locations need to be located on the pit floor, near the foot of the access ramp. Structural geology documentation (AECOM 2010) indicates that the Footwall fault is continuous along the east floor of the open pit. In the southern portion of the open pit, this fault is documented with a downthrow side on the west. Investigation borehole locations appear possible to target the Footwall fault zone, plus associated minor faulting, by angle-drilling eastward using GLL07-03 as a geological reference.	No obvious large rock instability of the pit wall was observed, only smaller rock. Staff with specific rock slope stability expertise are needed, to verify the safety of site investigation workers at the pit floor elevation. Faults in brittle rocks are generally not found as distinct transitions, rather zones of rock shatter. These zones are of interest as they can form conduits preferential groundwater movement. Coring and construction of a monitoring well into the angle borehole will be the most challenging of all the hydrogeology boreholes.
	2 - Open pit, interior - download groundwater level data from two loggers (Solinst Barologger and Levelogger) housed in monitoring well (GLL07-03) and one data logger (Solinst Levelogger) installed within the pit pond, using existing direct-read cables.	Data loggers successfully downloaded using existing direct-read cables. These data show the annual highest pit pond water levels occur in September and conversely, the lowest in April-May.	The 2013 site investigation water sampling event of the open pit pond and groundwater need to be scheduled for September 2013, to capture the possible range of seasonal quality variation related to water level change.	To representatively capture seasonal water quality changes arising from annual water level fluctuation, a follow-on freshet (April-May) water sampling event of the open pit pond and groundwater will be needed in 2014.
	3 - Open pit, exterior north area - review accessibility to drill rig and candidate location for one (1) borehole.	Open-pit exterior area, north side, reviewed and candidate drilling locations identified by GPS coordinates.	Facilitates selection of a final borehole location.	A final drilling location will be selected, after reviewing the candidate GPS locations from the freshet site visit, relative to previously-characterized geology and hydrogeology.
	4 - Open pit, exterior north area - download groundwater level data from one logger (Solinst Levelogger) housed in monitoring well (GLL07-01), using existing direct-read cable.	Data logger successfully downloaded from alternate well (MW09-15), adjacent to the public road, north-east side of the open pit, using existing direct-read cables. Correlation of recessional curves detected between the open pit pond level and groundwater measured at MW09-15.	Early indication of surface water-groundwater connection between the open pit pond (north part) and groundwater monitored by well MW09-15.	The significance of surface water leaving the open pit and entering the Pony Creek watershed might be greater than previously documented.

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	5 - Open pit, exterior south area - review accessibility to drill rig and candidate locations for three (3) boreholes.	Open-pit exterior area, south side, reviewed and candidate drilling locations identified by GPS coordinates.	Facilitates selection of final borehole locations.	Final drilling locations will be selected, after reviewing the candidate GPS locations from the freshet site visit, relative to previously-characterized geology and hydrogeology.
	6 - Dome Creek and Pony Creek – observe creek bed conditions for manometer and seepage meter manual probe surveys, plus creek bank conditions for temporary mini-piezometer installations.	Manual probing of the creek beds along Dome Creek and Pony Creek encountered uniformly frozen conditions during the freshet site visit. Straightforward walking access to the upper sections of Dome Creek, plus upper and lower sections of Pony Creek was prevented in areas by stunted, willow-type vegetation.	The total number of creek bed locations for groundwater-surface water interaction assessment should be reduced. Walkway clearing will be needed at 10, or so, of the proposed creek bed study locations for access to field staff and groundwater-surface water interaction equipment.	Using freshet site visit observations and aerial photographic coverage, GPS coordinates for all proposed Dome Creek and Pony Creek study locations will be compiled and those requiring walkway clearing identified for implementation one to weeks prior study commencement.
