Attachment 1

AVALON RARE METALS INC.

CONCEPTUAL AQUATIC EFFECTS MONITORING PLAN

THOR LAKE PROJECT
NORTHWEST TERRITORIES

REPORT

DECEMBER 2011
ISSUED FOR REVIEW
EBA FILE: V15101007.004

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1.0 INTRODUCTION

Avalon Rare Metals Inc. proposes to mine, mill, and produce rare earth carbonate and oxides, zirconium, niobium and tantalum oxides from the Nechalacho deposit, located on its Thor Lake Property. The proposed project is referred to as the Thor Lake Project (the Project).

Approximately 12-14 million tonnes of mineral resources will be mined from the Nechalacho deposit over a period of about 20 years of operations. Construction will begin 16-18 months before the start of operations. At the end of mine life, reclamation activities will begin and continue for a period of about three years.

The proposed TLP has two main site components: an underground mine and flotation plant (Nechalacho Mine and Flotation Plant site), to be located at the Thor Lake Property, and a hydrometallurgical plant (Hydrometallurgical Plant site) to be located at the existing brownfields site of the former Pine Point Mine, 85 km east of Hay River, NT on the south shore of Great Slave Lake (Figure 1).

Rare earth elements (REEs) will be mined underground and concentrated at the Nechalacho Mine and Flotation Plant site. The resulting REE concentrates will be barged during the summer months across the east end of Great Slave Lake to the Hydrometallurgical Plant site. Upon arrival, the concentrate will be trucked from the south shore of Great Slave Lake to the Hydrometallurgical Plant site via a short (8 km) haul road. The concentrate will be further processed at the Hydrometallurgical Plant. The resulting final products will be hauled to the Hay River railhead in sealed containers via truck, and direct shipped by the CN railway for further processing in the south.

The Developer's Assessment Report (DAR; Avalon 2011) for this Project provides a full description of the project, baseline environmental study results, effects assessments, and an outline of the proposed aquatic effects monitoring program (AEMP).

The present conceptual (framework) report is the next step in developing a comprehensive AEMP for this Project. It generally follows Indian and Northern Affairs Canada (now Aboriginal Affairs and Northern Development Canada) *Recommended Procedures for Developing Data Quality Objectives and a Conceptual Study Design* (INAC 2009), which is one of a series of guidance documents for the design and preparation of AEMP programs in the NWT.

The initial phase in the development of an AEMP involves a multidisciplinary approach to defining the aquatic environmental issues that may result from the construction, operations, and decommissioning phases of a project, and identification of mitigation measures to avoid or minimize potential adverse effects. In anticipation of, and adherence to regulatory requirements, Avalon Rare Metals Inc. retained teams of specialist consultants to carry out multi-year baseline studies to characterize existing aquatic environmental conditions (Stantec 2010), and to consolidate existing information, assess potential effects, and recommend mitigation strategies (Avalon 2011).

The Effects assessment was guided by the Terms of Reference (TOR) issued by the Mackenzie Valley Environmental Impact Review Board (MVEIRB 2011), which identified specific Key Lines of Enquiry and required the description and assessment of effects based on all Project activities and phases. The information and data compiled as a result of these efforts form the basis for the preparation of a science based AEMP.

2.0 AEMP STUDY DESIGN FRAMEWORK

INAC (2009) identifies a number of Data Quality Objective steps in the preparation of a conceptual study design for an AEMP. The first four steps: stating the problem; identifying the goals of the study; identifying the information inputs; and, defining the boundaries of the study, have been covered by the design and implementation of the baseline studies and subsequent effects assessment, as described in the following sections:

2.1 Stating the Problem

The 'problem', or the potential aquatic consequences of the mine development, was the focus for the design of baseline studies necessary to evaluate project-related effects. The approach that was adopted for this step was to characterize as completely as possible, water and sediment quality, and phytoplankton, zooplankton, and fish within the predicted effects area of the Project, as well as within Reference water bodies. Corresponding studies were carried out to identify environmental stressors resulting from Project activities and then to quantify or model the probable effects of these stressors. Pathways of effects (PoE) diagrams illustrating Construction and Operations Phase activity-stressor-effect linkages were included in the DAR (Avalon 2011), and are reproduced below as Figures 1 and 2, respectively.

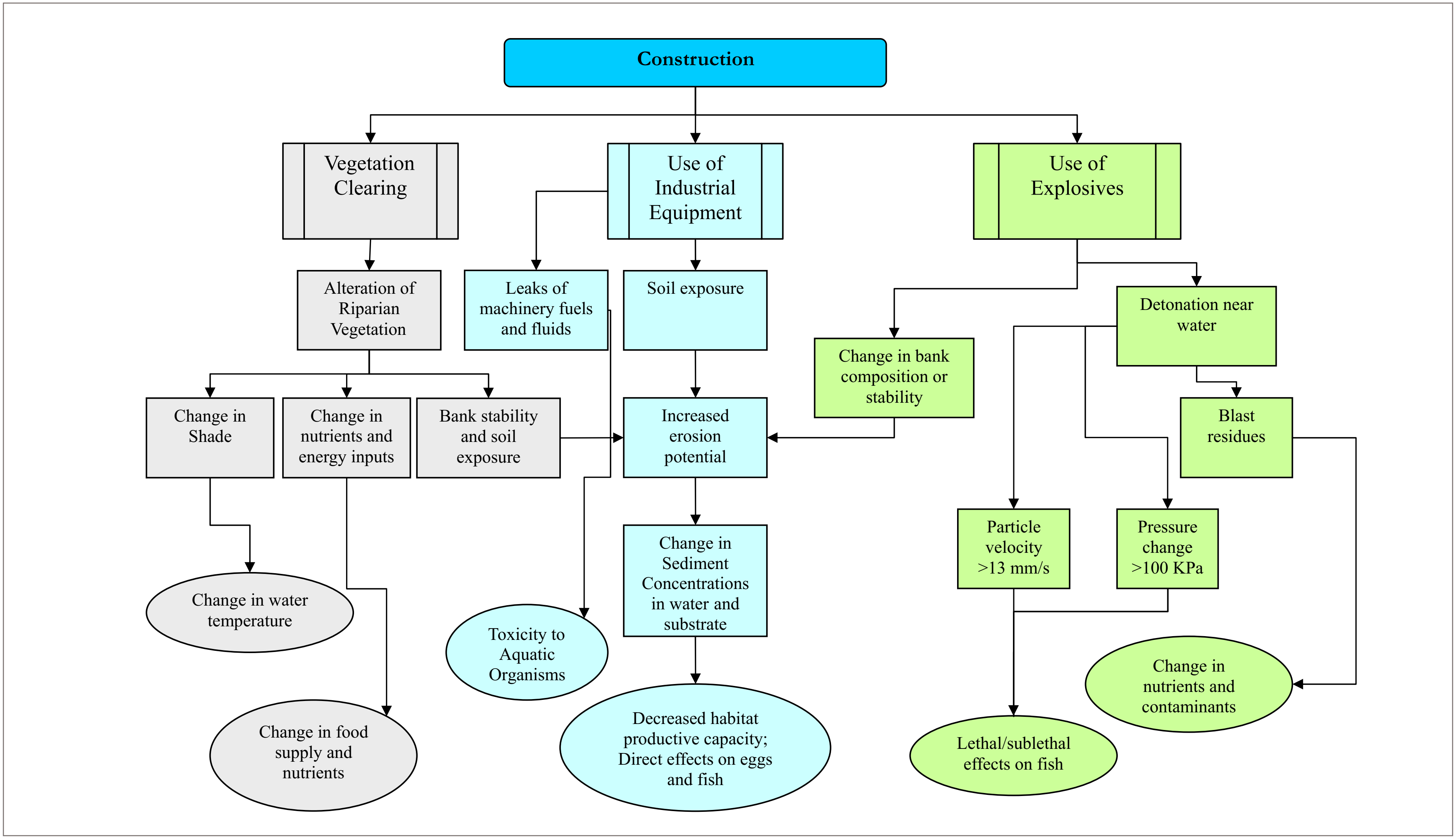
2.2 Identifying the Goals of the Study

This step involves identifying key questions or potential environmental issues that should be addressed as part of study design and implementation. This involves examining potential effects on the various components of the aquatic ecosystem based on anticipated terrestrial or aquatic habitat disturbances, and changes in water quality and quantity. For the purposes of the AEMP, identification of aquatic environmental sensitivities will lead to decisions regarding Action Levels, which are thresholds for the implementation of mitigation measures.

The DAR (Avalon 2011) discusses each issue (i.e. activity and stressor) that was identified during the scoping process in relation to potential effects, mitigation measures, residual effects, and the significance of the residual effects. These issues serve as the focus for the design of the monitoring program and the development of appropriate Action Levels, based on environmental component sensitivities, established guidelines, and background variability.

The key questions that provide the focus for aquatic background studies and the monitoring program include:

- How will water quantity, including total flows, lake levels, and seasonal flow patterns, be affected by water use and recirculation?
- What will be the effect on flows and flow patterns in downstream waterbodies due to the conversion of Ring, Buck, and Ball lakes to a Tailings Management Facility (TMF)?
- What are the potential stressors resulting from construction activities (i.e. land development), and what are the aquatic components/variables that might be affected by these stressors?



LEGEND

Activity

Stressor

Effect

NOTES

1.

STATUS

ISSUED FOR REVIEW

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THOR LAKE PROJECT

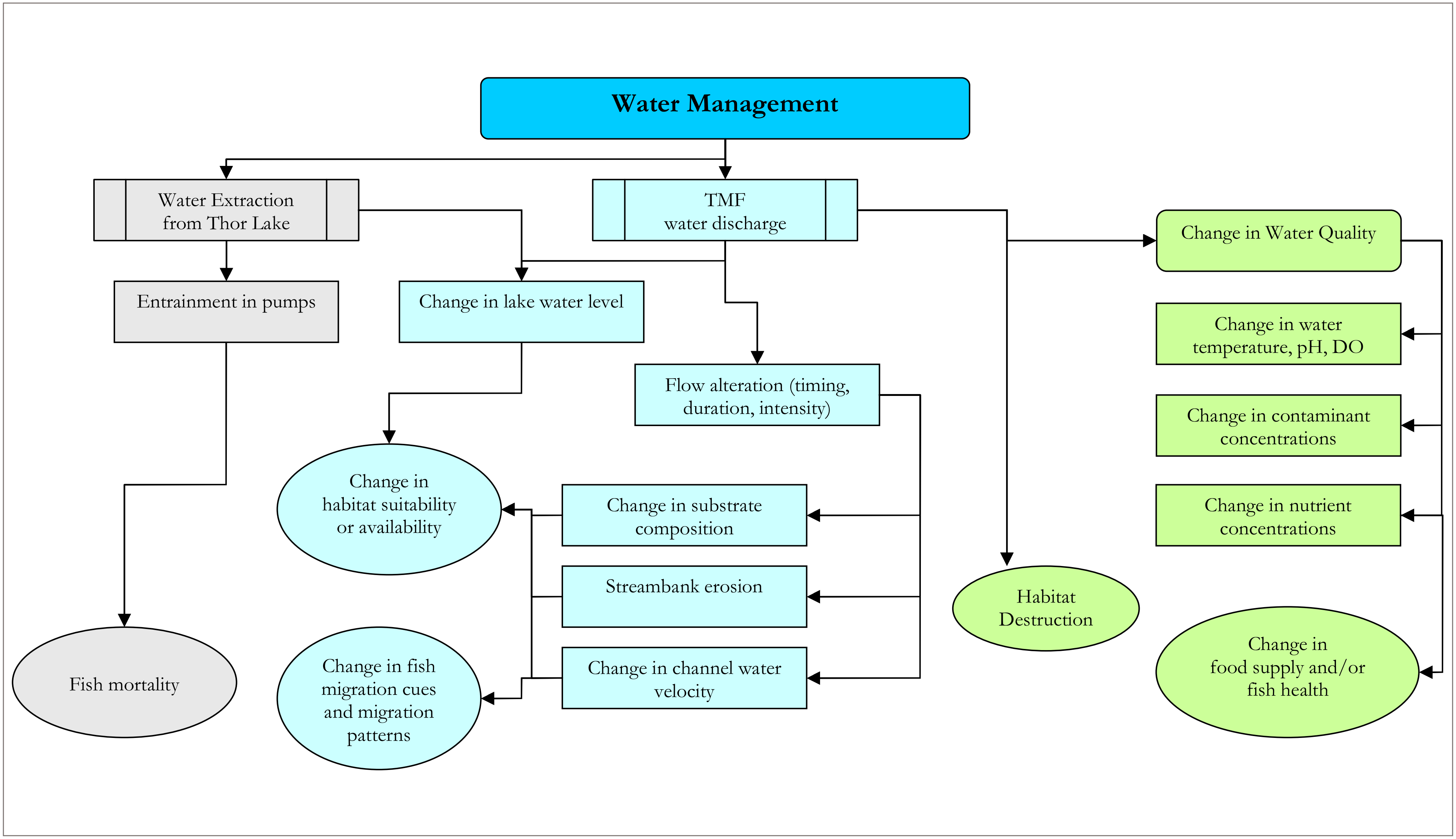
Aquatic Pathways of Effects for the Construction Phase of the Nechalacho Mine Site

PROJECT NO.	DWN	CKD	APVD	REV
V15101007.004	SL	DM	DM	0

OFFICE	DATE
EBA-VANC	November 30, 2011

Figure 1

Q:\Vancouver\Graphics\ENGINEERING\V151\V15101007_ThorLake\004\V15101007_004_CDR001_PathwaysConstruction.cdr



LEGEND

Activity
Stressor
Effect

NOTES

1.

STATUS

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THOR LAKE PROJECT

Aquatic Pathways of Effects for the Operations Phase of the Nechalacho Mine Site

PROJECT NO.	DWN	CKD	APVD	REV
V15101007.004	SL	DM	DM	0

OFFICE	DATE
EBA-VANC	November 30, 2011

Figure 2

Q:\Vancouver\Graphics\ENGINEERING\V151\V15101007_ThorLake\004\V15101007_004_CDR002_PathwaysOperations.cdr

- Which aquatic organisms should the baseline studies include, and which would be suitable as sentinel organisms for the AEMP?
- What are the chemical parameters in the effluent that have the potential to adversely affect aquatic organisms downstream of the final discharge location, and what is the potential downstream effect of predicted concentrations of these parameters, based on the integration of effluent concentrations and probable flow levels ?
- Will routine barging activities affect water or habitat quality in Great Slave Lake?

2.3 Identifying the Information Inputs and Defining the Boundaries of the Study

Responses to the issues raised by the above questions are provided throughout the DAR (Avalon 2011). Recent baseline studies that were conducted between 2008 and 2010 (Stantec 2010) included investigations of water quality, aquatic ecology (phytoplankton, zooplankton, benthic invertebrates), and fish and fish habitat studies in 26 lakes. In addition, the field program included fish and fish habitat investigations in 13 stream channels between lakes in the footprint area. The waterbodies were selected as being potentially affected by the Project; representing local aquatic conditions; and, potentially suitable as reference lakes.

Aquatic and fisheries sampling locations were selected based on the direct Project footprint, potential future expansion, and known information about the surface water drainage in the Nechalacho Mine site area. All lakes and streams that would potentially directly interact with the mine footprint and operations (i.e., lakes above the underground excavations, and lakes and streams affected by water extraction and/or discharge), tailings storage areas, and concentrate transport routes were selected, as was the first lake downstream of the mine area.

Sampled lakes are shown on Figure 3 (reproduced from the DAR (Avalon 2011)). Kinnikinnick Lake was selected as a suitable near-field reference lake, while Redemption Lake, located approximately 18 km northeast of the Nechalacho Mine site camp, was chosen as an appropriate far-field reference lake.

Table 1 (reproduced from the DAR (Avalon 2011) identifies the environmental issues potentially resulting from the various activities associated with mine development. It is apparent that many of these activities may interact with natural water resources.

LEGEND

- Aquatic Sample Station
- Fisheries Lake
- Watercourse
- Waterbody
- Wetland

NOTES
Figure Source: Appendix A, Figure 3-1, Stantec 2010c.

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THOR LAKE PROJECT

Nechalacho Mine Site Study Area

PROJECTION	DATUM	CLIENT
UTM Zone 12	NAD83	AVALON RARE METALS INC.

Scale: 1:70,000
1 0.5 0 1 2
Kilometres

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FILE NO.				
V15101007_004_Map001_ThorSA.mxd				
PROJECT NO.	DWN	CKD	APVD	REV
V15101007.004	SL	DM	DM	0
OFFICE	DATE			
EBA-VANC	December 6, 2011			

Figure 3

Table 1: Thor Lake Project: Nechalacho Mine and Flotation Plant Site Environmental Issue Matrix

Project Component	Air Quality	Water Quality	Fish	Wildlife	Vegetation
Site Preparation and Construction	✓	✓	✓	✓	✓
Underground Mining	✓	✓			
Mine Rock Storage		✓	✓	✓	✓
Acid Rock Drainage (ARD) if present		✓	✓		
Thor Lake Flotation Plant	✓	✓	✓	✓	✓
Power Generation	✓			✓	✓
Sewage		✓	✓		
Tailings Containment		✓	✓	✓	✓
Water Supply/Water Management		✓	✓		
Solid and Hazardous Waste Management	✓	✓	✓	✓	
Airstrip	✓			✓	✓
Access Roads	✓	✓	✓	✓	✓
Temporary Docking Facility		✓	✓	✓	✓
Seasonal Barge Traffic	✓	✓	✓	✓	

The assessment determined that for all valued ecosystem components (VEC), with the application of the proposed mitigation measures, the residual environmental effects of the Thor Lake Project were anticipated to be negligible and insignificant. Furthermore, any identified environmental effects were generally limited to the immediate footprints and local study areas of the Nechalacho Mine and Flotation Plant and associated infrastructure, and most were reversible once activities ceased. The AEMP, based on the framework identified in this document, is intended to confirm the assessment conclusion, and provide an approach to resolve unanticipated adverse effects.

The following subsections provide further information regarding the key aquatic environmental issues and questions resulting from the assessment of the Project.

2.3.1 Water Quantity

- Mine water and Plant site runoff will be collected and directed into the process as appropriate.
- All excess water released from the TMF will be returned to Thor Lake via the Drizzle Lake/Murky Lake drainage system.
- Water will be recycled from the TMF to the greatest extent possible to minimize the fresh water requirement (currently 50% recycle and 50% fresh water has been modelled).
- Extraction of fresh water from Thor Lake will be managed to conform to the 2010 Department of Fisheries and Oceans (DFO) Protocol for Winter Water Withdrawal (DFO 2010), which specifies the use of no more than 10% of the available under-ice water volume.
- Natural flows and conditions will be monitored and mimicked as closely as possible throughout operations to minimize possible effects on the local hydrological regime.

The development of a TMF within the Ring and Buck Lakes basin will result in slightly higher flows through Drizzle and Murky Lakes during operations, compared to pre-development baseline flows, assuming a 50% maximum recycle rate from the TMF. This increase is expected to be in the order of a 6% increase in flow at the start of operations. This initial increase is expected to slowly decline to an increase of about 3% in later years of operation as expected evaporation and tailings beach size increase.

