**NIRB File No.: 11MN034**

# Phase 1 All-Weather Access Road

# Agnico-Eagle Mines Limited
# Responses to Information Requests

## 11 December 2011

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| 1 | NIRB | The Board further recommends that AEM ensure that any outstanding information identified in the Board's screening decision related to the road proposal (NIRB File No. 11RN017) be included in AEM's present response to comments. | 1 |
| 2 | NIRB | The Board identified specific information as lacking in the original application and notes that the following items remain unaddressed in the current 12.10.2(b) application:<br>(1) a comprehensive spill response plan,<br>(2) detailed plans for the construction of the road and other associated components (i.e. bridges), and<br>(3) a table which outlines AEM's proposed mitigation measures or other commitments relating to the proposed development. | 2 |
| | | **AEM Commitment Table for AWAR** | 3 |
| 3 | TC-NWPA | AEM will likely require formal approvals for works under the Navigable Waters Protection Act (NWPA) | 19 |
| 4 | EC | Page 116 of the environmental assessment indicates AEM plans to conduct visual examinations if quarry materials for sulphur species and additional ARD/ML from each quarry and borrow source before and during construction. To ensure adequate samples sizes are taken for geochemcial charactertization of borrow and quarry materials, EC recommends the Proponent refer to the most recent version of the *Mine Environmental Neutral Drainage Prediction Manual* (MEND Report 1.20.2; Price 2009), which provides useful guidance on the prediction and mitigation of drainage chemistry from sulphidic geological materials. The Proponent is advised to adhere to the recommended practices for sampling, monitoring and testing during and follow the excavations. | 20 |
| 5 | EC | EC seeks clarification on what materials are planned for use in deck construction. If wood is being considered for bridge decking, EC does not support the use of creosote or CCA-treated wood for this purpose. In addition, EC advises against the use of grating in bridge design as this provides a pathway for road bed material entry into streams and can negatively impact the aquatic ecosystem. | 21 |
| 6 | EC | The Proponent also mentions that geo-textile material will be optional at the base of the road bed material over thaw susceptible soils. EC recommends best practices be used, such as routine installation of geo-textile material in thaw-susceptible soils or other methods recommended by the geotechnical engineer to provide greater structural integrity to the road base. | 22 |
| 7 | EC | Section 5.1.4.5 of the EA and p.15 of the *Transportation Management Plan* indicated that chemical dust suppressants will be used to control road dust as a last resort and only in accordance with the Government of Nunavut's *Environmental Guideline for Dust Suppression.* If AEM considers use of DL 10, EC recommends the product not be applied within 30 m of either side of all water bodies intersected or adjacent to the Meliadine AWAR. EC does not recommend the use of Bunker C or calcium chloride unless the Proponent can demonstrate the products can be applied and used effectively without mitigation into surface waters adjacent to the road. | 23 |
| 8 | EC | **Water Quality:** ...On this basis it is not clear why the Char R and Meliadine R crossings were not selected for monitoring. As a best practice, EC recommends all crossings be monitored in the first open water season following road construction. | 24 |
| | | **Monitoring Plan** for the AWAR This addresses monitoring of water quality, hydrolgy, wildlife and road building materials. | 25 |
| 9 | EC | EC noted that p.28 of the *Transportation Management Plan* indicates only three crossings will be monitored following road construction (i.e. M3.0, M5.0, M23.6) as opposed to 4 noted on p. 120 of the EA. EC seeks clarification on how many crossings AEM plans to monitor and recommends the Plan be revised to reflect the location and number of crossings to be monitored. | 43 |
| 10 | AANDC | Based on a review of the topographic mapping provided in the report, it is noted that there are multiple additional stream crossings along the proposed road route that could potentially require culverts at peak flows or during specific seasons. It is recommended that the Proponent consider the possibility of installing additional culverts during the construction of the proposed road to minimize the risk of water backup versus having to potentially address this once the road is already constructed. Additional culverts will minimize the potential risk of environmental effects and increased cost associated with potential water back-up. | 44 |
| 11 | AANDC | While there is a mention of testing of borrow pit materials for Acid Rock Drainage potential before excavation, no clear commitment to a continued testing program during or after excavation of borrow materials has been located in the document. It is recommended that the Proponent commit to testing of the rock during excavation to confirm rock type and to ensure potentially acid-producing rock is not being borrowed and/or used in road development (which is mentioned on page 116 in Section 5.2.4.2) | 45 |

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| 12 | AANDC | To properly assess water quality, it is recommended that the project proponent collect sufficient data to be representative of background/baseline water quality (with reasonable detection limits) for all parameters of concern prior to road development for all streams/water bodies of concern. The enhanced baseline data will greatly assist in post-project monitoring to determine any deleterious effects on water quality resulting from the proposed road development activities which will require mitigation.<br><br>The small stream water sample results for the August 2011 sampling event should be reviewed and compared to the July 2011 small stream sample results. A winter and a spring/melt small stream sampling event at upstream of the proposed development prior to development activities would also be beneficial for future comparison as part of the monitoring program. | 46 |
| 13 | AANDC | We suggest that the Proponent commit to managing ponded borrow pit water, if it occurs, so as to avoid potential deleterious effects to downstream surface water bodies due to release of this water (i.e. could have higher dissolved concentrations of metals or low pH). | 61 |
| 14 | AANDC | Predictions of potential hydrology and water quality effects were made in a qualitative manner resulting in a subjective pathway assessment. There are potential concerns about the uncertainty associated with the lack of topographic data within watersheds of ephemeral watercourses. This could affect culvert design and/or maintenance over time. The uncertainty of metal leaching of road material near water crossings may be another concern that should be noted by the Proponent and addressed through monitoring during construction.<br><br>Borrow material used to construct the road should be tested by the Proponent for ARD potential before use at any water crossings (multiple composites at minimum). | 62 |
| 15 | AANDC | There is mention on Page 94 of how the detection limits varied with the chronological timing of the studies; however, there is no discussion on why laboratory detection limits intermittently exceed the guidelines and how this issue was addressed when interpreting the results. Although it is likely that this was addressed in the water quality monitoring study reports conducted in support of this EA and detailed in the analytical results from the lab, an explanation of this should be provided as part of the environmental assessment documentation. Further, since no conclusive statement can be made regarding parameters with detection limits that exceeded the guidelines, the Proponent should address how this will be considered in interpretation of monitoring results. | 63 |
| 16 | AANDC | It is recommended that a spill response plan be developed for this project. AANDC would also like to note that all transportation of a Class 3 flammable substances must be conducted in compliance with Transport Canada's Transportation of Dangerous Goods Regulations. Further, vehicles transporting fuel should carry at least 10 square metres of polyethylene material (for lining a trench or depression), a spark-proof shovel & oil absorbent blankets or squares. | 72 |
| 17 | AANDC | The report provides no information on the potential impacts on surface water quality related to the use and discharge of water associated with the road construction and maintenance. This should be included in the impact analysis and monitoring plan.<br><br>The report does not mention using water as a dust suppressant. In drier climates, like the North or in extended times without precipitation, reducing speeds and maintaining the roads alone will not be adequate in suppressing the dust from road traffic. It is recommended that the use of water as a dust suppressant be included in the analysis described above. | 73 |
| 18 | AANDC | It does not appear that mitigation measures during installation of culverts to minimize sediment loading at spring freshet (from debris accumulating on snow and ice during winter installation of culverts) have been provided for in the report. It is requested that this be addressed by the Proponent. | 74 |

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| 19 | AANDC | Specific vegetation field survey methods were not provided in the report. Vegetation surveys can provide a range of information depending on the chosen method. The chosen methodology can impact the ability to accurately assess impacts to vegetation as this assessment is dependent on the level of information provided from the field surveys. Details on the vegetation survey should be provided in order to assess the accuracy of the effects assessment.<br><br>In the effects assessment for vegetation it is stated that no impacts to listed species (species listed under SARA or CESCC) are expected as none were identified in the project footprint. The report does not provide evidence backing this statement as it is not clear where the vegetation survey took place in context of the project footprint. More detail regarding the vegetation survey methods and a location map should be provided. | 75 |
| 20 | AANDC | Mitigation measures discussed for reducing impacts to vegetation resulting from dust only refer to selected areas and do not cover the full extent of the AWAR footprint. As such, there may be residual impacts to vegetation within the project boundary but outside the selected areas that have not been included in the assessment.<br><br>With the absence of mitigation measures within part of the project footprint, this pathway should be changed to "primary" during the construction and operation phases of the project and the resulting impacts to vegetation should be included in the vegetation effects analysis. The potential impacts to vegetation resulting from dust occurring outside the identified mitigation areas will lead to changes in the impact assessment as the loss of vegetation will increase beyond the actual AWAR footprint. Alternatively, mitigation measures that address dust impacts along the entire AWAR should be developed. | 78 |
| 21 | AANDC | This section discusses mitigation measures designed to reduce direct impacts to wetland habitats (potential habitat for listed plant species) but does not address potential indirect impacts to wetland habitat such as alterations to hydrology (e.g. water drawdown, or flooding) that may also impact potential habitat for listed plant species. The Proponent is requested to discuss impacts to wetland habitat caused by alterations to hydrology, including potential impact to listed plant species. | 79 |
| 22 | AANDC | This section states that impacts to listed plant species is predicted to be negligible as none were recorded, however the report does not confirm that vegetation surveys included the higher quality habitat located within the AWAR footprint such as Tussock-Hummock or Low Shrub Ecological Land Classification classes. The Proponent should clarify and adjust conclusions in consequence. | 81 |
| 23 | AANDC | Monitoring programs for vegetation do not include monitoring for the presence of listed species within the AWAR footprint. Where suitable habitat has been identified with the footprint, pre-construction surveys should be undertaken targeting potential listed species within key Ecological Land Classification classes. Monitoring programs should also include effects monitoring to assess potential indirect impacts to wetland habitat located adjacent to the AWAR footprint. | 82 |
| 24 | AANDC | This section states that the route for the road was selected "to minimize possible effects on the environment". Although it appears that many factors in relation to this were considered for the routing, permafrost parameters (such as mean annual permafrost temperature, ice content, and thickness of the active layer) appear not to have been considered.<br><br>While the report does indicate that two thicknesses of the road embankment will be considered, depending on permafrost conditions (1 m for stable permafrost and 1.3 m for unstable (thaw susceptible) permafrost), the risk of destroying permafrost is considerably higher if the road follows ice rich permafrost. It is recommended that the Proponent describe how the choice of alignment considered avoidance of crossing terrain with ice rich permafrost.<br><br>Also, the design provides quantitative assessment of both the 1m and 1.3 m embankment thicknesses. Quantitative assessment should also be provided for both stable permafrost and unstable permafrost situations, and definitions for these conditions should be included in the assessments. | 83 |
| 25 | AANDC | The criteria for selection of the required embankment thickness (1.3 m and 1 m) are not clear from the document. The selection criteria should be clearly described in the text otherwise it is difficult for reviewers to determine if the proposed thickness of the embankment is sufficient to protect permafrost against thawing.<br><br>Furthermore, the intervals of the road route with the embankment thickness of 1.3 m and 1 m are not shown on any of the maps (routing map and terrain unit route). | 85 |

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| 26 | AANDC | It is stated that "to the greatest extent possible, the construction of the AWAR will be carried out during winter months". It should be clarified when winter months start (i.e., when daily air temperature is below 0oC, or active layer is frozen for full depth?). The winter method of construction is widely used in permafrost regions; however, for the climate conditions of Rankin Inlet area, the winter construction may be limited only to ice rich portions of the road alignment.<br><br>The report implies that everything will be constructed in winter months, while only road maintenance will be done in summer months. If construction is undertaken during the winter, then methodology for embankment construction/compaction should be described. Based on past experience it is known that proper compaction of frozen granular material will not occur during winter construction, and significant volumes of granular materials will need to be placed during the following summer or subsequent summers to complete construction and properly compact the embankment. Since proper compaction does not occur during winter time, the road will be hardly passable during the summer following winter construction. The road will then require considerable compaction and placement of additional granular material which will require access in summer time to borrow sites, which can lead to undetermined potential impact on the environment, (e.g., wildlife disturbance, dust generation etc). This has been a typical issue for winter construction of northern roads. Construction for stable permafrost can likely be carried out in summer months. As the quality of construction is typically higher for roads built during summer months, the Proponent should further discuss and justify the choice to build the road during winter months.<br><br>It is not clear that the size of the culverts as currently proposed by the Proponent in construction of the road will be adequate. It is recommended that the Proponent further consider and discuss the likely performance of the small culverts currently proposed, in the severe climate conditions of the project area. The proposed culverts would be at risk of being blocked with ice and snow in winter months, and it is expected that the ice and snow in these culverts would not melt promptly in spring time, impeding a flow of the water through the culvert. This discussion should include consideration of the possibility of using larger culverts as well as the expected monitoring and maintenance, especially in spring, prior to snow melt, to be undertaken to ensure effectiveness of the culverts that are used. | 87 |
| 27 | AANDC | This section provides cross sections of the bridge design for the Meliadine and Char Rivers. The report states that single span bridges are recommended with the use of piles to support bridge structures. Due to the scale of the drawings in the EA, it difficult to examine detailed information on the cross sections and, as a result, reviewers are unable to assess and comment on the specific designs.<br><br>It was noted on the drawings, however, that permafrost cuts are expected at the bridge abutments. This contradicts the report's conceptual principle of the road construction which states that there will be no permafrost cuts. Cuts at the river banks can lead to significant development of processes which can potentially lead to damage of bridges and create muddiness at the river banks, change river hydrology, water quality and other related environmental impacts. It is recommended that this apparent contradiction be clarified and conclusions adjusted accordingly. | 91 |
| 28 | AANDC | In Section 4.2, Valued Components, permafrost is determined as a valued component. Accordingly, it is recommended that a permafrost map of the road alignment be created in which the main quantitative characteristics of the permafrost will be shown (such as mean annual permafrost temperature, thickness of the active layer, and ice content). It is recommended that this estimation should be based on the ice content of permafrost and that ice content together with other permafrost parameters should be shown on a permafrost map which can be used as a basis for determining the thickness of the embankment for the various road sections. Presently, the terrain units map do not provide sufficient information to determine where embankment thickness will be 1 m, where 1.3 m or why the different thickness have been selected. The permafrost map should be a base for determination of the road intervals with embankment thickness of 1 m and 1.3 m. Potential zones of thermo-erosion, thaw settlement and land sliding should also be shown on the permafrost map (this information can be based on the terrain units map). | 93 |

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| 29 | AANDC | This section is lacking in quantitative information on permafrost temperature, thickness of active layer, and ice content along the road alignment. The report implies that these permafrost characteristics were taken into account when the Proponent determined the required embankment thickness (1 m and 1.3 m), however this is not described or demonstrated in the report. Further, there is no quantitative definition for poor ice permafrost or ice rich permafrost, and these areas are not shown along the road alignment on any of the maps provided in the report.<br><br>It was also stated on page 223, that the active layer thickness will likely be re-equilibrated in quarries. This is possible in rock quarries, but may not happen in borrow sources containing granular materials, such as esker sand and gravel where presence of ice rich glacio-fluvial deposits or massive ice may result in progressive increase of the active layer and even formation of a talik or thermokarst pond.<br><br>The Proponent's conclusion is that the effect of snow drifts may result "in deepening of the active layer at the toe of the side-slope" may only be partially accurate. Significant snow drifts in the given severe climate conditions, where snow melting will only occur in part of summer, may result in swamping of the snow drift areas and degradation of the ground vegetation.<br><br>It is stated on page 226 that "accumulation of water within quarries will result in a deepening of the active layer". This is likely, however, the accumulation of the water, as noted above, may result in formation of taliks or thermokarst ponds. It is recommended that calculations be carried out to assess the maximum water depth in the quarries as a function of quarry dimension and expected snow thickness, which will not result in formation of the taliks.<br><br>It is therefore recommended that the following be added to the report:<br>1. Produce a permafrost map for the road alignment which provides information on quantitative permafrost characteristics such as thickness of active layer, mean annual permafrost temperature, and ice content below the active layer.<br>2. Provide a map to show the locations of borrow sites where ice rich permafrost can be encountered, requiring specific methods of excavation.<br>3. Determine and map locations along the proposed road where significant snow drifts can be accumulated resulting in swamping and degradation of ground vegetation. 4. Provide an estimation of the maximum water depth within excavated borrow sites which will not result in formation of taliks. Also provide recommendations on how to maintain this water depth, without enabling the depth to increase (water management plan). | 95 |
| 30 | AANDC | It is noted that the appendices provide detailed description of terrain units encountered along the road alignment. The terrain unit description and interpretation include such information as ground ice conditions (not quantitative), typical active layer processes, thaw stability, freezing stability, frozen stability, potential need for permafrost design and construction methods, and hazard for thaw and/or freezing induced displacement/aggregate suitability.<br><br>However, as for the body of the report, the map/legend provided in appendix does not provide quantitative characteristics of the permafrost (mean annual permafrost temperature, thickness of the active layer, and ice content).Furthermore, the scale on the map provided makes it difficult to determine which parts of the road have embankment thickness of 1 m or 1. 3 m. It is recommended that the appropriate mapping be provided as part of the report | 98 |
| 31 | AANDC | Report Reference: Appendix F-IT3E "Terrain Unit Description and Interpretation" Ground Ice Conditions. Information on the depth to which ice conditions are characterized is not provided? The meaning of the terms "possible near surface" and "limited near surface" related to ice conditions is not clear. The definitions should be provided in the Report.<br><br>Furthermore the ice content should be shown to some depth below the active layer, not only for active layer, as it was done in the report. | 100 |
| 32 | AANDC | Report Reference: Appendix F-IT3E "Terrain Unit Description and Interpretation" Typical Active Layer Processes. It is implied that there is a difference between frost heave and frost jacking (terms which are synonymous). These terms should be clearly defined so the differences understood by reviewers. | 102 |

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| 33 | AANDC | The report should clearly describe the consequences and expected management of possible improper determination of the stability of the permafrost, and therefore improper choice of thickness of embankment. If there is no change in the thickness of the active layer as a result of the road construction, the processes in the active layer will provide negligible impact on the road stability. A problem for the road stability will however occur if thawing of permafrost to some depth occurs resulting in development of such processes as thaw settlement, sliding, and thermo-erosion. | 103 |
| 34 | AANDC | Report Reference: Appendix F-IT3E "Terrain Unit Description and Interpretation" Potential Need for Permafrost Design and Construction Methods. This title introduces a new term "permafrost design". The meaning of this term is unclear. If it is defined as winter construction then there may be little need for "permafrost design" to be a consideration for construction during summer months. An explanation of the term should be provided. | 105 |
| 35 | AANDC | Report Reference: Appendix F-IT3E "Terrain Unit Description and Interpretation" Hazard for Thaw and/or Freezing Induced Displacement. Aggregate Suitability. Areas where there is high potential for thaw and freezing displacement are not identified. In areas where this potential is high, use of improper road construction methods could lead to permafrost thawing. It is recommended that the permafrost map requested above identify two risk categories: low risk for stable permafrost areas and high for unstable permafrost areas. It is recommended that information on aggregate suitability be taken out from the legend because the embankment will be built over the undisturbed surface (unless cuts are recommended) irrespective of the aggregate suitability. | 106 |
| 36 | AANDC | Report Reference: Section 8.0, p. 264 It is not clear that the time between March 2012 and when the ice bearing capacity is lost (i.e. April) will be sufficient to assemble and place the bridges. The Proponent should identify alternatives for the event that this is not possible. | 108 |
| 37 | AANDC | Report Reference: Section 6.27, p. 254 The proposed road will replace existing trails used as access for traditional activities. The Proponent concludes this effect to be low because 'other trails will be easily established'. Additional discussion is warranted on how re-establishment of the trails (i.e., when, by whom, potential effects) fits in the context of the proposed project. | 109 |
| 38 | GN | Socio-economic monitoring: The GN expects that, if the AWAR application is approved by NIRB, AEM will continue to work in conjunction with the Kivalliq Socio-Economic Monitoring Committee (SEMC) on monitoring for relevant socio-economic effects. In their application, AEM has indicated the contractor hired to construct the road has made commitments to the KIA to meet a 50% target for local Inuit employees (section 6.3.3.2). The GN suggests that, where applicable, this and other project-specific socio-economic effects be monitored (local employment for both construction and operations phase of the road; potential impacts that increased income may have on substance abuse; success of proposed training programs; etc.). Monitoring for the AWAR project should be designed to continue to align with current regional monitoring efforts and should be coordinated with any socio-economic monitoring plan that may be established for the proposed Meliadine Gold Project.<br><br>In Section 6.3.3.5, AEM states a low expectation that the AWAR will bring social change or will have any significant adverse or negative socio-economic effects. However, in their cumulative effects discussion (section 6.3.4), at the bottom of page 261, AEM suggests that people may not make wise decisions with an increased income, leading to potentially negative social issues. AEM has suggested, in Table 6.3.3-1, to work with the Municipality to monitor and develop mitigation for any adverse impacts. The GN suggests also working with government service providers to develop these mitigation measures. For example, through the Kivalliq SEMC, identifying impacts could lead to discussing possible recommendations with key government service providers, such as health and social services or the RCMP. | 110 |
| 39 | GN | The Proponent reminded to inform staff through training that they will not harass wildlife (subsection 71(1) of the *Wildlife Act* )). This includes persistently worrying or chasing animals, disturbing large groups of animals, and attempting to photograph an animal from an aircraft. Also, the proponent's staff shall not intentionally feed wildlife (subsection 90(1) of the *Wildlife Act* ). This includes leaving food in unsecured locations that wildlife can access (e.g., inside site vehicles). | 111 |

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| 40 | GN | It is unclear how the Proponent plans to identify and address the potential establishment and spreading of invasive species from the proposed AWAR. Mitigation measures presented in Section 5.3.4.2 provide little information should such species be transported to the region.<br><br>It should be further noted that the *Nunavut Wildlife Act* (S.Nu. 2003,c.26) applies *to —(a) all terrestrial, aquatic, avian and amphibian flora and fauna that are wild by nature or wild by disposition.* At present, the EIS does not adequately demonstrate how the Proponent intends to comply with the invasive species provisions of the Act, Subsection 91(2), which states that *—No person shall release a member of a species into a habitat in which that species does not belong or never naturally occurred.* Therefore, the DOE is seeking a clarification from the proponent on their intent to be in compliance with the *Nunavut Wildlife Act* ? | 112 |
| 41 | GN | While Peregrine Falcons were assessed by the proponent within their application, the location of nest within the Territorial Parks was neglected (Section. 5.3.7.4; Figure 5.3.7-2). The DOE request that the proponent include the location of nests within the Territorial Park in their Impact Assessment for the exemption application. | 113 |
| 42 | GN | It is the DOE's expectation that a standalone wildlife management plan will be developed by the proponent submitted and agreed to by the DOE before the commencement of the exemption Application activities. | 114 |
| 43 | GN | With regards to using a specific setback distance for reducing the speed of traffic when wildlife is present within 250m and 100m (Section 3.3.7 pg. 42), the DOE would rather the proponent use a 'line of sight' method, to prevent confusing staff with specific distances. Also, staff should be instructed not to exit a vehicle while on the road to approach and/or photograph wildlife. In addition, attention should be paid to the potential for human encounters with predators. While the proponent has identified that Polar bears are not common in their Local Study Area, observations by community members indicate an increase in Polar bear activity in and around Rankin Inlet. Within the Territorial Park four bears were spotted near the Thule site in the summer of 2011. Interactions with predators are always a possibility. Mortality as a result of an emergency kill can be a significant loss to the community who can request compensation for the loss (Article 6 of the NLCA; subsection 97(3) of the *Wildlife Act* ). | 115 |
| 44 | GN | The proponent has identified in Section 3.1 of the Application that the Rock quarry R19 (approximately 500m from the Park boundary) and Borrow pits B19 (approx 800m) and B15 (approx 1200m) as the closest sources to the park boundaries. However, the Feasibility Level Design Report for the AWAR dated Jan 20 2011 identifies an additional quarry R17 (less than 400m away from boundary) on Figure A-1.<br><br>In close proximity to the proposed road and within park boundaries are archaeological sites KfJm-3 (historical site and popular park attraction), KfJm-31, 32 and KfJm-6, and Park facilities that could be potentially impacted. DoE, Nunavut Parks, is seeking clarification on how many quarries/borrow pits are within the vicinity of the Territorial Park boundaries as well as a mitigation plan to address the potential impacts to historical sites, attractions and facilities within Park boundaries. | 116 |
| 45 | GN | Section 5.1.5.5 outlines a monitoring program; DOE is requesting the development of a noise abatement plan. With that, the DOE (Parks and Special Places Division)is willing to work with the proponent to ensure that monitoring is properly carried out. | 117 |
| 46 | GN | The DOE is concerned about the increase of dust from the AWAR and its impacts to the Territorial Park, its visitors and natural, cultural and historic features and attractions. The DOE is requesting the development of a dust management plan. The DOE (Parks and Special Places Division) is willing to work with the AEM road supervisor to ensure that monitoring is properly carried out. | 117 |
| | | **Draft Noise and Dust Management and Monitoring Plans** | 118 |
| 47 | GN | Presently, the Application does not adequately demonstrate how the Proponent intends to comply with Section 13(e) of The Territorial Parks Act which states - *No person shall, in a Territorial Park, operate a motor vehicle, motorcycle or snowmobile except in an area designated for that purpose* . With that, Nunavut Parks is requesting the development of a management plan that addresses the potential creation of unauthorized trails/access routes from the proposed AWAR into the Territorial Park. | 125 |

**Comment made by Interested Party: Nunavut Impact Review Board**
**(AEM Reference: Information Request #1)**

*The Board further recommends that AEM ensure that any outstanding information identified in the Board's screening decision related to the road proposal (NIRB File No. 11RN017) be included in AEM's present response to comments.*

**AEM's Response to Information request:**

AEM reviewed the screening decision (NIRB File No. 11RN017), in particular starting on page 9, "*The following is a summary of the comments and concerns received during the final public comment period for this file."*

In response to CLEY's comment, *"Notes that AEM has not yet submitted the gap analysis that was requested."* This gap analysis was sent to CLEY on the 8 December 2011.