	7 - Huestis Zone area, west of site camp – if observed, record GPS coordinates of signs of mine adit drainage, i.e., active surface seeps.	The hillside has been regraded, including significant infilling of surface depressions, leaving no obvious evidence of the adit. Documentation (Altura 2011) and historic photographs (AAM, pers. comm., 18 July 2013), indicates two Huestis adits are present (4100 and 4300 levels). The 4100 Adit is visible on the historic photo as a boxed portal with rail trestle.	Although no residual presence was observed during the site visit, it appears possible to relocate the 4100 Adit based on historic photos and documentation. The 4300 Adit will be harder to locate, as no evidence in photographs or documentation reviewed to-date. The hillside restoration, involving gravel placement at a high angle of repose, will make access to drilling equipment difficult or not possible.	Investigation should focus on 4100 Adit portal area, it being the lowest outlet for underground drainage. Drainage from the 4300 Adit can be assumed to be significantly less, as underground drainage should report to lower workings connected to the 4100 Adit.
	8 - Victoria Creek water supply well – measure total well depth and artesian flow rate.	Flow from well-head overflow pipe used to estimate artesian flow rate at approximately 3 L/sec (40 igpm).	The total depth is unknown as the supply well is operational and needed for camp operations. Cannot access wellhead during site investigation. Likely the well screen intake section does not extend significantly deeper than the elevation of Victoria Creek.	The well depth question will be deferred. Assumed values can be used in remediation design, to be verified after the cessation of camp activities.
	9 - In-service and accessible groundwater monitoring wells – measure static water level, or top of frozen water, as applicable. Update the general well condition status which was last checked in 2012 (EBA, 1 to 5 June 2012).	For summary of reviewed wells see Excel table (*MNRP - Freshet Gw Field Data - May 2013.xlsx*).	Significant number of wells were dry or frozen during freshet site visit. Supports similar 2012 observations, of wells in the active zone still being frozen during first week of June.	Summer groundwater monitoring and sampling of existing (shallow, active zone wells), should be scheduled for slightly later, in second half of June. Proposed new wells, with multi-level design, must include provision for remote heat tracing, especially as four of these six wells will likely encounter permafrost.
Water Quality/ Geochemistry	1 – Surface runoff quality from waste rock pile and lower slope seeps.	A decent stream was observed at the bottom of the southwest waste rock pile. The sample collected from this location has neutral pH with elevated sulphate and zinc. No running water was observed near the ore	Sampling locations will be revisited and samples collected if the surface runoff continues into summer.	

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		ramp at the south end of the pit but there were several water ponds. The sample collected from the standing pond had neutral pH. Sulphate and zinc concentrations were lower compared concentration of these two parameters in the waste rock pile runoff. Zinc concentration was higher than CCME limit value. The sample was also collected from lysimeter located at West Lower Pile. Water level at the lysimeter was approximately 0.9 metres. Laboratory analysis results are pending. Seepage from the waste rock pile and pit area was also observed at the lower slope and a sample was collected from this area. Two other locations, which were previously sampled during the previous studies, lacked water.		
	2 – Surface runoff at mill area.	Surface runoff samples were collected from a small stream located behind the first building at the upper platform, including a small stream at the first mill building, lower platform area, plus also the exploration trenches near Mill road. The upper platform sample had neutral pH with elevated sulphate. Zinc concentrations were greater than the CCME limit value. The water sample for the lower platform also had neutral pH with total arsenic content relatively higher compared to arsenic in the upper platform sample. Laboratory analytical results for the exploration trenches are pending.	Sampling locations will be revisited and samples will be collected if the surface runoff still occurs.	
	3 - Leachates quality from field bin testing.	Only leachate from the unsaturated tailing bin was available for sampling. The leachate from the unsaturated waste rock and unsaturated ore bins, and also water columns from the saturated waste rock and saturated tailings bins were still frozen. Laboratory analytical results are pending.	Sampling from the field bin testing will be continued when the leachates are available.	For updating the source term used for the water quality model, it is recommended that the monthly sampling to be performed on the field bin testing.