2.3.2 Water Quality

A hydrodynamic model was run by EBA to predict the transport and fate of metals and nutrients. The modelled metals of concern were Mercury (Hg), silver (Ag), Aluminum (Al), Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Iron (Fe), Molybdenum (Mo), Nickel (Ni), Lead (Pb), Selenium (Se), and Zinc (Zn). Three radioactive metals, Uranium (U), Thorium (Th), and Radium-226 (Ra-226) were also included in the simulation. Nitrogen levels were also modeled due to the possible release of elevated levels of this nutrient originating from explosive chemicals (ANFO) used for underground mine blasting during the mining operation. The model also incorporated anticipated effluent phosphorous concentrations, as well as phytoplankton and herbivore zooplankton levels in Thor Lake, to determine downstream effects of possible nutrient enrichment.

The model predicts that the Metal Mining Effluent Regulation (MMER) effluent criteria for all parameters will be met over the entire 20 year simulation period, in each of the lakes within the Thor Lake system. Concentrations of metals reaching Thor Lake are predicted to be extremely low, especially since modelled concentrations represent conservative values, since no allowance was made in the model for decreases in concentration due to natural remediation processes including degradation, chemical oxidation, precipitation, and biodegradation.

The model predicts that the input of additional nitrogen from the TMF decant water to the Thor Lake system may lead to seasonally increased phytoplankton growth and concentration. Although the nitrogen level is predicted to continue to increase over the ten-year model simulation period, phytoplankton productivity appears to remain very similar from year to year. It also appears that the phytoplankton biomass is likely limited by the amount of bio-available phosphorus in the water body as the annual peak phytoplankton biomass remains stable even as the annual peak nitrogen values rise in the system. However, since the potential for seasonally increased primary and secondary production of the system exists, a major focus of the biological and water quality monitoring program will be identification of changes in phytoplankton, zooplankton, fish, and nutrient levels.

This step of the Framework also includes the identification of Action Levels, or values for *"… a measurement endpoint that provides a basis for choosing one or more of the various management alternatives."* Action levels for effluent discharge at the final discharge point will be set for substances regulated by the MMER, namely: arsenic, copper, cyanide, lead, nickel, zinc, total suspended solids, radium 226, and pH, and/or maximum levels identified in the Water Licence. In addition, periodic sampling pursuant to the MMER will also include analyses for aluminum, cadmium, iron, molybdenum, ammonia, nitrate, and mercury.

2.3.3 Action Levels

Action levels for metals and nutrients in water bodies downstream of the final discharge point will be guided by: the requirements of the Mackenzie Valley Land and Water Board (MVLWB) Water Licence, which may require the establishment of Surveillance Network Program (SNP) sampling locations; the Metal Mining Effluent Regulations (MMER); and, the Canadian Ministers of the Environment (CCME) Guidelines for the Protection of Aquatic Life (CCME 2007). The analysis of monitoring results will require the identification of background levels of those parameters which approach licence or guideline limits, since even relatively small additions of these substances could result in adverse effects to water quality and aquatic biota.

The MMER further requires periodic sublethal testing of effluent on fish, invertebrates, plants, and algae. The results of these tests provide a sensitive measure and early warning of potential biotic effects since it is the effluent that is tested, rather than the receiving waters, in which the effluent is diluted.

Action Levels for water discharges will be based on variances from predicted seasonal discharge levels from the TMF to Drizzle Lake. Differences of greater than 20% of predicted levels will require detailed assessments of causes, with consideration of natural precipitation and runoff variability.

The availability of background biological data from all potentially affected lakes and from two reference lakes provides the basis for a before-after control-impact (BACI) monitoring design to account for environmental variability and temporal trends found in both the control and exposure areas. Action levels will be based on multivariate statistical tests of significance.

2.4 A Conceptual Design for Obtaining Data

Data and information required to resolve the questions and issues identified in Section 2.2 of this report throughout all phases of the Project will be based, in part, on regulatory requirements and on studies intended to validate predictions and modelling results identified in the DAR (Avalon 2011). The following summarizes the regulatory environment pertaining to development and implementation of the AEMP for this project:

- The MMER identifies water sampling and analysis requirements, for effluent and receiving water bodies. In addition, the MMER includes requirements for sublethal toxicity testing and periodic environmental effects monitoring (EEM) involving biological sampling. The MMER regulates levels of particular substances in effluents.
- The MVLWB Water Licence for this Project will regulate water use, water discharge, and effluent and downstream water quality. Water and effluent quality sampling and analysis will be regulated through a Surveillance Network Program (SMP) that identifies sampling locations, scheduling, and required analyses. It may also include recommendations or requirements for additional studies targeting specific issues of concern.
- The *Fisheries Act*, administered by Fisheries and Oceans Canada (DFO), prohibits the harmful alteration, disruption or destruction of fish habitat (HADD), where fish habitat is inclusively defined as "spawning grounds and nursery, rearing, food supply, migration and any other areas on which fish

depend directly or indirectly in order to carry out their life processes." Based on this prohibition, DFO may request plans or specifications as part of the AEMP to demonstrate that the Project is not adversely affecting the productive capacity of fish habitats.

- Although not part of legislation, the CCME Guidelines for the Protection of Aquatic Life (CCME 2007) are generally recognized as the established general biological effect levels in receiving water bodies. Their interpretation and application requires judgement based on site-specific conditions, particularly respecting ambient water quality conditions and biotic assemblages.

2.4.1 Metal Mining Effluent Regulations

Because the MMER provides very specific requirements for monitoring at metal mines, these will necessarily form the core of the AEMP developed for this Project.

2.4.1.1 Effluent Characterization

The elements of the MMER pertaining to characterization of the effluent include:

- Weekly effluent monitoring at the final discharge point for analysis of pH, arsenic, copper, cyanide, lead, nickel, zinc, total suspended solids, and radium 226;
- Monthly acute lethality testing from samples of effluent collected at the final discharge point;
- Monthly Daphnia magna monitoring tests; and,
- Monthly cumulative measurement of effluent volume at the final discharge point and calculation of effluent loading of the substances identified above.

The MMER also requires the design and implementation of environmental effects monitoring studies (EEM) partitioned into *effluent and water quality monitoring studies*, and *biological monitoring studies* as follows:

2.4.1.2 Effluent and Water Quality Monitoring Studies

- Quarterly sampling and analysis *of the effluent* at the final discharge point, for aluminum, cadmium, iron, mercury, molybdenum, ammonia, and nitrate, to further characterize the chemical composition of the effluent;
- Quarterly sampling of water *from an exposure area* in a receiving water body surrounding the point of entry of effluent into water from the final discharge point, for analysis of pH, hardness, alkalinity, as well as the substances noted above; and,
- Twice yearly sublethal testing, based on specified criteria, of a fish species, an invertebrate species, a plant species, and an algal species, using effluent samples collected at the final discharge point.

2.4.1.3 Biological Monitoring Studies

The required biological monitoring studies involve site characterization, fish populations, fish tissue analysis, and assessment of the benthic invertebrate community. These studies are conducted at prescribed intervals, beginning about 18 months following mine start-up, and thereafter:

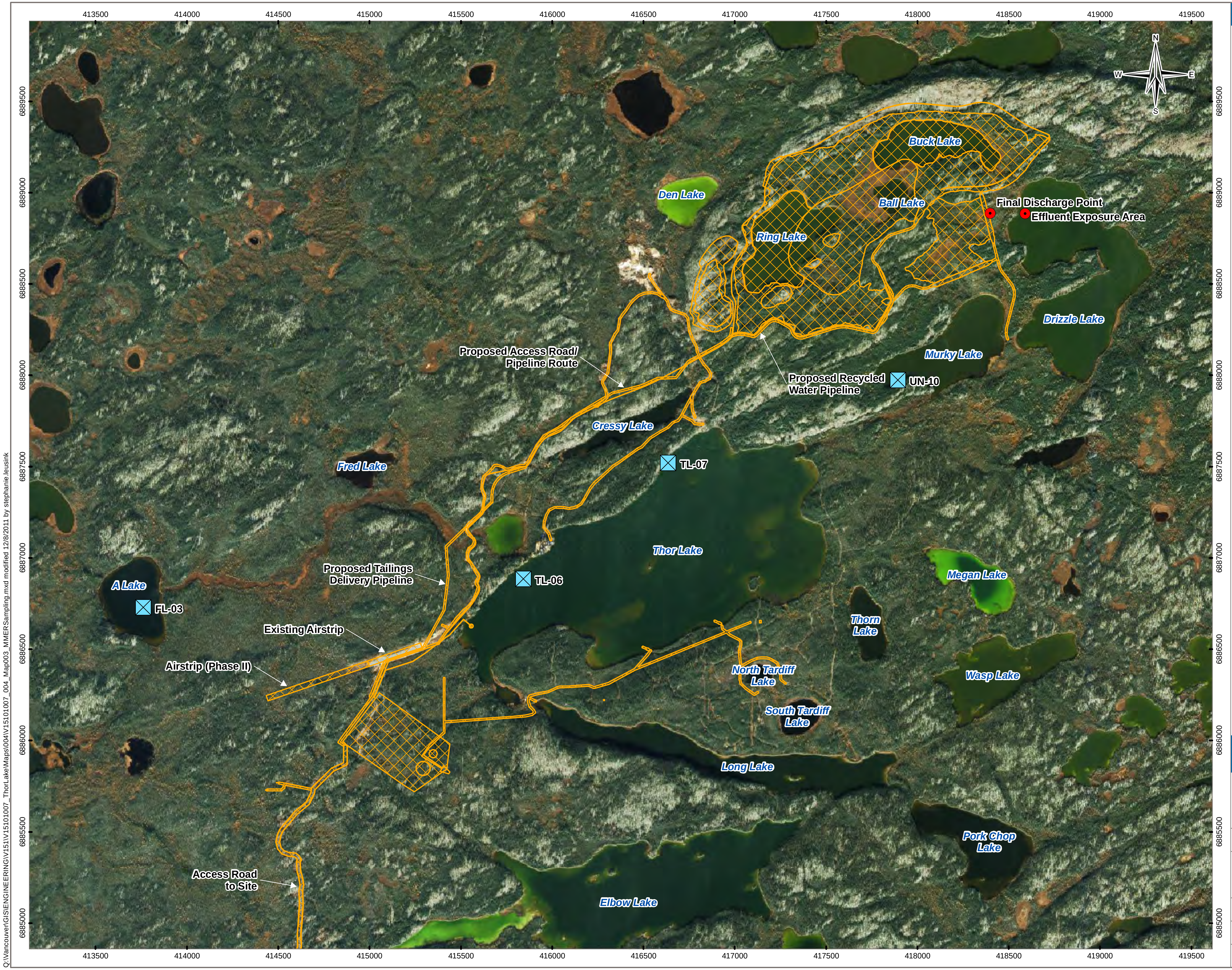
- every two years if effects on fish populations, fish tissue and the benthic community are detected;
- every three years if no effects are indicated from the previous study;
- every 72 months if no effects are detected from two previous consecutive studies; and,
- within one year following notice of mine closure.

The biological monitoring studies are based on detailed study designs, which must be submitted and approved by Environment Canada following review by a technical advisory panel consisting of representatives of stakeholder agencies. These designs include details and justification for the proposed sampling methods, reference and exposure site locations, and analytical methods that will be followed during the study. As prescribed in the MMER, a detailed study design for each biological monitoring study will be submitted to Environment Canada a minimum of six months prior to the commencement of field sampling. It is anticipated that sampling for this program will normally occur in August.

The study design will include designation of a sentinel fish species, which will be selected in consultation with Environment Canada. Lake whitefish (*Coregonus clupeaformis*), which are common in Thor Lake, may be suitable as a sentinel species. However, due to the low productivity of northern waters, lethal sampling should be very limited to minimize the impact of the study on fish populations. All sampling and analysis will follow the methods recommended in the MMER guidance documents (Environment Canada 2002, 2011).

2.4.1.4 MMER Sampling Locations

Sampling locations proposed as part of MMER effluent characterization sampling and the EEM study program are shown in Figure 4. Effluent from the TMF will be discharged from the TMF outlet into Drizzle Lake. As such, this outlet represents the final discharge location for the proposed mine. Effluent discharges into the Thor Lake system will follow a path through Drizzle Lake to Murky Lake, and then into Thor Lake. Thor Lake discharges to Fred Lake and then follows an 18 km route through A Lake to Great Slave Lake. Based on this flow pattern, it is proposed that EEM biological monitoring study sites be established at Murky Lake, Thor Lake, and A Lake, to provide nearfield, midfield, and farfield sampling locations. Reference sites will be established at Kinnikinnick and Redemption lakes.



LEGEND

- Effluent Characterization
- EEM Biological Monitoring Site
- Infrastructure Footprint

NOTES
1. Base footprint generated from data provided by Avalon (April 2011).
2. Base imagery provided by Avalon (October 2010).

STATUS
ISSUED FOR REVIEW

THOR LAKE PROJECT

Proposed MMER Sampling Locations

PROJECTION	DATUM	CLIENT
UTM Zone 12	NAD83	AVALON RARE METALS INC.

Scale: 1:20,000
250 125 0 250 500
Metres

FILE NO.
V15101007_004_Map003_MMERSampling.mxd

PROJECT NO.	DWN	CKD	APVD	REV
V15101007.004	SL	-	DM	0

OFFICE	DATE
EBA-VANC	December 8, 2011

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Figure 4

2.4.2 Water Licence

The MVLWB, upon overall approval for the commencement of mining operations, will issue a Water Licence in accordance with the *Northwest Territories Water Act*. It is anticipated that the conditions of this Licence will:

- Require submission of monthly and annual volumes related to: water use, discharges of mine waste to the TMF, discharges of treated sewage to the TMF, and flow releases from the TMF;
- Set limits to water extraction from natural water bodies and identify pump screening specifications;
- Identify conditions related to the design, construction, and operation of the TMF;
- Establish effluent quality requirements; and,
- Outline the SMP, including sampling locations and sampling and analysis requirements see Section 2.4.2.1).

The proposed water balance during mine operations is shown in Figure 5 (reproduced from Avalon 2011). Flows will be continuously monitored and reported, according to the schedule required by the Water Licence. In addition, water levels in Thor Lake will be monitored weekly to detect changes in lake level beyond those expected due to normal seasonal variation.

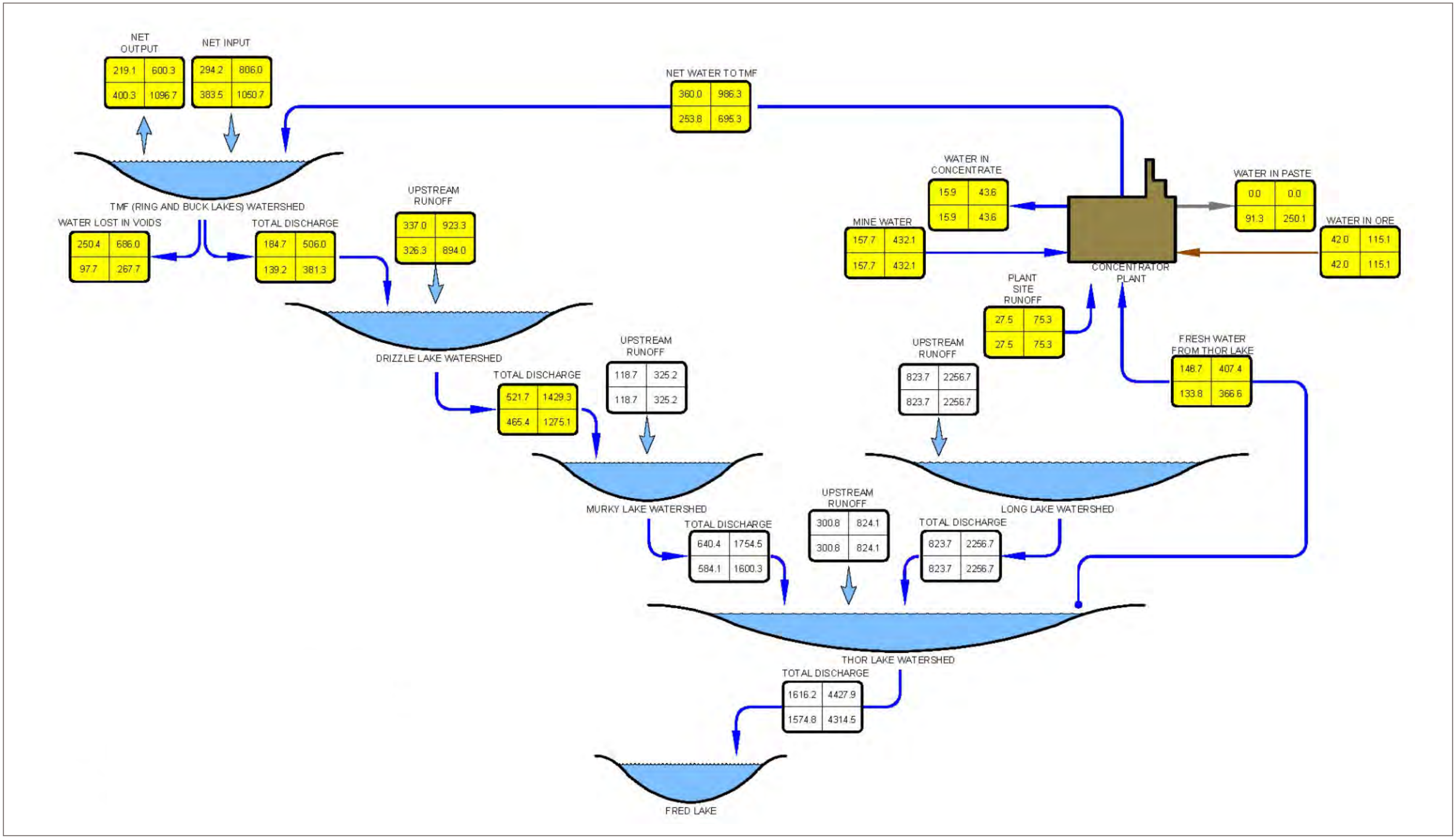
It is expected that the effluent quality criteria and sample scheduling identified in the Water Licence will, at a minimum, follow those listed in the MMER.

2.4.2.1 Surveillance Network Program

The SNP details regarding water sampling locations, timing, and analysis requirements will be issued with the Water Licence. The SNP is intended to provide frequent water quality monitoring within natural waterbodies that may be affected by Project activities with the purpose of providing early warning of degraded water quality conditions. Because this AEMP framework is intended to provide an outline of the proposed aquatic monitoring program, suggestions for sampling locations, scheduling, and analysis are included to complement the sampling program required under the MMER.