AEM acknowledges the Department of Environment's comment that it does not have a guideline for caribou and caribou habitat. This was a mistake on our part. The response should have said, "AEM commits to avoid air, ground, and general noise disturbances which disrupt caribou behaviour as best possible. Some helicopter flights close to camp can be at a low elevation for safety reasons".

All remaining comments and concerns raised during the final public comment period for this file were addressed in the Phase 1 – Meliadine All-weather Access Road Project Description and Environmental Assessment, and in the responses to the current AWAR Information Requests.

**Comment made by Interested Party: Nunavut Impact Review Board**
**(AEM Reference: Information Request #2)**

*The Board identified specific information as lacking in the original application and notes that the following items remain unaddressed in the current 12.10.2(b) application:*

*(1) a comprehensive spill response plan,*

*(2) detailed plans for the construction of the road and other associated components (i.e. bridges), and*

*(3) a table which outlines AEM's proposed mitigation measures or other commitments relating to the proposed development.*

**AEM's Response to Information request:**

(1) A comprehensive spill plan has been sent to the NIRB under a separate cover. This same Plan was requested by the NWB and sent to them on November 9th, 2011.
(2) Detailed plans for the construction of the road and other associated components have been sent to the NIRB under a separate cover due to their large size.
(3) A table of proposed mitigation measures and other commitments follow this page.

| Section | Commitment |
|---|---|
| **1 AWAR Project Description** | |
| **Compliance inspection** | will check that project components are built to approved design standards that include the required environmental controls. Compliance monitoring will be repeated throughout the life of the AWAR Project. |
| **Follow-up monitoring** | Water quality monitoring: Water sampling in and around the AWAR to make sure that the predictions used to assess the effects were accurate. Follow-up monitoring will also assess the potential for success of the proposed closure and reclamation plan. |
| **Environmental monitoring** | Wildlife monitoring program: The scope of these programs will be developed in consultation with regulators, local HTO, and with the KIA. |
| **Designated road supervisor** | responsible for the ongoing road inspection and maintenance of the AWAR |
| | The road and its shoulders will be inspected weekly (at a minimum) during the summer period for evidence of seasonal freeze and thaw adjacent to the toe of the road embankment |
| | The road will be inspected for signs of accumulation of ponded water either on the road surface or along the sides of the road. Where observed will evaluate and monitor the accumulation to determine the cause of ponded water. will then take remedial action to correct the cause of the ponding, such as grading of the road surface to remove areas of ponding or installation of additional culverts if the road is causing excessive water ponding adjacent to the road. |
| | The quarry and borrow locations along the AWAR will also be inspected weekly (at a minimum) to monitor wall conditions, ponding of water, and snow accumulations. Remedial actions will be taken in a reasonable time when problems are noted. These could include remedial actions, such as re-shaping of borrow/quarry area walls and/or grading of quarry floors. |
| | periodic inspections (minimum of weekly) of the road to verify that the road is maintained for safe travel of personnel, equipment, and supplies. These inspections will be recorded and any deficiency reported and followed by a corrective plan. These periodic inspections will include an inspection of the bridge abutments and a visual observation of the road surface to assess the status of road foundation |
| | Inspection frequency will be increased during the following critical time periods: |
| | ¡ just prior to spring freshet to verify that the culverts and stream crossings are in good state to pass flows from the rapid spring thaw that occurs in the north; |
| | ¡ during the spring freshet to verify that the culverts and bridges are not impeding spring freshet and to initiate action when and where required to prevent road wash outs; and |
| | ¡ just after heavy rainfall events to monitor water accumulation along the road, to verify that culverts are passing precipitation as planned and to initiate action when and where required to prevent erosion and road wash outs. |
| **Regular Crossing Inspection and Maintenance** | ¡ Visual inspection of its infrastructure to identify defects, cracks, or any other risks to structural integrity. Particular attention will be paid to the inlet and outlet structures of culverts, and to bridge abutments and their foundations, as required. |
| | ¡ Visual inspection to identify sediment or other debris accumulation impeding the free flow of water through the crossings. Maintenance operations will consist of hand removal of accumulated debris and repairing damages as soon as possible. |

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| | ¡ Visual inspection of the upstream and downstream channel to identify bed erosion or scour around the watercourse crossing structure. Particular attention will be paid to bridge abutments and abutment foundations as they will be vulnerable to scour and erosion during flood events. Particular attention will also be paid to potential sources of sediment transport at the crossing. Inspection results will be recorded by AEM to help track change in conditions over time. Maintenance operations will consist of undertaking remediation of any detected problems and repairing damage as soon as possible. |
| **Event Crossing Inspection and Maintenance** | Following heavy or prolonged rainfall storm events, visual inspection of each watercourse crossing will be completed to identify potential risks to the crossing's structural integrity, debris accumulation, and whether erosion and scour have occurred. Results will be recorded by AEM to help track changes in condition over time. |
| **Emergency shelter** | AEM will install an emergency shelter, similar to those used along the Meadowbank road, at a suitable site somewhere near the mid-point of the Phase 1 AWAR. |
| **Proposed post-construction monitoring** | (photos taken of the site before construction, during construction and after construction; photographs should be taken form the same reference point for easy comparison) |
| | Refer to the preconstruction photos in the Project Description for the Phase 1 AWAR, Appendix C. |
| | AEM commits to take photos of the water crossings during and after construction and submit them to the NWB as part of its annual report for the road. |
| **Section 5.1 - Atmospheric Environment** | |
| Section 5.1.3 - Effects Analysis (pg.71) | The following environmental design and mitigation features will lessen the effects of Phase 1 AWAR construction on air quality:<br>• Controlling fugitive dust from construction activities<br>• Equipment and vehicles will comply with relevant non-road emission criteria at the time of purchase<br>• Regular maintenance will be implemented for equipment and vehicles |
| Section 5.1.3 - Effects Analysis (pg.71) | The following environmental design and mitigation features will lessen the effects of Phase 1 AWAR operations on air quality:<br>• Watering of roads, in select areas, and enforcing speed limits to suppress dust production<br>• The road surface will be maintained through grading and the addition of granular material Equipment and vehicles will comply with relevant non-road emission criteria at the time of purchase<br>• Regular maintenance will be implemented for equipment and vehicles |
| Section 5.1.3 - Effects Analysis (pg.71) | The following environmental design and mitigation features will lessen the effects of Phase 1 AWAR construction on noise:<br>• Equipment and vehicles will be operated with manufacturers' supplied noise controls<br>• Regular maintenance will be implemented for equipment and vehicles<br>• Use of screen at the quarries or borrow areas |
| Section 5.1.3 - Effects Analysis (pg.72) | The following environmental design and mitigation features will lessen the effects of Phase 1 AWAR operations on noise:<br>• All vehicles will adhere to the 50 km/h speed limit (enforced by AEM)<br>• Phase 1 AWAR vehicles will be operated with manufacturers' supplied noise controls<br>• Phase 1 AWAR will be maintained to minimize pot holes and ruts |

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| Section 5.1.3 - Effects Analysis (pg.72) | The following environmental design and mitigation features will lessen the effects of Phase 1 AWAR operations on Greenhouse Gas emissions:<br>• All vehicles will adhere to the 50 km/h speed limit (enforced by AEM).<br>• Regular maintenance will be implemented for AEM equipment and vehicles |
| Section 5.1.4.2 - Effects Assessment (pg. 76) | Dust will be mitigated by maintaining posted speed limits (50 km/h). In areas or times identified by the AEM road supervisor as being prone to high dust levels or areas where safe road visibility is impaired, or in areas where dust deposition is impacting fish habitat and/or water quality, the road supervisor will arrange mitigation measures as appropriate. Use of chemical dust suppressants will be used only as a last resort and only in accordance with the Environmental Guidance for Dust Suppression published by the Government of Nunavut Department of Environment (January 2002) |
| Section 5.1.4.5 - Monitoring & Follow-up (pg. 79) | Dust will be monitored through regular inspections of the road dust conditions by the AEM road supervisor during both construction and operation. Dust will be mitigated partly by maintaining posted speed limits. In areas or times identified by the AEM road supervisor as being prone to high dust levels, or areas where safe road visibility is impaired, or in areas where dust deposition is impacting fish habitat and/or water quality, the road supervisor will arrange mitigation measures as appropriate. This could involve actions such as grading of the road surface, placement of new coarser topping, and/or watering of the road surface. Use of chemical dust suppressants will be only used as a last resort and only in accordance with the Environmental Guidance for Dust Suppression published by the Government of Nunavut Department of Environment (January 2002). |
| Section 5.1.5.2 - Effects Assessment (pg. 82) | Most of the blasting will occur in winter when quarry material will be stockpiled for use along the road |
| Section 5.1.5.5 - Monitoring & Follow-up (pg. 83) | Noise emissions for construction vehicles should be minimized as part of a best management practices plan by ensuring noise control features installed on construction vehicles are maintained and operating according to specifications |
| Section 5.1.5.5 - Monitoring & Follow-up (pg. 84) | For road traffic usage, noise emissions should be maintained by enforced of posted speed limits, maintaining manufacturer's noise control features (i.e., mufflers) for AWAR Project vehicles, and maintaining the road surface to minimize the occurrence of pot holes and ruts |
| Section 5.1.5.5 - Monitoring & Follow-up (pg. 84) | A focussed monitoring program will be implemented to collect noise data at the park during the period when construction activities occur in the area. In addition, a limited monitoring program will be undertaken to demonstrate that the predicted noise effects during operations are restricted to the areas immediately adjacent to the AWAR. |
| **Section 5.2 - Aquatic Envrionment** | |
| Section 5.2.4 - Effects Analysis (pg.105) | Cross-drainage structures will be designed and constructed such that structures will not create a hydraulic barrier to fish passage and will convey peak flows corresponding to 1:25 year rainfall event. |
| Section 5.2.4 - Effects Analysis (pg.105) | Cross-drainage structures will be designed and constructed such that structures convey peak flows of 1:25 year event. |
| Section 5.2.4 - Effects Analysis (pg.105) | Use of staggered culvert configuration to promote drainage during spring thaw and freshet. |
| Section 5.2.4 - Effects Analysis (pg.105) | Regular inspection of the road to identify any areas where ponding of water along the road represents a risk, and installing additional culverts or French drains to alleviate the risk. |
| Section 5.2.4 - Effects Analysis (pg.105) | Cross-drainage structures will be designed to allow navigation (i.e., bridge) for crossings with navigable waters. |

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| Section 5.2.4 - Effects Analysis (pg.106) | • In-stream works conducted in winter, thereby avoiding critical periods for fish (i.e., installation prior to the 1 May to 15 July in-stream work exclusion window).<br>• Bridge abutment installation will occur outside of the high-water mark, and construction will occur in winter.<br>• Best management practices for erosion and sedimentation control (e.g., silt curtains, runoff management), where necessary.<br>• Disturbed areas along the streambanks will be stabilized and allowed to re-vegetated upon completion of work.<br>• Most streams crossed have low quality habitat.<br>• Rock material at inlet and outlet can improve habitat quality for species such as Arctic grayling.<br>• Assessment using the DFO Risk Based Technique indicates that risk to fish populations is low. |
| Section 5.2.4 - Effects Analysis (pg.106) | • In-stream works will be constructed in winter when watercourses are frozen.<br>• No in-stream works conducted between 1 May to 15 July to avoid critical periods for fish.<br>• Best management practices for erosion and sedimentation control (e.g., silt curtains, runoff management), where needed. |
| Section 5.2.4 - Effects Analysis (pg.106) | • Use of non-acid generating material at all watercourse crossings (to date all testing has shown rock to be non-acid rock drainage).<br>• Borrow and rock quarry activity will be at least 100 m from the high water mark of any waterbody. |
| Section 5.2.4 - Effects Analysis (pg.106) | • Enforcing speed limits (maximum speed 50 km/h) to suppress dust production.<br>• Design road as narrow as possible while maintaining safe construction practices; passing turnouts will be placed to accommodate multi-directional traffic.<br>• Crossings will be perpendicular to watercourse.<br>• The running surface of the road will be maintained thereby reducing the generation of dust. |
| Section 5.2.4 - Effects Analysis (pg.107) | • Hazardous materials and fuels will be stored according to regulatory requirements.<br>• Explosives will be stored at the Meliadine site.<br>• Equipment will be re-fueled, serviced, and washed away from stream crossings.<br>• Fuel, lubricants, hydraulic fluids, etc. will be stored at least 30 m away from the high-water mark of any waterbody. Storage tanks and materials currently at the Meliadine exploration site will be used for the Phase 1 AWAR Project.<br>• Construction equipment will be regularly maintained<br>• Soils from any petroleum spills will be collected and treated on-site. If not possible, the contaminated soils will be shipped off-site for treatment and disposal.<br>• Construction of much of the road base during winter, so there would be opportunity to clean up any spills prior to spring thaw.<br>• An emergency response and spill contingency plan will be developed and implemented. |
| Section 5.2.4 - Effects Analysis (pg.107) | Stockpiling of rock and fill from quarries and borrow sites will be placed such that surface water is not diverted through the piles with runoff to surface waterbodies. |
| Section 5.2.4 - Effects Analysis (pg.107) | • Using the required amount of explosive at each quarry location that is proportional to the amount of rock in the quarry.<br>• Placement of overburden away from drainage pathways to surface water. |
| Section 5.2.4 - Effects Analysis (pg.108) | • Use of non-acid generating material at any watercourse crossings.<br>• Construction materials will be clean and contaminant free. |

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| Section 5.2.4 - Effects Analysis (pg.108) | Enforcing speed limits, and regular road maintenance to suppress dust production. |
| Section 5.2.4 - Effects Analysis (pg.108) | • An emergency response and spill contingency plan will be developed and implemented, including ready access to an emergency spill clean-up kit for cleaning up any spills.<br>• Drivers appropriately qualified and cautioned.<br>• Vehicles properly loaded and loads appropriately covered where necessary.<br>• Equipment will be regularly maintained. |
| Section 5.2.4 - Effects Analysis (pg.108) | Runoff from roads, as well as ponding along the roads, will be monitored. Silt fences will be used near watercourses, if necessary, to prevent erosion. |
| Section 5.2.4 - Effects Analysis (pg.108) | • Quarries will be excavated and sloped for positive drainage.<br>• Quarries will be inspected on a regular basis to monitor water ponding, particularly at spring melt.<br>• Excavations will be at least 100 m away from any watercourses.<br>• Drainage from quarries will not flow directly into any waterbodies or watercourses.<br>• When there is flow from a quarry that could enter a waterbody, a water quality sample will be collected and analyzed. |
| Section 5.2.4 - Effects Analysis (pg.109) | • Single span bridges at the Char and Meliadine rivers and at the M5.0 crossing will be used to minimize blockages to fish movement.<br>• Culverts will be designed to allow fish movement throughout the open water period, including low-flow periods.<br>• Watercourses will be inspected upstream and downstream of the crossings for erosion, scour and flow blockages. |
| Section 5.2.4 - Effects Analysis (pg.109) | Mining staff are not allowed to hunt or fish while on their work rotation. |
| Section 5.2.4 - Effects Analysis (pg.109) | • Best management practices for erosion and sedimentation control (e.g., silt curtains, runoff management), as needed.<br>• In-stream work will be limited to when watercourses are not flowing for ephemeral watercourses or when watercourses are frozen. If any of the culverts need to be removed when the watercourses are flowing, the work will be completed late in the summer, and best management practices for erosion and sedimentation control (e.g., silt curtains, runoff management) will be employed. |
| Section 5.2.4.1 - Pathways with No Linkage (pg. 110) | Construction of the watercourse crossings will occur during winter when the streams are frozen or are not flowing. There will be no in-stream works except during frozen or non-flowing conditions. Any equipment used in the stream will be clean and inspected for leaks. All construction activities will be subject to a sediment control plan, and best management practices, that will include standard erosion and sediment control measures (e.g., erosion mats, silt curtains) that will be used, as needed, during construction. |
| Section 5.2.4.1 - Pathways with No Linkage (pg. 111) | Best management practices, with respect to sediment and erosion control, will be applied to prevent surface runoff from disturbed banks and subsequent sediment delivery to the channel during the construction period |
| Section 5.2.4.1 - Pathways with No Linkage (pg. 111) | In-stream construction activities related to culvert installation on the 8 ephemeral streams will be completed during the winter before snowmelt |

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| Section 5.2.4.1 - Pathways with No Linkage (pg. 111) | Seven mitigation measures were listed including the following:<br>1) no in-stream work from 1 May to 15 July;<br>2) implementation of sediment control measures prior to and during construction;<br>3) sediment control measures to be maintained until all disturbed areas have been stabilized;<br>4) all disturbed areas to be stabilized and re-vegetated upon completion of work;<br>5) machinery to arrive on-site in clean condition and be maintained leak-free;<br>6) machinery to be washed, re-fuelled, and serviced away from the water to prevent entry of deleterious substances; and<br>7) maintenance of an emergency spill kit on-site in case of fluid leaks or spills from equipment.<br>AEM has incorporated these conditions into the construction planning, and will abide by them during the construction program. |
| Section 5.2.4.2 - Secondary Pathways (pg. 111) | Cross-drainage structures will be implemented in such a way that they will provide sufficiently low flow velocity that the slowest local fish can navigate the structure under a particular design flow condition (i.e., 3-day delay; 1:10 year return flood condition). They will also provide a design conveyance for 1:25 year event without overtopping the roadway, which will result in minor changes in stream velocity. |
| Section 5.2.4.2 - Secondary Pathways (pg. 111) | AEM will not permit the deposit of chemicals, sediment, wastes, or fuels into any waterbody. |
| Section 5.2.4.2 - Secondary Pathways (pg. 112) | During construction, hazardous materials and fuel will be stored according to regulatory requirements to protect the environment and workers. During operation, hazardous materials will be stored at the Meliadine Exploration site. Individuals working on the AWAR Project and handling hazardous materials will be trained in the Transportation of Dangerous Goods. Emergency spill kits will be available near work areas. |
| Section 5.2.4.2 - Secondary Pathways (pg. 113) | Should a spill occur, contaminated areas will be collected and treated on-site, or shipped off-site for treatment and disposal if not possible to treat on-site. |
| Section 5.2.4.2 - Secondary Pathways (pg. 113) | A water quality monitoring program will be implemented. Monitoring will be conducted at upstream and downstream stations at selected watercourse crossings. The upstream station will be established based on predicted air quality deposition rates with the station placed far enough upstream |
| Section 5.2.4.2 - Secondary Pathways (pg. 113) | Materials for road building will be extracted from identified quarry locations along the AWAR. |
| Section 5.2.4.2 - Secondary Pathways (pg. 114) | Quarries will be inspected on a regular basis to identify any areas of water ponding, particularly during spring freshet |
| Section 5.2.4.2 - Secondary Pathways (pg. 114) | If there is noticeable flow from a quarry that could enter a waterbody, a water quality sample will be collected. Water quality samples for monitoring will be collected in the quarry and in the watercourse upstream and downstream of the point source impact. Samples will be analyzed for physical parameters, nutrients (i.e., phosphorus and nitrogen), and trace metals. Results will be reported in the monthly NWB report. |
| Section 5.2.4.2 - Secondary Pathways (pg. 114) | no rock and construction material will be gathered from below the high water mark of any watercours |
| Section 5.2.4.2 - Secondary Pathways (pg. 116) | Visual examinations of the quarry material for sulphur species and additional testing for acid rock drainage/metal leaching from each quarry and borrow will be conducted before and during construction. All material used at the watercourse crossings will be non-acid generating; however, this will be verified through testing of the rock fill material and through monitoring of water quality in the watercourse during and after construction |

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| Section 5.2.4.2 - Secondary Pathways (pg. 117) | Inspection of the culverts, as part of weekly inspections along the road during the spring-summer time, will be undertaken to ensure connectivity is maintained |
| Section 5.2.6.2 - Water Quality (Uncertainity) (pg. 119) | Water quality will be monitored during construction (after spring thaw) and post construction |
| Section 5.2.6.3 - Fish and Fish Habitat (Uncertainity) (pg. 120) | If it is found that the culverts are not operating as planned, then remedial actions will be implemente |
| Section 5.2.7.2 - Water Quality (Monitoring & Follow-up) (pg. 120) | Water quality monitoring will be completed to better characterize water quality in the watercourses during road construction (open water period) and subsequently during operation and decommissioning.<br>Monthly monitoring during the open water period will be conducted in watercourses that are most likely to be affected by the road and which have high habitat for Arctic grayling (M5.0, M11.5, M23.7) and have the highest potential for metal leaching due to the size of the drainage basin (M3.0, M5.0, and M23.7).<br>Water samples will be collected monthly during the open water period, at stations upstream and downstream of the road, in each of the above 5 watercourses. Water quality will be analyzed for conventional parameters (total suspended solids, alkalinity, hardness), major ions, total and dissolved metals (including in particular metals of potential concern due to elevated background concentrations or potential inputs from runoff as a result of vehicle operations [arsenic, copper, zinc, and cadmium]), and petroleum hydrocarbons.<br>Monitoring will be adaptive in that, if changes to water quality are detected, causation will be determined to allow for appropriate remedial actions and subsequent monitoring will be revisited to ensure it is appropriate both to monitor the effectiveness of remedial actions and future operations. |
| Section 5.2.7.3 - Fish and Fish Habitat (Monitoring & Follow-up) (pg.121) | Field monitoring will be conducted to characterize fish and fish habitat conditions in the watercourses that are fish bearing during the first year post-construction and during decommissioning. Monitoring will focus on the effects of any sediment release and deposition during the first year after construction.<br><br>Post-construction monitoring will be conducted in watercourses most likely to be affected by the road culvert crossings to evaluate the effects of any sediment releases and deposition at crossing sites, and to evaluate fish passage potential through the culverts on the 2 streams used by Arctic grayling.<br><br>The effectiveness of habitat reclamation following construction will also be evaluated. Monitoring will be adaptive in that, if changes to fish and fish habitat are detected, appropriate remedial actions will be implemented and subsequent monitoring programs adjusted to ensure the effectiveness of remedial actions and future operations. |
| **Section 5.3 - Terrestrial Envrionment** | |
| Section 5.3.4 - Effects Analysis (pg. 154) | • The Phase 1 AWAR will be as narrow as possible, while maintaining safe construction and operation practices<br>• Erosion control practices will limit wind and water erosion on steep slopes (e.g., vegetation, erosion mats). |
| Section 5.3.4 - Effects Analysis (pg. 154) | Use of culverts and other design features that reduce changes to local flows and drainage patterns and drainage areas. |
| Section 5.3.4 - Effects Analysis (pg. 154) | The road generally will be 1.3 m or less in height |