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	4 – Collected two groundwater samples near the tailings dam to confirm major ion chemistry. Samples were collected from MW09-02 and MW09-24 for general chemistry, Total Kjeldahl Nitrogen (TKN) and dissolved and total metals testing. This limited groundwater sampling was conducted to confirm previous analytical results in this site area, particularly for TKN which measures organic nitrogen and ammonia. Samples were not collected for cyanide compounds as the required field sampling and preservation procedures have not been finalized.	These results confirm previous analytical results at these two wells and suggest that a large fraction of the total nitrogen concentration in the water is not measured by the specific nitrogen tests, i.e., ammonia, nitrate, nitrate, cyanides, thiocyanante. The TKN test results indicate that there may be unidentified organic nitrogen compounds (which could include cyanide, CN^-), in the groundwater, particularly near the tailings dam.	Standard water sample preservation protocols may not be sufficient to maintain the integrity of water samples. Specifically, the standard field preservation procedures used to-date for sulphide, cyanide and arsenic appear to have under-estimated the concentrations of these parameters and over-estimate the concentration of thiocyanate (SCN^-). Hydrogen sulphide presence (as would be expected here due to oxidation of organic carbon by sulphate reducing bacteria), can interfere with the measurement of cyanide and/or arsenic unless appropriate field sampling measures are taken to address the presence of sulphide. From the BC Laboratory Lab Manual method for strong acid dissociable cyanide (page B-46): **Sulfides:** *It is preferred that sulfide treatment be carried out before preservation,but it can be done after preservation.* Sulfides can interfere by two mechanisms: 1.) Oxidized products of sulfide rapidly convert cyanide to thiocyanate, especially at high pH (APHA). Therefore, if sulfides are present at time of NaOH preservation, free cyanide may not be detected by the method. 2.) Hydrogen sulfide distills over with cyanide, and interferes with colourimetric, titrimetric, and electrode procedures. Arsenic may be under-estimated in sulphide-rich waters when acid is added to preserve the dissolved metals sample. This promotes the formation of thioarsenical (i.e., sulphur-arsenic) compounds that may precipitate from the water sample resulting in a lower dissolved arsenic concentration. The total and dissolved metals samples collected on 16 May 2013 were preserved with acid, as per standard protocols.	Field preservation procedures for cyanide and arsenic should be modified to account for the apparent presence of hydrogen sulphide. The field protocols will be revised as follows: • Sulphide will be measured in the field which is more reliable than attempting to preserve these samples for later laboratory analysis. • Arsenic will be sampled by collecting unpreserved samples for dissolved metals analysis. Regular dissolved metals sampling will also be completed for comparison and to measure the other dissolved metals. • Cyanide and thiocyanate will be sampled either as unpreserved samples, or reagents will be added in the field to remove sulphide. Analyses will also be needed to identify and quantify metal-cyanide complexes such as iron-cyanide.
Permafrost	1 - Determination vegetative indicators for frozen and unfrozen terrain units.	The main indicator for demonstrating a presence/absence of permafrost is the type of the ground vegetation. Areas with permafrost correspond to a thick mossy cover (0.1 to 0.2 metre thick) consisting of sphagnum and green mosses. The terrain units with permafrost can be treed with spruce (sparse or dense) or short (dwarf) shrubs consisting of polar birch and willow. It was found that areas likely with no permafrost, had a thin layer of ground vegetation, consisting of lichen (less than 0.05 metres thick) and serial grasses. Tall shrubs	Aerial photographs, likely scale 1:40,000 or smaller, will be required, if production of a permafrost map is needed.	It is likely that geotechnical drilling and temperature measurements will be needed within each (or main) terrain units shown at the permafrost map.

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		to 3 metres tall) presented by willow and Middendorf's birch indicated unfrozen terrain. Such terrain was found at the mine mill area. A correlation between permafrost and face aspect of slopes is expected, although was not clearly detected during 22-24 May.		
	2 - Estimation permafrost conditions in the open pit.	Indicators of permafrost across the open pit bottom and pit walls were not found. Initially considered that the numerous wall seepages were an indicator of the permafrost absence. However, these seepages have a solid frozen base and seeping water was snow melt. Overburden material was also reviewed at the pit walls. It was found that overburden is only several meters thick and presented mainly by granular materials. Thus, it is more likely that unfrozen areas are present around the pit perimeter. It is also more likely that there is no permafrost across the pit bottom. It is due to an absence of the ground vegetation and likely significant thickness of the snow inside the pit (snow is a considerable warming factor which protects ground against freezing)	Large scale aerial photographs will be required for the vicinity of the open pit.	A detail aerial photograph interpretation is recommended, to determine the extend of permafrost around the open pit area. Results of aerial photograph interpretation should be confirmed by limited geotechnical drilling and/or geophysical survey (resistivity and seismic).