Table 2 indicates the sampling lakes, frequency and specific sites for the proposed SNP. All sites would be georeferenced to enable re-sampling at the same locations. Georeferenced sampling locations would be established at the following locations, as indicated in Figure 6: Drizzle, Murky, Thor (two locations), Long, Fred, A, Elbow, and Great Slave Lake (two locations). Drizzle, Murky, and Fred lakes are very shallow and may not have open water under the ice during winter.

Analysis should include major anions, alkalinity, total suspended solids (TSS), total dissolved solids (TDS), pH, conductivity, total metals, dissolved metals, total Kjeldahl nitrogen (TKN), nitrate and nitrite nitrogen, total phosphate, orthophosphate, and dissolved organic carbon (DOC). In addition, water samples should be analyzed for radionuclides including radium-226 (226Ra), radium-228 (228Ra), lead-210 (210Pb), thorium-230 (230Th) and thorium-232 (232Th). Detection limits must be set to permit comparison with regulated limits, or in their absence, with CCME Guidelines for the Protection of Aquatic Life. It is recommended that the requirement to analyze for radionuclides be discontinued after three years of sampling if the levels of these elements are consistently below guideline or detection limits, and if no increasing trend is detected.



LEGEND

ANNUAL FLOW IN THOUSAND m³/yr

AVERAGE FLOW IN m³/day

Years 1 to 4	1616.2	4427.9
Years 5 to 20	1574.8	4314.5

NOTES

1. Estimates are for average precipitation conditions and do not include extreme precipitation events.
2. Highlighted values are taken from KPL Memo Cont. No. NB10-00596.
3. Upstream runoff to each lake includes direct precipitation and evaporation on the lake.
4. Figure Source: Knight Piesold Consulting, March 2011 (Ref No. NB11-00132, Figure 5).

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THOR LAKE PROJECT

Annual Watershed Flowsheet Mine Operations

PROJECT NO.	DWN	CKD	APVD	REV
V15101007.004	SL	RH	DM	0

OFFICE	DATE
EBA-VANC	December 6, 2011

Figure 5

Table 2. Proposed SNP Surface Water Sampling Locations and Sampling Frequency

Location	Sample Frequency	Sample Site* (site no./Easting/Northing)
Drizzle	Monthly during open water season; December and March under ice (if open water is present)	Surface grab sample UN-13 418851 6888823
Murky	Monthly during open water season; December and March under ice (if open water is present)	Surface grab sample UN-10 417893 6887973
Thor	Monthly year round	Surface grab sample TL-06 415842 6886885 TL-07 416636 6887520
Fred	Monthly during open water season; December and March under ice (if open water is present)	Surface grab sample FL-01 415751 6887108
A	Monthly year round	Surface grab sample FL-03 413762 6886729
Long	Monthly year round	Surface grab sample LL-02 417273 6885871
Elbow	Monthly year round	Surface grab sample EL-01 416388 6885140 EL-02 415576 6883908
Great Slave Barge embayment	Monthly year round	Surface grab sample GL-01 413845 6882398
Great Slave At inflow from Thor L. system	Monthly year round	Surface grab sample location to be determined based on site examination
Kinnikinnick (reference)	Monthly year round	Surface grab sample UN-08 420757 6885658
Redemption (reference)	Monthly year round	Surface grab sample UN-14 429566 6899312

*Note: Site numbers and locations follow those of Stantec (2010; also reproduced in Avalon 2011).

Water quality analyses will be compared against background levels (Stantec 2010; Avalon 2011) and regulatory/guideline levels to identify exceedances presumably resulting from Project activities, or trends toward these levels. Exceedances or trends indicating deteriorating water quality conditions will result in an examination of the effluent discharge pathway to identify the source of the contaminant(s), and will initiate contingency plans that will be established to resolve such issues.

The construction phase of the Project may result in relatively short term effects on water quality and fish habitat, resulting from land disturbance involving vegetation removal, soil exposure, and blasting (see Figure 1), as well as the possible requirement to construct stream crossing structures for roads or pipelines. Construction, land clearance, and stream crossing activities will adhere to the DFO Land Development Guidelines for the Protection of Aquatic Habitat (DFO 1993) to avoid or minimize adverse effects. Similarly, blasting will follow the DFO blasting guidelines (DFO 1998) to avoid direct or indirect effects on fish or fish habitat.

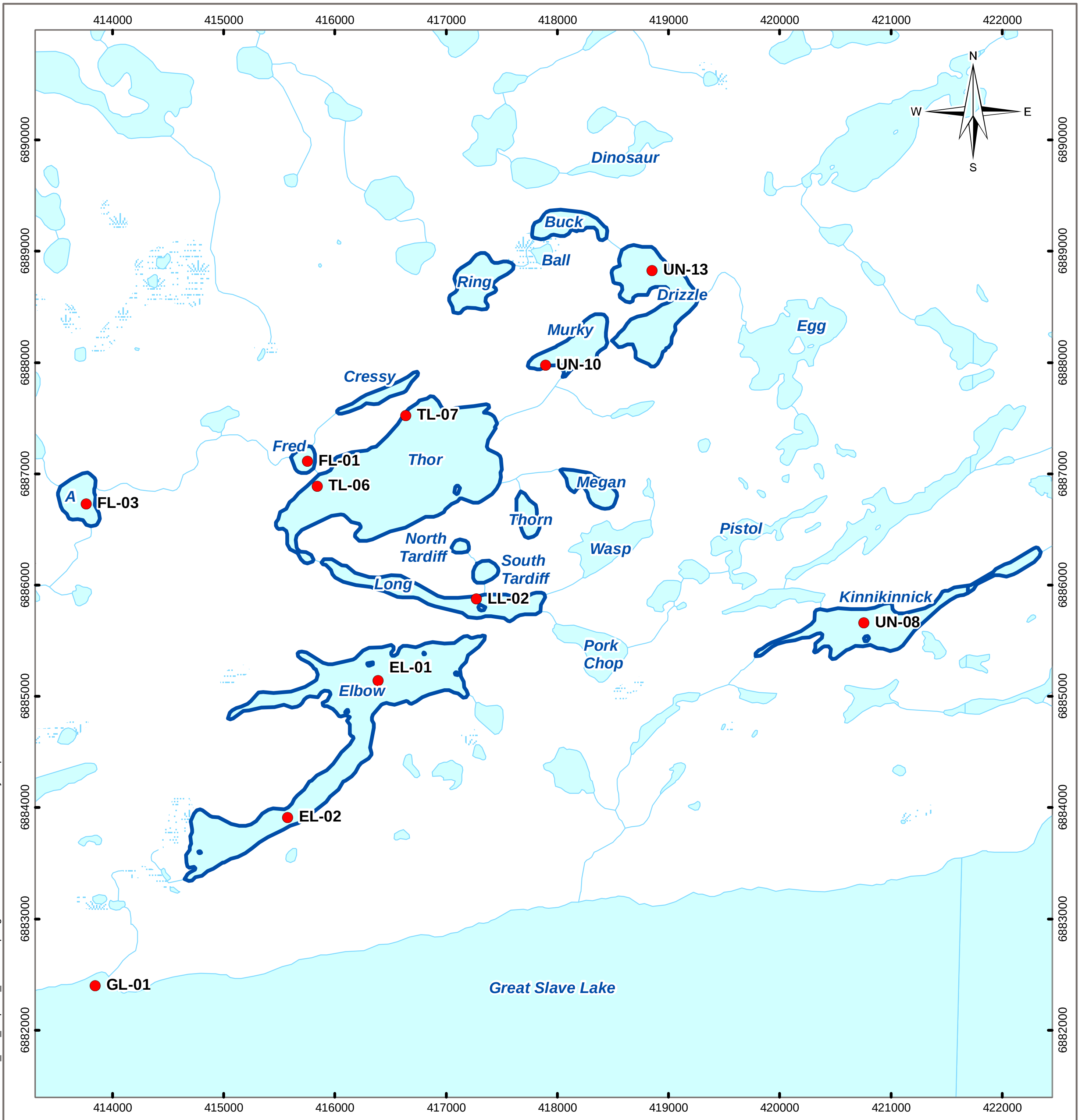
The preliminary site layout design shows that infrastructure construction will be generally restricted to the northwest of the property, where overland drainage flows to Fred, Cressy, Thor, Ring, Buck, Ball, Drizzle, and Murky lakes (see Figure 4). During the construction phase, one or more environmental monitors will be retained to oversee construction activities, conduct water quality and habitat monitoring, and ensure implementation of the Construction Environmental Management Plan (EMP) and Environmental Protection Plan (EPP), which will be developed for this Project.

2.4.3 Additional Monitoring Initiatives

Fish and benthic invertebrate sampling, analysis, and assessment will be conducted as part of regulated MMER EEM studies. However, those sampling efforts generally occur every three years, which may not be sufficient to detect cumulative biotic effects resulting from chronic releases of deleterious substances. As such, this AEMP Framework includes annual sampling and analysis of phytoplankton, zooplankton, and benthic invertebrates at the locations identified in Table 2. Sampling for these organisms will follow the methods reported by Stantec (2010) to permit direct comparisons.

Changes to the community structure and abundance of organisms within each of these trophic levels can serve as a sensitive indicator of effects from a variety of factors, including water discharge, water quality, or habitat modifications. Cause and effect relationships can then be identified from an integration of the biological information with evidence provided by background, reference, and current water quality data.

Fish sampling is not recommended as part of this initiative. Fish are relatively slow growing and long lived, and as such, are not rapid indicators of environmental change. In addition, fish productivity in northern latitudes is restricted due to cold temperatures and the short growing season. As such, excessive sampling by gill netting can result in excessive mortalities and adverse effects on fish abundance.



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LEGEND

- Proposed SNP Sampling Site
- Fisheries Lake
- Watercourse
- Waterbody
- Wetland

NOTES

1. Not shown: Redemption Lake and Great Slave Lake at the outflow from Thor Lake System.
2. Base data source: NTS 1:50,000 (Sheets 85I01 and 85I02).

STATUS
ISSUED FOR REVIEW

THOR LAKE PROJECT

Proposed SNP Sampling Sites

PROJECTION	DATUM	CLIENT
UTM Zone 12	NAD83	AVALON RARE METALS INC.

Scale: 1:50,000
1 0.5 0 1
Kilometres

FILE NO.
V15101007_004_Map002_SNPSampling.mxd

eba A TETRA TECH COMPANY

PROJECT NO.	DWN	CKD	APVD	REV
V15101007.004	SL	DM	DM	0

OFFICE	DATE
EBA-VANC	December 12, 2011

Figure 6

2.4.4 Monitoring Summary

Table 3 summarizes the sampling that is proposed as part of the Thor Lake Project AEMP.

Table 3. Summary of AEMP Sampling Program

Reason for Sampling	Sampling for…	Location	Frequency
MMER	Effluent characterization (MMER regulated substances)	Final discharge point	Weekly
	Acute lethality testing	Final discharge point	Monthly
	Daphnia magna testing	Final discharge point	Monthly
	Cumulative effluent volume	Final discharge point	Monthly
	Effluent analysis (analyses other than MMER regulated substances)	Final Discharge Point	Quarterly
	Water quality (analyses other than MMER regulated substances)	Exposure area adjacent to final discharge point	Quarterly
	Sublethal testing of 4 trophic level organisms	Final discharge point	Twice yearly
	Biological monitoring studies (fish, invertebrates, sediments, water quality)	Murky, Thor, A, Kinnikinnick and Redemption lakes*	Variable (see Section 2.4.1.3) Usually every 3 years
SNP*	Water quality	13 locations in 10 lakes	Monthly
Avalon Initiative	Phytoplankton, zooplankton, benthic invertebrates	Same as SNP sampling sites	Annually

*Proposed

3.0 MANAGEMENT RESPONSE PLANNING

Adaptive Management, also called Management Response Planning (INAC 2009) for the Thor Lake Project will involve establishing alternative options in the event of regulatory or guideline exceedances, or if trends indicate deteriorating aquatic environmental conditions. Action levels will be determined in advance of project initiation in consultation with regulatory agencies.

During construction, contingencies included in the EMP and EPP will include the installation of replacement of additional silt fences, progressive revegetation where feasible, or the redirection of surface flows to sediment ponds. The presence of a full time environmental monitor will permit rapid responses to ongoing or potential adverse effects. The EMP and EPP will include procedures for the management of unanticipated spills of hazardous materials or elevated levels of suspended sediment in receiving water bodies.

A detailed Management Response Plan for the Operation and Decommissioning phases of the Project will be developed as part of the AEMP. This plan will involve preparation for unexpected adverse effects based on the results of project mitigation techniques as well as experiences at other, similar locations. Avalon will prepare remedial plans in the event that trends point toward potential negative changes in environmental indicators. Early indicators may include water chemistry parameters and/or shifts in lower trophic level organisms and community structure, which have short generation times and react rapidly to changing environmental conditions. These plans may involve treatment of tailings, modification of TMF discharge levels or flow patterns, changes to plant operations, or any combination of these options.

Importantly, AEMP will integrate considerations of water chemistry, hydrologic, and biological factors that combine to determine environmental effects, as required by a properly designed adaptive management program. For example, the identification of effluent water chemistry alone is not sufficient to determine downstream effects, since valued environmental components are affected by a variety of chemical, physical and biological characteristics which interact to influence species composition, abundance, and health. It is for this reason that Avalon is proposing to include annual sampling for lower trophic level organisms, which will serve as 'early warning' indicators of environment change.

As described in the DAR Section 6.4.2.6, modelling predicts that the MMER effluent criteria for all parameters will be met over the entire 20 year simulation period, in each of the lakes within the Thor Lake system. However, nutrient modelling identifies the possibility that seasonally increased primary and secondary production of the system may occur as a result of potential inputs of additional nitrogen from the TMF decant water. Nitrogen additions might not significantly affect lower trophic level community structure and composition due to the limitation of primary production by phosphorous. However, this potential effect must be carefully assessed and will therefore be a major focus of the biological and water quality monitoring program. Trends toward higher levels of nitrogen coupled with changes in phytoplankton species composition and abundance (through analysis of species richness, diversity, evenness, etc.) will result in the identification and implementation of additional mitigation to reduce nitrate levels in the TMF.

4.0 CLOSURE

We trust this report meets your present requirements. Should you have any questions or comments, please contact the undersigned at your convenience.

EBA, A Tetra Tech Company

Prepared by:	Reviewed by:
ISSUED FOR REVIEW	***ISSUED FOR REVIEW***
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Attachment 2

AVALON RARE METALS INC.
TRANSPORTATION ASSESSMENT

RED SKY ENTERPRISES INC.

September 21, 2011

Table of Contents

1.0 Introduction: This report provides an assessment of the proposed method to transport moist concentrate from the Nechalacho, Thor Lake mine (Thor) across Great Slave Lake to Pine Point where the concentrate will be further processed before onward shipping to southern destinations. Fuel, reagents and other commodities will be shipped to Thor from Hay River, which may or may not be a separate operation.

Information pertaining to quantities, port location/infrastructure, load/offload operations and lay down areas was provided by Avalon Rare Minerals Inc. (Avalon).

Various over water transportation modes have been investigated; however, the current mode described in Developer's Assessment Report (DAR) is predicated upon tug and barge transport. Most criteria pertaining to marine equipment and cost estimates have been provided by the Northern Transportation Company Limited (NTCL).

Three tug and barge options have been considered for the transportation of Moist concentrates from Thor to Pine Point:

- Option 1 – 2 tugs, 6 1500 series barges
- Option 2 – 1 towing tug, 6 1500 series barges & 2 port tugs
- Option 3 – 2 tugs, 6 1000 series barges

Three tug and barge options have been considered for the transportation of fuel, reagents and other commodities from Hay River to Thor:

- Option 1 – 1 tug, 3 1500 series barges
- Option 2 – 1 tug, 3 1000 series barges
- Option 3 – 1 tug, 1 port tug, 6 1000 series barges

Detailed and summary schedules have been developed for all of the above options which are based on current tonnage data for all commodities. Cost estimates according to the above schedules and information received from NTCL are also included.

Two other local marine companies were contacted to ascertain their potential interest in this project. Both companies, which are described below, had positive responses.

Suggested docking arrangements at the Ports of Thor and Pine Point have been altered from what was initially envisaged by Avalon. This new arrangement should decrease load/offload times, but will require further consultation with tug and barge operators.

Transportation by Hovercraft was also investigated. Details of these craft was provided by Dale Wilson and followed by discussions with Paul Schmidt. It should be noted that the writer has had previous experience with 3 separate Hovercraft models, 2 working the Beaufort Sea off Tuktoyaktuk, NT and 1 working as a Pilot Project along the Athabasca River at Fort McMurray, AB. These machines were much smaller than proposed herein; however, it is believed that operational characteristics may be similar.

2.0 **Commodities to be Transported**: Listed below are the recent estimates of annual quantities of the various commodities to be transported by barge.

2.1 ***Moist Concentrates***: 144,540 tonnes – Thor to Pine Point. Concentrates are intended to be loaded in 40 tonne purpose built low rise containers having dimensions of 6.1 x 2.4 x 1.3 m. The containers will be stored at laydown areas located adjacent to the Thor and Pine Point docks.

2.2 ***Diesel Fuel***: 18,136 tonnes (21,800,000 litres) from Hay River to Thor.

2.3 ***Reagents*** : 4,025 tonnes from Hay River or Pine Point to Thor.

2.4 ***Mill Equipment***: Approximately 4280 tonnes from Hay River to Thor. A part of this equipment may be shipped from Pine Point.

2.5 ***Underground Equipment***: Approximately 480 tonnes of which the majority may be brought into Thor by ice road.

2.6 ***Other Commodities***: To be determined.

3.0 **Port Access, Infrastructure, Loading and Offloading:** Initially, seasonal docks comprised of flat deck barges will be used at each site. A mooring arrangement will be developed to adequately secure the dock barges during the open water season. Careful consideration <u>must</u> be given to the configuration of the barge dock to enhance loading/offloading operations. Where practicable, the preferred arrangement for the dock barge is an alongside mooring rather than bow on. These reasons include:

- easier to moor the cargo barge to be loaded;
- less travel for the lift trucks; and
- cargo barge can be loaded from center rather than over the bow or stern, therefore more efficient in keeping the cargo barge in trim.

In cases where the dock barge(s) are moored bow on (Pine Point), preference would be to moor the cargo barge across the stern of the dock barge, again for ease of mooring and cargo operations. If this is not possible, the cargo barge should be moored stern to the dock barge to eliminate the requirement to cross the raised bow of the 1500 series barge. In any event <u>only one cargo barge should be moored to the dock barge during loading/offloading operations.</u> Other barges would be tended by the towing tug. *Note: In the case of a 1 towing tug, 6 cargo barge operation (Option 2) it would be necessary to have a smaller tending tug at each Port.*

Under the current arrangement as described in the DAR, NTCL 1000 series barges are considered for use as dock barges and 1500 series barges for cargo. The moulded depth of each barge series differ by 0.77 metres (2.5 ft.) (Figures 3.0, 3.0.1), therefore ramping will be required, up or down, as the draft of the cargo barge changes. Ramping between barges can be eliminated by either ballasting or a lift truck pass-pass operation. Either method would add time to the load/offload operation.