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| Section 5.3.4 - Effects Analysis (pg. 154) | • Access to the Phase 1 AWAR will be controlled (gated); public vehicles (cars, trucks) allowed only with special authorization.<br>• Access will be limited when large numbers of caribou are crossing the road; this will occur in consultation with the local HTO.<br>• Prohibit hunting, trapping, harvesting and fishing by employees and contractors, and enforce this prohibition.<br>• Upon consultation with the KIA and HTO, an appropriate “no shooting zone” will be established along the road |
| Section 5.3.4 - Effects Analysis (pg. 155) | • Posted speed limits of 50 km/h will be maintained and enforced.<br>• Potential watering of Phase 1 AWAR surface in key areas (e.g., near camp, over bridge) will suppress dust production.<br>• Potential use of chemical dust suppressants in accordance with the Environmental Guidance for Dust Suppression published by the Government of Nunavut Department of Environment. Their use will be limited, as they tend to attract wildlife to the road. |
| Section 5.3.4 - Effects Analysis (pg. 155) | • Hazardous materials and fuel will be stored according to regulatory requirements to protect the environment and workers (i.e., Materials and Waste Management Plan).<br>• Individuals working on site and handling hazardous materials will be trained in the Transportation of Dangerous Goods and Hazmat.<br>• Soils from petroleum spill areas will be excavated, placed into appropriate containers and shipped for remediation.<br>• An Emergency Response and Spill Contingency Plan will be implemented.<br>• Emergency spill kits will be available wherever hazardous materials or fuel are stored and transferred. |
| Section 5.3.4 - Effects Analysis (pg. 155) | Cleaning of construction equipment/vehicles before delivery to Rankin Inlet |
| Section 5.3.4 - Effects Analysis (pg. 156) | • Locations of large aggregations of animals must be reported to the road supervisor, who will inform all potentially affected employees and the environmental representative so that appropriate actions can be taken.<br>• Speed limit reduced to 30 km/h when 1-50 caribou observed within 100 m of Phase 1 AWAR; access will be limited when large numbers of caribou near to, or are crossing, the road.<br>• Caribou and all wildlife will be given right-of-way on the road and must be allowed to pass uninhibited.<br>• Where active raptor nests are identified, a nest-specific management plan will be developed to minimize disturbance to nesting activities.<br>• To the greatest extent possible, blasting and stockpiling at quarries will be conducted under winter conditions prior to arrival of the nesting birds. |
| Section 5.3.4 - Effects Analysis (pg. 157) | • The bottom rock layer will be added prior to May 1 as part of the road footprint.<br>• The road alignment will attempt to avoid potential topographic features that may provide nesting habitat for raptors |
| Section 5.3.4 - Effects Analysis (pg. 157) | • Most construction of the Phase 1 AWAR will be based out of Rankin Inlet or the exploration camp eliminating the need for temporary camps along the route.<br>• Littering and feeding of wildlife will be prohibited.<br>• Education and reinforcement of proper waste management practices to all workers and visitors to the site.<br>• Education on the risk associated with feeding wildlife and careless disposal of food garbage.<br>• Ongoing review of the efficiency of the waste management program and improvement through adaptive management. |

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| Section 5.3.4.1 - Pathways with No Linkages (pg. 158) | Mitigation will be implemented during AWAR construction to limit the attraction of wildlife and the associated increased risk of mortality from human-carnivore interactions |
| Section 5.3.4.1 - Pathways with No Linkages (pg. 158) | no new camps will be required for construction or operation of the AWAR |
| Section 5.3.4.1 - Pathways with No Linkages (pg. 158) | The only building to be installed will be a temporary emergency shelter at the approximate mid-point of travel along the AWAR |
| Section 5.3.4.1 - Pathways with No Linkages (pg. 158) | AEM will not permit the deposit of chemicals, sediment, wastes, or fuels into any waterbody. During construction, hazardous materials and fuel will be stored according to regulatory requirements to protect the environment and workers. During operation, hazardous materials will be stored at the Meliadine Exploration site |
| Section 5.3.4.2 - Secondary Pathways (pg. 160) | Key mitigation activities also include the following:<br>• the watering of roads in select locations during the non-winter period;<br>• enforcement of the posted speed limit of 50 km/h; and<br>• restricted public access to the road. AEM will work with the KIA and the Municipality of Rankin Inlet to devise a system for controlling access by non-AEM traffic and will have this in place before construction starts |
| Section 5.3.4.2 - Secondary Pathways (pg. 161) | To mitigate the transport and introduction of non-native plant species into native plant communities, any construction equipment not sourced locally will be cleaned before shipment to Rankin Inlet |
| Section 5.3.4.2 - Secondary Pathways (pg. 164) | Passenger vans will transport workers from Rankin Inlet to site during construction and operation to reduce traffic volume. In addition, the AWAR will be gated and public traffic will require special authorization to use the AWAR. Road safety training will be provided to site personnel and partnerships built to educate the public on road safety. Speed limits will be posted and enforced on the AWAR. The maximum speed will be 50 km/h. Speed limit will be reduced to 30 km/h when 1 to 50 caribou are observed within 100 m of AWAR and traffic may be suspended when 50 or more caribou are observed within 100 m of AWAR.<br><br>The presence of wildlife will be monitored and communicated to site personnel, and wildlife on the AWAR will be given the right-of-way; vehicles must stop until animals are off the road |
| Section 5.3.5 - Effects to Soil (pg .164) | Site clearing and soil stripping and storage will occur only at the borrow and quarry sites |
| Section 5.3.5 - Effects to Soil (pg .165) | Environmental design features and mitigation (i.e., erosion control practices) will be applied to control wind and water erosion on topsoil and overburden stockpiles |
| Section 5.3.6 - Effects to Vegetation (pg .166) | Direct vegetation effects (removal and covering) will occur mainly during the construction phase of the AWAR Project |
| Section 5.3.6.7 - Monitoring & Follow-up (pg.170) | A monitoring program will be implemented during regular inspections of the AWAR by the road supervisor and site environmental staff to track conditions and implement further mitigation as required (e.g., monitoring for invasive plant species (weeds) not indigenous to the pre-AWAR area where the plant was introduced as a result of the construction and operation of the AWAR, and implementation of a weed management plan, if required). |
| Section 5.3.7.4 - Effects to Behaviour and Movement (pg. 180) | A number of environmental design features and management plans will be implemented to limit olfactory, visual, and auditory disturbances to caribou and carnivores (e.g., traffic will be at low volumes |

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| Section 5.3.7.4 - Effects to Behaviour and Movement (pg. 184) | All previously identified nest locations will be monitored during construction of the AWAR. Where active raptor nests are identified, a nest-specific management plan will be developed. construction activities, particularly blasting, will be shifted to non-nesting locations so that disruptions to breeding raptors are kept to a minimum; however, it should be noted that the current construction plan for the AWAR includes most blasting and stockpiling of the rock material at quarries being completed during the winter period prior to migratory birds returning to nest sites. All crew members will be trained to recognize signs that a bird may be nesting in the area. |
| Section 5.3.7.5 - Effects to Caribou and Wolf Survival (pg. 185) | The proponent will work with the KIA and the Municipality of Rankin Inlet to devise a system for controlling access by public vehicles (i.e., cars, trucks). |
| Section 5.3.7.9 - Monitoring & Follow-up (pg. 190) | Once the road is operational, AEM will implement a monitoring program to record on a systematic basis the prevalence of wildlife seen along the AWAR. The program will be developed with the input of the local HTO and with the KIA. AEM will request that all large mammals observed by project related drivers on the road be reported to AEM environmental staff (via the road dispatcher), and recorded in a log book. This is anticipated to include caribou, muskox, grizzly bear, polar bear, and wolf. This information will be provided in an annual report. Information to be recorded will include species, number of individuals, approximate location and distance from the road, and date. In the case of grizzly bear or polar bear observations, the GN Conservation Officer will be contacted. The program, as envisioned by AEM, will be completed weekly and AEM will explore sub-contracting this program to the local HTO in Rankin Inlet |
| **Section 5.4 - Physical Envrionment** | |
| Section 5.4.4 - Effects Analysis (pg. 218) | • Use of non-acid generating materials for road fills.<br>• Enforcing speed limits will assist in reducing dust emissions.<br>• Equipment and fleet equipped with industry-standard emission control systems.<br>• Operating procedures will be developed that reduce dust generation and air emissions (e.g., regular maintenance of equipment to meet emission standards |
| Section 5.4.4 - Effects Analysis (pg. 218) | The Phase 1 AWAR is narrow to minimize footprint area while maintaining safe construction and operation practices. |
| Section 5.4.4 - Effects Analysis (pg. 218) | Use of non-acid generating material for road construction. |
| Section 5.4.4 - Effects Analysis (pg. 218) | • The road alignment has been chosen to avoid areas that are ice-rich and, therefore, more susceptible to disturbance.<br>• Thaw-stable construction fills will be used to construct the road.<br>• Fill thickness' is designed to preserve the permafrost and promote permafrost growth into the thaw-stable road fills.<br>• Road fill material will be placed directly over the existing soil layer without cutting, stripping, or grubbing to avoid disturbing the subgrade soils.<br>• Placement of much of the road construction materials during winter will minimize disturbance to the permafrost.<br>• Only thick drifted snow greater than 1 m thick will be removed before the road fills are placed |
| Section 5.4.4 - Effects Analysis (pg. 219) | • Coarse road fills will be placed in winter when soils are frozen and the road fill thickness will be designed with a minimum thickness to maintain frozen conditions in the soil subgrade. Top dressing will be finished in early summer. |
| Section 5.4.4 - Effects Analysis (pg. 219) | • Road design includes the use of culverts or French drains to control and manage drainage adjacent to and under the road. |
| Section 5.4.4 - Effects Analysis (pg. 219) | • Minimize quarrying activities and use dust suppression measures where appropriate. |

| Section | Commitment |
|---|---|
| Section 5.4.4 - Effects Analysis (pg. 219) | • Active layer and permafrost table will equilibrate to final quarry shape and profile.<br>• Minimize depth of quarrying to limit impact on active layer. |
| Section 5.4.4 - Effects Analysis (pg. 219) | • Minimize volume of quarried materials required |
| Section 5.4.4 - Effects Analysis (pg. 219) | • Minimize surface area to be quarried.<br>• Use best management practices to close quarry sites to minimize rock and soil cuts and restrict where possible the development of quarry lakes by promoting drainage from sites. |
| Section 5.4.4 - Effects Analysis (pg. 219) | • Quarries will be excavated and sloped for positive drainage.<br>• Maximum quarry depths of 3 m are currently planned.<br>• Excavations will be at least 100 m away from any watercourses.<br>• Drainage from quarries will not flow directly into any waterbodies or watercourses; drainage will be directed to swells before runoff can enter watercourses. |
| Section 5.4.4 - Effects Analysis (pg. 219) | • Typical freeze/thaw processes.<br>• Quarries will be shallow excavations and will be closed on completion using best management practices.<br>Quarries will be excavated and sloped for positive drainage.<br>• Excavations will be at least 100 m away from any watercourses.<br>• Drainage from quarries will not flow directly into any waterbodies or watercourses; drainage will be directed to swells before runoff can enter watercourses.<br>• Install culverts to promote drainage.<br>• Where possible, construct road along exposed ridge lines to reduce potential snow accumulation.<br>• Where possible use thaw-stable road fills for construction.<br>• Annual road maintenance as required.<br>• Use appropriate culvert design based on the site specific hydraulics.<br>• Use of staggered culvert configuration to promote drainage during spring thaw and freshet.<br>• Regular inspection of the road to identify any areas where ponding of water along the road represents a risk, and installing additional culverts or French drains to alleviate the risk.<br>• Dust suppression through regular surface maintenance (e.g., grading, adding coarse top material), and watering where the AEM road supervisor identifies areas prone to high dust levels, or areas where dust may be adversely affecting water quality or fish habitat .<br>• Use of non-acid generating materials for road bed and fills.<br>• Enforcing speed limits will assist in reducing dust emissions. |

| Section | Commitment |
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| | • Operating procedures will be developed that reduce dust generation and air emissions (e.g., regular maintenance of equipment to meet emission standards).<br>• Minimize activity using appropriate equipment and re-establish drainage paths and promote permafrost re-equilibration within the decommissioned road bed.<br>• Make road surface impassable by vehicular traffic.<br>• In-stream work will be limited to when watercourses are not flowing for ephemeral watercourses or when watercourses are frozen. If any of the culverts need to be removed when the watercourses are flowing, the work will be completed late in the summer, and best management practices for erosion and sedimentation control (e.g., silt curtains, runoff management) will be employed. |
| Section 5.4.4.1 - Pathways with No Linkages (pg. 222) | the AWAR will be constructed in the winter when the subgrade soils are frozen. |
| Section 5.4.4.1 - Pathways with No Linkages (pg. 222) | The quarries will be excavated through the active layer and into the underlying materials by ripping, drilling, and blasting. The active layer will eventually re-equilibrate with the surrounding permafrost with no residual effects |
| Section 5.4.4.1 - Pathways with No Linkages (pg. 223) | Culverts or French drains will be used to re-direct drainage paths and to convey water from upstream areas to downstream areas across or under the AWAR |
| Section 5.4.4.1 - Pathways with No Linkages (pg. 223) | • in-stream work (e.g., culvert removal) will be limited to the extent possible to when watercourses are not flowing for ephemeral watercourses or when watercourses are frozen |
| Section 5.4.4.1 - Pathways with No Linkages (pg. 223) | • if any of the culverts need to be removed when the watercourses are flowing, the work will be completed late in the summer, and best management practices for erosion and sedimentation control (e.g., silt curtains, runoff management) will be employed |
| Section 5.4.4.2 - Secondary Pathways (pg. 225) | Mitigation and environmental design features to reduce the potential for permafrost degradation are as follows:<br>• the road alignment avoids, where possible, fine-grained, poorly drained, ice-rich, frost susceptible soil conditions as noted by geomorphologic mapping, due to susceptibility to thaw related settlement;<br>• regions of high ground relief (higher elevations) were sought to provide better drainage conditions, to minimize the potential for snow drifting and to avoid organic depressions and/or other poor ground conditions, which are more abundant in the low lying areas;<br>• road fill material will be placed directly over the existing soil layer without cutting, stripping, or grubbing to avoid disturbing the subgrade soils;<br>• only thick drifted snow will be removed before the road fills are placed; and<br>• the road fill thickness should be a minimum of 1 m in thaw-stable soils, and 1.3 m in thaw-sensitive soils |
| Section 5.4.4.2 - Secondary Pathways (pg. 225) | Rock and soil materials will be excavated from the quarry areas, transported to the AWAR route, and then used for construction of the AWAR |
| Section 5.4.4.2 - Secondary Pathways (pg. 226) | Where possible, the borrows and quarries will be graded to provide drainage, but this may not be possible in all areas due to the flat topography |
| Section 5.4.4.3 - Primary Pathways (pg. 226) | Construction of the AWAR will be undertaken predominately during winter months to minimize impact to permafrost and to limit potential thaw-settlement due to permafrost degradation. The road fills will be placed directly over existing terrain, including soils and vegetation, without stripping or grubbing to avoid disturbance of the subgrade soils |

| Section | Commitment |
|---|---|
| Section 5.4.4.3 - Primary Pathways (pg. 228) | The quarries will be developed at semi-regular intervals along the proposed AWAR route to optimize haulage distances while minimizing the number of quarries to be developed. Depending on the material types overlying the bedrock, and the requirements for road construction, it is possible that much of the terrain and soil types will not be suitable for road construction; consequently these materials will be stripped and spoiled |
| Section 5.4.7 - Monitoring & Follow-up (pg. 230) | Monitoring of the performance of the AWAR will include annual inspections of the road surface, shoulders, culverts, and bridges. Due to the nature and purpose of the AWAR, the nature of the construction materials, and the conditions under which the road will be constructed, it is anticipated that maintenance over areas identified during the annual inspection will be required, and will be part of the general annual mine maintenance activities carried out by AEM |
| **Section 6.0 - Cultural Envrionment** | |
| Section 6.1.3.1 - Baseline Collection Methods (pg. 233) | Beyond just meeting the permit requirements, reports present the archaeological results and in situations where archaeological sites will be removed from the landscape as the result of AWAR Project development, the report was the ultimate stage of mitigation and pathway reduction. The report will 'preserve' the archaeological site data, which will not be left in situ and protected from disturbance |
| Section 6.1.5.5 - Secondary Pathways (pg. 240) | These sites are located close enough to the AWAR that during the construction of the road and use of the borrow sources/rock quarries that these sites are located in, will be actively avoided (e.g., 30 m buffer staked around them so they will not be disturbed during construction). Both awareness training and the implementation of a monitoring plan to verify compliance with an active avoidance strategy will assist in the success of this environmental design feature |
| Section 6.1.5.5 - Secondary Pathways, Table 6.1.5.4 | Remaining features of Borden Number KfJm-171 will be avoided during construction. All other borden numbers within referenced table, Environmental design feature includes avoidance during construction |
| Section 6.1.8 - Monitoring (pg. 242) | Archaeological sites will be removed from the landscape owing to AWAR Project construction activities. Key environmental design features were implemented to reduce the potential for significant affects on archaeological resources. An archaeological awareness training manual will be provided to all AWAR Project staff. The training provides basic information regarding what archaeological resources in the LSA look like, that these resources are protected by law, and what actions need to be taken should AWAR Project activities come in to conflict with an archaeological site |
| Section 6.1.8 - Monitoring (pg. 242) | Should previously unrecorded archaeological sites be identified during road construction, borrow source use, or maintenance, the following steps will be taken:<br>• all construction activity in the vicinity of the site will stop;<br>• the AWAR Project archaeologist and the Territorial Archaeologist will be contacted;<br>• based on details provided by the AWAR Project archaeologist, the Territorial Archaeologist will consult with the Inuit Heritage Trust and local community to establish a mitigation plan. It should be noted, that should the remains be Human remains the Royal Canadian Mounted Police must be contacted and steps as outlined in the Nunavut's Human Remain Policy will be invoked; and<br>• the mitigation plan will be implemented at the cost of AEM |
| Section 6.2.3 - Traditional Knowledge Program (pg. 246) | AEM arranged to contract an Inuit-owned company in Rankin Inlet to undertake traditional knowledge (IQ) studies in Rankin Inlet, Whale Cove, and Chesterfield Inlet. At the time of this report, results were unavailable. When the results of the studies become available, they will be considered in AWAR Project planning. |
| Section 6.2.4 - Access (pg. 251) | Since AEM will only control traffic turning onto the AWAR and will have no effect or control over traffic driving on the existing municipal road that continues on past the Char River, a system to enhance safe use of the AWAR will be implemented for both AEM and non-AEM traffic, prior to construction |

| Section | Commitment |
|---|---|
| Section 6.2.5.1 - Contribution to Project Design (pg. 251) | Results of the IQ studies initiated in January 2010 will be used to inform the design of environmental monitoring programs and operational features of the AWAR Project |
| Section 6.2.6.1 - Mitigation (pg. 253) | The following identifies AEM's mitigative commitments related to traditional use of the land:<br>• Dust can be mitigated by maintaining posted speed limits and by regular maintenance of the road surface to reduce impacts to wildlife and vegetation.<br>• Close to camp, the road will be watered to keep dust under control (the use of salt to reduce dust will be avoided, as it would serve as an animal attractant).<br>• The construction of a single-span bridge across the Meliadine River and efforts to keep all ancillary infrastructure above the ordinary high-water mark so that the road will not have any impact on the river or Arctic char using the river.<br>• The Char River will be crossed using a single-span bridge (installed in the winter) to replace an existing one to protect fish habitat and fish migration.<br>• Streams that are crossed using culverts will have a culvert seated 300 mm below grade to facilitate fish migration (installed in winter).<br>• All other water crossings will have bridges or culverts installed (when the AWAR Project is closed, culverts and bridges will be removed and the natural drainage re-established).<br>• When the road is closed, the area will be scarified, allowing a plant community to establish itself on the (former) road surface.<br>• The importance of caribou to the cultural, social, and economic well-being of Nunavummiut (people of Nunavut) is clearly known, and the protection of the caribou is foremost in all developments.<br>• Measures to mitigate effects on caribou due to drivers will include observing the speed limits, giving animals the right-of-way, and coming to a stop if necessary.<br>• If a consultation process determines that it is required, the road could be closed when large herds of caribou are present.<br>• AEM has consulted with the KIA and the Municipality of Rankin Inlet on the processes and procedures that will be used to control non-project related access onto the Phase 1 AWAR. |
| Section 6.2.6.2 - Monitoring (pg. 253) | • To document any residual effects resulting from the road, including deposits of dust in nearby waterbodies, AEM will undertake water-monitoring.<br>• AEM will work with local HTO and the KIA, to develop a wildlife monitoring program that will focus on caribou, bear, muskox, migratory birds, and raptors.<br>• Wildlife monitoring is anticipated to take place on a regularly scheduled basis and would include logging wildlife observations, estimated numbers, and nearest kilometre marking. |
| Section 6.3 - Socio-economics (pg. 255) | AEM currently has a consultant carrying out a baseline assessment of the existing socio-economic conditions with the Kivalliq Region of Nunavut that will become part of the socio-economic assessment of the full proposed Meliadine Gold Project contained within the Draft Environmental Impact Statement that AEM is targeting to submit to the Nunavut Impact Review Board (NIRB) in early 2012. |
| Section 6.3.2 - Study Area (pg. 255) | Rankin Inlet is the community closest to the Meliadine site, and its residents will receive preference when it comes to the employment and business opportunities that will flow from building the road and later, from servicing the underground exploration program, surface drilling, and the camp. |

| Section | Commitment |
|---|---|
| Section 6.3.3.2 - Effects Analysis (pg. 257) | Commitments have been made to the KIA by AEM and its road contractor to maximize local employment (set a target of 50%) during Phase 1 AWAR construction. |
| Section 6.3.3.2 - Effects Analysis (pg. 257) | Road construction will be carried out by a local Inuit Owned firm. |
| Section 6.3.3.2 - Effects Analysis (pg. 257) | Work with Municipality to monitor potential problem and develop mitigation. |
| Section 6.3.3.2 - Effects Analysis (pg. 257) | To the greatest extent possible maximize local workforce who will not require temporary rental accommodation. |
| Section 6.3.3.2 - Effects Analysis (pg. 258) | Ongoing road maintenance and operation activity creates an opportunity to create new heavy equipment training opportunities. |
| Section 6.3.3.2 - Effects Analysis (pg. 258) | AEM will work to maximize local employment on road maintenance and road operational contracts |
| Section 6.3.3.2 - Effects Analysis (pg. 258) | Work with Municipality to monitor potential problem and develop mitigation. |
| Section 6.3.3.4 - Project Specific Effects (pg. 259) | • Construction of the AWAR in 2012 will provide an opportunity for AEM, working with its community partners, to use construction of the AWAR to train approximately 30 new heavy equipment operators in 2012 (a program that was in development with a partnership of AEM, the Municipality of Rankin Inlet, and Nunavut Arctic College). |
| Section 6.3.3.4 - Project Specific Effects (pg. 259) | • Construction of the AWAR in 2012 will provide enhanced opportunities for the local business community in Rankin Inlet. The construction of the AWAR Project prior to mine development (if approved) will provide substantial advantage to the Rankin Inlet business community by providing access and developing business links with the proposed Meliadine Gold Project. This early access will help these businesses understand the proposed Meliadine Gold Project needs, as well as build their ability to access business opportunities earlier in the construction phase of the proposed Meliadine Gold Project. |
| **Section 7.0 - Transportation Management Plan** | |
| Section 7.0 - Transportation Management Plan (pg. 263) | The Management Plan will be updated on an annual basis at a minimum or more often as change in circumstances require. |
| **Section 10.0 - Reclamation** | |
| Section 10.0 - Reclamation (pg. 268) | The AWAR will be decommissioned and reclaimed by AEM if the proposed Meliadine Gold Project fails to pass either the Feasibility stage or Environmental Assessment phase. This would take place within a year of the road no longer being required to complete the reclamation of the Meliadine West Advanced Exploration site |
| Section 10.0 - Reclamation (pg. 269) | Where affected watercourses are fish bearing, the timing of work will have to be restricted to within the designated DFO fisheries work window (16 July through 30 April). For these sites, appropriate fish exclusion measures will be undertaken prior to the in-stream works. All in-stream works will be carried out using best management practices for erosion and sediment control |
| Quarry Sites and Borrow Sources (pg. 270) | Water quality monitoring and testing will be undertaken periodically during the construction and operational period of the road to measure the quality of water draining from the open quarry/borrow sites and from the road base materials |
| **Information Responses' Committments** | |

| Section | Commitment |
|---|---|
| Information response #1 | (1) A comprehensive spill plan has been sent to the NIRB under a separate cover.<br>(2) A table of proposed mitigation measures and other commitments follow this page. |
| Information response # 4 | AEM will follow MEND 2009 guidance on sampling and testing of geological material for borrow and quarry materials used for road construction. |
| Information response # 7 | AEM will ensure that any other dust suppressants being used do not impact surface waters adjacent to the road. |
| Information response # 8, #9 & #14 | AEM commits to sampling all eleven water crossings including the Char and Meliadine Rivers in the first open water season following road construction. |
| Information response # 10 | Agnico-Eagle Mines is committed to a crossing inspection program to ensure that culverts have been installed in the right location with respect to the watercourse and to identify potential risks to culvert structural integrity following construction of the AWAR. |
| Information response # 11 | AEM will take additional samples of borrow and quarry materials during excavation and test the materials for their potential to generate acidity and leach chemicals. |
| Information response # 13 | AEM commits to managing ponded quarries/borrow pit water so as to avoid potential deleterious effects to downstream surface water bodies. |
| Information response # 16 | A spill contingency plan for the AWAR is attached. |
| Information response # 23 | In cases where mitigation measures have been implemented to avoid or minimize impacts to listed plant species, a monitoring program will be implemented to monitor listed vegetation species populations during the post-construction period. |
| Information response # 24 | Annual road inspections and maintenance work will be carried out during operation. |
| Information response # 38 | AEM commits to monitoring local employment for both construction and operations phase of the road. |
| Information response # 39 | AEM will ensure its staff and contractors are trained to not harass or feed wildlife. |
| Information response # 40 | AEM intends to remain in compliance with the Nunavut Wildlife Act. |
| Information response # 42 | AEM remains prepared to develop an AWAR wildlife management plan that meets the satisfaction of the Department of Environment. |
| Information response # 43 | All employees and contractors will be reminded to remain in their vehicle should wildlife be on or near the road, and to be mindful of predators such as polar bears. |
| Information response # 44 | AEM and its contractors will not enter the Park in constructing the road and bridges. |

**Comment made by Interested Party: Transport Canada – Navigable Waters Protection Program (AEM Reference: Information Request #3)**

*AEM will likely require formal approvals for works under the Navigable Waters Protection Act (NWPA)*

**AEM's Response to Information request:**

AEM will be applying to the Navigable Waters Protection Program for approval of the Meliadine River bridge. The bridge as designed will be at least 2.5 metres above the ordinary high water mark.