	3 - Estimation for initial frozen/unfrozen conditions of terrain units over the present tailings and waste rock stockpile.	A close look of peripheral portions of the tailings and waste rock stock pile areas allowed make a preliminary conclusion that terrain the majority of the terrain surrounding the facilities was initially in a frozen state (thick moss cover, sparse spruces dwarf birch). Based on these findings, it is possible to suggest that a talik through entire permafrost exists under the tailings pond. However, a talik can be shallow along a peripheral of the tailings. It is unknown right now (with no proper calculations) how an initial terrain will be restored and what type of earth processes will be developed over the disturbed terrain after removal of the tailings material. It seems that permafrost exists under the waste rock material. Likely this terrain can be	Large-scale aerial photographs will be required for the vicinity of the tailings and waste rock stockpile.	A detail aerial photograph interpretation is recommended, to determine permafrost extent around the tailings and waste rock stockpile. The aerial photograph interpretation results should be confirmed by limited geotechnical drilling and/or geophysical survey (resistivity and seismic).

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		restored easily by placement of a thin organic layer (peat, top soil). A thickness of the required organic layer can be assessed by calculations.		
	4 - Assessment of permafrost conditions for the Dome Creek valley within the present tailings based on conditions of the creek valley upstream and downstream from the tailings.	There are indicators of frozen terrain units within the Dome Creek valley, both upstream and downstream from the tailings pond. The creek is braiding in a wide valley (over 50 metres) upstream from the tailings. The majority of the valley was covered with snow during the 22-24 May site visit. However, a presence of sparse, not healthy, spruces and thick moss cover indicates a frozen terrain. The creek valley immediately south from the tailings has a V-like shape. It seems that a bottom of the valley likely is frozen (thick moss), however, the valley slopes may be in frozen and unfrozen state depending on a slope face aspect, its steepness and surficial soil composition (cohesive soils have a greater chance to be in a frozen state.	Confirmation of frozen/unfrozen state of the terrain units should be carried out likely during 2013 site investigations.	Access for drilling within the creek valley may be difficult, even for a track-mounted drill rig. Boundaries of frozen and unfrozen materials likely can be determined with geophysical survey (both resistivity and seismic). This will provide information for Dome Creek restoration.
	5 - Visual observation of erosion parameters for granular/cohesive overburden which would be required to calculate/predict erosion and thermoerosion within a portion of the Dome Creek valley which will be restored.	It was expected that the thermoerosion rate can be assessed during the site visit. However, it was understood that water in Dome Creek has a temperature just marginally above 0^{o}C and flows over a solid frozen creek channel. From discussion with Denison Environmental, erosion and sedimentation processes are noticeable in the tailings diversion channel. In some locations, erosion destroys channels, while in other locations, sedimentation results in ponding of the channel. Water in the diversion channel was not highly turbid, indicating that thermoerosion (washing out of frozen materials is insignificant at the site). It may be due to soil composition or cold winters.	Soil samples should be collected to determine the coefficient of erosion. Erosion rates then can be calculated based on empirical equations.	Disturbed samples can be derived from shallow test pits advanced along the diversion channel. Site observations in 22-24 May show that the samples can be taken of sand, silt, and likely silty clay.
	6 – Assessment of permafrost extent over the mine site.	A site-wide assessment of permafrost extent was not undertaken. Based on observations	For site-wide permafrost map, several reconnaissance trips will be needed to confirm extent of frozen/unfrozen	Aerial photograph interpretation is recommended, prior the 2013 site investigation program.

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		of the terrain units in the vicinity of the tailings, waste rock stockpile, and mill, it was concluded that the permafrost occupies 30 to 60 percent of the site.	terrain units, as identified on aerial photographs.	