As well, adverse weather conditions will be a limiting factor throughout operations; floating barge docks may have to be disassembled to avoid damage. During these conditions operations would cease until weather moderates to safely continue.

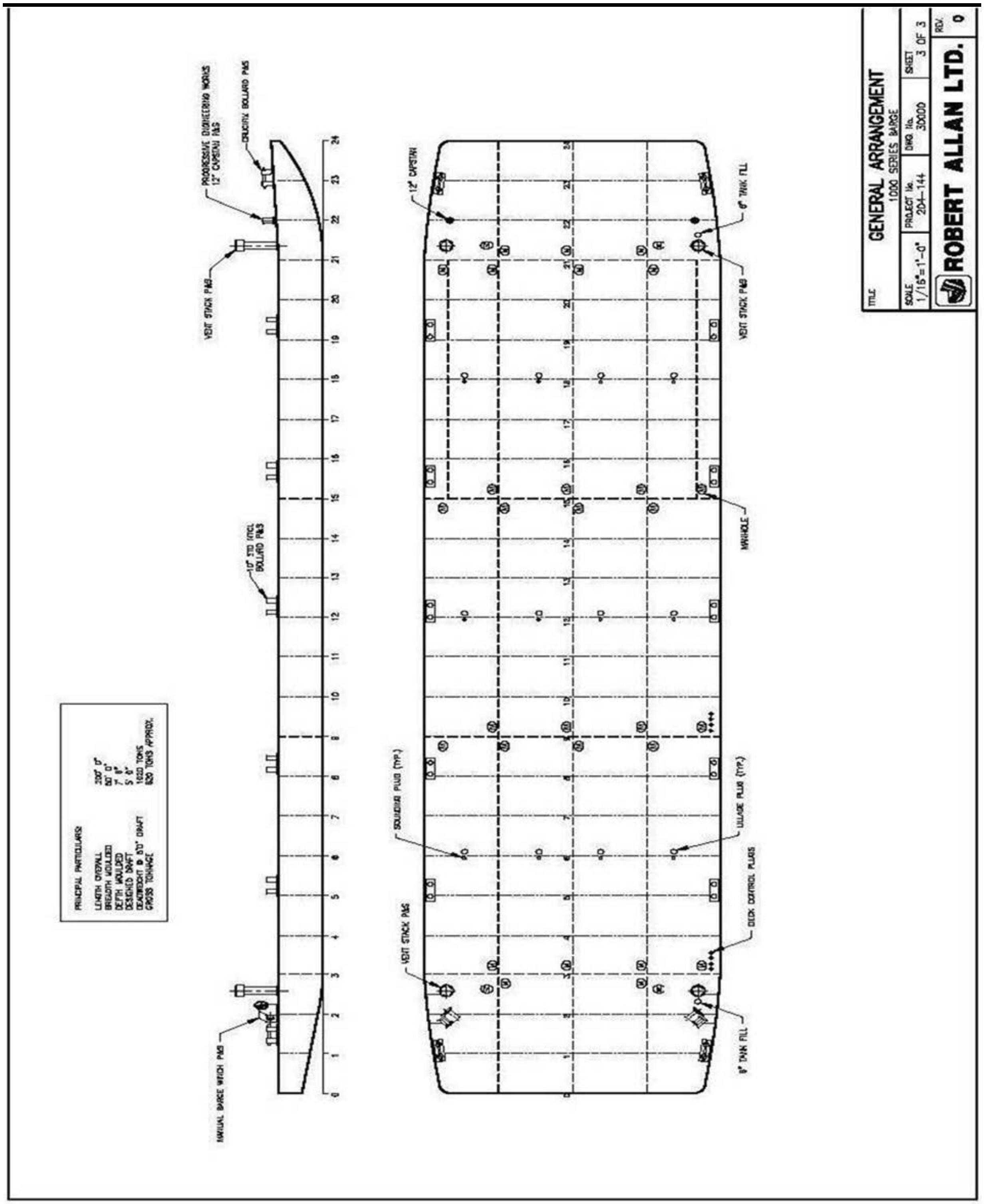

Figure 3.0 – NTCL 1000 Series Barge. Moulded Depth – 2.31 m (7' 6")

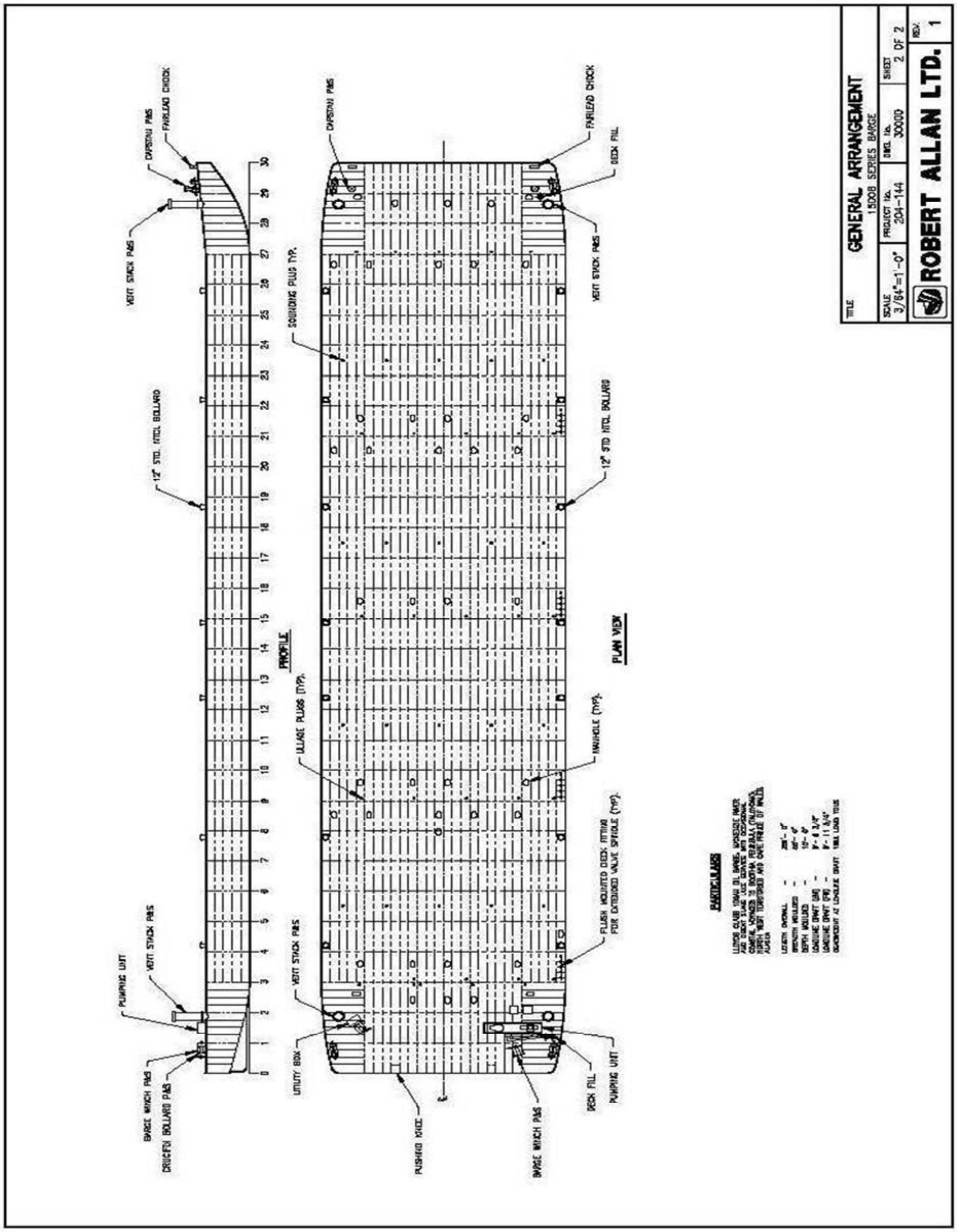

Figure 3.0.1 – NTCL 1500 Series Barge. Moulded Depth – 3.08 m (10’)

3.1 ***Nechalacho, Thor Lake Mine:*** Located along the north shore of Great Slave Lake (Hearne Channel), the port is reasonably protected from adverse winds except those originating from the westerly to south westerly quadrants. Access is believed to be satisfactory for equipment having a draft of not more than 3 metres (near shore). For more certainty a bathymetric survey is recommended. The recommended bathymetric survey was subsequently completed by EBA (2011) and the results are provided as Appendix 1 to this report.

3.1.1 ***Mooring Arrangement:*** Figure 3.1.1 describes the mooring arrangement at the Thor Dock. One 1000 series barge is moored alongside the shore with lines running to 4 dead men (anchor points) ashore. A ramp can be set about amidships of the dock barge. One cargo barge is then moored alongside the dock barge for loading. Other barges in the tow (2) can be anchored nearby or tied to the shore and shuttled into the loading dock when barge 1 is loaded.

A second mooring arrangement for the discharge of fuel should be considered as this is a time-sensitive operation and will interrupt cargo operations. As well, for safety reasons, fuel is not normally discharged in an isolated area. For fuel discharge 1 dock barge may be required; however, subject to near shore water depth, the fuel barge can be nosed into the beach and moored to deadmen ashore. Reagents and other commodities can be offloaded over the primary docking arrangement with little interruption to concentrate operations (Figure 3.1.1 of Avalon's Image shows inserted comment for recommended fuel discharge area).

3.1.2 ***Loading:*** It is anticipated that loading will be performed by 2 Hyster 1050 Series Lift Trucks, each carrying 40 tonne containers from a nearby laydown area. The weight of the lift truck is approximately 61 tonnes, therefore ramps onto the dock barge and/or cargo barge should be certified for a minimum 110 tonne weight. In the stow plan shown in Figure 3.1.2, the lift truck(s) will board the cargo barge at amidships, then place the containers fore and aft to keep the barge in trim. Figure 3.1.3 shows an alternate stow plan which provides more room at the center of the barge for the lift trucks to manoeuvre.

Thirty eight (38) containers, each loaded with 40 tonnes of moist concentrate, are loaded on each cargo barge. Including container weight (estimated at 5 tonnes each) total load will be 1710 tonnes, which translates into a barge draft of 1.93 metres. Lighter containers would reduce the loaded draft of the barge which would be beneficial for docking at Pine Point.

Estimated cycle time to load 1 container is 10 minutes. With 2 machines, a barge can be loaded in 3.2 hours. Unloading empty containers will take about half the time (1.6 hrs) as 2 containers can be moved at one time; therefore 1 barge load equals 4.8 hours. Shuttling time would be about 1 hour per barge times 2 barges equals 2 hours. Total estimated time for each tow load (3 barges) would be approximately 16.4 hours. Tow preparation for departure would take an additional 2 hours for a total sum of approximately 18.4 hours. Stow plans are shown in Figures 3.1.2 and 3.1.3.

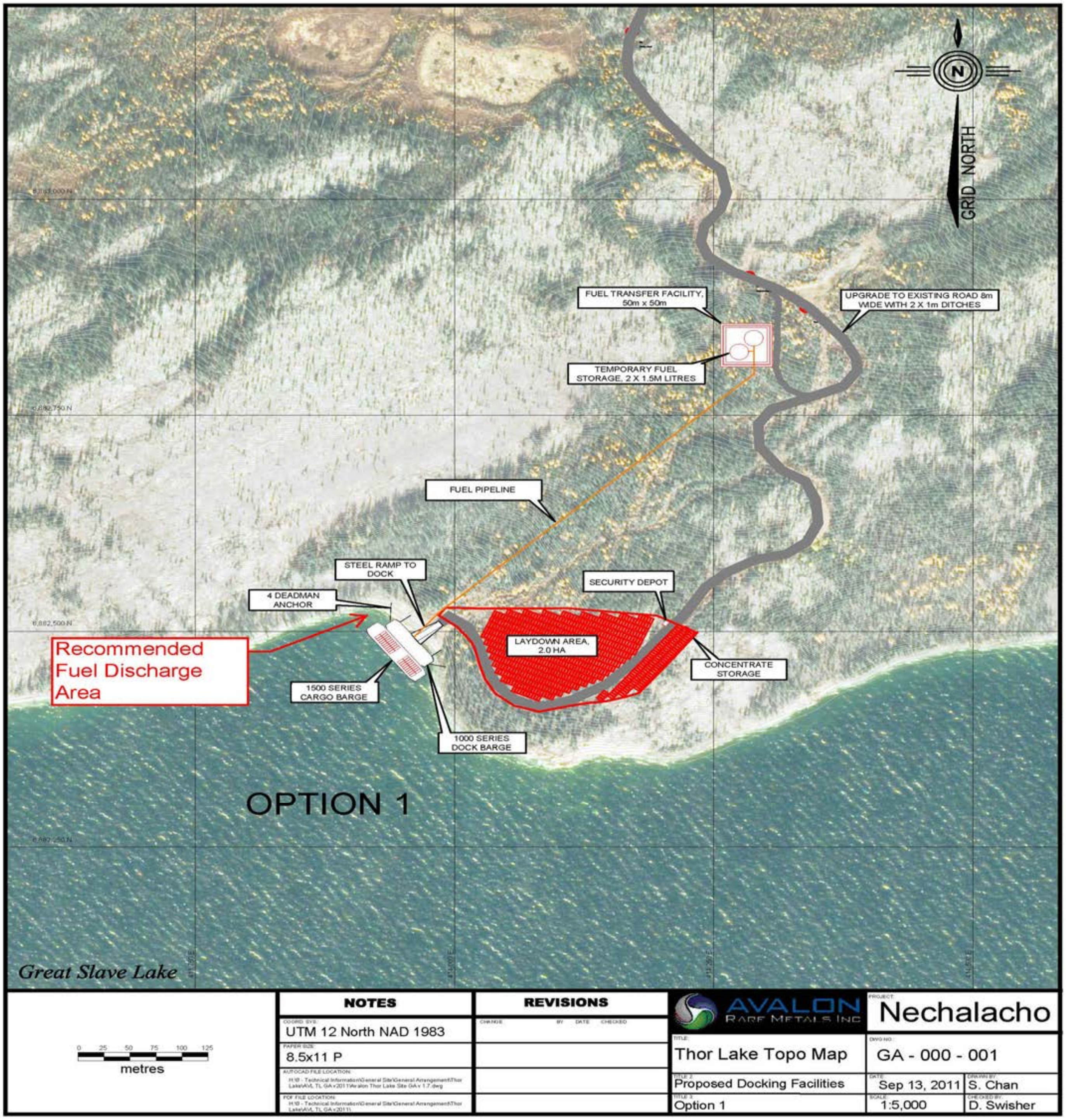

Figure 3.1.1 Avalon image with inserted caption showing recommended fuel discharge area