**Comment made by Interested Party: Environment Canada**
**(AEM Reference: Information Request #4)**

*Page 116 of the environmental assessment indicates AEM plans to conduct visual examinations if quarry materials for sulphur species and additional ARD/ML from each quarry and borrow source before and during construction. To ensure adequate samples sizes are taken for geochemical characterization of borrow and quarry materials, EC recommends the Proponent refer to the most recent version of the Mine Environmental Neutral Drainage Prediction Manual (MEND Report 1.20.2; Price 2009), which provides useful guidance on the prediction and mitigation of drainage chemistry from sulphidic geological materials. The Proponent is advised to adhere to the recommended practices for sampling, monitoring and testing during and follow the excavations.*

**AEM's Response to Information request:**

AEM will follow MEND 2009 guidance on sampling and testing of geological material for borrow and quarry materials used for road construction.

**Comment made by Interested Party: Environment Canada**
**(AEM Reference: Information Request #5)**

*EC seeks clarification on what materials are planned for use in deck construction. If wood is being considered for bridge decking, EC does not support the use of creosote or CCA-treated wood for this purpose. In addition, EC advises against the use of grating in bridge design as this provides a pathway for road bed material entry into streams and can negatively impact the aquatic ecosystem.*

**AEM's Response to Information request:**

AEM opted for clear span bridges at three locations along the All Weather Access Road (AWAR). This was principally done to avoid impacts on fish and fish habitat, and Fisheries and Oceans Canada's Operational Statement for Clear Span Bridges will be respected. A standard northern clear span bridge design for remote areas was used. This is a steel structure having steel grating for the deck.

Steel grating is to be used because of safety considerations and load bearing capacity. There always remains a possibility that a vehicle will slip on a snow covered or wet bridge deck leading to an accident. Steel grating provides traction under all weather conditions as neither snow nor ice will accumulate on its surface. To do otherwise would compromise road safety, something AEM does not care to do.

The bridge design for the three bridges to be installed is based on Canadian Highway Code - CSA, S6-06, CL-625. The design stress loads of two 18m long vehicles of GVW (gross vehicle weight) of 62,500 kg are considered travelling simultaneously on a bridge. The loading is factored by 40% dynamic allowance and another 60% safety factor. The ultimate capacity is around 280,000 kg. These requirements cannot easily be met using a wood deck.

The driving surface of the road will be topped with minus 2 inch gravel and that smaller than minus 1 inch could fall through the grating. But this normally occurs on the first few metres of the bridge deck. As all the bridges are clear span with all ancillary infrastructure above the ordinary high water mark, most coarse material falling through the grating will not end up in the river but in the rip rap and on the river bank. The small amount falling into the water should not have a significant adverse impact the rivers and stream.

**Comment made by Interested Party: Environment Canada**
**(AEM Reference: Information Request #6)**

*The Proponent also mentions that geo-textile material will be optional at the base of the road bed material over thaw susceptible soils. EC recommends best practices be used, such as routine installation of geo-textile material in over thaw-susceptible soils or other methods recommended by the geotechnical engineer to provide greater structural integrity to the road base.*

**AEM's Response to Comment:**

Construction of the All Weather Access Road (AWAR) will be carried out based on the engineering design and construction recommendations provided in the supporting document to the Road Environmental Assessment by Golder Associates, "Report on All Weather Access Road Meliadine Gold Project Feasibility Level Design", dated 20 January 2011 (Golder 2011)

In particular, the required use and placement of geotextile will be assessed during construction of the road, and will be based on the season during which construction occurs and on the location of thaw-susceptible materials as stated in the following excerpt from the supporting document:

*"It is assumed that the proposed AWAR will be built during winter or in cold temperatures and that geotextile placement may be omitted during the winter construction. However, the road project should have on site a reasonable quantity if the construction carries on in thaw season. A geotextile fabric should be installed in areas with thaw-susceptible sub-grades. The geotextile should be non-woven needle punched with a minimum mass of 200 g/m$^2$."* (Section 4.3, 2$^{nd}$ paragraph p. 10, Golder 2011)

**Comment made by Interested Party: Environment Canada**
**(AEM Reference: Information Request #7)**

*Section 5.1.4.5 of the EA and p.15 of the Transportation Management Plan indicated that chemical dust suppressants will be used to control road dust as a last resort and only in accordance with the Government of Nunavut's Environmental Guideline for Dust Suppression. If AEM considers use of DL 10, EC recommends the product not be applied within 30 m of either side of all water bodies intersected or adjacent to the Meliadine AWAR. EC does not recommend the use of Bunker C or calcium chloride unless the Proponent can demonstrate the products can be applied and used effectively without mitigation into surface waters adjacent to the road.*

**AEM's Response to Information request:**

AEM will ensure that any other dust suppressants being used do not impact surface waters adjacent to the road.

**Comment made by Interested Party: Environment Canada**
**(AEM Reference: Information Request #8)**

*On this basis it is not clear why the Char R and Meliadine R crossings were not selected for (water quality) monitoring. As a best practice, EC recommends all crossings be monitored in the first open water season following road construction.*

**AEM's Response to Information request:**

AEM commits to sampling all eleven water crossings including the Char and Meliadine Rivers in the first open water season following road construction. The details are presented in the attached Monitoring Plan for the AWAR. This Plan covers water quality, wildlife, road fill testing, permafrost, and hydrology monitoring.

# MELIADINE GOLD PROJECT

# MONITORING PLAN

**for the Phase 1 All-weather Access Road between Rankin Inlet and the Meliadine site**

**November 2011**

# DOCUMENT CONTROL

| Version | Date | Section | Page | Revision |
|---|---|---|---|---|
| 1 | 6 Nov 2011 | | | First draft of the Phase 1 AWAR Monitoring Plan |
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Project Manager
Meliadine Gold Project

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Introduction

The monitoring programs in this Monitoring Plan are proposed to deal with the uncertainties associated with the impact predictions and environmental design features noted in the project description and environmental assessment of the Phase 1 All Weather Access Road (AWAR). In general, monitoring is used to test (verify) impact predictions and determine the effectiveness of environmental design features (mitigation). Monitoring is also used to identify unanticipated effects and implement adaptive management. Typically, monitoring includes one or more of the following categories, which may be applied during the construction, operation and closure of the Phase 1 All Weather Access Road.

1. Compliance inspection: monitoring the activities, procedures, and programs undertaken to confirm the implementation of approved design standards, mitigation, and conditions of approval and company commitments;
2. Environmental monitoring: monitoring to track conditions or issues during the development lifespan, and subsequent implementation of adaptive management; and
3. Follow-up: programs designed to test the accuracy of impact predictions, reduce uncertainty, determine the effectiveness of environmental design features, and provide appropriate feedback to operations for modifying or adopting new mitigation designs, policies, and practices.

Results from these programs can be used to increase the certainty of impact predictions in future environmental assessments. These programs form part of the environmental management system for the AWAR Project. If monitoring or follow-up detects effects that are different from predicted effects, or the need for improved or modified design features, then adaptive management will be implemented. This may include increased monitoring, changes in monitoring plans, or additional mitigation.

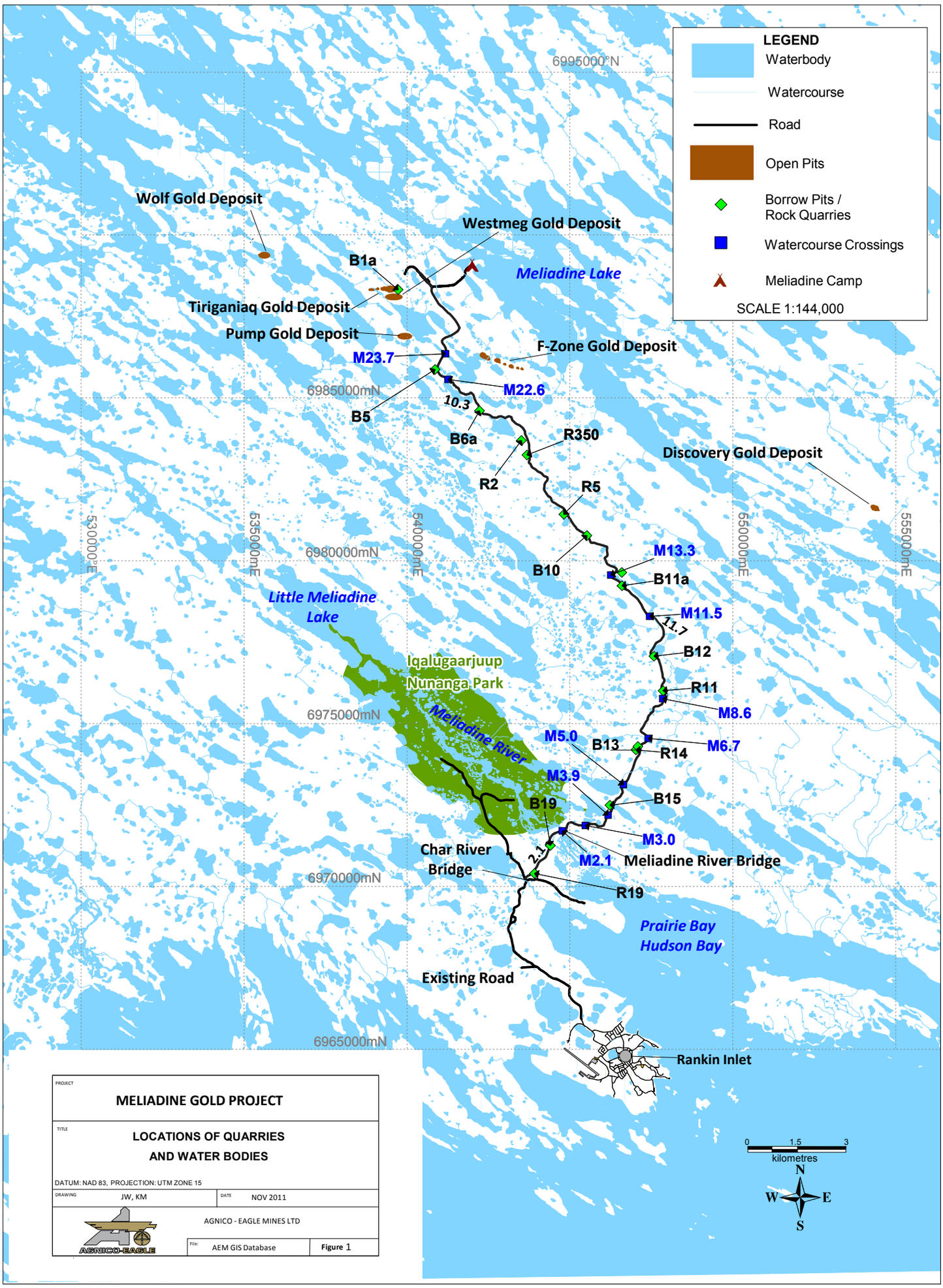
The Monitoring Plan for the All Weather Access Road (AWAR) covers in order wildlife, water quality, hydrology, geochemistry (road fill testing) and permafrost. The Phase 1 AWAR is illustrated on figure 1.

## 1. Wildlife Monitoring Program

Once the road is operational, AEM will implement a monitoring program to record on a systematic basis the prevalence of wildlife seen along the Meliadine Phase 1 AWAR. The program will be developed with the input of the local HTO and with the KIA. The program will focus on caribou, muskox, bear, wolves, migratory birds, and raptors.

The program as envisioned will consist of a periodic ground survey of wildlife observed along the road. At the current time AEM is thinking that the minimum frequency would be weekly. The survey would log type of wildlife observed, estimate of numbers and nearest kilometre marking along the road. The data would be aggregated and presented in an annual report. AEM will explore sub-contracting this program to the local HTO in Rankin Inlet.

Wildlife is expected occasionally to be observed on or immediately along the side of the AWAR. Caribou and other wildlife will have the right-of-way at all times. In case of problems (e.g., aggregations of caribou), the environmental personnel on-site will be in charge of managing the situation and with the collaboration of the security department will advise road users by patrolling the road. The project personnel will be notified by dispatch radio if any wildlife is observed on or near the road. The protocol to use when wildlife is on or near the road is presented in appendix 1.




PROJECT
**MELIADINE GOLD PROJECT**

TITLE
**LOCATIONS OF QUARRIES AND WATER BODIES**

DATUM: NAD 83, PROJECTION: UTM ZONE 15

| DRAWING | DATE |
|---|---|
| JW, KM | NOV 2011 |

AGNICO - EAGLE MINES LTD

File: AEM GIS Database

**Figure 1**

All wildlife observations will be recorded on a wildlife monitoring form. An example of such a form can be found in appendix 2.

## 2. Water Quality Monitoring Program

The AWAR between Rankin Inlet and the Meliadine Site could impact water quality as described in the project description and environmental assessment. This would largely occur due to the leaching of trace metals from the road building material and road dust settling on receiving waters. There are eight water crossings using culverts and these would offer the highest likelihood of metal leaching. Three water crossings will have clear span bridges with all ancillary infrastructure above the ordinary high water mark. These are not expected to impact on receiving waters. However, all 11 water crossings will initially be monitored to measure the impact of the road on receiving waters.

For the first year after construction of the road, at the end of the freshet season, a full round of water quality sampling will be conducted along the AWAR. This shall include:

- Any significant water seeps and/or water ponded in contact with the road. The sample locations will be chosen to represent areas where standing water is in regular contact with the road fill. Other criteria for selecting a sampling location include areas of evident rock staining (rust colour particularly) and areas where an accidental spill has previously occurred;
- Any significant seeps originating from the borrow pits or rock quarries will be sampled if the water is likely to reach receiving waters. (Standing water will not be collected as it poses little risk to the receiving environment); and
- Upstream and downstream from the 11 major road stream crossings in order to confirm there are no water quality issues resulting from these crossings or the adjacent road fill.

The monitoring program will be scaled back after the second year of sampling only if there are no water quality concerns with any of the sampling locations[1] no longer to be sampled. Areas having elevated levels of trace metals or TSS will continue to be sampled as will Meliadine River(M2.1), M3.0, M5.0 and M23.6. These are being continued as they represent the largest drainage basins and are of most environmental significance. M3.0 and M5.0 are both near the Meliadine River and are located in the "low lands" before the road climbs to the higher ground. Water here would have a greater probability of being in contact with any road building material for an extended period. M23.6 has the advantages of having historical water quality data collected in the past, being downstream of the waste rock pad located at the underground exploration ramp, and upstream of the future F Zone gold deposit.

The area of the drainage basins is as follows:

- M3.0 having a drainage basin of 2.77 $km^2$;
- M5.0 having a drainage basin of 11.02 $km^2$; and
- M23.6 having a drainage basin of 3.62 $km^2$.

The final decision on the monitoring program after year 1 will be reviewed by the NWB, KIA and AEM to determine if less sampling can be carried out in subsequent years.

[1] Borrow pits and rock quarries will not be sampled should raptors be nesting in them.

Samples from water crossings, flow from the borrow pits /rock quarries, standing water against the road will be collected in clean laboratory-supplied containers and preserved as directed by the analytical laboratory. The samples will be returned to an accredited commercial analytical laboratory for the analysis of the parameters specified on the chain-of-custody forms. Quality assurance and quality control measures outlined in the QA/QA Plan[2] for the Meliadine Gold Project will be followed. Generalized quality control is presented in table 1. The standard operating procedure for collecting environmental water samples as outlined in appendix 3 will be followed.

**Table 1. Generalised Quality Control Measures**

General quality control guidelines of a field sampling program are as follows:

- *all personnel involved in field procedures should have appropriate education and training;*
- *sampling methods should be consistently applied among sites throughout the study;*
- *samples should be collected according to SOPs that should be available to personnel at all times during the field program;*
- *sampling equipment should be appropriate for the habitat being studied, properly cleaned, and accompanied by the appropriate documentation (i.e., manual, calibration and maintenance schedule);*
- *all samples should be properly labelled as to date, location, type, number and collector;*
- *samples should be in the proper container with the appropriate preservative or fixative if necessary;*
- *field technicians should maintain detailed field notes using indelible ink and waterproof notebooks;*
- *personnel should use chain-of-custody/sample submission forms and custody seals for contaminant samples;*
- *personnel should follow appropriate shipping and storage methods; and*
- *standardised field collection forms should be used during the field program.*

The parameters to be analysed in all samples are presented in table 2 with particular attention paid to total suspended solids and total trace metals.

**Table 2. Parameters for Analysis**

**Physical Parameters**: pH (field and laboratory), temperature (field), alkalinity, bicarbonate, carbonate, electrical conductivity, hardness, hydroxide, ion balance, oil & grease, total dissolved solids, total suspended sediments, turbidity

**Nutrients:** $NH_4$, $NO_3$, $NO_2$, $PO_4$

**Major Ions:** Ca, Cl, Mg, K, Na, $SO_4$

**Trace Metals:** Al, Sb, As, Ba, Be, B, Cd, Cr, Cu, Fe, Pb, Li, Mn, Hg, Mo, Ni, Se, Ag, Sr, Sn, Ti, U, V, Zn

[2] Refer to the NWB ftp site for the Quality Assurance / Quality Control Plan for the Meliadine Gold Project, October 2009 under water licence 2BB-MEL0914

## 3. Hydrology Monitoring Program

Each crossing location was assessed during a preliminary study based on crossing descriptions and photographs in the Meliadine Gold Project Aquatics Baseline Synthesis Report[3] to determine its potential for classification as navigable waters based on the *Navigable Waters Protection Act* (NWPA) administered by Transport Canada. For crossings of non-navigable waters, culverts were recommended as the preferred crossing method.

The sizing of the culverts and bridges was based on an estimated peak flow at each crossing. Due to a lack of site-specific hydrometric data for the study area, the peak flow for each ephemeral crossing was estimated based on the 1:25 year 24-hour rainfall (52.3 millimetres [mm]); this was derived using rainfall data from Chesterfield Inlet (MSC Station Number 2300707), approximately 80 km north of the Meliadine Exploration site, which has a longer period of record than Rankin Inlet A (MSC Station 2303401) located approximately 26 km south of the Meliadine Exploration site. Corresponding water levels were derived using a 1-day flow model based on the channel cross-sections and peak flows. For the Meliadine River, the peak flow was estimated by extending the record of peak discharges from the crossing location by comparison with data from the regional Water Survey of Canada hydrometric stations 06NC001 Diana River near Rankin Inlet and 06NB002 Ferguson River below O'Neil Lake. The corresponding high water level was derived based on the peak flow and a 1-day flow model calibrated to water depths measured at the crossing location. The 1:25 year rainfall event was selected as the design criterion because of the proposed use of the road for 2 years under Phase 1 for the exploration and bulk sampling program, and, if Phase 2 is approved, the road would be used for 10 years for the construction and operation of the proposed mine, and because of the general absence of additional public infrastructure in the vicinity of the road.

The watercourse crossing visual inspection and maintenance program is designed to identify issues relating to watercourse crossings structural integrity and hydraulic function. It has three main objectives:

- Just prior to spring freshet to ensure that the culverts and stream crossings are in good state to accommodate the rapid spring thaw that is seen in the north;
- During the spring freshet to ensure that the culverts and bridges are not impeding spring freshet and to initiate action when and where required to prevent road wash outs; and
- Just after heavy rainfall events to monitor water accumulation along the road, to ensure that culverts are passing precipitation as planned and to initiate action when and where required to prevent erosion and road wash outs.

If more freshet water is evidenced than expected, the hydrology of the basin will be surveyed once again to ensure the proper culvert design was used for the size of the drainage basin.

[3] Golder (Golder Associates Ltd.). 2009. Aquatics Baseline Synthesis Report; Meliadine Gold Project. Submitted to Compalex Minerals Corporation. November 2009. Report 09-1371-0010-4000.

## 4. Road Fill Testing[4]

There will be five rock quarries and eight borrow pits used in construction the AWAR. Rock and aggregate will be used directly after blasting for road building over the 6 month building period. Once the base of the road is completed, it will be topped with crushed rock and till to establish the driving surface

The AWAR Project design includes the use rock and till materials, from identified quarry locations along the road, to be used for installation of culverts and bridges. All identified road building material comes from quarries and not from existing watercourses; no rock and construction material will be gathered from below the high water mark of any watercourse. Initial testing, using static methods to assess the chemical composition of the potential road building material, its potential to generate acid rock draining (ARD), and its potential to leach metals to the receiving environment upon exposure to ambient conditions was completed in 2010. The quarry locations identified for the AWAR show no potential to generate acid drainage. The low ARD potential stems from the low sulphide content and high buffering capacity in the same material. Sulphide sulphur content ranges from <0.01 to 0.17% (in rock) and 0.07% (in till), and total sulphur ranges from <0.005 to 0.34% (in rock) and0.09% (in till). Based on the low sulphide sulphur content, samples are classified as non-acid generating.

The sites chosen for potential quarry and borrow sites along the road alignment were also tested for metal leaching. The results indicated no acid rock drainage and low metal leaching. Water leach tests yielded chemical concentrations that were less than the Metal Mining Effluent Regulations guidelines and were less than the CWQG for the protection of aquatic life for most parameters except for arsenic, aluminum, copper, and pH. Results from the laboratory testing serve to highlight chemicals of environmental interest and are not necessarily indicative of actual drainage quality because this will depend on the exposure of the materials to ambient conditions, particularly to water and snow melt.

Visual examinations of the quarry material for sulphur species and additional testing for acid rock drainage/metal leaching from each quarry and borrow will be conducted during construction. All material used at the watercourse crossings will be non-acid generating; however, this will be verified through testing of the rock fill material and through monitoring of water quality in the watercourse or in standing water during and after construction.

The additional samples collected from each borrow pit / rock quarry will be dependent on the quantity of material to be extracted. For every 10,000 $m^3$ of material removed from a borrow pit or rock quarry a sample will be collected for static testing. The results will be presented in a report three months following receipt of the analytical results.

## 5. Permafrost Monitoring

The AWAR is to be largely built over the winter period with the driving surface completed by August 2012. By building the AWAR during winter, the permafrost will aggrade into the road bed with the original ground remaining frozen year round.

[4] Please refer to Golder Associates Geochemical Assessment of Potential Road Construction Material, Meliadine Golder Project, Nunavut, December 2010. This report is on the NWB's ftp site.

Inspection precedes maintenance. AEM recognizes that a good inspection program will lead to the early identification of areas of the road where improvements are necessary. The early resolution of any deficiencies will result in less ongoing maintenance and repair of the driving surface.

The road and its shoulders will be inspected weekly (at a minimum) during the summer period for evidence of seasonal freeze and thaw adjacent to the toe of the road embankment. Such movements are expected and may lead to longitudinal cracking and thaw settlement especially for portions of the road founded on thaw susceptible (ice rich) soil. When such areas are discovered, the affected area would be repaired using granular material and/or crushed rock. AEM will maintain stockpiles of such material in select borrow/quarry areas along the road and these will be used to ensure that the minimum road fill thickness is maintained to preserve the subgrade soil in a frozen state and so that the surface remains drivable.

# Appendix 1.

# Protocol for Animals

# on or immediately adjacent to

# the AWAR

The following protocol will be implemented along the road for the protection of wildlife:

1. Vehicular traffic speeds on the access road will be limited to 50 km/hr.
2. Where small to moderate aggregations of caribou (i.e., 1-50 animals) are observed within 100 m of the road, travel speeds will be reduced to 30 km/hr
3. Where large aggregations of caribou (i.e., 50 or more) are observed within 100 m of the road, at the discretion of the road supervisor, vehicle movements may be suspended until animals have moved away from the road.
4. Caribou and other wildlife will be given right-of-way on the road. Vehicles must stop until the animal is off the road.
5. Locations of large aggregations of animals must be reported to the road supervisor who will inform all potentially affected employees, contractors and the environmental representative.
6. All incidents between vehicles and wildlife must be reported to the AEM road supervisor and the environmental representative whether they are:
    - near-miss;
    - collision with injury to the wildlife; or
    - accidental death.
7. Each incident will be investigated by the road supervisor and the environment department and measures taken to avoid re-occurrence put in place. Disciplinary measures will be taken against any employee if the investigation concludes that the accident is the result of negligence.
8. In the case of accidental death of an animal, the AEM Meliadine Project Environmental Coordinator(s) will contact the GN Conservation Officer in Rankin Inlet. The carcass will be removed from the road and incinerated to avoid attracting scavengers such as Arctic Fox, Wolves, Grizzly Bear, and/or Wolverine.

# Appendix 2.

# Technical Procedures

# for

# Wildlife Monitoring

`

**OBJECTIVE**

The objective is to determine if wildlife (particularly caribou, foxes, wolves, wolverines, bears, and birds) are distributed along the project footprint (e.g., road, quarries and borrow pits).

**FIELD PROCEDURES**

Wildlife sign monitoring surveys should be performed on a weekly basis or every two weeks. Using an ATV vehicle, environmental staff and/or contractors will travel the AWAR at a slow speed and stop periodically to search for birds (ptarmigans, raptors and waterfowl) in the distance. Consecutive surveys should be alternated between morning and afternoon. Borrow pits and rock quarries will be surveyed using a systematic meander survey on foot of the outside perimeter of each site. **If raptors are nesting in the quarries or borrow pits, they will not be approached for any water sampling or wildlife surveys.**

Observations of all wildlife or wildlife sign will be recorded. Data recorded will include species, location of group and the number of animals. If applicable, any wildlife sign, the species that left the sign, an estimation of the number of individuals that were in the area and any reports from staff of animals in the area being surveyed should also be recorded on the data sheets. Photos may also be taken. A new sheet should be used for each location.

Wildlife reports from staff, contractors and/or private individuals travelling the road will be recorded on the wildlife observation form.

If surveys detected no sign of wildlife, then a "0" should be entered on the data sheet and in the database for that date

**EQUIPMENT AND MATERIALS**

- Data sheets;
- Digital camera;
- Binoculars;
- GPS units; and,
- Classification codes for group composition (e.g., caribou groups – bulls, nursery groups), behaviour (running, bedded, feeding, walking) and habitat (vegetation codes).

**SAFETY CONCERNS AND PRECAUTIONS**

- Animal encounters - Watch bear safety video, have bear deterrent, do not approach any known den areas, talk loudly before cresting a hill, etc.;
- Working along the AWAR - watch for traffic.

**AWAR WILDLIFE MONITORING**
**WILDLIFE SIGN MONITORING**

**Date:**_____ **Time:**_____ **Observers:**_____ **Temperature:** _____

**% Snow Cover (if applicable):**__ **Days Since Last Snow:**_ **Visibility (est distance):**

**Cloud Cover:**_____ **Wind Speed (Beaufort):**_____

**Beaufort scale**: **0 – calm**; **1 – light air**, smoke indicates wind direction; **2 – light breeze**, felt on face; **3 – gentle breeze**, vegetation in constant motion; **4 – moderate breeze**, dust and loose leaves raised up; **5 – fresh breeze**, small trees/shrubs begin to sway; **>5 – strong breeze**, winds are >25 mph.

**Wildlife Observations**

| Waypoint Number | UTM Coordinates (Grid Zone, Northing, Easting) | Species | Observation Type (Sighting or Sign and list sign | Estimated # Individuals | Comments on Observation/Behaviour |
|---|---|---|---|---|---|
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Places to visit include: Roads, borrow pits / rock quarries, water crossings
Wildlife Sign: (tracks, scat, digs, dens, bed, feeding craters, etc.)

**Additional Comments/Reports from Staff**

_____
_____
_____
_____
_____

# Appendix 3.

# Standard Operating Procedure

# for

# Collecting Environmental Water Samples

**Standard Operating Procedure for Collecting Environmental Water Samples.**

## 1. Principle

This Standard Operating Procedure provides guidance on the collection of environmental water samples along the AWAR.

## 2. Materials

The person collecting the samples will require the following to collect samples:

- A map showing the sample locations and the GPS coordinates,
- A Chain of Custody form to record the sample location, date and time of sample collection,
- A worksheet to record field data, climate at the time, and any observations relevant to the environmental conditions at the time of collection.

The materials required include:

- A cooler to hold the samples,
- Ice packs to keep the samples cool,
- pH and temperature meter,
- A beaker or wide mouth sample bottle to measure pH and temperature in the field,
- the proper sample bottles for the parameters being analysed.
- Disposable latex gloves,
- A GPS,
- A radio for emergencies.

## 3. Procedure

Before going into the field to collect the samples:

- Do a two point calibration on the pH meter using 2 buffer solutions,
- Label all the sample bottles using a water proof marker for all locations excepting the time of collection. This can be written on the bottle in the field or directly afterwards when back in camp,
- Take sufficient ampoules of preservatives into the field for all samples. Each sample needing preservation gets a different preservative. The ampoules are colour coded to match the colour coding on the bottles,
- Check the GPS to ensure it is working,
- Take sufficient disposal latex gloves into the field, one set for each sample location. These should be placed in a new Ziploc locked bag or the like so they do not get contaminated,
- Put two ice packs in the cooler along with the labelled, empty bottles.

Collecting the samples:

- Check the GPS against the field sheet to ensure you are at the correct sampling location,
- Rinse the beaker used for pH and temperature measurements three times,
- Fill the beaker with water and immerse the pH/temperature probe
- Record the temperature immediately,
- Stir the pH probe in the beaker without touching the sides if possible until the readings stabilize. This may take some time seeing the water is normally cold,
- Check to see that the correct bottles are assembled for the sampling location,
- Put on a set of clean, disposable latex gloves,
- Rinse the sample bottle 3 times before collecting the sample. Dispose of the rinse water away from where the sample is to be collected, preferably on land or downstream,
- After collecting the sample, leave enough head space in the bottle to add the preservative,
- **ENSURE THE RIGHT PERSERVATIVE IS USED FOR THE SAMPLE COLLECTED,**
- Upon adding the preservative, tighten the cap and invert the bottle three or four times to cause thorough mixing of the sample water and preservative,
- Samples bottles for faecal coliforms, oil and grease and PAHs should **not** be rinsed before taking the sample,
- Place the sample bottles in the cooler right side up for transport,
- It is best to collect samples for time sensitive parameters the morning the cooler is to be sent to the laboratory.

## 4. Reporting

- Complete the chain of custody form recording the field pH, temperature, date and time, location, name of technician on the form,
- Keep the yellow copy for camp records. Put the remaining copies in a Ziploc bag and place it in the cooler,
- Check the freezer packs to ensure they are frozen. That way they will keep the samples cool until they arrive at the laboratory,
- Securely seal the cooler,
- Contact M&T Enterprises and tell them that a cooler with environmental samples is coming. Emphasize the samples have to be on the next plane to the laboratory,
- Get the waybill number from M&T and transmit it to the laboratory contact telling them what plane the cooler will be on. They will meet the plane and take the cooler to the laboratory.

**Comment made by Interested Party: Environment Canada**
**(AEM Reference: Information Request #9)**

*EC noted that p.28 of the Transportation Management Plan indicates only three crossings will be monitored following road construction (i.e. M3.0, M5.0, M23.6) as opposed to 4 noted on p. 120 of the EA. EC seeks clarification on how many crossings AEM plans to monitor and recommends the Plan be revised to reflect the location and number of crossings to be monitored.*

**AEM's Response to Information request:**

AEM commits to sampling all eleven water crossings including the Char and Meliadine Rivers in the first open water season following road construction. The details are presented in the Monitoring Plan for the AWAR following Information Response #8. This Plan covers water quality, wildlife, road fill testing, permafrost, and hydrology monitoring.

**Comment made by Interested Party: Aboriginal Affairs and Northern Development Canada (AEM Reference: Information Request #10)**

*Based on a review of the topographic mapping provided in the report, it is noted that there are multiple additional stream crossings along the proposed road route that could potentially require culverts at peak flows or during specific seasons. It is recommended that the Proponent consider the possibility of installing additional culverts during the construction of the proposed road to minimize the risk of water backup versus having to potentially address this once the road is already constructed. Additional culverts will minimize the potential risk of environmental effects and increased cost associated with potential water back-up.*

**AEM's Response to Comment:**

The Environmental Assessment report includes all major crossings identified from available mapping and field observations; however, it is recognized that additional crossings (e.g., ephemeral streams) may be present that were not specifically identified based on the available information. Additional crossings and/or low spots along the road alignment requiring culverts may be identified as additional detailed topographic data is collected and/or during ground-truthing prior to construction.

Culverts will be installed at all stream crossings and low spots along the proposed All-Weather Access Road (AWAR) with potential risk of environmental effects including the potential to significantly backup water and risk overtopping the road. While it is anticipated that any crossings that were not identified in the Environmental Assessment report will be smaller than M13.3 (i.e., the crossing with the smallest drainage area in the report), these additional crossings will be constructed using specifications provided for M13.3 (i.e., 1 culvert x 1.0 m diameter, 1 culvert x 0.7 m in an "offset stacked" configuration) to be conservative. Low spots along the AWAR alignment with the possibility of backing up water will also be equipped with culverts as specified for M13.3.

Agnico-Eagle Mines is also committed to a crossing inspection program to ensure that culverts have been installed in the right location with respect to the watercourse and to identify potential risks to culvert structural integrity following construction of the AWAR. This program includes regular crossing inspection and maintenance, event crossing inspection and maintenance, and culvert location inspection as described in the Operations and Maintenance Manual provided in Appendix A of the Environmental Assessment report.

**Comment made by Interested Party: Aboriginal Affairs and Northern Development Canada (AEM Reference: Information Request #11)**

*While there is a mention of testing of borrow pit materials for Acid Rock Drainage potential before excavation, no clear commitment to a continued testing program during or after excavation of borrow materials has been located in the document. It is recommended that the Proponent commit to testing of the rock during excavation to confirm rock type and to ensure potentially acid-producing rock is not being borrowed and/or used in road development (which is mentioned on page 116 in Section 5.2.4.2)*

**AEM's Response to Information request:**

AEM will take additional samples of borrow and quarry materials during excavation and test the materials for their potential to generate acidity and leach chemicals. This will be done to verify results previously obtained as part of the baseline study. The monitoring program is described in the attached Monitoring Program.

**Comment made by Interested Party: Aboriginal Affairs and Northern Development Canada (AEM Reference: Information Request #12)**

*To properly assess water quality, it is recommended that the project proponent collect sufficient data to be representative of background/baseline water quality (with reasonable detection limits) for all parameters of concern prior to road development for all streams/water bodies of concern. The enhanced baseline data will greatly assist in post-project monitoring to determine any deleterious effects on water quality resulting from the proposed road development activities which will require mitigation.*

*The small stream water sample results for the August 2011 sampling event should be reviewed and compared to the July 2011 small stream sample results. A winter and a spring/melt small stream sampling event at upstream of the proposed development prior to development activities would also be beneficial for future comparison as part of the monitoring program.*

**AEM's Response to Comment:**

1. ***It is recommended that the project proponent collect sufficient data to be representative of background/baseline water quality (with reasonable detection limits) for all parameters of concern prior to road development for all streams/water bodies of concern***

There has been only one year of sampling of watercourses along the proposed road alignment, but watercourses in the vicinity of the proposed mine have been sampled since 1997. Since there is currently no development in the vicinity of those streams, it is suggested that the baseline water quality collected from them can be used to provide a good understanding of spatial and temporal variability in water quality of watercourses in the general project area.

Surface grab water quality samples were collected from 22 watercourse stations between 1995 and 2008 (Table 1). These stations were located in the watercourses on the Peninsula draining to Meliadine Lake (specifically, from Basins A, B, D, and G), watercourses in the Peter Lake drainage, and watercourses in the Atulik Lake drainage. A summary of all watercourses in the vicinity of the mine footprint that have been sampled is provided in Table 1. A summary of all watercourse crossing data, including the 2011 All-weather Access Road (AWAR) sampling and the historic sampling listed in Table 1, is provided in Attachment A. Historical data for watercourses in the vicinity of the proposed mine are included in Attachment A, Table 1, and 2011 AWAR watercourse data are included in Attachment A, Table 2.

**Table 1. Water Quality Sampling Program in Streams, 1995 to 2008**

| Sampling Location | Drainage System | 1995 | 1997 | 1998 | 1999 | 2000 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|---|
| **Meliadine Lake Drainage** | | | | | | | | |
| Outflow of Watershed B of the Discovery Area to Meliadine Lake (NEW-1) | Meliadine Lake Drainage | | | | | | | Spring and Summer |
| Outlet of DI4 Lake into Meliadine Lake (DI-4) | Meliadine Lake Drainage | | | | | | | Summer |
| **Peninsula Streams** | | | | | | | | |
| A7-8 | Peninsula Drainage - Basin A | | Spring | Spring and Summer | | | Summer and Fall | Spring and Summer |
| A5-6 | Peninsula Drainage - Basin A | | Spring | Spring and Summer | | | | |
| A0-1 | Peninsula Drainage - Basin A | | Spring | Spring and Summer | Spring | Spring | | |
| B6-7 | Peninsula Drainage - Basin B | | Spring | Spring and Summer | | | | Spring and Summer |
| B5-6 | Peninsula Drainage - Basin B | | | Spring and Summer | | | | |
| B4-5 | Peninsula Drainage - Basin B | | Spring and Summer | Spring and Summer | | | | Spring and Summer |
| B3-4 | Peninsula Drainage - Basin B | | Spring | Spring and Summer | | | | |
| B1-2 | Peninsula Drainage - Basin B | | Spring and Fall | Spring and Summer | Spring | Spring | | |
| D6-7 | Peninsula Drainage - Basin D | | Spring and Summer | | | | | |
| D0-1 | Peninsula Drainage - Basin D | | Spring and Summer | | | | | |
| G1-2 (1997 Control Lake outlet to ML) | Peninsula Drainage - Basin G | | Spring | | | | | |

**Table 1. Water Quality Sampling Program in Streams, 1995 to 2008 (continued)**

| Sampling Location | Drainage System | 1995 | 1997 | 1998 | 1999 | 2000 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|---|
| **Meliadine River** | | | | | | | | |
| ML to Meliadine River (ML-MR) | Meliadine River Drainage | | Spring and Fall | Spring and Summer | Spring | Spring | | Spring and Summer |
| Meliadine River to Ocean (MR-L) | Meliadine River Drainage | | | Spring and Summer | | | | |
| **Peter Lake Drainage** | | | | | | | | |
| ML to Peter Lake (ML-PL) | Peter Lake Drainage | | Spring and Fall | Spring and Summer | | | | |
| Peter Lake to Diana Lake (PL-DL) | Peter Lake Drainage | | Spring and Fall | Spring and Summer | | | | |
| ***Atulik Lake Drainage*** | | | | | | | | |
| Outlet of Atulik Lake (DI-6) | Atulik Lake Drainage | Summer | | | | | | Spring |
| Downstream of basins below Atulik Lake on Atulik River (DI-7) | Atulik Lake Drainage | Summer | | | | | | Spring |
| Downstream of NEW-3; outlet into DI5 which flows into Meliadine Lake (NEW-2) | Atulik Lake Drainage | | | | | | | Spring |
| Outlet of Chickenhead Lake (i.e., Lake DI1) (NEW-3) | Atulik Lake Drainage | | | | | | | Spring |

**2. *The small stream water sample results for the August 2011 sampling event should be reviewed and compared to the July 2011 small stream sample results***

Watercourses along the AWAR were sampled by AEM in July, August, September, and October 2011 (Table 2).

**Table 2. Water Quality Sampling of Streams Associated with the All-Weather Access Road Project**

| Location | Sampled 12 July 2011 | Sampled 29 August 2011 | Sampled 14 September 2011 | Sampled 11 October 2011 |
|---|---|---|---|---|
| Char River | Yes | [c] | [c] | [c] |
| M2.1[a] | Yes | [c] | [c] | [c] |
| M3.0 | [b] | Yes | Yes | Yes |
| M3.9 | [b] | Yes | Yes | Yes |
| M5.0 | Yes | Yes | Yes | Yes |
| M6.7 | [b] | Yes | Yes | Yes |
| M8.6 | Yes | Yes | Yes | Yes |
| M11.5 | Yes | Yes | Yes | Yes |
| M13.3 | Yes | Yes | Yes | Yes |
| M22.6 | Yes | Yes | Yes | Yes |
| M23.6 | Yes | Yes | Yes | Yes |

[a] Meliadine River 1:25 year flood.

[b] Channel was dry.

[c] Not sampled.

Complete 2011 sampling data for the AWAR watercourses are provided in Attachment A, Table 2. Conductivity ranged from 46 to 424 µS/cm, with the highest conductivity in Stream M3.9 in October. The major ions were bicarbonate (19.2 to 89.2 mg/L), calcium (7.1 to 33.1 mg/L), chloride (2.7 to 94.7 mg/L), sodium (2.0 to 47.8 mg/L), and sulphate (1.2 to 18.1 mg/L).

Total alkalinity ranged from 15.8 to 73.1 mg/L while hardness ranged from 15.5 to 111 mg/L, which indicated that the waters were soft to moderately soft (based on the ratings of McNeely et al. 1979). Total suspended solids were less than the detection limit in many samples, and ranged up to 28 mg/L.

Nutrient concentrations were very low. Total phosphorus ranged from less than the detection limit (0.01 mg/L) to 0.016 mg/L, which is less than the guideline of 0.03 mg/L (Environment Canada 2011). Nitrogen compounds including ammonia, nitrate, and nitrite were not detected in any water sample. Total Kheldahl nitrogen (TKN), a combination of organic nitrogen and ammonia, was detected in most samples (27 out of 35), and when it was detected, ranged from 0.31 to 1.57 mg/L.

Water samples were tested for a suite of 39 different total metals. Dissolved metals were only analyzed in 3 samples and are not discussed here. There were no detectable concentrations for 15 of the total metals, including antimony, beryllium, bismuth, cadmium, cesium, chromium, mercury, silver, tellurium,

thallium, thorium, tin, tungsten, uranium, and zirconium. The detection limit for total mercury was higher than the guideline for inorganic mercury. Concentrations for other metals ranged from less than the detection limit to a value generally less than the CWQG for protection of aquatic life. Concentrations of aluminum, copper, iron, selenium, and zinc were above the CWQG in at least one sample. Aluminum exceeded the guideline at M3.9; copper exceeded the guideline at M3.9, M6.7, M8.6, M11.5, and M13.3; iron exceeded the guideline at M3.0, M3.9, M5.0, M6.7, M13.3, and M22.6; selenium exceeded the guideline at M22.6; and zinc exceeded the guideline at M3.0 and M3.9.

With respect to future monitoring, the design of the future monitoring program would involve the comparison of a water quality sample taken upstream of the road for comparison with a sample taken immediately downstream of the road crossing. The would provide a more powerful assessment of any potential water quality impacts related to the road stream crossings in comparison to a pre- versus post-development comparison (i.e., it reduces confounding contributions such as differences in flows, temporal variability, any non-road related alterations in the upstream watershed, such as ATV crossing, and natural bank slumps). Thus, additional water quality monitoring during spring melt prior to road construction would not contribute substantially to power of the monitoring program to assess any effects directly linked to the proposed road construction or operation.