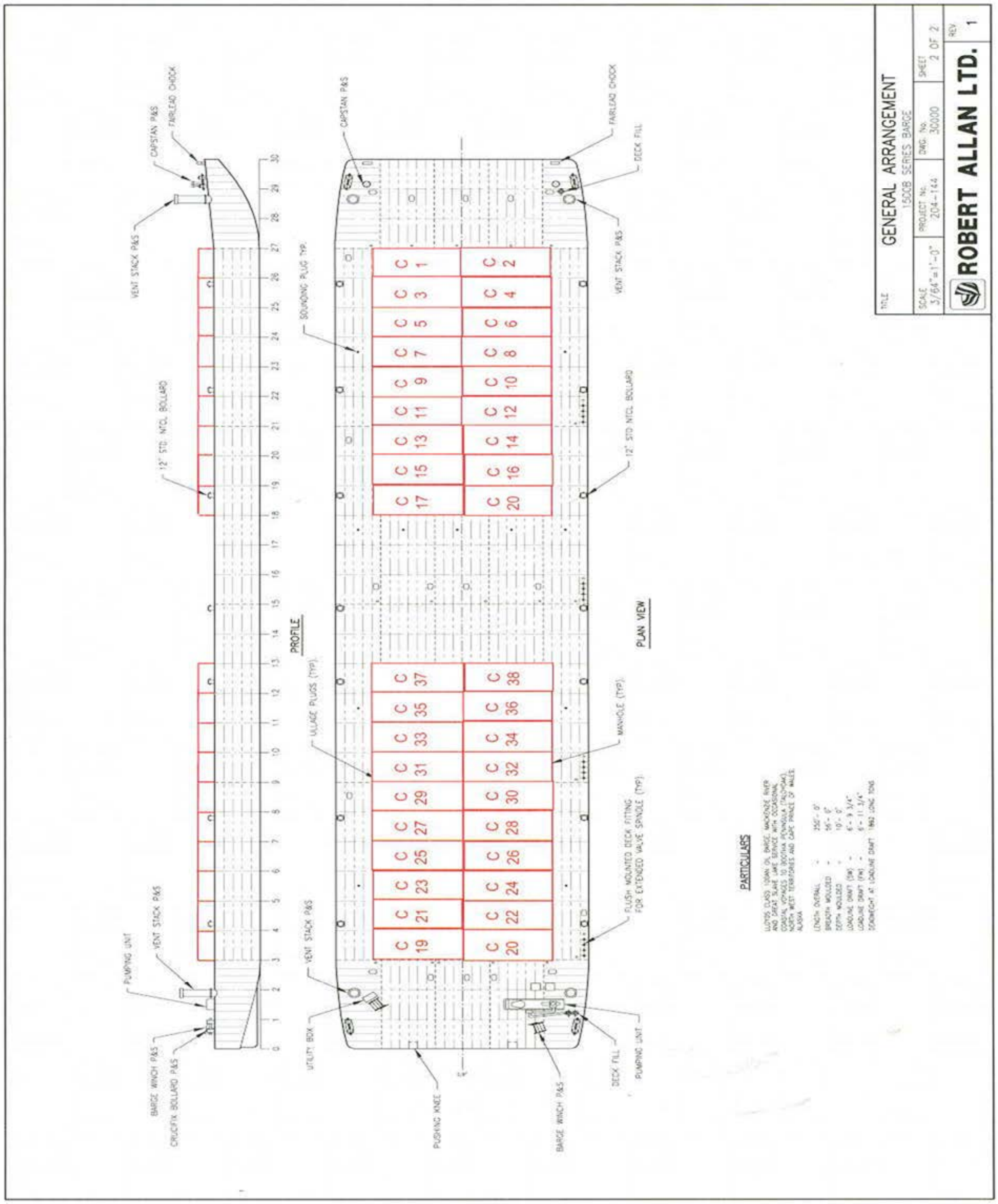

Figure 3.1.2 Primary Stow Plan

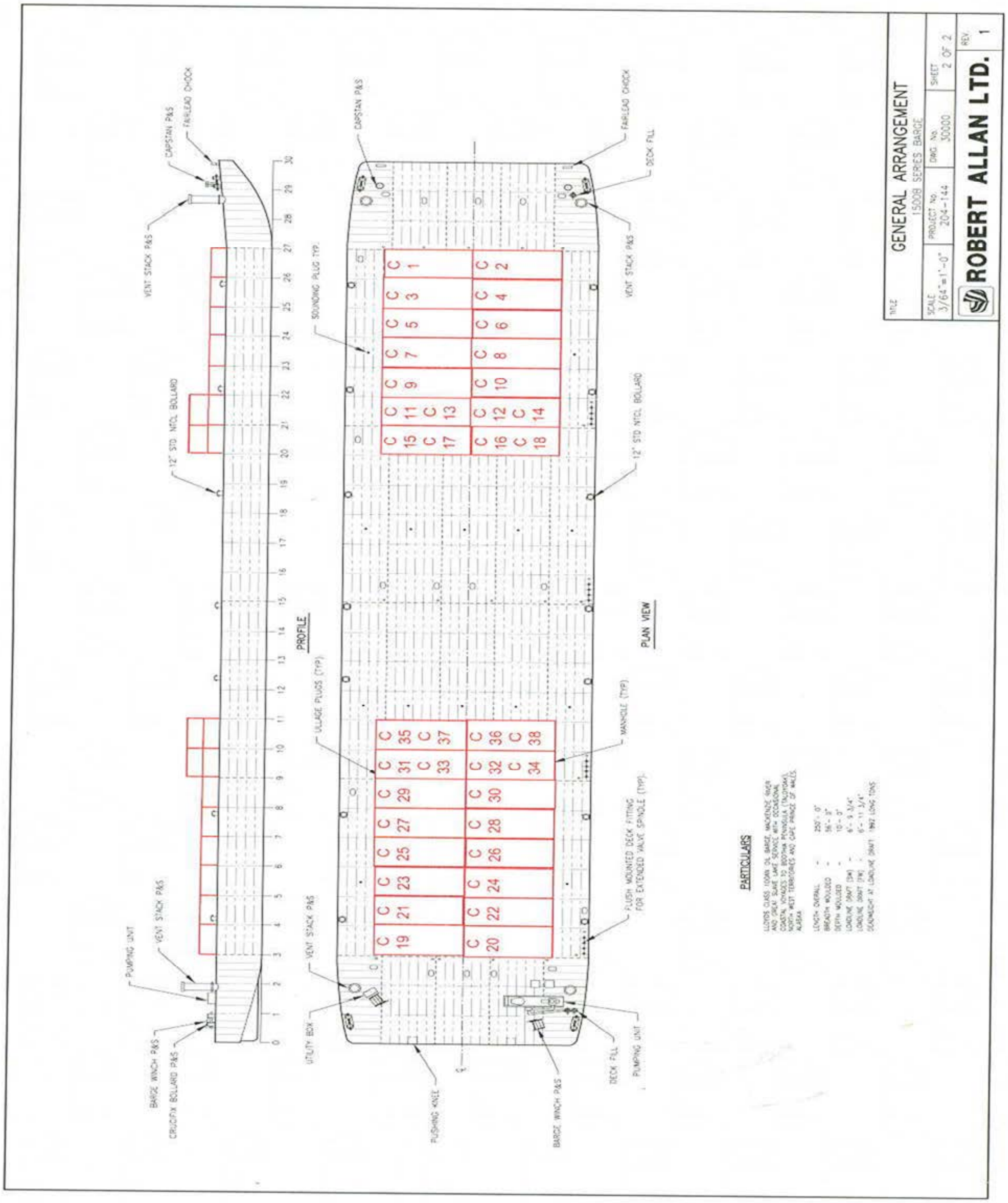

Figure 3.1.3 Alternate Stow Plan

3.2 ***Pine Point****:* Located along the southern shores of Great Slave Lake, the Port is essentially unprotected from adverse winds originating from the south southwest through north to the north northeasterly quadrant (SSW-N-NNE). In other words, most weather conditions may affect offloading operations.

3.3 This area is mostly low lying causing shallow approaches into the Port. A thru-ice bathymetric survey was conducted by EBA Engineering Consultants Ltd. in 2010 to determine the boundary of the 2 meter curve. The result suggested the 2 meter curve was 194 meters (630 ft.) offshore. This becomes problematic for cargo barges having a draft of 1.93 meters. <u>It is recommended that an in water bathymetric survey be conducted of this area plus surrounding areas nearby to ascertain water depth and bottom configuration. The recommended bathymetric survey was subsequently completed by EBA (2011) and the results are provided as Appendix 2 to this report.</u>

Assuming that the existing Pine Point docking area (end of the road) were to be used, 3 1000 series dock barges, secured in line, would be required to moor the cargo barge (see Figure 3.2). A well planned securing arrangement for the dock barges would be required to withstand adverse weather conditions. Grounding the dock barges by ballast water is another possibility but would require further investigation and approval by the barging contractor.

Offloading and reloading empty containers across this arrangement would be time consuming, probably 2 times, or more, longer than the loading operation. As well, weather related delays can be expected, especially later in the barging season.

For future use,Dawson Bay might be considered as an alternative landing site (see Figure 3.2.1, Google and Figure 3.2.2 CHS Chart 6371). As opposed to Pine Point, Dawson Bay provides some protection from adverse winds however updated bathymetry would be required to ascertain its suitability as a landing site. An analysis of the area was conducted and it was determined that it was not economic at this time and also would require further environmental investigations Further studies for use of Dawson Bay as a landing site should be undertaken at a later time.

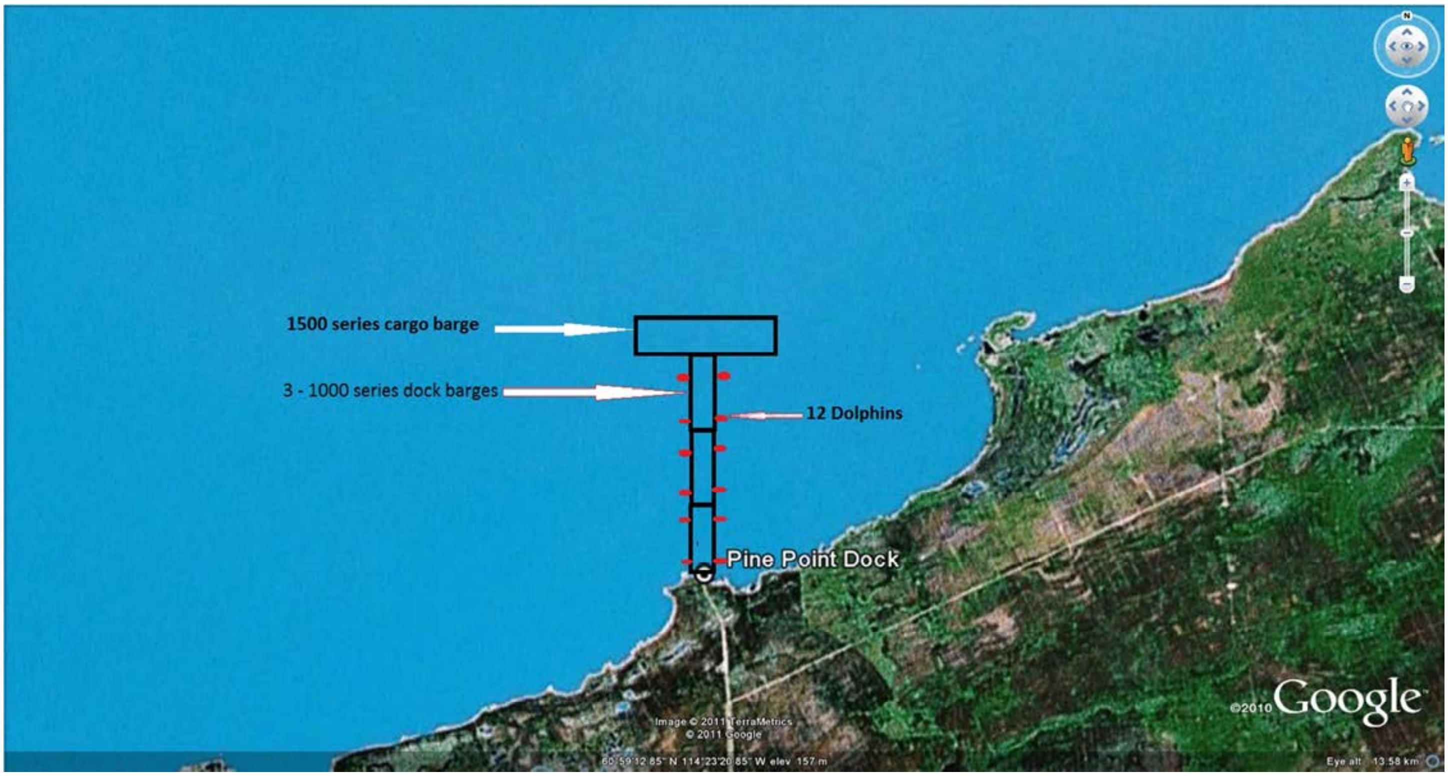

Figure 3.2 – Pine Point Docking Arrangement

Figure 3.2.1 – Dawson Bay

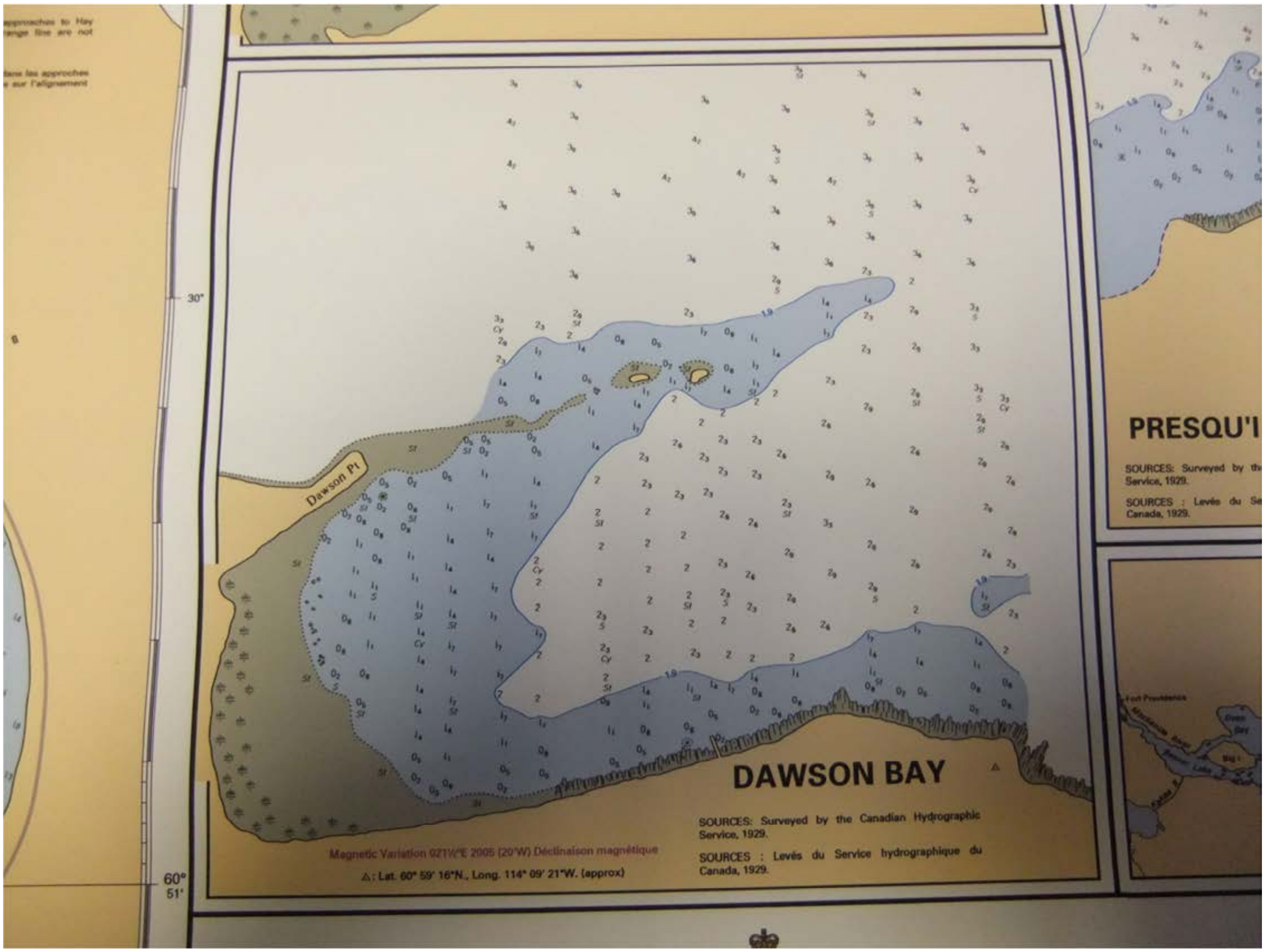

Figure 3.2.2 – Dawson Bay – CHS Chart 6371

4.0 Sea Fastenings: A lashing arrangement for securing concentrate containers must be developed and, preferably, approved by Class or Transport Canada. Several options are available for this task all of which are standard within the industry.

5.0 Routing: Figure 5.0 and 5.0.1 each show 2 routes from Thor to Pine Point and Hay River to Thor. It will be the mariner's decision which route is chosen.

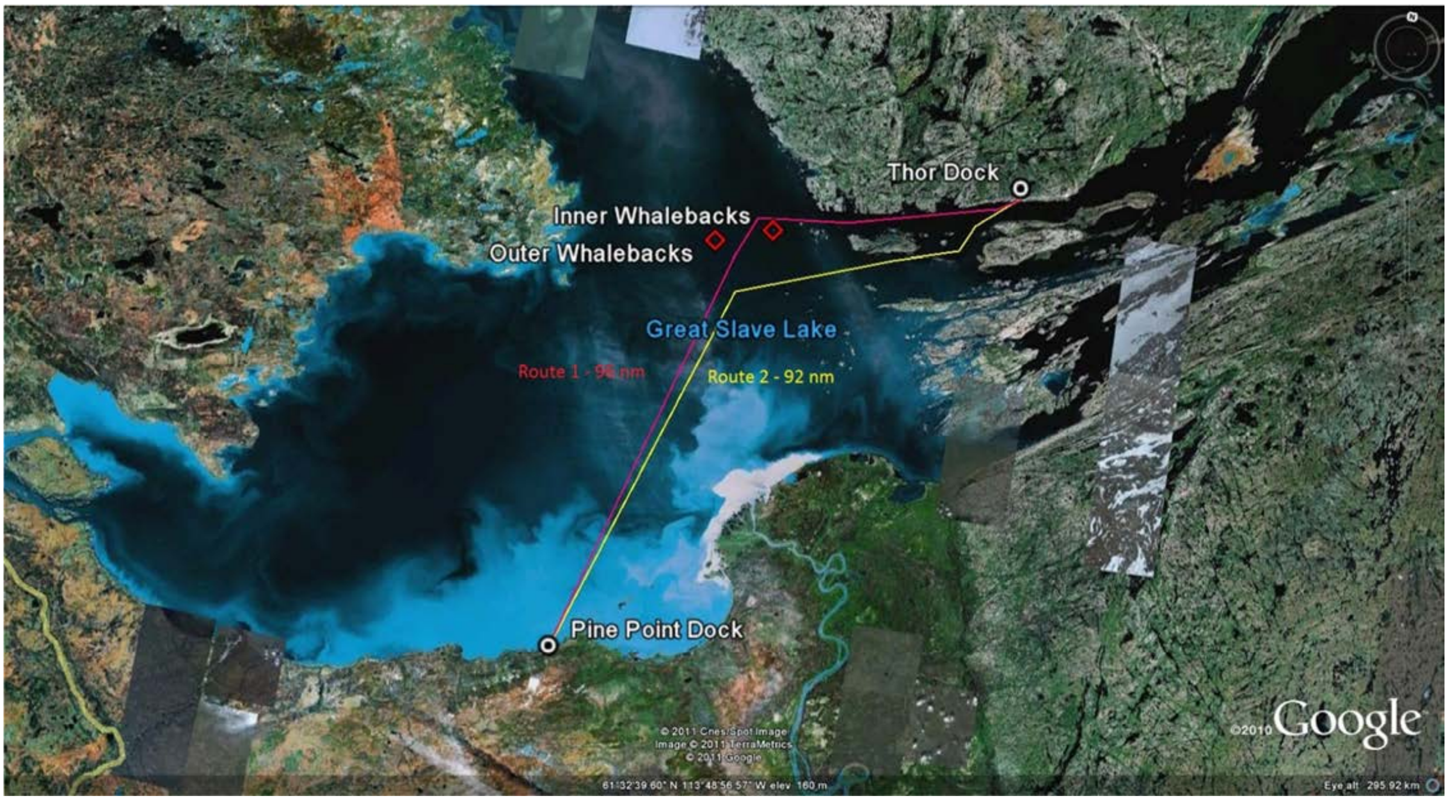

Figure 5.0 – Thor to Pine Point

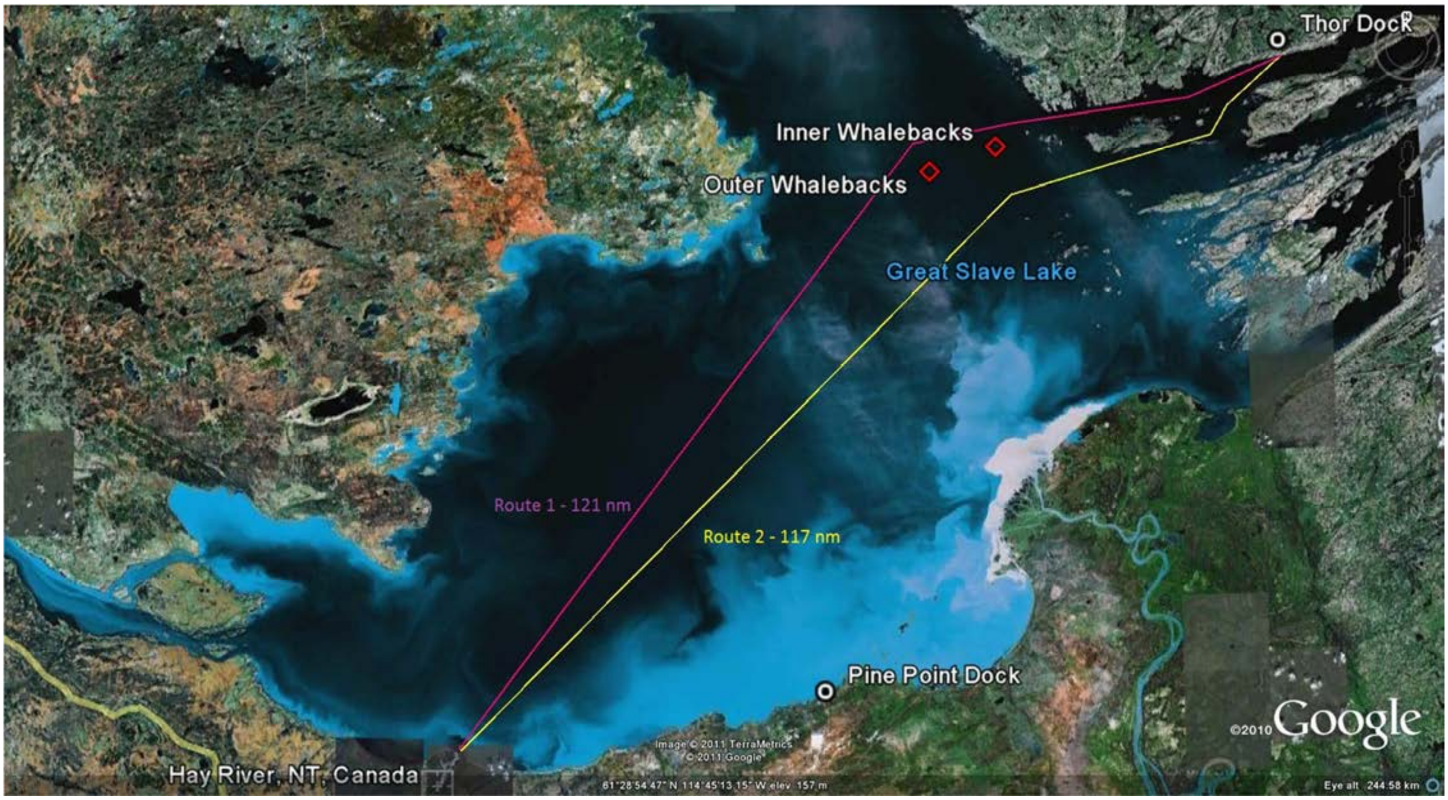

Figure 5.0.1 Hay River to Thor

6.0 Weather and Wave Data: Random data for wave and wind measurements has been collected from 4 wave buoys on Great Slave Lake (Figure 6.0);

- Wave buoy C45141 – West Great Slave Lake
- Wave buoy C45150 – North Great Slave Lake
- Wave buoy MEDS089 – Hay River (operational 1975 only)
- Wave buoy MEDS326 – Fort Resolution (operational1995 only)

This information, provided on line by Fisheries and Oceans Canada, is randomly selected to ensure best data quality. The MED Stations listed above did not provide wind direction or wind speed.