# ATTACHMENT A

**Summary of all Watercourse Crossing Data**

**Attachment A. Table 1: Historical Meliadine Watercourse Data**

**IR #12**
**12 December 2011**

| | | | NEW-1 | NEW-1 | DI-4 | A0-1 | A0-1 | A0-1 | A0-1 | A0-1 | A5-6 | A5-6 | A5-6 | A7-8 | A7-8 | A7-8 | A7-8 | A7-8 | A7-8 | A7-8 | B1-2 | B1-2 | B1-2 | B1-2 | B1-2 | B1-2 | B3-4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream |
| | | | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water |
| | | | 23-Jun-08 | 20-Jul-08 | 24-Jun-08 | 15-Jun-97 | 12-Jun-98 | 17-Jul-98 | 19-Jun-99 | 21-Jun-00 | 15-Jun-97 | 12-Jun-98 | 18-Jul-98 | 15-Jun-97 | 12-Jun-98 | 20-Jul-98 | 18-Jul-07 | 7-Oct-07 | 21-Jun-08 | 14-Jul-08 | 16-Jun-97 | 25-Aug-97 | 12-Jun-98 | 18-Jul-98 | 19-Jun-99 | 22-Jun-00 | 16-Jun-97 |
| | | | 546982, 6987421 | 0546505, 6987540 | 549441, 6983602 | - | - | 0544352, 6986081 | 0544366, 6986045 | - | - | - | - | 0 | - | - | 0540748, 6986690 | 0540748, 6986690 | 0540750, 6986701 | 0540750, 6986687 | - | - | - | - | 0537382, 6986031 | 0537468, 6986108 | - |
| **Parameter** | **Units** | **Freshwater CWQG** [a] | Golder | Golder | Golder | RL&L 1998 | RL&L 1999 | RL&L 1999 | RL&L 2000 | RL&L 2001 | RL&L 1998 | RL&L 1999 | RL&L 1999 | RL&L 1998 | RL&L 1999 | RL&L 1999 | Comaplex | Comaplex | Golder | Golder | Dillon 1994 | RL&L 1998 | RL&L 1999 | RL&L 1999 | RL&L 2000 | RL&L 2001 | RL&L 2001 |
| **Field Measurements** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Water Temperature | °C | - | 15.2 | 12.8 | 11.45 | 4 | 2.5 | 11.7 | 5 | 4 | 6 | 1.9 | 9.9 | 4.8 | 1.5 | 10.2 | 17.8 | 1.9 | 6.85 | 16.7 | 2.5 | 10.2 | 1.3 | 10.1 | 5.6 | 2 | 5.5 |
| Dissolved Oxygen | mg/L | - | 11.37 | 12.34 | 11.61 | 12.5 | - | - | - | - | 12.8 | - | - | 12.9 | - | - | - | - | 13.3 | 10.97 | 13.5 | 10 | - | - | - | - | 12.7 |
| pH | pH | 6.5-9 | 7.91 | 6.95 | 8.11 | 7.64 | 7.1 | - | 7.79 | 7.2 | 7.78 | 7.04 | - | 7.6 | 7.13 | - | 8.12 | 8.02 | - | 6.53 | 6.83 | 7.05 | 7 | - | 6.81 | 7.21 | 7.2 |
| Specific Conductivity | µS/cm | - | 80 | 137 | 72 | 102 | 80.6 | - | - | 82.3 | 91.3 | 77.5 | - | 93.3 | 84.7 | - | - | - | 74 | 109 | 100.9 | 114.7 | 75.4 | - | - | 90.1 | 107.3 |
| **Conventional Parameters (Laboratory-Measured)** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total Alkalinity | mg/L | - | 23 | 39 | 26 | 33.4 | 24 | 41 | 31 | 25 | 30.9 | 25 | 29 | 30.4 | 26 | 31 | 30 | 33 | 24.8 | 27 | 32.1 | 34.7 | 22 | 21 | 27 | 28 | 34.1 |
| Specific Conductivity | µS/cm | - | 94.3 | 151 | 92 | 80.4 | 70.9 | 121 | 94.8 | 74.4 | 72.4 | 68 | 80.5 | 74.3 | 74 | 86.4 | 106 | 135 | 113 | 118 | 80 | 94.7 | 64.6 | 61.1 | 78.4 | 82.1 | 85.3 |
| Total Hardness | mg/L | - | 29 | 47 | 37 | 36.7 | 27 | 47 | 36 | 28 | 37.7 | 26 | 31 | 35.9 | 28 | 37 | 41 | 52 | 46 | 49 | 35.9 | 37 | 23 | 21 | 29 | 31 | 41.1 |
| pH | pH | 6.5-9 | 7.6 | 7.6 | 7.7 | 7.66 | 7.2 | 7.7 | 7.2 | 7.1 | 7.65 | 7.2 | 7.5 | 7.62 | 7.3 | 7.3 | 7.7 | 7.7 | 7.11 | 7.6 | 7.65 | 7.53 | 7.2 | 7.3 | 7.2 | 7 | 7.73 |
| Total Dissolved Solids (calculated) | mg/L | - | - | 99 | - | 53 | 33 | 57 | 45 | 35 | 48 | 32 | 37 | 52 | 34 | 41 | - | - | 70 | 82 | 54 | 66 | 30 | 28 | 37 | 39 | 57 |
| Total Dissolved Solids (calculated) | mg/L | - | 49 | - | 50 | - | - | - | - | - | - | - | - | - | - | - | 51 | 64 | - | - | - | - | - | - | - | - | - |
| Total Suspended Solids | mg/L | - | <3 | <3 | <3 | 4 | <2 | <2 | <3 | <3 | 3 | 3 | <2 | 3 | 2 | 2 | - | <3 | <3 | <3 | 5 | <3 | 5 | 5 | 4 | <3 | 3 |
| Turbidity | NTU | - | - | - | - | 0.64 | 0.5 | 0.6 | 1.5 | 0.78 | 0.63 | 0.3 | 0.4 | 1.95 | 0.4 | 0.5 | - | 0.45 | - | - | 1.15 | 0.8 | 0.4 | 0.5 | 1.1 | 0.48 | 0.7 |
| **Major Ions** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Bicarbonate | mg $CaCO_3$/L | - | 28 | 47 | 32 | 33.4 | 30 | 50 | 38 | 31 | 30.9 | 31 | 35 | 30.4 | 31 | 38 | 37 | 40 | 24.8 | 33 | 32.1 | 34.7 | 27 | 25 | 33 | 35 | 34.1 |
| Calcium (Ca)-Dissolved | mg/L | - | 8.5 | 13.7 | 11.3 | 12.6 | 9.1 | 16.1 | 12.2 | 8.04 | 13.1 | 8.69 | 10.5 | 12 | 9.07 | 11.9 | 13.6 | 17.1 | 15.8 | 15.3 | 12.4 | 12.4 | 7.85 | 7.19 | 9.61 | 8.84 | 14.3 |
| Carbonate | mg $CaCO_3$/L | - | <5 | <5 | <5 | <0.3 | <1 | <1 | <1 | <5 | <0.3 | <1 | <1 | <0.3 | <1 | <1 | <5 | <5 | <2 | <5 | <0.3 | <0.3 | <1 | <1 | <1 | <5 | <0.3 |
| Chloride | mg/L | - | 13 | 18 | 9 | 4.38 | 4 | 7.72 | 6.3 | 4 | 3.24 | 3.2 | 3.79 | 4.24 | 4.2 | 4.57 | 12 | 17 | 16.9 | 17 | 4.69 | 5.9 | 3.3 | 3.48 | 4.03 | 4 | 5.01 |
| Fluoride | mg/L | - | <0.05 | - | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - | <0.02 | - | - | - | - | - | - | - | - |
| Hydroxide | mg/L | - | <5 | <5 | <5 | - | <1 | <1 | <1 | <5 | < | <1 | <1 | < | <1 | <1 | <5 | <5 | <2 | <5 | - | < | <1 | <1 | <1 | <5 | - |
| Magnesium (Mg)-Dissolved | mg/L | - | 1.5 | 2.27 | 1.4 | 1.27 | 1.05 | 1.74 | 1.4 | 0.954 | 1.2 | 1.07 | 1.26 | 1.44 | 1.3 | 1.7 | 1.7 | 2.2 | 2.03 | 1.8 | 1.19 | 1.47 | 0.92 | 0.83 | 1.12 | 0.989 | 1.31 |
| Potassium (K)-Dissolved | mg/L | - | 0.9 | 1.03 | 3.1 | 0.676 | 0.75 | 0.95 | 0.72 | 0.591 | 0.632 | 0.73 | 0.68 | 0.643 | 0.77 | 0.8 | 0.8 | 1 | <2 | 0.95 | 0.79 | 0.952 | 0.87 | 0.66 | 0.83 | 0.803 | 0.844 |
| Sodium (Na)-Dissolved | mg/L | - | 7 | 9.69 | 11 | 2.13 | 1.6 | 2.8 | 2.3 | 1.36 | 1.79 | 1.5 | 1.9 | 1.84 | 1.6 | 2.1 | 2 | 3 | 2.5 | 2.6 | 2.76 | 3.48 | 1.9 | 2.1 | 2.5 | 1.9 | 3 |
| Sulphate | mg/L | - | 3.6 | 4.4 | 6.7 | <3 | 1.8 | 2.62 | 3.08 | 3.2 | 4 | 1.5 | 1.74 | 4 | 1.6 | 1.67 | 3.2 | 4.1 | 2.78 | 2.1 | <3 | 4 | 1.6 | 1.5 | 2.81 | 4.2 | <3 |
| **Organic/Inorganic Carbon** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total Carbon | mg/L | - | 11 | 8 | 11 | 11 | 11 | 15.9 | 10.7 | 9.3 | 10 | 11 | 11.2 | 10 | 11 | 11.5 | - | 11 | 8.04 | 10 | 11 | 12.9 | 11 | 9 | 10 | 10.8 | 11 |
| Total Organic Carbon | mg/L | - | 5 | 9 | 5 | 3.4 | 5.7 | 5.9 | 3.8 | 3.6 | 2.8 | 5 | 3.9 | 2.8 | 5.3 | 3.9 | - | - | 2.67 | 4 | 2.8 | 3.9 | 5.6 | 4 | 3.7 | 4.1 | 3.2 |
| Dissolved Organic Carbon | mg/L | - | 5 | 8.4 | 5 | - | - | - | - | - | - | - | - | - | - | - | - | - | 2.88 | 4 | - | - | - | - | - | - | - |
| Total Inorganic Carbon | mg/L | - | 5 | 17 | 6 | 8 | 5.7 | 10 | 6.9 | 5.7 | 7 | 6 | 7.3 | 7 | 6.2 | 7.5 | - | 8 | 5.37 | 6 | 8 | 9 | 5.5 | 4.9 | 6.3 | 6.7 | 8 |
| Total Inorganic Carbon (Calculated) | mg/L | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Nutrients** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total Ammonia as Nitrogen | mg/L | - [h] | <0.05 | <0.05 | <0.05 | 0.004 | 0.013 | 0.008 | <0.005 | 0.011 | 0.004 | 0.024 | <0.005 | 0.005 | 0.028 | 0.016 | - | <0.05 | <0.02 | <0.05 | 0.008 | 0.009 | 0.014 | 0.007 | <0.005 | 0.022 | 0.007 |
| Nitrate+Nitrite as Nitrogen | mg/L | - | <0.1 | <0.1 | <0.1 | <0.008 | 0.007 | <0.006 | 0.009 | 0.007 | <0.008 | 0.011 | <0.006 | <0.008 | 0.011 | <0.006 | <0.1 | <0.1 | 0.0168 | <0.1 | <0.008 | 0.027 | 0.01 | <0.006 | 0.024 | 0.014 | <0.008 |
| Nitrate as Nitrogen | mg/L | 2.9 [i] | <0.05 | <0.05 | 0.09 | - | - | - | - | - | - | - | - | - | - | - | <0.05 | <0.05 | 0.001 | <0.05 | - | - | - | - | - | - | - |
| Nitrite as Nitrogen | mg/L | 0.06 | <0.1 | <0.1 | <0.1 | <0.008 | 0.007 | <0.006 | 0.009 | 0.008 | <0.008 | 0.011 | <0.006 | <0.008 | 0.011 | <0.006 | <0.1 | <0.1 | - | <0.1 | <0.008 | 0.027 | 0.01 | <0.006 | 0.024 | 0.015 | <0.008 |
| Phosphorus (P)-Dissolved | mg/L | - | 0.003 | 0.004 | 0.003 | 0.006 | 0.007 | 0.006 | 0.002 | 0.004 | 0.007 | 0.006 | 0.004 | 0.006 | 0.004 | 0.005 | - | <0.02 | <0.002 | 0.004 | 0.008 | 0.014 | 0.006 | 0.005 | 0.002 | 0.003 | 0.007 |
| Phosphorus, Total | mg/L | - [k] | 0.012 | 0.009 | 0.01 | 0.009 | 0.008 | 0.007 | 0.005 | 0.008 | 0.009 | 0.006 | 0.004 | 0.008 | 0.005 | 0.006 | - | <0.02 | 0.0042 | 0.007 | 0.014 | 0.014 | 0.006 | 0.006 | 0.006 | 0.008 | 0.02 |
| Phosphorus (P)-Total Reactive | mg/L | - | <0.001 | <0.001 | <0.001 | <0.002 | <0.001 | <0.001 | <0.001 | 0.005 | <0.002 | <0.001 | <0.001 | <0.002 | <0.001 | <0.001 | - | <0.01 | <0.001 | <0.001 | <0.002 | <0.002 | <0.001 | <0.001 | 0.001 | 0.005 | <0.002 |
| Total Kjeldahl Nitrogen | mg/L | - | 0.4 | 0.4 | 0.4 | 0.3 | 0.21 | 0.41 | 0.29 | 0.12 | 0.27 | 0.22 | 0.77 | 0.3 | 0.25 | 0.52 | - | 0.2 | 0.208 | 0.4 | 0.3 | 0.27 | 0.3 | 0.32 | 0.24 | 0.35 | 0.36 |
| **Total Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum (Al) | mg/L | 0.005 - 0.100 [n] | 0.0052 | 0.0077 | 0.005 | 0.0044 | 0.0018 | <0.0003 | 0.0022 | 0.0056 | 0.0014 | 0.0017 | <0.0003 | 0.0009 | 0.0023 | 0.0005 | <0.01 | - | <0.005 | 0.0023 | <0.0005 | <0.0005 | 0.0021 | <0.0003 | 0.0051 | 0.0073 | 0.0029 |
| Antimony (Sb) | mg/L | - | <0.0004 | <0.00003 | <0.0004 | 0.0005 | 0.00014 | 0.00007 | 0.00004 | 0.00007 | 0.0005 | 0.00017 | 0.00008 | 0.0002 | 0.00015 | 0.00007 | <0.0004 | - | <0.0005 | <0.00003 | 0.0003 | 0.0003 | 0.00018 | 0.00011 | 0.00003 | 0.00014 | 0.0002 |
| Arsenic (As) | mg/L | 0.005 | 0.0011 | 0.00165 | 0.0009 | 0.0004 | 0.00069 | <0.00003 | 0.00092 | 0.0008 | 0.0007 | 0.00079 | 0.00013 | 0.0009 | 0.001 | 0.00245 | 0.0023 | - | 0.00115 | 0.003 | 0.0003 | 0.0012 | 0.00063 | 0.00065 | 0.00073 | 0.00063 | 0.0004 |
| Barium (Ba) | mg/L | - | 0.009 | 0.0111 | 0.012 | 0.0107 | 0.0087 | <0.00005 | 0.0111 | 0.00913 | 0.0098 | 0.0091 | 0.0008 | 0.0107 | 0.0109 | 0.00917 | 0.014 | - | <0.02 | 0.0143 | 0.0104 | 0.0099 | 0.0086 | 0.00068 | 0.011 | 0.0115 | 0.0115 |
| Beryllium (Be) | mg/L | - | <0.001 | <0.0002 | <0.001 | <0.0001 | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0001 | <0.0002 | <0.0002 | <0.0001 | <0.0002 | <0.0002 | <0.001 | - | <0.001 | <0.0002 | <0.0001 | 0.0003 | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0001 |
| Bismuth (Bi) | mg/L | - | - | - | - | <0.0001 | <0.00005 | <0.00003 | <0.00003 | - | <0.0001 | <0.00005 | <0.00003 | <0.0001 | <0.00005 | <0.00003 | - | - | 0 | - | <0.0001 | <0.0001 | <0.00005 | <0.00003 | <0.00003 | - | <0.0001 |
| Boron (B) | mg/L | - | <0.05 | 0.008 | <0.05 | - | - | - | - | <0.001 | - | - | - | - | - | - | <0.05 | - | <0.1 | 0.002 | - | - | - | - | - | 0.002 | - |
| Cadmium (Cd) | mg/L | 0.000017 [p] | <0.000017 | <0.00005 | <0.000017 | <0.0001 | <0.00005 | <0.00005 | <0.00002 | <0.00005 | <0.0001 | <0.00005 | <0.00005 | 0.0001 | <0.00005 | <0.00005 | <0.0002 | - | <0.000017 | <0.00005 | <0.0001 | <0.0001 | <0.00005 | 0.00018 | <0.00002 | <0.00005 | <0.0001 |
| Calcium | mg/L | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Cesium (Cs) | mg/L | - | - | - | - | <0.0001 | <0.0001 | <0.0001 | <0.0001 | - | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | - | - | - | - | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | - | <0.0001 |
| Chromium (Cr) | mg/L | 0.0089 / 0.001 [q] | <0.00006 | 0.00017 | <0.00006 | 0.0007 | <0.00006 | <0.00006 | 0.0014 | 0.0005 | 0.0005 | <0.00006 | <0.00006 | 0.0004 | <0.00006 | 0.00329 | <0.005 | - | <0.001 | 0.00026 | 0.0002 | <0.002 | <0.00006 | <0.00006 | 0.00118 | 0.00084 | <0.0002 |
| Cobalt (Co) | mg/L | - | <0.002 | 0.0002 | <0.002 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0001 | <0.0001 | <0.0001 | <0.002 | - | <0.0003 | <0.0001 | <0.0001 | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Copper (Cu) | mg/L | 0.002 - 0.004 [s] | 0.001 | 0.0014 | 0.001 | 0.0008 | 0.0009 | 0.0009 | 0.0006 | <0.0006 | 0.0007 | 0.0011 | 0.0008 | 0.001 | 0.0013 | 0.0008 | 0.001 | - | <0.001 | 0.0009 | 0.0012 | 0.0017 | 0.0006 | 0.0008 | 0.0007 | 0.0007 | 0.0007 |
| Iron (Fe) | mg/L | 0.3 | 0.207 | 0.587 | 0.095 | 0.136 | 0.02 | <0.005 | 0.087 | 0.106 | 0.088 | 0.01 | 0.008 | 0.109 | 0.02 | 0.028 | - | - | 0.067 | 0.138 | 0.066 | 0.143 | 0.03 | 0.007 | 0.084 | 0.121 | 0.087 |
| Lead (Pb) | mg/L | 0.001 - 0.007 [t] | <0.0001 | <0.00005 | <0.0001 | <0.0002 | <0.00005 | <0.00005 | 0.00006 | 0.00008 | <0.0002 | 0.00007 | <0.00005 | <0.0002 | <0.00005 | <0.00005 | <0.0001 | - | <0.0005 | 0.0001 | <0.0002 | 0.0031 | <0.00005 | <0.00005 | 0.00005 | 0.00011 | <0.0002 |
| Lithium (Li) | mg/L | - | <0.01 | - | <0.01 | 0.0009 | 0.0009 | <0.0001 | 0.0012 | - | 0.0007 | 0.0007 | 0.0007 | 0.001 | 0.0011 | 0.0002 | <0.01 | - | <0.005 | - | 0.0009 | 0.0008 | 0.0006 | 0.0004 | 0.0006 | - | 0.001 |
| Magnesium | mg/L | - | 1.5 | 2.27 | 1.4 | - | - | - | - | - | - | - | - | - | - | - | - | - | 2.03 | 1.8 | - | - | - | - | - | - | - |
| Manganese (Mn) | mg/L | - | 0.003 | 0.0099 | 0.005 | 0.0076 | 0.0017 | 0.0001 | 0.0125 | 0.0181 | 0.0128 | 0.0014 | 0.0002 | 0.0135 | 0.0016 | 0.0012 | 0.014 | - | 0.00646 | 0.0241 | 0.009 | 0.0262 | 0.0045 | 0.0003 | 0.02 | 0.0269 | 0.0089 |
| Mercury (Hg) | mg/L | 0.000026 [u] | <0.00002 | <0.00002 | <0.00002 | <0.00001 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00001 | <0.00002 | <0.00002 | <0.00001 | <0.00002 | <0.00002 | <0.0002 | - | <0.00002 | <0.00002 | <0.00001 | <0.00001 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00001 |
| Molybdenum (Mo) | mg/L | 0.073 | <0.005 | 0.00025 | <0.005 | 0.0002 | 0.00011 | 0.00019 | 0.00012 | 0.0001 | 0.0001 | 0.00014 | 0.00014 | 0.0001 | 0.00011 | 0.00021 | <0.005 | - | <0.001 | 0.00016 | 0.0002 | 0.0005 | 0.00013 | 0.0002 | 0.00014 | 0.0001 | 0.0002 |
| Nickel (Ni) | mg/L | 0.025 - 0.15 [w] | <0.002 | 0.00183 | 0.002 | 0.0008 | 0.0005 | 0.00032 | 0.00069 | 0.00053 | 0.0007 | 0.0005 | 0.00027 | 0.0016 | 0.0008 | 0.00103 | <0.002 | - | <0.001 | 0.00051 | <0.0001 | 0.0007 | 0.0005 | 0.00046 | 0.00077 | 0.00069 | <0.0001 |
| Potassium | mg/L | - | 0.9 | 1.03 | 3.1 | - | - | - | - | - | - | - | - | - | - | - | - | - | <2 | 0.95 | - | - | - | - | - | - | - |
| Rubidium (Rb) | mg/L | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.0009 | - | - | - | - | - | 0.001 |
| Selenium (Se) | mg/L | 0.001 [x] | <0.0004 | 0.0002 | <0.0004 | <0.001 | <0.0001 | <0.0001 | 0.0001 | <0.0001 | <0.001 | <0.0001 | <0.0001 | <0.001 | <0.0001 | 0.0002 | 0.0004 | - | <0.001 | 0.0002 | <0.01 | <0.01 | <0.0001 | <0.0001 | 0.0001 | 0.0002 | <0.01 |
| Silver (Ag) | mg/L | 0.0001 | <0.0004 | <0.0001 | <0.0004 | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0004 | - | <0.00002 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Sodium | mg/L | - | 7 | 9.69 | 11 | - | - | - | - | - | - | - | - | - | - | - | - | - | 2.5 | 2.6 | - | - | - | - | - | - | 0 |
| Strontium (Sr) | mg/L | - | - | 0.0702 | - | 0.0419 | 0.0351 | <0.0001 | 0.0487 | 0.031 | 0.0384 | 0.0338 | 0.0004 | 0.047 | 0.0428 | 0.0562 | - | - | - | 0.0837 | 0.0413 | 0.048 | 0.0323 | <0.0001 | 0.04 | 0.0364 | 0.0483 |
| Thallium (Tl) | mg/L | 0.0008 | <0.0001 | <0.00003 | <0.0001 | 0.0001 | <0.00005 | <0.00003 | <0.00003 | - | <0.0001 | <0.00005 | <0.00003 | <0.0001 | <0.00005 | <0.00003 | <0.0001 | - | <0.0002 | <0.00003 | <0.0001 | <0.0001 | <0.00005 | <0.00003 | <0.00003 | - | <0.0001 |
| Tin (Sn) | mg/L | - | <0.05 | - | <0.05 | - | - | - | - | - | - | - | - | - | - | - | <0.00005 | - | <0.0005 | - | - | - | - | - | - | - | 0 |
| Titanium (Ti) | mg/L | - | <0.001 | - | <0.001 | 0.0005 | <0.0003 | 0.0001 | <0.0001 | - | 0.0001 | <0.0003 | <0.0001 | <0.0001 | <0.0003 | <0.0001 | <0.001 | - | <0.01 | - | <0.0001 | 0.0007 | <0.0003 | <0.0001 | 0.0002 | - | 0.0001 |
| Uranium (U) | mg/L | - | <0.0001 | 0.00006 | <0.0001 | <0.0001 | <0.00005 | <0.00005 | <0.00005 | <0.00005 | <0.0001 | <0.00005 | <0.00005 | <0.0001 | <0.00005 | <0.00005 | <0.0001 | - | <0.0002 | <0.00005 | <0.0001 | <0.0001 | <0.00005 | <0.00005 | 0.00007 | <0.00005 | 0.0001 |
| Vanadium (V) | mg/L | - | <0.001 | 0.0004 | <0.001 | 0.0003 | 0.0005 | 0.00066 | 0.00005 | <0.00005 | 0.0002 | 0.0005 | 0.00046 | 0.0002 | 0.0006 | 0.00006 | <0.001 | - | <0.001 | 0.00019 | <0.0001 | 0.0004 | 0.0004 | 0.00038 | <0.00005 | <0.00005 | 0.0001 |
| Zinc (Zn) | mg/L | 0.03 | <0.004 | <0.0008 | <0.004 | <0.0005 | 0.0029 | <0.0008 | 0.0151 | <0.0008 | 0.001 | 0.0043 | <0.0008 | 0.0008 | 0.0042 | <0.0008 | 0.006 | - | <0.005 | 0.0028 | <0.0005 | 0.0011 | 0.0018 | <0.0008 | 0.0158 | 0.0012 | 0.0008 |
| **Dissolved Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum (Al) | mg/L | - | 0.0033 | 0.0037 | 0.0026 | - | - | - | - | - | - | - | - | - | - | - | - | 0.01 | <0.005 | 0.0014 | - | - | - | - | - | - | - |
| Antimony (Sb) | mg/L | - | <0.0004 | <0.00003 | <0.0004 | - | - | - | - | - | - | - | - | - | - | - | - | 0.0018 | <0.0005 | <0.00003 | - | - | - | - | - | - | - |
| Arsenic (As) | mg/L | - | 0.0009 | 0.00141 | 0.0009 | - | - | - | - | - | - | - | - | - | - | - | - | 0.0016 | 0.00098 | 0.00224 | - | - | - | - | - | - | - |
| Barium (Ba) | mg/L | - | 0.009 | 0.0108 | 0.013 | - | - | - | - | - | - | - | - | - | - | - | - | 0.013 | <0.02 | 0.0134 | - | - | - | - | - | - | - |
| Beryllium (Be) | mg/L | - | <0.001 | <0.0002 | <0.001 | - | - | - | - | - | - | - | - | - | - | - | - | <0.001 | <0.001 | <0.0002 | - | - | - | - | - | - | - |
| Bismuth (Bi) | mg/L | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

| | | | **NEW-1** | **NEW-1** | **DI-4** | **A0-1** | **A0-1** | **A0-1** | **A0-1** | **A0-1** | **A5-6** | **A5-6** | **A5-6** | **A7-8** | **A7-8** | **A7-8** | **A7-8** | **A7-8** | **A7-8** | **A7-8** | **B1-2** | **B1-2** | **B1-2** | **B1-2** | **B1-2** | **B1-2** | **B3-4** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream |
| | | | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water |
| | | | 23-Jun-08 | 20-Jul-08 | 24-Jun-08 | 15-Jun-97 | 12-Jun-98 | 17-Jul-98 | 19-Jun-99 | 21-Jun-00 | 15-Jun-97 | 12-Jun-98 | 18-Jul-98 | 15-Jun-97 | 12-Jun-98 | 20-Jul-98 | 18-Jul-07 | 7-Oct-07 | 21-Jun-08 | 14-Jul-08 | 16-Jun-97 | 25-Aug-97 | 12-Jun-98 | 18-Jul-98 | 19-Jun-99 | 22-Jun-00 | 16-Jun-97 |
| | | | 546982, 6987421 | 0546505, 6987540 | 549441, 6983602 | - | - | 0544352, 6986081 | 0544366, 6986045 | - | - | - | - | 0 | - | - | 0540748, 6986690 | 0540748, 6986690 | 0540750, 6986701 | 0540750, 6986687 | - | - | - | - | 0537382, 6986031 | 0537468, 6986108 | - |
| **Parameter** | **Units** | **Freshwater CWQG [a]** | Golder | Golder | Golder | RL&L 1998 | RL&L 1999 | RL&L 1999 | RL&L 2000 | RL&L 2001 | RL&L 1998 | RL&L 1999 | RL&L 1999 | RL&L 1998 | RL&L 1999 | RL&L 1999 | Comaplex | Comaplex | Golder | Golder | Dillon 1994 | RL&L 1998 | RL&L 1999 | RL&L 1999 | RL&L 2000 | RL&L 2001 | RL&L 2001 |
| Boron (B) | mg/L | - | <0.05 | 0.009 | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | <0.05 | <0.1 | 0.002 | - | - | - | - | - | - | - |
| Cadmium (Cd) | mg/L | - | <0.000017 | <0.00005 | <0.000017 | - | - | - | - | - | - | - | - | - | - | - | - | <0.0001 | <0.000017 | <0.00005 | - | - | - | - | - | - | - |
| Chromium (Cr) | mg/L | - | <0.00006 | 0.00015 | <0.00006 | - | - | - | - | - | - | - | - | - | - | - | - | <0.005 | <0.001 | <0.00006 | - | - | - | - | - | - | - |
| Cobalt (Co) | mg/L | - | <0.002 | 0.0002 | <0.002 | - | - | - | - | - | - | - | - | - | - | - | - | <0.002 | <0.0003 | <0.0001 | - | - | - | - | - | - | - |
| Copper (Cu) | mg/L | - | 0.001 | 0.0013 | 0.002 | - | - | - | - | - | - | - | - | - | - | - | - | 0.001 | <0.001 | 0.0007 | - | - | - | - | - | - | - |
| Iron (Fe) | mg/L | - | 0.149 | 0.269 | 0.061 | - | - | - | - | - | - | - | - | - | - | - | 0.142 | 0.04 | 0.043 | 0.044 | - | - | - | - | - | - | - |
| Lead (Pb) | mg/L | - | <0.0001 | <0.00005 | <0.0001 | - | - | - | - | - | - | - | - | - | - | - | - | <0.0001 | <0.0005 | 0.00005 | - | - | - | - | - | - | - |
| Lithium (Li) | mg/L | - | <0.003 | - | <0.003 | - | - | - | - | - | - | - | - | - | - | - | - | 0.004 | <0.005 | - | - | - | - | - | - | - | - |
| Manganese (Mn) | mg/L | - | 0.002 | 0.0087 | 0.004 | - | - | - | - | - | - | - | - | - | - | - | - | 0.005 | 0.00492 | 0.0079 | - | - | - | - | - | - | - |
| Mercury (Hg) | mg/L | - | <0.00002 | <0.00002 | <0.00002 | - | - | - | - | - | - | - | - | - | - | - | - | <0.0001 | <0.00002 | <0.00002 | - | - | - | - | - | - | - |
| Molybdenum (Mo) | mg/L | - | <0.005 | 0.00025 | <0.005 | - | - | - | - | - | - | - | - | - | - | - | - | <0.005 | <0.001 | 0.00015 | - | - | - | - | - | - | - |
| Nickel (Ni) | mg/L | - | <0.002 | 0.0018 | 0.002 | - | - | - | - | - | - | - | - | - | - | - | - | <0.002 | <0.001 | 0.00052 | - | - | - | - | - | - | - |
| Potassium (K) | mg/L | - | - | 1.04 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | <2 | 0.93 | - | - | - | - | - | - | - |
| Selenium (Se) | mg/L | - | <0.0004 | 0.0002 | <0.0004 | - | - | - | - | - | - | - | - | - | - | - | - | <0.0004 | <0.001 | 0.0001 | - | - | - | - | - | - | - |
| Silver (Ag) | mg/L | - | <0.0001 | <0.0001 | <0.0001 | - | - | - | - | - | - | - | - | - | - | - | - | <0.0001 | <0.00002 | <0.0001 | - | - | - | - | - | - | - |
| Sodium (Na) | mg/L | - | - | 9.51 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2.5 | 2.61 | - | - | - | - | - | - | - |
| Strontium (Sr) | mg/L | - | - | 0.0699 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.0822 | - | - | - | - | - | - | - |
| Thallium (Tl) | mg/L | - | <0.0001 | <0.00003 | <0.0001 | - | - | - | - | - | - | - | - | - | - | - | - | <0.0001 | <0.0002 | <0.00003 | - | - | - | - | - | - | - |
| Tin (Sn) | mg/L | - | <0.05 | - | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | <0.00005 | <0.0005 | - | - | - | - | - | - | - | - |
| Titanium (Ti) | mg/L | - | <0.001 | - | <0.001 | - | - | - | - | - | - | - | - | - | - | - | - | <0.001 | <0.01 | - | - | - | - | - | - | - | - |
| Tungsten (W) | mg/L | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Uranium (U) | mg/L | - | <0.0001 | 0.00006 | <0.0001 | - | - | - | - | - | - | - | - | - | - | - | - | <0.0001 | <0.0002 | <0.00005 | - | - | - | - | - | - | - |
| Vanadium (V) | mg/L | - | <0.001 | 0.00038 | <0.001 | - | - | - | - | - | - | - | - | - | - | - | - | <0.001 | <0.001 | 0.00015 | - | - | - | - | - | - | - |
| Zinc (Zn) | mg/L | - | <0.002 | <0.0008 | <0.002 | - | - | - | - | - | - | - | - | - | - | - | - | 0.009 | <0.005 | 0.0015 | - | - | - | - | - | - | - |

| | | | B3-4 | B3-4 | B3-4 | B4-5 | B4-5 | B4-5 | B4-5 | B4-5 | B4-5 | B4-45 | B5-6 | B5-6 | B6-7 | B6-7 | B6-7 | B6-7 | B6-7 | B6-7 | D0-1 | D0-1 | D6-7 | D6-7 | G1-2 | ML-MR | ML-MR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream |
| | | | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water |
| | | | 16-Jun-97 (dup) | 13-Jun-98 | 18-Jul-98 | 16-Jun-97 | 25-Aug-97 | 13-Jun-98 | 18-Jul-98 | 21-Jun-08 | 14-Jul-08 | 23-Jul-11 | 13-Jun-98 | 18-Jul-98 | 17-Jun-97 | 13-Jun-98 | 13-Jun-98 (dup) | 18-Jul-98 | 21-Jun-08 | 13-Jul-08 | 18-Jun-97 | 25-Aug-97 | 18-Jun-97 | 26-Aug-97 | 17-Jun-97 | 19-Jun-97 | 24-Aug-97 |
| | | | - | - | - | - | - | - | 0 | 0538395, 6987778 | 0538395, 6987778 | 0538951, 6986433 | - | - | - | - | - | - | 0537876, 6989363 | 0537905, 6989335 | - | - | - | - | - | - | - |
| **Parameter** | **Units** | **Freshwater CWQG** [a] | RL&L 1998 | RL&L 1999 | RL&L 1999 | RL&L 1998 | RL&L 1999 | RL&L 1999 | RL&L 1999 | Golder | Golder | Golder | RL&L 1999 | RL&L 1999 | R&L 1998 | RL&L 1999 | RL&L 1999 | RL&L 1999 | Golder | Golder | RL&L 1998 | RL&L 1998 | RL&L 1998 | RL&L 1998 | RL&L 1998 | RL&L 1998 | RL&L 1998 |
| **Field Measurements** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Water Temperature | °C | - | 5.5 | 0.7 | 10.4 | 7.5 | 12.8 | 0.7 | 10.5 | 5.78 | 14.01 | 15.9 | 1.2 | 10.2 | 10 | 1.9 | 1.9 | 10 | 10.9 | 16.72 | 7 | 12.7 | 7.2 | 8.9 | 18.5 | 6.9 | 11.6 |
| Dissolved Oxygen | mg/L | - | 12.7 | - | - | 12.8 | 10.4 | - | - | 13.52 | 11.63 | 9.4 | - | - | 12.7 | - | - | - | 11.85 | 11.66 | 12.7 | 11.3 | 12.7 | 10.8 | 10.4 | 14.1 | 11.1 |
| pH | pH | 6.5-9 | 7.2 | 7.23 | - | 7.28 | 7.14 | 6.85 | - | - | 6.86 | 6.8 | 6.61 | - | 7.55 | 7 | 7 | - | 8.28 | 7.02 | 7.55 | 7.49 | 7.31 | 7.14 | 8.12 | 7.15 | 7.48 |
| Specific Conductivity | µS/cm | - | 107.3 | 68.3 | - | 85.7 | 96.5 | 49.5 | - | 50 | 89 | 104 | 47.9 | - | 81.9 | 53.8 | 53.8 | - | 78 | 116 | 79.4 | 138 | 95.2 | 157 | 72.3 | 62 | 61.6 |
| **Conventional Parameters (Laboratory-Measured)** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total Alkalinity | mg/L | - | 34.2 | 20 | 26 | 28.8 | 28.4 | 14 | 24 | 24.7 | 28 | 33.9 | 14 | 25 | 27.8 | 16 | 16 | 24 | 22.7 | 26 | 26.1 | 44.6 | 33.7 | 49.9 | 24.9 | 16.2 | 15.2 |
| Specific Conductivity | µS/cm | - | 85.9 | 61.1 | 84.4 | 70.7 | 75.7 | 41.8 | 71.3 | 80.1 | 86.2 | 112 | 40.5 | 68.4 | 66.7 | 46.1 | 46.2 | 66.9 | 104 | 106 | 64 | 113 | 82.8 | 135 | 59.1 | 50.3 | 50.4 |
| Total Hardness | mg/L | - | 38.4 | 20 | 28 | 36.1 | 31.6 | 15 | 26 | 33.2 | 35 | 38.1 | 15 | 26 | 31 | 17 | 17 | 25 | 44.5 | 42 | 30.3 | 48.1 | 37 | 51.4 | 27.5 | 20.2 | 16.7 |
| pH | pH | 6.5-9 | 7.71 | 7.2 | 7.2 | 7.62 | 7.74 | 7 | 7.3 | 7.14 | 7.6 | 7.92 | 7 | 7.4 | 7.56 | 7 | 7 | 7.3 | 7.08 | 7.6 | 7.57 | 7.78 | 7.55 | 7.89 | 7.67 | 7.22 | 7.32 |
| Total Dissolved Solids (calculated) | mg/L | - | 60 | 26 | 39 | 49 | 61 | 19 | 32 | 47 | 62 | 68 | 18 | 32 | 42 | 21 | 21 | 31 | 79 | 78 | 39 | 72 | 49 | - | 34 | 38 | 38 |
| Total Dissolved Solids (calculated) | mg/L | - | - | - | - | - | - | - | - | - | 43 | 54.9 | - | - | - | - | - | - | - | 51 | - | - | - | - | - | - | - |
| Total Suspended Solids | mg/L | - | 8 | <2 | 6 | 7 | <3 | <2 | 2 | <3 | 3 | 5 | <2 | 3 | <3 | <2 | <2 | 6 | <3 | <3 | <3 | <3 | 3 | <3 | <3 | <3 | <3 |
| Turbidity | NTU | - | 1.48 | 0.4 | 0.8 | 0.7 | 0.7 | 0.6 | 0.6 | - | - | 0 | 0.4 | 0.5 | 0.551 | 0.5 | 0.3 | 0.5 | - | - | 0.779 | 1.7 | 0.826 | 0.5 | 0.569 | 0.2 | 0.9 |
| **Major Ions** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Bicarbonate | mg $CaCO_3$/L | - | 34.2 | 25 | 32 | 28.8 | 28.4 | 17 | 30 | 24.7 | 34 | 41.4 | 18 | 30 | 27.8 | 19 | 19 | 29 | 22.7 | 31 | 26.1 | 44.6 | 33.7 | 49.9 | 24.9 | 16.2 | 15.2 |
| Calcium (Ca)-Dissolved | mg/L | - | 13.2 | 6.63 | 9.2 | 12.4 | 10.3 | 4.81 | 8.54 | 10.9 | 10.9 | - | 4.79 | 8.7 | 10.5 | 5.52 | 5.66 | 8.41 | 15.2 | 14 | 10.3 | 15.8 | 12.2 | 16.1 | 9.57 | 6.86 | 5.43 |
| Carbonate | mg $CaCO_3$/L | - | <0.3 | <1 | <1 | <0.3 | <0.3 | <1 | <1 | <2 | <5 | <5.0 | <1 | <1 | <0.3 | <1 | <1 | <1 | <2 | <5 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 |
| Chloride | mg/L | - | 5.04 | 3 | 5.84 | 3.66 | 4.11 | 2.1 | 3.62 | 7.27 | 7 | 10.8 | 1.9 | 3.11 | 3.01 | 2.1 | 2.1 | 2.83 | 14.5 | 14 | 3.3 | 6.21 | 5 | 8.09 | 2.74 | 4.24 | 4.25 |
| Fluoride | mg/L | - | - | - | - | - | - | - | - | <0.02 | < | - | - | - | - | - | - | - | 0.02 | - | - | - | - | - | - | - | - |
| Hydroxide | mg/L | - | - | <1 | <1 | - | - | <1 | <1 | - | <5 | <5.0 | <1 | <1 | - | <1 | <1 | <1 | <2 | <5 | - | - | - | - | - | - | - |
| Magnesium (Mg)-Dissolved | mg/L | - | 1.32 | 0.87 | 1.23 | 1.25 | 1.43 | 0.69 | 1.22 | 1.48 | 1.35 | - | 0.67 | 1.13 | 1.15 | 0.75 | 0.75 | 1.09 | 1.63 | 1.39 | 1.11 | 2.1 | 1.59 | 2.71 | 0.879 | 0.743 | 0.77 |
| Potassium (K)-Dissolved | mg/L | - | 0.84 | 0.72 | 0.84 | 0.636 | 0.734 | 0.51 | 0.63 | <2 | 0.71 | - | 0.54 | 0.7 | 0.66 | 0.61 | 0.62 | 0.69 | <2 | 0.89 | 0.579 | 0.978 | 0.764 | 2.52 | 0.806 | 1.71 | 0.725 |
| Sodium (Na)-Dissolved | mg/L | - | 2.98 | 1.7 | 3.6 | 2.02 | 2.28 | 1.1 | 2 | 2.5 | 2.59 | - | 1.1 | 1.8 | 1.83 | 1.1 | 1.1 | 1.7 | 2.2 | 2.14 | 1.78 | 3.43 | 3.24 | 5.09 | 1.74 | 2.53 | 2.59 |
| Sulphate | mg/L | - | 4 | 1.5 | 2.45 | 4 | <3 | 1.1 | 2.04 | 2.81 | 2.6 | 3.99 | 1 | 1.44 | 5 | 1.6 | 1.6 | 1.39 | 3.02 | 2.9 | 4 | 3 | <3 | <3 | <3 | 5 | <3 |
| **Organic/Inorganic Carbon** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total Carbon | mg/L | - | 11 | 10 | 10.7 | 10 | 11.7 | 8 | 10.1 | 8.01 | 10 | 12.1 | 8 | 11 | 10 | 9 | 9 | 10.9 | 8.6 | 11 | 8 | 18.2 | 10 | 16.5 | 11 | 6 | 6.1 |
| Total Organic Carbon | mg/L | - | 3 | 4.8 | 4 | 3.2 | 4.7 | 4.2 | 3.9 | 2.5 | 4 | 5.5 | 4.7 | 4.8 | 3.4 | 5.2 | 5.3 | 4.9 | 3.55 | 5 | 2.3 | 7.2 | 2.3 | 4.5 | 4.6 | 1.6 | 2.1 |
| Dissolved Organic Carbon | mg/L | - | - | - | - | - | - | - | - | 2.85 | 4.1 | 0 | - | - | - | - | - | - | 3.61 | 5 | - | - | - | - | - | - | - |
| Total Inorganic Carbon | mg/L | - | 8 | 4.8 | 6.7 | 7 | 7 | 3.7 | 6.2 | 5.51 | 6 | 8.6 | 3.6 | 6.2 | 7 | 3.9 | 3.9 | 6 | 5.05 | 6 | 6 | 11 | 8 | 12 | 6 | 4 | 4 |
| Total Inorganic Carbon (Calculated) | mg/L | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Nutrients** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total Ammonia as Nitrogen | mg/L | - [h] | 0.008 | 0.021 | 0.007 | 0.008 | 0.003 | 0.046 | 0.01 | <0.02 | <0.05 | <0.050 | 0.078 | 0.009 | 0.006 | 0.01 | 0.01 | 0.008 | <0.02 | <0.05 | 0.004 | 0.02 | 0.003 | 0.006 | 0.006 | 0.005 | 0.01 |
| Nitrate+Nitrite as Nitrogen | mg/L | - | <0.008 | 0.008 | <0.006 | <0.008 | 0.023 | 0.009 | <0.006 | <0.005 | <0.1 | <0.050 | 0.008 | <0.006 | 0.011 | 0.007 | 0.008 | <0.006 | <0.005 | <0.1 | <0.008 | 0.08 | <0.008 | 0.025 | 0.012 | <0.008 | 0.024 |
| Nitrate as Nitrogen | mg/L | 2.9 [i] | - | - | - | - | - | - | - | <0.001 | <0.05 | <0.050 | - | - | - | - | - | - | <0.001 | <0.05 | - | - | - | - | - | - | - |
| Nitrite as Nitrogen | mg/L | 0.06 | <0.008 | 0.008 | <0.006 | <0.008 | 0.023 | 0.009 | <0.006 | - | <0.1 | <0.071 | 0.008 | <0.006 | 0.011 | 0.007 | 0.008 | <0.006 | - | <0.1 | <0.008 | 0.08 | <0.008 | 0.025 | 0.012 | <0.008 | 0.024 |
| Phosphorus (P)-Dissolved | mg/L | - | 0.011 | 0.006 | 0.006 | 0.005 | 0.004 | 0.005 | 0.006 | <0.002 | 0.003 | 0.0023 | 0.004 | 0.005 | 0.004 | 0.005 | 0.005 | 0.005 | <0.002 | 0.004 | 0.007 | 0.011 | 0.004 | 0.016 | 0.004 | 0.004 | 0.005 |
| Phosphorus, Total | mg/L | - [k] | 0.019 | 0.006 | 0.007 | 0.008 | 0.017 | 0.006 | 0.006 | 0.0044 | 0.008 | 0.0162 | 0.007 | 0.004 | 0.006 | 0.007 | 0.006 | 0.006 | 0.0049 | 0.009 | 0.007 | 0.019 | 0.006 | 0.02 | 0.006 | 0.004 | 0.009 |
| Phosphorus (P)-Total Reactive | mg/L | - | <0.002 | <0.001 | <0.001 | <0.002 | <0.002 | <0.001 | <0.001 | <0.001 | <0.001 | <0.0010 | <0.001 | <0.001 | <0.002 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| Total Kjeldahl Nitrogen | mg/L | - | 0.3 | 0.14 | 0.37 | 0.28 | 0.4 | 0.13 | 0.41 | 0.202 | 0.3 | 0.38 | 0.19 | 0.5 | 0.35 | 0.39 | 0.3 | 0.39 | 0.252 | 0.4 | 0.26 | 0.55 | 0.3 | 0.38 | 0.41 | 0.25 | 0.28 |
| **Total Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum (Al) | mg/L | 0.005 - 0.100 [n] | 0.0025 | 0.0019 | <0.0003 | <0.005 | 0.0011 | 0.0021 | <0.0003 | <0.005 | 0.0039 | 0.0364 | 0.0021 | <0.0003 | <0.005 | 0.002 | 0.0021 | <0.0003 | <0.005 | 0.0037 | <0.005 | 0.0036 | 0.005 | 0.002 | <0.005 | <0.0005 | <0.0005 |
| Antimony (Sb) | mg/L | - | 0.0003 | 0.00016 | 0.00008 | 0.0004 | 0.0002 | 0.00016 | 0.00009 | <0.0005 | <0.00003 | <0.0001 | 0.00021 | 0.00009 | 0.0032 | 0.00013 | 0.00018 | 0.00007 | <0.0005 | <0.00003 | 0.0004 | 0.0003 | 0.0005 | 0.0003 | 0.0008 | 0.0003 | 0.0003 |
| Arsenic (As) | mg/L | 0.005 | 0.0004 | 0.00058 | 0.00065 | 0.0004 | 0.0013 | 0.00057 | 0.00091 | <0.00083 | 0.00164 | 0.00237 | 0.00044 | 0.00082 | 0.0006 | 0.00055 | 0.00056 | 0.00091 | 0.00074 | 0.00162 | 0.0003 | 0.0006 | 0.0003 | 0.0005 | 0.0003 | <0.0003 | <0.0002 |
| Barium (Ba) | mg/L | - | 0.0117 | 0.0081 | <0.00005 | 0.0104 | 0.0071 | 0.0067 | <0.00005 | <0.02 | 0.0105 | 0.0142 | 0.0068 | <0.00005 | 0.0101 | 0.0076 | 0.0078 | <0.00005 | <0.02 | 0.013 | 0.0086 | 0.0144 | 0.0137 | 0.0167 | 0.0135 | 0.0068 | 0.0063 |
| Beryllium (Be) | mg/L | - | <0.0001 | <0.0002 | <0.0002 | <0.0001 | 0.0001 | <0.0002 | <0.0002 | <0.001 | <0.0002 | <0.0005 | <0.0002 | <0.0002 | <0.0001 | <0.0002 | <0.0002 | <0.0002 | <0.001 | <0.0002 | <0.0001 | 0.0002 | <0.0001 | 0.0002 | <0.0001 | <0.0001 | 0.0002 |
| Bismuth (Bi) | mg/L | - | <0.0001 | <0.00005 | <0.00003 | <0.0001 | <0.0001 | <0.00005 | <0.00003 | - | - | <0.00005 | <0.00005 | <0.00003 | <0.0001 | <0.00005 | <0.00005 | <0.00003 | - | - | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Boron (B) | mg/L | - | - | - | - | - | - | - | - | <0.1 | 0.002 | 0.0069 | - | - | - | - | - | - | <0.1 | 0.002 | - | - | - | - | - | - | - |
| Cadmium (Cd) | mg/L | 0.000017 [p] | <0.0001 | <0.00005 | <0.00005 | <0.0001 | <0.0001 | <0.00005 | <0.00005 | <0.000017 | <0.00005 | <0.00001 | <0.00005 | <0.00005 | <0.0001 | <0.00005 | <0.00005 | <0.00005 | <0.000017 | <0.00005 | <0.0001 | <0.0001 | <0.0001 | 0.0001 | <0.0001 | <0.0001 | 0.0001 |
| Calcium | mg/L | - | - | - | - | - | - | - | - | - | - | 12.9 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Cesium (Cs) | mg/L | - | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | - | - | 0 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | - | - | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Chromium (Cr) | mg/L | 0.0089 / 0.001 [q] | <0.0002 | <0.00006 | <0.00006 | 0.0003 | <0.002 | <0.00006 | <0.00006 | <0.001 | <0.00006 | 0.00018 | <0.00006 | <0.00006 | 0.0004 | <0.00006 | <0.00006 | <0.00006 | <0.001 | <0.00006 | <0.0002 | <0.002 | 0.0009 | 0.002 | 0.0007 | 0.0009 | 0.002 |
| Cobalt (Co) | mg/L | - | <0.0001 | <0.0001 | <0.0001 | 0.0001 | 0.0002 | <0.0001 | <0.0001 | <0.0003 | <0.0001 | 0.0002 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0003 | <0.0001 | <0.0001 | 0.0002 | <0.0001 | 0.0002 | <0.0001 | <0.0001 | 0.0002 |
| Copper (Cu) | mg/L | 0.002 - 0.004 [s] | 0.0012 | <0.0006 | 0.0009 | 0.0008 | 0.0009 | <0.0006 | <0.0006 | <0.001 | 0.0006 | 0.00163 | <0.0006 | 0.0008 | 0.0008 | <0.0006 | <0.0006 | 0.0006 | <0.001 | 0.0008 | 0.0015 | 0.0016 | 0.0012 | 0.001 | 0.0016 | 0.0014 | 0.001 |
| Iron (Fe) | mg/L | 0.3 | 0.113 | 0.02 | 0.007 | 0.095 | 0.117 | 0.02 | 0.007 | 0.107 | 0.143 | 0.421 | 0.02 | <0.005 | 0.066 | 0.02 | 0.02 | 0.009 | 0.065 | 0.122 | 0.133 | 0.305 | 0.086 | 0.084 | 0.074 | 0.013 | 0.021 |
| Lead (Pb) | mg/L | 0.001 - 0.007 [t] | <0.0002 | <0.00005 | 0.00009 | <0.0002 | 0.0002 | <0.00005 | <0.00005 | <0.0005 | <0.00005 | 0.000076 | <0.00005 | <0.00005 | <0.0002 | <0.00005 | <0.00005 | <0.00005 | <0.0005 | <0.00005 | <0.0002 | 0.0002 | <0.0002 | 0.0002 | <0.0002 | <0.0002 | <0.0002 |
| Lithium (Li) | mg/L | - | 0.0011 | 0.0005 | 0.0009 | 0.0009 | 0.0009 | 0.0004 | 0.0006 | <0.005 | - | <0.005 | 0.0004 | 0.0007 | 0.0008 | 0.0004 | 0.0004 | 0.0005 | <0.005 | - | 0.0012 | 0.0012 | 0.0014 | 0.002 | 0.001 | 0.0006 | 0.0005 |
| Magnesium | mg/L | - | - | - | - | - | - | - | - | 1.48 | 1.35 | 1.76 | - | - | - | - | - | - | 1.63 | 1.39 | - | - | - | - | - | - | - |
| Manganese (Mn) | mg/L | - | 0.0086 | 0.0033 | 0.0001 | 0.0143 | 0.0138 | 0.0082 | <0.0001 | 0.0126 | 0.0177 | 0.0385 | 0.0059 | <0.0001 | 0.0046 | 0.005 | 0.0053 | 0.0001 | 0.00515 | 0.0072 | 0.0068 | 0.0615 | 0.0167 | 0.0163 | 0.0017 | 0.0026 | 0.0028 |
| Mercury (Hg) | mg/L | 0.000026 [u] | <0.00001 | <0.00002 | <0.00002 | <0.00001 | <0.00001 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00001 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | <0.00001 | - | <0.00001 |
| Molybdenum (Mo) | mg/L | 0.073 | 0.0002 | 0.00011 | 0.00026 | 0.0001 | 0.0002 | 0.00007 | 0.00014 | <0.001 | 0.00012 | 0.000361 | <0.00006 | <0.00006 | 0.0001 | 0.00007 | 0.00008 | <0.00006 | <0.001 | 0.00013 | 0.0001 | 0.0005 | 0.0002 | 0.0005 | 0.0001 | 0.0002 | 0.0001 |
| Nickel (Ni) | mg/L | 0.025 - 0.15 [w] | <0.0001 | 0.0006 | 0.00032 | 0.0008 | 0.0008 | 0.0006 | 0.00135 | <0.001 | 0.00045 | 0.00099 | 0.0006 | 0.00056 | 0.0001 | 0.0008 | 0.0008 | 0.00049 | <0.001 | 0.00066 | <0.0001 | 0.0011 | <0.0001 | 0.001 | <0.0001 | <0.0001 | 0.0006 |
| Potassium | mg/L | - | - | - | - | - | - | - | - | <2 | 0.71 | 1.05 | - | - | - | - | - | - | <2 | 0.89 | - | - | - | - | - | - | - |
| Rubidium (Rb) | mg/L | - | 0.0011 | - | - | - | - | - | - | - | - | 0 | - | - | 0.0009 | - | - | - | - | - | 0.0007 | - | 0.0009 | - | 0.0013 | 0.0011 | - |
| Selenium (Se) | mg/L | 0.001 [x] | <0.01 | <0.0001 | <0.0001 | <0.01 | <0.01 | <0.0001 | <0.0001 | <0.001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.01 | <0.0001 | <0.0001 | <0.0001 | <0.001 | 0.0002 | <0.01 | <0.01 | <0.01 | 0.001 | <0.01 | <0.01 | <0.01 |
| Silver (Ag) | mg/L | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.00002 | <0.0001 | <0.00001 | <0.0001 | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.00002 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Sodium | mg/L | - | - | - | 0 | - | - | 0 | 0 | 2.5 | 2.59 | 4.82 | - | - | - | - | - | - | 2.2 | 2.14 | - | - | - | - | - | - | - |
| Strontium (Sr) | mg/L | - | 0.0508 | 0.0307 | <0.0001 | 0.0465 | 0.0503 | 0.0258 | <0.0001 | - | 0.051 | 0.0612 | 0.0255 | <0.0001 | 0.0501 | 0.0293 | 0.0297 | <0.0001 | - | 0.0818 | 0.0415 | 0.0701 | 0.0516 | 0.0862 | 0.0468 | 0.0267 | 0.0263 |
| Thallium (Tl) | mg/L | 0.0008 | <0.0001 | <0.00005 | <0.00003 | <0.0001 | <0.0001 | <0.00005 | <0.00003 | <0.0002 | <0.00003 | <0.00005 | <0.00005 | <0.00003 | <0.0001 | <0.00005 | <0.00005 | <0.00003 | <0.0002 | <0.00003 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0001 |
| Tin (Sn) | mg/L | - | - | - | 0 | - | - | 0 | 0 | <0.0005 | - | <0.0001 | 0 | 0 | - | - | - | - | <0.0005 | - | - | - | - | - | - | - | - |
| Titanium (Ti) | mg/L | - | 0.0012 | <0.0003 | <0.0001 | <0.0001 | 0.0006 | <0.0003 | <0.0001 | <0.01 | - | 0.00213 | <0.0003 | <0.0001 | <0.0001 | <0.0003 | <0.0003 | <0.0001 | <0.01 | - | 0.0009 | 0.0013 | 0.0004 | 0.0013 | 0.0004 | <0.0001 | 0.0006 |
| Uranium (U) | mg/L | - | 0.0001 | <0.00005 | <0.00005 | <0.0001 | <0.0001 | <0.00005 | <0.00005 | <0.0002 | <0.00005 | 0.000061 | <0.00005 | <0.00005 | <0.0001 | <0.00005 | <0.00005 | <0.00005 | <0.0002 | <0.00005 | <0.0001 | 0.0001 | 0.0001 | 0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Vanadium (V) | mg/L | - | 0.0001 | 0.0005 | 0.00049 | 0.0003 | 0.0001 | 0.0004 | 0.00051 | <0.001 | 0.00011 | 0.00037 | 0.0004 | 0.00035 | <0.0001 | 0.0005 | 0.0005 | 0.00041 | <0.001 | 0.00017 | 0.0003 | 0.0004 | 0.0001 | 0.0002 | 0.0002 | 0.0002 | 0.0001 |
| Zinc (Zn) | mg/L | 0.03 | 0.0007 | 0.0024 | <0.0008 | <0.005 | 0.0008 | 0.0026 | <0.0008 | <0.005 | <0.0008 | <0.003 | 0.0045 | <0.0008 | <0.0005 | 0.0043 | 0.002 | <0.0008 | <0.005 | <0.0008 | <0.0005 | 0.0016 | 0.0227 | <0.005 | 0.0162 | <0.0005 | 0.0014 |
| **Dissolved Metals** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum (Al) | mg/L | - | - | - | - | - | - | - | - | <0.005 | 0.0019 | <0.003 | - | - | - | - | - | - | <0.005 | 0.0023 | - | - | - | - | - | - | - |
| Antimony (Sb) | mg/L | - | - | - | - | - | - | - | - | <0.0005 | <0.00003 | <0.0001 | - | - | - | - | - | - | <0.0005 | <0.00003 | - | - | - | - | - | - | - |
| Arsenic (As) | mg/L | - | - | - | - | - | - | - | - | 0.00059 | 0.00121 | 0.00154 | - | - | - | - | - | - | 0.00069 | 0.00144 | - | - | - | - | - | - | - |
| Barium (Ba) | mg/L | - | - | - | - | - | - | - | - | <0.02 | 0.0101 | 0.0135 | - | - | - | - | - | - | <0.02 | 0.0126 | - | - | - | - | - | - | - |
| Beryllium (Be) | mg/L | - | - | - | - | - | - | - | - | <0.001 | <0.0002 | <0.0005 | - | - | - | - | - | - | <0.001 | <0.0002 | - | - | - | - | - | - | - |
| Bismuth (Bi) | mg/L | - | - | - | - | - | - | - | - | - | - | <0.00005 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