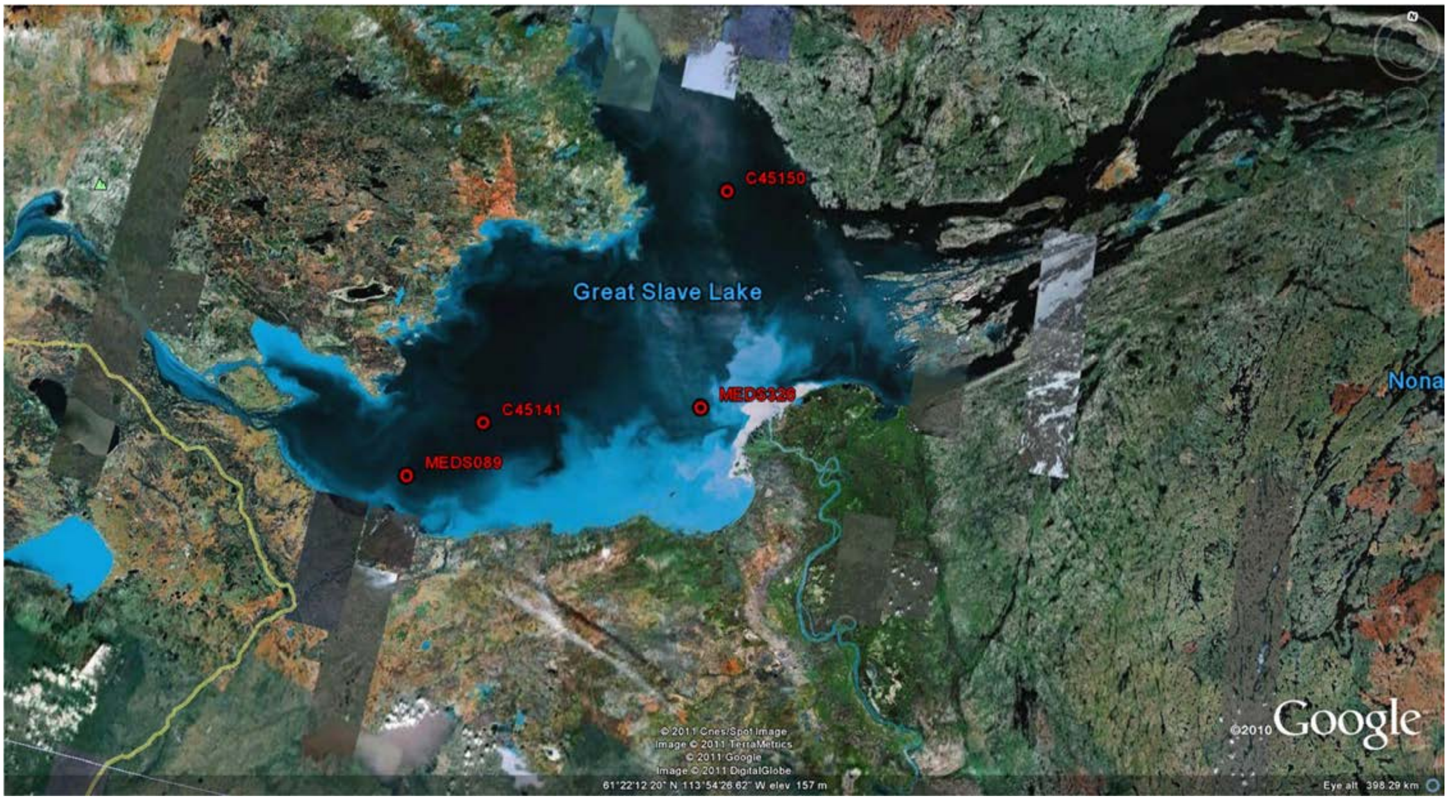

Figure 6.0 Buoy Stations on Great Slave Lake

Limiting weather conditions for sailing across Great Slave Lake is generally based upon:

- 20 knot wind speed (10.3meters/second) but dependent upon direction
- 0.91 meter (3 foot) sea state

Figures 6.0.1 and 6.0.2 show wind direction speed and wave heights. In all cases strongest winds are from the west through north quadrant. Wave heights tend to increase as the season progresses. Figures 6.0.3 and 6.0.4 show wave heights only which also indicates an increase in heights as the season progresses.

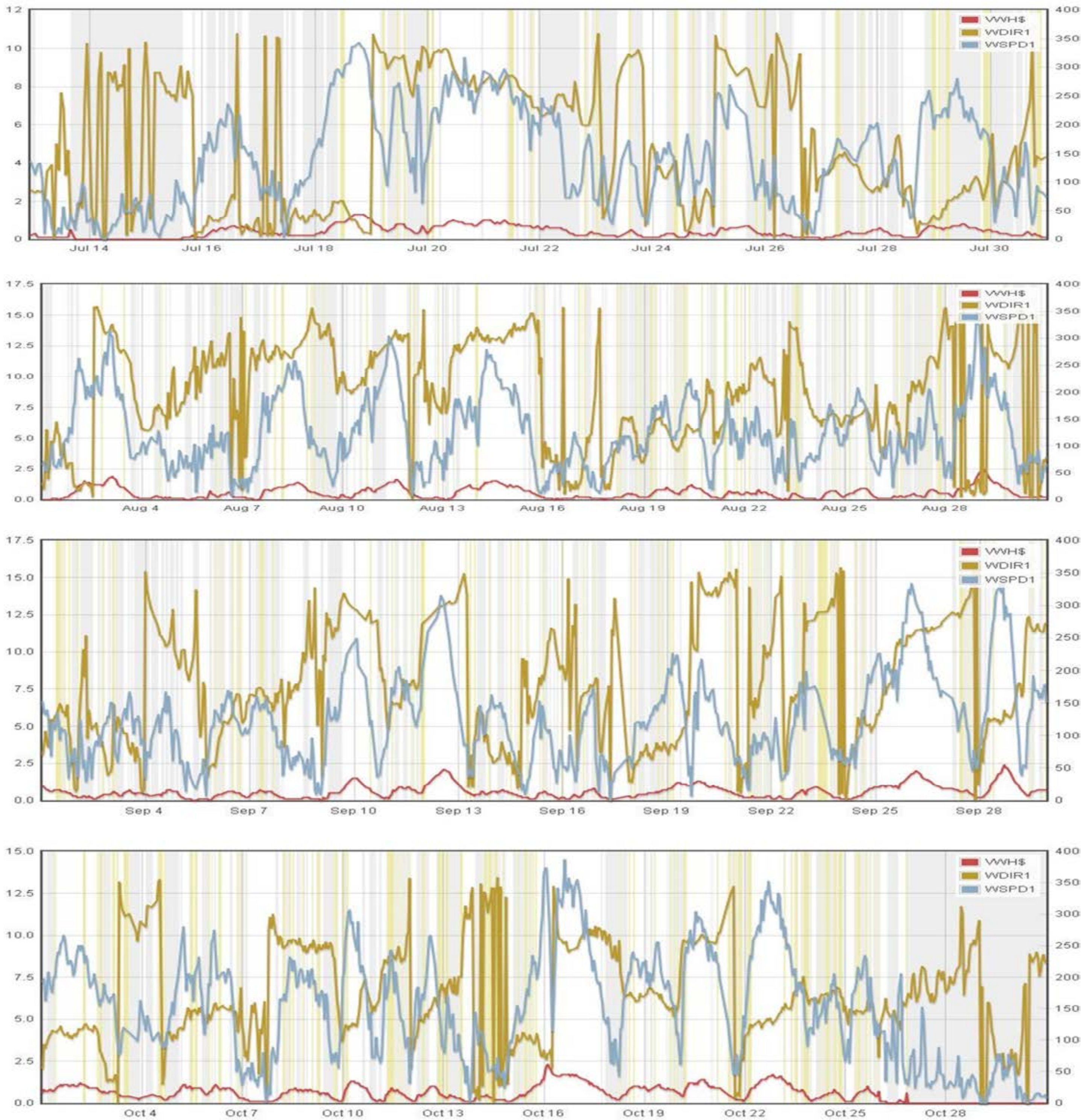

Figure 6.0.1 Buoy C45141 2005

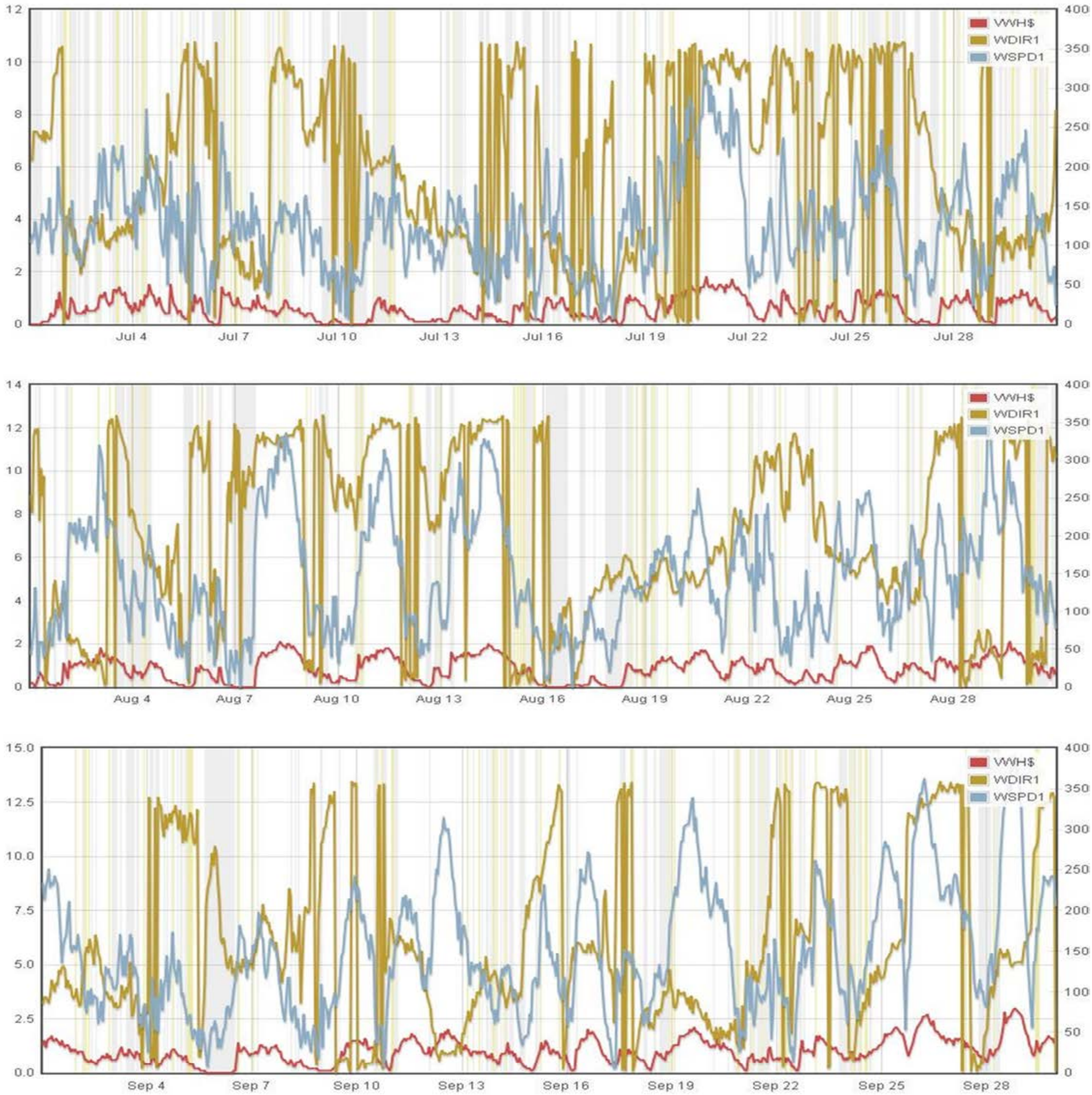

Figure 6.0.2 Buoy C45150 2005

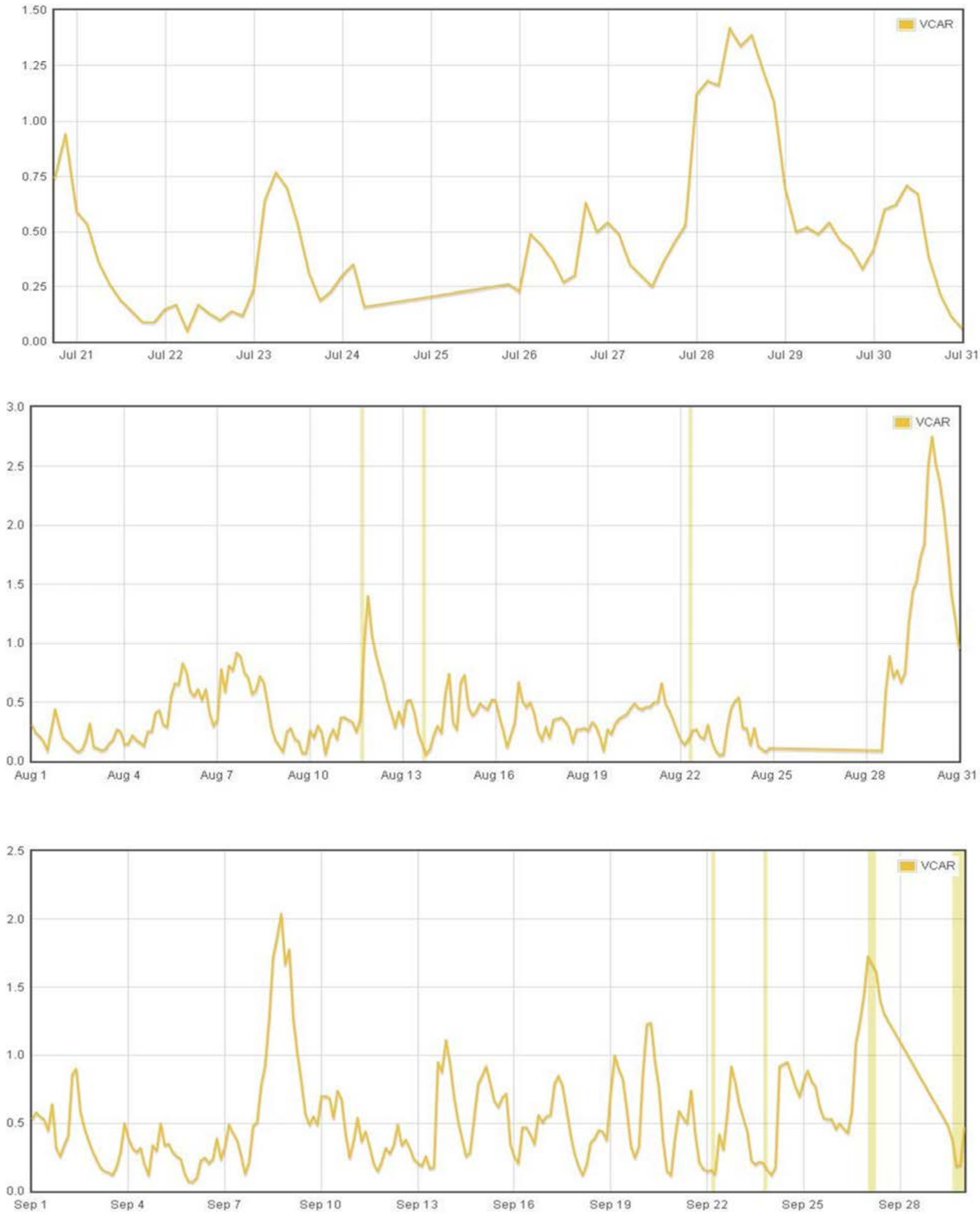

Figure 6.0.3 Buoy MEDS089 – Hay River 1975

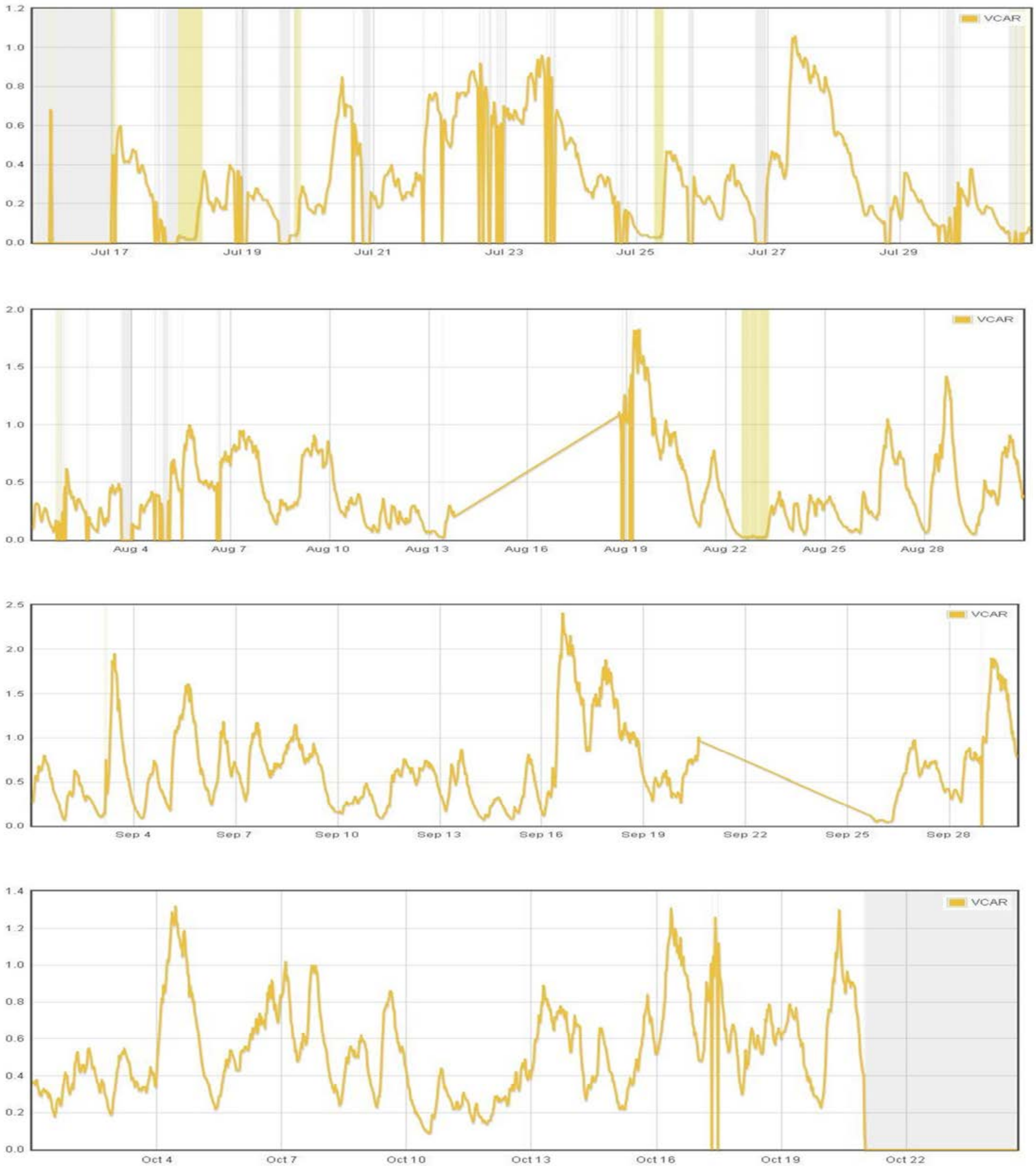

Figure 6.0.4 Buoy MEDS326 – Fort Resolution 1995

7.0 Preliminary Schedules: Detail and summary schedules have been developed to indicate days and timelines to transport by barge all commodities destined for Thor and Pine Point. These schedules, which are based on current tonnage estimates, are indications only and are subject to change. Two separate operations have been scheduled as two operations limit overall time and take advantage of favourable weather conditions on Great Slave Lake. Summary schedules are shown as tables; detail is attached as Appendix 1.

7.1 ***Moist Concentrates:*** 3 options have been considered to transport 144,500 tonnes of concentrate from Thor to Pine Point (Table 1)

Thor Cargo - Metric Tonnes

		Barge Series	Quantities	Container WT	Container Cargo	Total Wt	No. Of Containers		Barge DW Capacity	Containers per Barge	Product per Barge	Barge Loads	Barge Trips
Concentrate		1500	144,500	5	40	45	3,613		1710	38	1520	96	32
Concentrate		1000	144,500	5	40	45	3,613		900	20	800	181	60

Option 1 - 2 4500 HP Tugs, 6 1500 Series Barges

	No. Tugs	No. Barges	Voyage Distance (nm)	Speed (nmh)	Voyage Time (hrs.)	Offload Time (hrs.)	Load Time (hrs.)	Lapsed Time (hrs.)	Contin. (%)	Contin. Time (hrs.)	Total Time (hrs.)	Round Trip (hrs.)	Days Required
Concentrate	2	6	92	6.5	14		18.4	33	10%	3.3	35.8		61.24
Empty	2	6	92	6.5	14	36.8		51	10%	5.1	56.0		
												91.86	
Total Days													**61.24**

Option 2 - 1 4500 Hp Tug, 2 Port Tugs, 6 1500 Series Barges

		No. Barges	Voyage Distance (nm)	Speed (nmh)	Voyage Time (hrs.)	Offload Time (hrs.)	Load Time (hrs.)	Lapsed Time (hrs.)	Contin. (%)	Contin. Time (hrs.)	Total Time (hrs.)	Round Trip (hrs.)	
Concentrate	1	3	92	6.5	14		6	20	10%	2.0	22.2		67.92
Empty	1	3	92	6.5	14	12		26	10%	2.6	28.8		
												50.9	
Total Days													**67.92**

Option 3 - 2 4500 Hp Tugs, 6 1000 Series Barges

		No. Barges	Voyage Distance (nm)	Speed (nmh)	Voyage Time (hrs.)	Offload Time (hrs.)	Load Time (hrs.)	Lapsed Time (hrs.)	Contin. (%)	Contin. Time (hrs.)	Total Time (hrs.)	Round Trip (hrs.)	
Concentrate	1	3	92	6.5	14		12	26	10%	2.6	28.8		88.91
Empty	1	3	92	6.5	14	24		38	10%	3.8	42.0		
												70.7	
Total Days													**88.91**

Table 1 - Concentrates

7.2 ***Diesel Fuel, Reagents & Mine Supplies:*** These commodities, totalling 26,444 tonnes, have been combined as all are transported from Hay River to Thor (Table 2). 3 options have been considered. Load and offload times for fuel has been provided by NTCL; load offload times for general cargo is based upon 150 tonnes per hour. Option 2 or 3 appears to be the best solution due to significantly less time to load and offload fuel.

Due to the length of time it takes to load and offload fuel (more than 50% of total days) consideration should be given to using more barges and having a port tug at the Thor site to perform offload operations. This port tug would also be useful to assist in concentrate loading operations.

Hay River Cargo - Metric Tonnes								
	Quantities	Conversion	Tonnes	Barge Draft (m)	1500 Series DW Capacity	1000 Series DW Capacity	15000 Series Barge Loads	1000 Series Barge Loads
Fuel (litres)	21,800,000	0.000832	18,138	1.69	1,300	900	13.95	20.15
Reagents			4,026	1.69	1,300	900	3.10	4.47
Mine Supplies			4,280	1.69	1,300	900	3.29	4.76
Totals			26,444				20.34	29.38

Option 1 - 1 4500 HP Tug, 3 1500 Series Barges													
	No. Tugs	No. Barges	Voyage Distance (nm)	Speed (nmh)	Voyage Time (hrs)	Offload Time (hrs)	Load Time (hrs)	Lapsed Time (hrs)	Contingency (%)	Contingency Time (hrs)	Total Time (hrs)	Round Trip (hrs)	Days Required
Fuel	1	3	121	6.5	20	90	54	164	10%	16.4	180.9	203.5	39.43
Reagents	1	3	121	6.5	20	27	27	74	10%	7.4	81.6	104.1	4.48
Supplies	1	3	121	6.5	20	29	29	78	10%	7.8	85.3	107.8	4.93
Empty	1	3	121	6.5	20			20	10%	2.0	22.5		
Total Days													**48.83**

Option 2 - 1 4500 Hp Tug, 3 1000 Series Barges													
	No. Tugs	No. Barges	Voyage Distance (nm)	Speed (nmh)	Voyage Time (hrs)	Offload Time (hrs)	Load Time (hrs)	Lapsed Time (hrs)	Contingency (%)	Contingency Time (hrs)	Total Time (hrs)	Round Trip (hrs)	
Fuel	1	3	121	6.5	20	45	30	95	10%	9.5	105.0	127.6	35.70
Reagents	1	3	121	6.5	20	18	18	56	10%	5.6	62.1	84.7	5.26
Supplies	1	3	121	6.5	20	18	18	56	10%	5.6	62.1	84.7	5.59
Empty	1	3	121	6.5	20			20	10%	2.0	22.5		
Total Days													**46.55**

Option 3 - 1 4500 Hp Tug, 1 Port Tug, 6 1000 Series Barges													
	No. Tugs	No. Barges	Voyage Distance (nm)	Speed (nmh)	Voyage Time (hrs)	Offload Time (hrs)	Load Time (hrs)	Lapsed Time (hrs)	Contingency (%)	Contingency Time (hrs)	Total Time (hrs)	Round Trip (hrs)	
Fuel	1	3	121	6.5	20	4	30	54	10%	5.4	59.9	82.5	23.08
Reagents	1	3	121	6.5	20	4	2	26	10%	2.6	28.6	51.2	3.18
Supplies	1	3	121	6.5	20	4	0	25	10%	2.5	27.4	49.9	3.30
Empty	1	3	121	6.5	20			20	10%	2.0	22.5		
Total Days													**29.55**

Table 2 – Fuel, Reagents & Mine Supplies

8.0 Northern Tug & Barge Companies: Described below are 3 tug and barge companies currently operating in the Northwest Territories.

8.1 ***Northern Transportation Company Limited (NTCL)***: Jointly owned by the Inuvialuit of the Northwest Territories and the Nunasi of Nunavut, NTCL is the largest tug and barge company operating in the area. They have ample equipment to satisfy the needs of this project; however, they have suggested this may not be the case in the future as their equipment may be dedicated to other projects. Fleet details of the company can be viewed on line at www.ntcl.com.

8.2 ***Horizon North Logistics Inc. (HNL)****:* HNL is a public company trading on the TSX. They are headquartered in Calgary and have a marine operations base at Inuvik, NT. Except for 2 tugs that could be used as towing or port support tugs, their equipment is not suitable to meet Avalon's project requirements. HNL has shown a keen interest in this project and wish to be included in any tender process that may occur. It would be their intent to partner with a West Coast Company (Seaspan International or Island Tug and Barge) and possibly a First Nations

Group, and then build equipment to satisfy the needs of the project. HNL's web site is www.horizonnorth.ca.

8.3 ***Cooper Barging Service Ltd. (CBSL)****:* CBSL is a private company with headquarters in Fort Nelson, BC and operations base in Ft. Simpson, NT. Except for barges suitable for dock barges and possibly port support tugs, they currently do not have adequate equipment to satisfy the requirement for this project. CBSL web site is www.cooperservices.ca

9.0 **Hovercraft:** Use of a hovercraft to transport concentrates has introduced as an alternative to tug and barge. Craft proposed for this project is the SRN 4 model which previously operated in a car/passenger ferry service across the English Channel. Paul Schmidt has developed the economics of this craft, so the following will be an elaboration based on previous experience by the writer.

- 1973-74 - Bell Voyageur – Mackenzie Delta. A jet propulsion cargo craft chartered to Imperial Oil, primary use was to provide a "hot shot" service on a year round basis from base camp to drill sites. This was essentially a pilot project to evaluate performance in cold climates. Winter operations, coupled with very high maintenance costs, were problematic. In extreme cold (-30+ degrees), skirts became brittle and tore very easily. As well, rough ice very abrasive to fingers. In fairness, skirt material is more advanced today. The pilot project was not considered a success.
- 1985-1989 – Larus – Beaufort Sea. Larus was a Finnish craft constructed by Wartsila in 1981. In 1985, Wartsila Arctic and Arctic Transportation Ltd. formed a joint venture (Arctic Hovertrans), Canadianized the craft and transported her to station in Tuktoyaktuk, NT. The purpose of this venture was to introduce an alternate means of transportation to the offshore industry. The craft was diesel propelled, carried 46 passengers or 25 tonnes of cargo. It was a learning experience in terms of capabilities over ice. Fully loaded, operators could not get the craft on cushion over thin ice. In attempting to do so, fingers and skirts were severely damaged. To avoid this problem, an ice thickness of 17 inches was required. Rough ice and ridging proved to be a problem as well. Rough ice was very abrasive to the skirts and ridges over 0.5 meters had to be avoided due to skirt height. Visibility over ice and determining ice objects well in advance proved to be a challenge. Due to the suspension of activities in the Beaufort (1988 and onwards) the craft was demobilized from the Arctic and transported to Singapore.
- 2008 – 2009 – AP 1-88 – Fort McMurray. The craft was owned by Alaska Hovercraft (Lynden Transport) and chartered by NTCL for a period of 1 year. Canadian duty was paid on the 1/120 basis to bring the craft into Canada. This was a pilot project initiated by Canadian Natural Resources and Petro Canada (chartered from NTCL) to move personnel from Fort McMurray to CNRL's Base Camp 40+ miles north and along the Athabasca River. This was primarily a winter operation, but transit did occur over open water as well. The pilot project proved to be reasonably successful; however, there were issues with the navigation system for night travel. At the end of the term the craft was moved back to Prudhoe Bay, AK.

Transportation of concentrates by Hovercraft can be a viable alternative to tug and barge. From an economic perspective (developed by Paul Schmidt) this appears to be the case. Unfortunately (except

for Russian craft) long term operational history in cold climates is very limited. The SRN4, proposed for this operation, has had a very successful operation as a passenger/car ferry crossing the English Channel. Channel crossings were very short to what is contemplated here. Even with the short runs, maintenance and running costs appear to be on the high side. For cold climate operations some things that must be considered are:

- Skirt flexibility in -40 degree C temperatures;
- High wind conditions for control of the craft;
- Cabin insulation for crew members;
- Navigation equipment to identify ice obstacles, especially during the hours of darkness;
- Skirt height to navigate ice ridging;
- Finger abrasion on rough ice;
- Ice thickness required to achieve “on cushion” with full load; and
- Speed over ice in darkness

There are many other considerations; however, these can be discussed in the next phase of the project.

10.0 Preliminary Transportation Cost:

Note..This section has been removed from this copy of the report for reasons of corporate confidentiality.

11.0 **Other Transportation Options**: Two other options that should be considered are:

- Transporting concentrates in bulk. This would entail installing conveyor systems but could reduce dock infrastructure.
- Building purpose built power barges having shallow draft and a deadweight capacity of about 6,000 tonnes. This may also reduce dock infrastructure. *Note; A Naval Architectural firm was engaged to evaluate using large shallow draft self-propelled barges to transport moist concentrates from Thor to Pine Point. This proved to be uneconomical due to the large dimensional requirements of the barge and high horsepower required to propel the unit at a reasonable speed. Their recommendation was using a tug/barge system employing a drop/swap operation with 2 shallow draft tugs, each having about 1200 kW horsepower, and 4 1350 tonnes DWT barges. A single barge would be pushed rather than towed using an ATB connecting system Articouple KD type or equal deck-mounted pin connectors. These barges would not be fuel capable therefore only suitable for the transportation of deck cargo.*

12.0 Summary & Recommendations: Several alternatives have been considered to perform Avalon's transportation requirements across Great Slave Lake. tug and barge appears to be the best solution for this task. Weather will be a factor, in particular at Pine Point, where delays in offloading/loading operations can be expected. It is important therefore, to start operations early in the season when ice conditions permit. From a weather point of view, June, July and August are the most favourable months. Beginning in early September, weather conditions begin to deteriorate causing considerably more lost time in operations.

A number of recommendations are suggested:

1. In-water bathymetry surveys should be conducted at Thor and Pine Point to determine bottom conditions as well as water depth*. The recommended bathymetric surveys of both sites were completed by EBA (2011) and the results provided in Appendix 1 to this report.* The possibility of using Dawson Bay as an alternative to Pine Point should be examined. Dawson location would provide more shelter, which would reduce weather down time. This area would also require an in-water bathymetry survey to determine bottom conditions and water depth. *For future study*
2. Contact should be made with Canadian Coast Guard at Hay River to request setting buoys and marking a channel into Pine Point. This contact should occur 1 or 2 years in advance of transportation operations so the Coast Guard can budget accordingly. *Completed. CCG Hay River has advised, subject to confirmation from head office, that they would buoy a channel into Pine Point at the beginning of each season and retrieve the buoys at the end of each season. This would be a user pay operation.*
3. For safety reasons, a port tug will be required at Thor and Pine Point unless line haul tugs stand by during load and offload operations. *After further investigation a port tug may not be required at Thor*
4. For safety reasons, a separate location for offloading fuel should be planned. This will also eliminate interference with concentrate operations. *A separate location for the discharge of fuel at Thor has been identified.*
5. For fuel discharge, consideration should be given to using floater hose to connect the barge discharge line to the shore pipeline *Potential operators have advised that this is not a problem*
6. All barges should be fitted with an anchor and a means to deploy and retrieve*. This is only necessary if mooring buoys are not installed at Pine Point and Thor.*
7. For securing purposes, all barges should be fitted with hand or mechanical winches.
8. Deck strength of all barges must be suitable for heavy lift trucks carrying 45 tonne containers and point loading for containers stacked 2 high. *The RFP will describe this requirement.*
9. All ramps need to be certified for the heaviest load. *Aspen Trailer in Nisku, AB was contacted and they provided a price indication for constructing 110 tonne ramps*
10. Engage a naval architect to do a preliminary design of a shallow draft power barge capable of lifting up to 6,000 tonnes. *Completed. Resolve advised that a power barge for shallow water operations was not cost effective*
11. Submit a competitive tender to interested marine companies for the work to ensure best overall price and guaranteed equipment availability. *An RFP is currently being developed*

APPENDIX I

EBA BATHYMETRY REPORT

A TETRA TECH COMPANY

October 27, 2011

ISSUED FOR USE
EBA FILE: V15101007.011

Avalon Rare Minerals Inc.
330 – 6165 Hwy 17
Delta, BC V4K 5B8

Confidential

Attention: David Swisher

Subject: Thor Lake Mine – Environmental Services
Bathymetry and Side-Scan Study of Proposed Barge Landing Locations
Avalon Rare Minerals Inc.

1.0 INTRODUCTION

EBA, a Tetra Tech Company (EBA) was retained by Avalon Rare Minerals Inc. (Avalon) to perform a bathymetric and side-scan sonar investigation at two proposed barge landing locations on Great Slave Lake, Northwest Territories. The objective of the survey was to provide preliminary maps of the water depth and any underwater obstructions, such as rocks and boulders, which may inhibit the docking and mooring of barges at the two sites. The two proposed barge landing locations are near Pine Point (641073 E, 6762112 N, UTM Zone 11) on the southern shore of Great Slave Lake; and near Thor Lake (413945 E, 6882576 N, UTM Zone 12), on the northern shore of Great Slave Lake at the beginning of the Eastern Arm.

EBA acquired bathymetric and side-scan sonar data, and surveyed complete water-bottom coverage within the proposed barge landing footprint. The surveys were performed on October 15th, 2011 by Mr. James Mickle, M.Sc., P. Geoph. (pending), by floatplane (Arctic Sunwest's DHC-2 Turbo Beaver). Rocky areas were identified at the Pine Point site that will need to be considered with respect to the mooring plan usage and draft of the barges to be used.

2.0 METHODOLOGY: BATHYMETRY AND SIDE-SCAN SONAR

2.1 Bathymetry Data Collection

Bathymetry data at both locations was acquired using a hydrographic grade echosounder. The data collected provides water depths in metres in relation to the surface of the lake water at the time of the survey. It has not been referenced to a geodetic datum as this was beyond the defined work scope authorized. It therefore should be considered suitable for general proof of concept use only. Echosounders measure water depth by emitting a short-duration sound pulse from an acoustic transducer and measuring the elapsed time for the pulse to travel to the water bottom and back to the transducer. The elapsed time is combined with the speed of sound in water to determine the depth to the bottom. The system was calibrated at each site by determining site-specific sound velocity values by measuring true water depth with a weighted rope at a specific calibration location.

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2.2 Side-Scan Sonar Data Collection

Side-scan sonar produces a full-coverage image of the bottom by repetitively illuminating the bottom with a short-duration pulse of sound shaped into a beam that is very wide (typically 60°) in the direction perpendicular to travel, and very narrow (typically 1° to 2°) in the direction parallel to travel. Typically, two channels of data are collected: one beam is directed to port, and one to starboard. The sound pulse reflects off rough features on the bottom and back to the side-scan system (even sand and silt are sufficiently rough to reflect some sound energy back to the sonar transducer). Features that stand proud above the water bottom reflect back relatively more energy than does a flat soft bottom, resulting in higher-amplitude responses. In addition, these features produce 'shadow zones' behind them, as for a limited period of time immediately after these higher-amplitude responses, no sound energy is reflected back. The time duration of these shadow zones can be used to determine the height of the feature above the bottom.

Since the side-scan beam is wide, it insonifies a strip or swath of the sediments on the water bottom either side of the track travelled by the survey boat. These systems can resolve items on the bottom that are a few decimetres in size depending on the frequency used and the distance of the side-scan fish from the bottom. In the case of this survey, the area was surveyed using a nominal line spacing of 25 m, with a nominal side-scan coverage of 50 m to either side of the boat, for greater than 100 percent bottom coverage. The side-scan data and GPS positions were recorded to a laptop computer for post processing and mapping using the commercial software Hypack.

3.0 EQUIPMENT

3.1 Bathymetry Equipment

Bathymetry data was acquired using a SonarLite portable echo sounder, manufactured by Ohmex Instrumentation in the UK. Its specifications are:

- Transducer frequency: 200 kHz Active Transducer
- Beam spread: 8° to 10 °
- Depth range: 0.30 m to 50.00 m (Software limited)
- Accuracy: ±0.025 m (RMS)
- Sound velocity range: 1390 to 1500 m/sec
- Pulse frequency: 1 Hz

The echosounder was mounted 1 m aft of the GPS antenna, 50 cm below the water surface. All positional offsets have been applied to the data presented.

3.2 Side-Scan Sonar Equipment

Side-scan sonar data was acquired using a Starfish 450F system manufactured by Tritech International Ltd. of the UK. Its specifications are:

- Acoustic frequency: 450 kHz
- Range: 1 m to 100 m
- Transmitted power: < 210 db relative to 1 μPa at 1 m
- Vertical beam width: 60°
- Horizontal beam width: 1.7°
- Transducer arrangement: dual fin-mounted transducers, with 30° down-angle

The side-scan towfish was towed off the float plane, 4 m aft of the GPS antenna, approximately 1 m below the water surface. Use of the floatplane as the survey platform precluded operations in very shallow water (less than 2 m) due to safety concerns expressed by the pilot.

3.3 GPS Equipment

Survey track lines were recorded using a Novatel Smart V1 GPS system. The GPS was configured to output NMEA data strings every second. This data stream was split and then merged with the side-scan and echosounder data as the survey data was collected. In addition to the NMEA data strings, the GPS system was also configured to output RINEX positional data that was logged every 5 seconds. This data was used for GPS post processing using Natural Resources Canada's online CSRS service. The post-processed GPS positions are of sub-metre accuracy. Post-processed positions were compared with the NMEA positions, and the differences calculated. These differences, along with the data offset form GPS layback, were applied to the final figures to correct the absolute position of the data in the horizontal plane. GPS data is reported in UTM coordinates. It should be noted that Pine Point and Thor Dock are in different UTM zones. Pine Point is in UTM Zone 11 and Thor Dock is in UTM Zone 12.

4.0 RESULTS

4.1 Pine Point

Figure 01 shows the results of the bathymetry and side-scan sonar data. All data has been corrected for transducer and GPS offsets. The Pine Point survey area is the more shallow of the two survey areas, ranging in depth from 2 to 7 m, with water depths gradually decreasing towards the shoreline. The shoreline was approximately 150 m southeast from the edge of the survey area. It was imprudent to survey closer to the shore due to the increasing possibility of rocks being present that would reduce water depths abruptly to less than 1 metre, the maneuvering required to collect the survey data, and the risk of damage to the floatplane's floats. Bathymetry contour spacing on Figure 01 is 0.2 m.

The side-scan data has been mosaicked using Hypack and laid underneath the bathymetry contours. Ten rocks, generally less than 0.5 m in diameter, have been picked and are shown as red crosses on the figure.

Five areas containing several rocks with rock sizes generally less than 0.5 m in diameter are shown as orange rectangles. A list of specific rock targets and their locations is included in the following Tables section.

As a general comment, the nature of the side-scan data suggests a coarse hard bottom material with some cobbles and rocks. Areas with softer finer grained materials show in the side-scan data as patches or bands of darker colours.

4.2 Thor Dock

Figure 02 shows the results of the bathymetry and side-scan sonar data at Thor Dock. The Thor Dock survey area is very deep, ranging in depth from 3 to over 70 m, with water depths decreasing steeply towards the north shoreline, which has been approximately shown on the figure. The shoreline is also visible in the side-scan mosaic as a dark region of low signal return along the north edge of the side-scan mosaic caused by the side-scan signal being lost between the bottom and the water's surface where the water is shallow. Bathymetry contour spacing on Figure 02 is 1 m..

The side-scan data has been mosaicked using Hypack and laid underneath the bathymetry contours. Two rocks, generally less than 0.5 m in diameter, have been picked and are shown as red crosses on the figure. A list of specific rock targets and their locations is included in the following Tables section.

In general little detail is visible with respect to the character of the bottom at Thor Dock. This is because of the steeply dipping bathymetry and resulting slopes coupled with the distance from the side-scan fish to the bottom over much of the survey area. In order to obtain more detailed data of the character of the bottom material at this site, it would have been necessary to fit a depressor weight to the side-scan fish and repeat the survey varying the cable length so the side-scan fish was kept a constant distance off the bottom. This was beyond the work scope provided for, given the time budgeted at this site, and considering the deeper water depths, it was not considered critical.

5.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Avalon Rare Minerals Inc. and their agents. EBA, A Tetra Tech Company, does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Avalon Rare Minerals Inc. or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. EBA's General Conditions are provided in Appendix A of this report.

6.0 CLOSURE

We trust this report meets your present requirements. Should you have any questions or comments, please contact the undersigned at your convenience.

Sincerely,
EBA, A Tetra Tech Company

REGISTERED PROFESSIONAL GEOPHYSICIST
P.I. FINLAY
NWT/NU

October 27, 2011

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October 27, 2011

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/ln

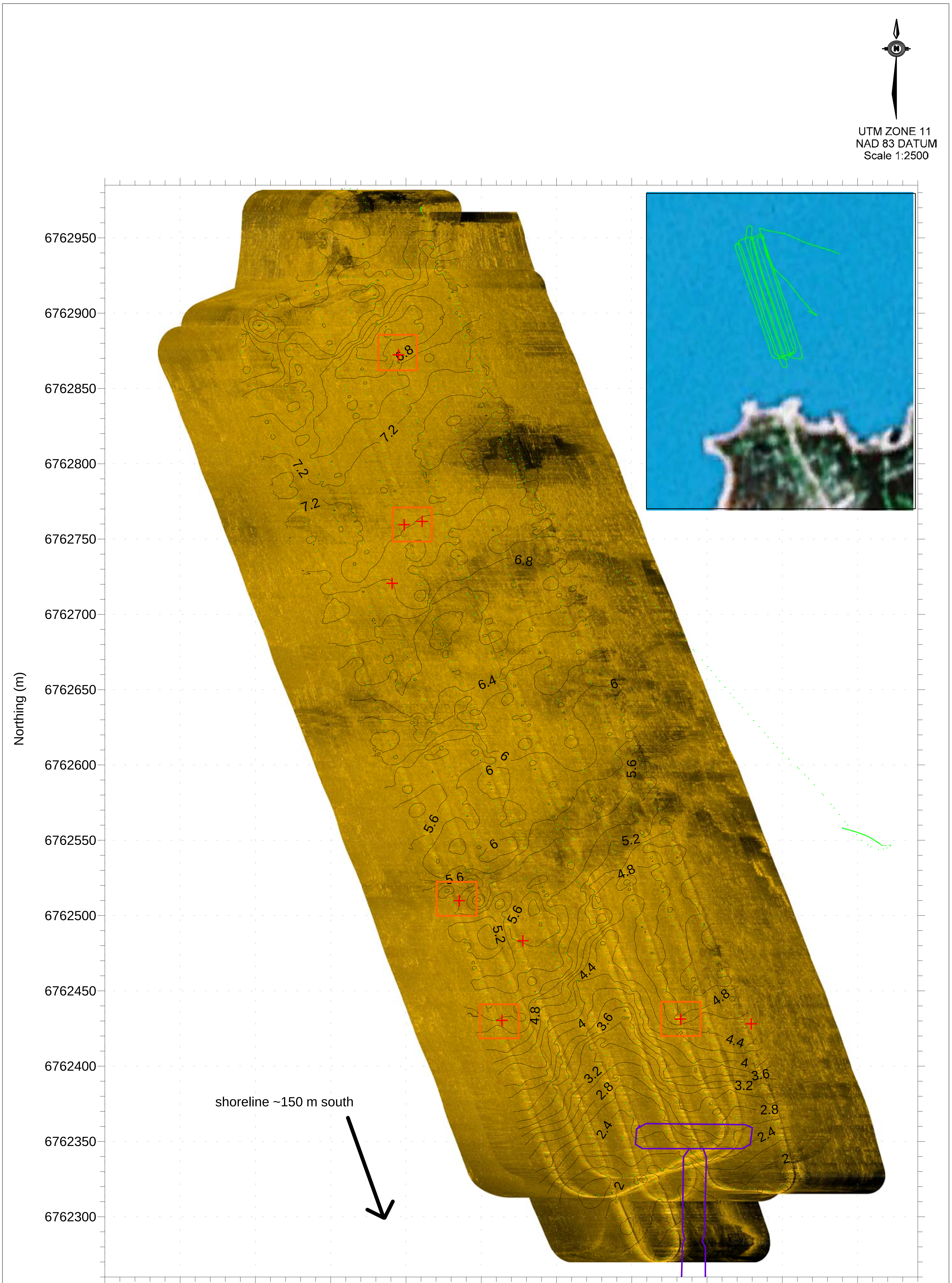
PERMIT TO PRACTICE
EBA ENGINEERING CONSULTANTS LTD.
Signature
Date October 27, 2011
PERMIT NUMBER: P 018
NWT/NU Association of Professional Engineers and Geoscientists

TABLES

Table: Side-Scan Targets

Pine Point (UTM Zone 11)		
Easting (m)	**Northing**	**Comments**
640898.9	6762759.6	Height: 1.8 Length: 2.9 Width: 1.5
640895	6762872.4	Height: 0.5 Length: 1.4 Width: 1.5
641129.4	6762428.2	Height: 0.7 Length: 1.8 Width: 1.5
641082.5	6762431.3	Height: 0.6 Length: 1.4 Width: 4.5 rocky area
640963.8	6762430.4	Height: 0.7 Length: 5.8 Width: 12.2 rocky area
640935.5	6762510	Height: 2.6 Length: 3.5 Width: 3.0 big shadow
640890.8	6762720.7	Height: 0.9 Length: 1.4 Width: 2.9
640977.7	6762483.3	Height: 1.0 Length: 0.6 Width: 0.6 Rocky Area
640910.8	6762761.8	Height: 0.6 Length: 4.6 Width: 3.8 Rocky area
Thor Dock (UTM Zone 12)		
Easting (m)	**Northing**	**Comments**
413939.4	6882501	Height: 0.4 Length: 0.5 Width: 1.2
413878.2	6882387.2	Height: 1.5 Length: 3.4 Width: 3.0

FIGURES



LEGEND

Rocky Areas

Rocks

Bathymetry Contours

GPS Trackline

Proposed Dock Infrastructure

CLIENT

AVALON

eba
A TETRA TECH COMPANY

Thor Lake Project
Northwest Territories

Pine Point Barge Area

Bathymetry and Side-scan Sonar

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OFFICE	DATE
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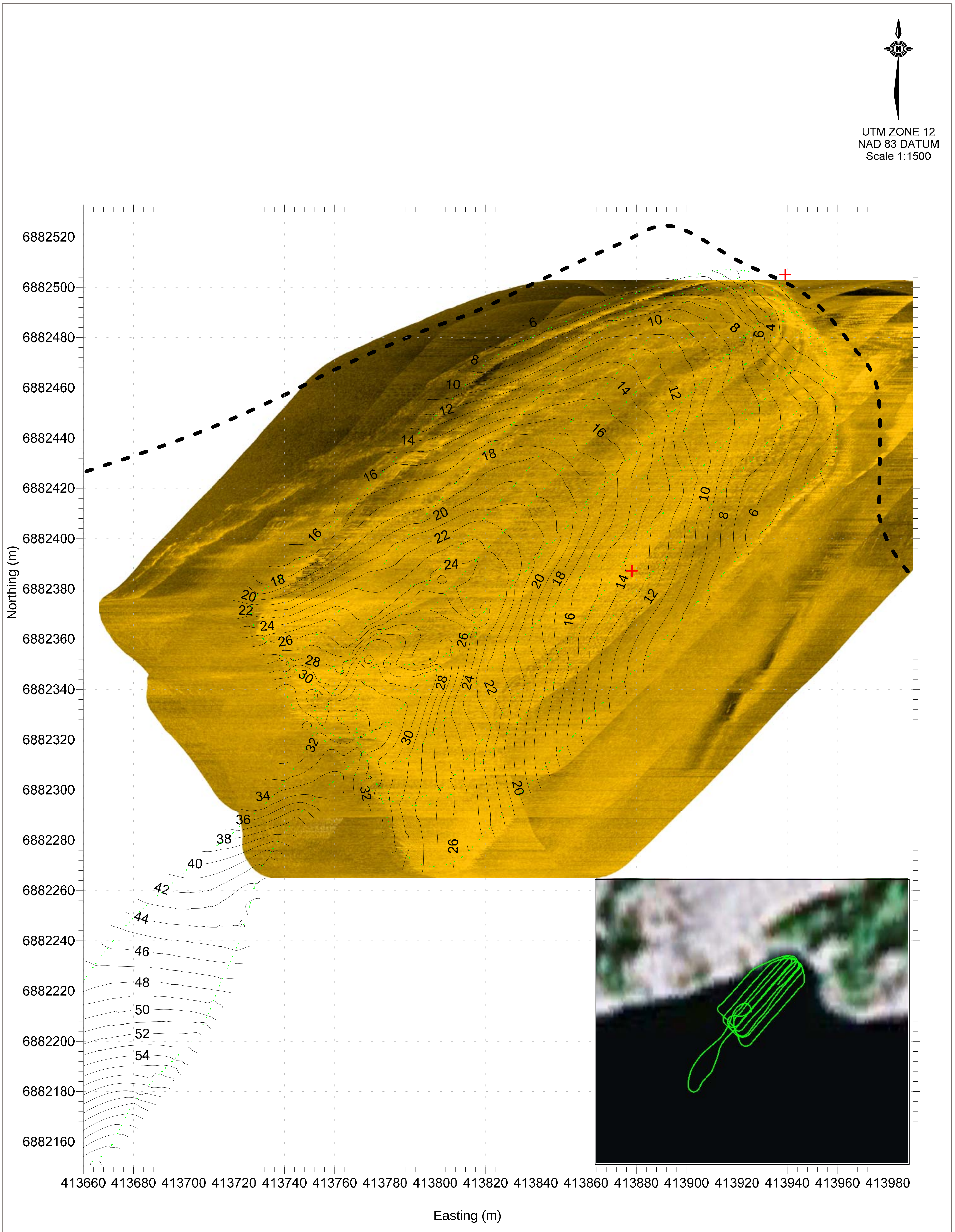
Figure 01



LEGEND

- Rocks
- Bathymetry Contours
- Approximate Shoreline
- GPS Trackline

CLIENT

AVALON

A TETRA TECH COMPANY

Thor Lake Project
Northwest Territories

Thor Dock Barge Area
Bathymetry and Side-scan Sonar Results

PROJECT NO.	DWN	CKD	APVD	REV
V15101007.011	PIF	RJM	NSP	000

OFFICE	DATE
EBA-OTT	October 27, 2011

Figure 02

APPENDIX A

APPENDIX A EBA'S GENERAL CONDITIONS

GENERAL CONDITIONS

GEOPHYSICAL REPORT

This report incorporates and is subject to these "General Conditions".

1.0 USE OF REPORT

This geophysical report pertains to a specific site, a specific development, and a specific scope of work. It is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site or proposed development would necessitate a supplementary investigation and assessment.

This report and the assessments and recommendations contained in it are intended for the sole use of EBA's client. EBA does not accept any responsibility for the accuracy of any of the data, the analysis or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than EBA's client unless otherwise authorized in writing by EBA. Any unauthorized use of the report is at the sole risk of the user.

This report contains figures, maps, drawings and sketches that represent processed geophysical data collected at a specific site. This processed data will have inherent interpretation assumptions and accuracies that are discussed in the report. Consequently, the report can only be considered in its entirety and individual figures, maps, drawings and sketches shall not be distributed without the text of the report unless authorized in writing by EBA.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

Where EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed EBA's instruments of professional service), the Client agrees that only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by EBA shall be deemed to be the original for the project.

Both electronic file and hard copy versions of EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except EBA. EBA's instruments of professional service will be used only and exactly as submitted by EBA.

Electronic files submitted by EBA have been prepared and submitted using specific software and hardware systems. EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

3.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, EBA has not been retained to investigate, address, or consider and has not investigated, addressed, or considered any environmental or regulatory issues associated with the development of the site.

4.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgemental in nature as to both type and condition. EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

5.0 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

6.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

7.0 SURFACE WATER AND GROUNDWATER CONDITIONS

Surface and groundwater conditions mentioned in this report are those observed at the times recorded in the report. These conditions vary with geological detail between observation sites; annual, seasonal and special meteorological conditions; and with development activity. Interpretation of water conditions from observations and records is judgmental and constitutes an evaluation of circumstances as influenced by geology, meteorology and development activity. Deviations from these observations may occur during the course of development activities.

8.0 INFORMATION PROVIDED TO EBA BY OTHERS

During the performance of the work and the preparation of the report, EBA may rely on information provided by persons other than the Client. While EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.