| | | | B3-4 | B3-4 | B3-4 | B4-5 | B4-5 | B4-5 | B4-5 | B4-5 | B4-5 | B4-45 | B5-6 | B5-6 | B6-7 | B6-7 | B6-7 | B6-7 | B6-7 | B6-7 | D0-1 | D0-1 | D6-7 | D6-7 | G1-2 | ML-MR | ML-MR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream |
| | | | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water |
| | | | 16-Jun-97 (dup) | 13-Jun-98 | 18-Jul-98 | 16-Jun-97 | 25-Aug-97 | 13-Jun-98 | 18-Jul-98 | 21-Jun-08 | 14-Jul-08 | 23-Jul-11 | 13-Jun-98 | 18-Jul-98 | 17-Jun-97 | 13-Jun-98 | 13-Jun-98 (dup) | 18-Jul-98 | 21-Jun-08 | 13-Jul-08 | 18-Jun-97 | 25-Aug-97 | 18-Jun-97 | 26-Aug-97 | 17-Jun-97 | 19-Jun-97 | 24-Aug-97 |
| | | | - | - | - | - | - | - | 0 | 0538395, 6987778 | 0538395, 6987778 | 0538951, 6986433 | - | - | - | - | - | - | 0537876, 6989363 | 0537905, 6989335 | - | - | - | - | - | - | - |
| **Parameter** | **Units** | **Freshwater CWQG [a]** | RL&L 1998 | RL&L 1999 | RL&L 1999 | RL&L 1998 | RL&L 1999 | RL&L 1999 | RL&L 1999 | Golder | Golder | Golder | RL&L 1999 | RL&L 1999 | R&L 1998 | RL&L 1999 | RL&L 1999 | RL&L 1999 | Golder | Golder | RL&L 1998 | RL&L 1998 | RL&L 1998 | RL&L 1998 | RL&L 1998 | RL&L 1998 | RL&L 1998 |
| Boron (B) | mg/L | - | - | - | - | - | - | - | - | <0.1 | 0.002 | 0.0062 | - | - | - | - | - | - | <0.1 | 0.002 | - | - | - | - | - | - | - |
| Cadmium (Cd) | mg/L | - | - | - | - | - | - | - | - | <0.000017 | <0.00005 | <0.00001 | - | - | - | - | - | - | <0.000017 | <0.00005 | - | - | - | - | - | - | - |
| Chromium (Cr) | mg/L | - | - | - | - | - | - | - | - | <0.001 | <0.00006 | <0.0001 | - | - | - | - | - | - | <0.001 | <0.00006 | - | - | - | - | - | - | - |
| Cobalt (Co) | mg/L | - | - | - | - | - | - | - | - | <0.0003 | <0.0001 | <0.0001 | - | - | - | - | - | - | <0.0003 | <0.0001 | - | - | - | - | - | - | - |
| Copper (Cu) | mg/L | - | - | - | - | - | - | - | - | <0.001 | 0.0007 | 0.00097 | - | - | - | - | - | - | <0.001 | 0.0008 | - | - | - | - | - | - | - |
| Iron (Fe) | mg/L | - | - | - | - | - | - | - | - | 0.037 | 0.05 | 0.088 | - | - | - | - | - | - | 0.039 | 0.059 | - | - | - | - | - | - | - |
| Lead (Pb) | mg/L | - | - | - | - | - | - | - | - | <0.0005 | 0.00009 | <0.00005 | - | - | - | - | - | - | <0.0005 | 0.00005 | - | - | - | - | - | - | - |
| Lithium (Li) | mg/L | - | - | - | - | - | - | - | - | <0.005 | - | <0.005 | - | - | - | - | - | - | <0.005 | - | - | - | - | - | - | - | - |
| Manganese (Mn) | mg/L | - | - | - | - | - | - | - | - | 0.00484 | 0.007 | 0.017 | - | - | - | - | - | - | 0.00395 | 0.0046 | - | - | - | - | - | - | - |
| Mercury (Hg) | mg/L | - | - | - | - | - | - | - | - | <0.00002 | <0.00002 | <0.00002 | - | - | - | - | - | - | <0.00002 | <0.00002 | - | - | - | - | - | - | - |
| Molybdenum (Mo) | mg/L | - | - | - | - | - | - | - | - | <0.001 | 0.00011 | 0.000349 | - | - | - | - | - | - | <0.001 | 0.00013 | - | - | - | - | - | - | - |
| Nickel (Ni) | mg/L | - | - | - | - | - | - | - | - | <0.001 | 0.00048 | 0.00067 | - | - | - | - | - | - | <0.001 | 0.00068 | - | - | - | - | - | - | - |
| Potassium (K) | mg/L | - | - | - | - | - | - | - | - | <2 | 0.71 | 1.04 | - | - | - | - | - | - | <2 | 0.91 | - | - | - | - | - | - | - |
| Selenium (Se) | mg/L | - | - | - | - | - | - | - | - | <0.001 | <0.0001 | <0.0001 | - | - | - | - | - | - | <0.001 | 0.0002 | - | - | - | - | - | - | - |
| Silver (Ag) | mg/L | - | - | - | - | - | - | - | - | <0.00002 | <0.0001 | <0.00001 | - | - | - | - | - | - | <0.00002 | <0.0001 | - | - | - | - | - | - | - |
| Sodium (Na) | mg/L | - | - | - | - | - | - | - | - | 2.5 | 2.61 | 4.93 | - | - | - | - | - | - | 2.3 | 2.21 | - | - | - | - | - | - | - |
| Strontium (Sr) | mg/L | - | - | - | - | - | - | - | - | - | 0.0509 | 0.0612 | - | - | - | - | - | - | - | 0.0829 | - | - | - | - | - | - | - |
| Thallium (Tl) | mg/L | - | - | - | - | - | - | - | - | <0.0002 | <0.00003 | <0.00005 | - | - | - | - | - | - | <0.0002 | <0.00003 | - | - | - | - | - | - | - |
| Tin (Sn) | mg/L | - | - | - | - | - | - | - | - | <0.0005 | - | <0.0001 | - | - | - | - | - | - | <0.0005 | - | - | - | - | - | - | - | - |
| Titanium (Ti) | mg/L | - | - | - | - | - | - | - | - | <0.01 | - | <0.0003 | - | - | - | - | - | - | <0.01 | - | - | - | - | - | - | - | - |
| Tungsten (W) | mg/L | - | - | - | - | - | - | - | - | - | - | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Uranium (U) | mg/L | - | - | - | - | - | - | - | - | <0.0002 | <0.00005 | 0.000038 | - | - | - | - | - | - | <0.0002 | <0.00005 | - | - | - | - | - | - | - |
| Vanadium (V) | mg/L | - | - | - | - | - | - | - | - | <0.001 | 0.0001 | 0.00011 | - | - | - | - | - | - | <0.001 | 0.00014 | - | - | - | - | - | - | - |
| Zinc (Zn) | mg/L | - | - | - | - | - | - | - | - | <0.005 | 0.0015 | <0.003 | - | - | - | - | - | - | <0.005 | 0.0012 | - | - | - | - | - | - | - |

| | | | ML-MR | ML-MR | ML-MR | ML-MR | ML-MR | ML-MR | ML-MR | MR-L | MR-L | ML-PL | ML-PL | ML-PL | ML-PL | ML-DL | ML-DL | PL-DL | PL-DL | DI-6 | DI-6 | DI-7 | DI-7 | NEW-2 | NEW-3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream |
| | | | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water |
| | | | 24-Aug-97 (Dup) | 12-Jun-98 | 18-Jul-98 | 20-Jun-99 | 22-Jun-00 | 21-Jun-08 | 19-Jul-08 | 12-Jun-98 | 20-Jul-98 | 19-Jun-97 | 24-Aug-97 | 12-Jun-98 | 18-Jul-98 | 19-Jun-97 | 24-Aug-97 | 12-Jun-98 | 20-Jul-98 | 20-Jul-95 | 23-Jun-08 | 20-Jul-95 | 23-Jun-08 | 23-Jun-08 | 24-Jun-08 |
| | | | - | - | - | - | - | 0530714, 6989630 | 0530712, 6989681 | - | - | - | - | - | - | - | - | - | - | - | 0565841, 6972744 | - | 0574494, 6969739 | 0550631, 6981869 | 0553779, 6980992 |
| **Parameter** | **Units** | **Freshwater CWQG** [a] | RL&L 1998 | RL&L 1999 | RL&L 1999 | RL&L 2000 | RL&L 2000 | Golder | Golder | RL&L 1999 | RL&L 1999 | RL&L 1998 | RL&L 1998 | RL&L 1999 | RL&L 1999 | RL&L 1998 | RL&L 1998 | RL&L 1999 | RL&L 1999 | Dillon 1995 | Golder | Dillon 1995 | Golder | Golder | Golder |
| **Field Measurements** | | | | | | | | | | | | | | | | | | | | | | | | | |
| Water Temperature | °C | - | 11.6 | 1.7 | 9.8 | 6 | 3 | 5.63 | 12.7 | 3.2 | 10.8 | 4.9 | 12.5 | 2.1 | 9.8 | 5.1 | 13.2 | 2.4 | - | 13.6 | 5.5 | 14.1 | 7.82 | 18.16 | 11.03 |
| Dissolved Oxygen | mg/L | - | 11.1 | - | - | - | - | 16.54 | 16.03 | - | - | 13.9 | 11.2 | - | - | 14.3 | 11 | - | - | 7.3 | 14.57 | 9.7 | 13.43 | 9.59 | 11.83 |
| pH | pH | 6.5-9 | 7.48 | - | - | 6.89 | 7.11 | - | 6.78 | 7.7 | - | 7.02 | 7.5 | 6.54 | - | 6.75 | 7.35 | 6.5 | - | 7.52 | - | 7.83 | 7.59 | 8.35 | 7.55 |
| Specific Conductivity | µS/cm | - | 61.6 | 79.8 | - | - | 72.9 | 42 | 63 | 85.5 | - | 50.6 | 52.3 | 68.8 | - | 38.5 | 34.7 | 52.3 | - | 29.9 | 34 | 40.5 | 37 | 82 | 37 |
| **Conventional Parameters (Laboratory-Measured)** | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total Alkalinity | mg/L | - | 14.8 | 18 | 15 | 19 | 20 | 17.8 | 16 | 19 | 18 | 12.4 | 11.9 | 15 | 13 | 7.9 | 7.1 | 9 | 9 | 13.7 | 11 | 15.5 | 12 | 33 | 14 |
| Specific Conductivity | µS/cm | - | 49.9 | 62.4 | 52.4 | 62.4 | 68 | 68.8 | 64.2 | 72.4 | 80 | 42.1 | 42.3 | 57.3 | 55 | 31 | 28.9 | 41.1 | 35.5 | 53.7 | 51.7 | 67.6 | 53.3 | 91.3 | 50.1 |
| Total Hardness | mg/L | - | 16 | 20 | 16 | 19 | 20 | 24 | 20 | 21 | 22 | 15.9 | 12.8 | 17 | 15 | 10.1 | 8.23 | 11 | 9 | 14.1 | 15 | 17.5 | 16 | 37 | 18 |
| pH | pH | 6.5-9 | 7.36 | 7.1 | 7.2 | 7 | 6.9 | 7.06 | 7.5 | 7.2 | 7.1 | 7.2 | 7.37 | 7 | 7.1 | 6.92 | 7.19 | 6.8 | 6.9 | 6.87 | 7.4 | 7.03 | 7.4 | 7.8 | 7.4 |
| Total Dissolved Solids (calculated) | mg/L | - | 39 | 29 | 24 | 30 | 32 | 34 | 40 | 33 | 38 | 26 | 34 | 26 | 25 | 15 | 19 | 18 | 16 | 26 | - | 34 | - | - | - |
| Total Dissolved Solids (calculated) | mg/L | - | - | - | - | - | - | - | 30 | - | - | - | - | - | - | - | - | - | - | - | 26 | - | 27 | 49 | 27 |
| Total Suspended Solids | mg/L | - | <3 | <2 | 2 | <3 | <3 | <3 | <3 | <2 | 2 | <3 | <3 | <2 | <2 | <3 | <3 | <2 | 4 | < | <3 | < | <3 | <3 | <3 |
| Turbidity | NTU | - | 0.3 | 0.3 | 0.2 | 0.1 | 0.23 | - | - | 0.5 | 0.3 | 0.3 | 0.2 | 0.2 | 0.4 | 0.3 | 0.2 | 0.2 | 0.2 | 0.31 | - | 0.42 | - | - | - |
| **Major Ions** | | | | | | | | | | | | | | | | | | | | | | | | | |
| Bicarbonate | mg $CaCO_3$/L | - | 14.8 | 22 | 18 | 23 | 25 | 17.8 | 19 | 23 | 22 | 12.4 | 11.9 | 18 | 16 | 7.9 | 7.1 | 10 | 11 | - | 14 | - | 15 | 41 | 17 |
| Calcium (Ca)-Dissolved | mg/L | - | 5.17 | 6.47 | 5.23 | 6.3 | 5.93 | 7.59 | 5.97 | 6.9 | 6.94 | 5.38 | 4.06 | 5.45 | 4.62 | 3.18 | 2.44 | 3.3 | 2.78 | 4.32 | 4.4 | 5.26 | 4.5 | 12.2 | 5.7 |
| Carbonate | mg $CaCO_3$/L | - | <0.3 | <1 | <1 | <1 | <5 | <2 | <5 | <1 | <1 | <0.3 | <0.3 | <1 | <1 | <0.3 | <0.3 | <1 | <1 | 13.7 | <5 | 15.5 | <5 | <5 | <5 |
| Chloride | mg/L | - | 4.24 | 4.7 | 4.19 | 4.67 | 5 | 6.91 | 5 | 6.3 | 9.6 | 3.66 | 3.93 | 4.6 | 5.45 | 2.74 | 2.56 | 3.4 | 2.78 | 5.6 | 6 | 7.4 | 7 | 6 | 4 |
| Fluoride | mg/L | - | - | - | - | - | - | 0.021 | - | - | - | - | - | - | - | - | - | - | - | 0.04 | <0.05 | 0.04 | <0.05 | <0.05 | <0.05 |
| Hydroxide | mg/L | - | - | <1 | <1 | <1 | <5 | <2 | <5 | <1 | <1 | - | - | <1 | <1 | - | - | <1 | <1 | - | <5 | - | <5 | <5 | <5 |
| Magnesium (Mg)-Dissolved | mg/L | - | 0.76 | 0.88 | 0.71 | 0.9 | 0.816 | 1.12 | 0.865 | 0.97 | 1.23 | 0.593 | 0.64 | 0.8 | 0.79 | 0.52 | 0.52 | 0.64 | 0.55 | 0.805 | 0.8 | 1.07 | 0.8 | 1.3 | 0.8 |
| Potassium (K)-Dissolved | mg/L | - | 0.702 | 0.9 | 0.7 | 0.81 | 0.74 | <2 | 0.76 | 1.14 | 1.04 | 0.598 | 0.651 | 0.87 | 0.74 | 0.562 | 0.554 | 0.74 | 0.61 | <2 | 0.7 | <2 | 0.8 | 3.4 | 3.3 |
| Sodium (Na)-Dissolved | mg/L | - | 2.57 | 2.9 | 2.6 | 3.2 | 2.61 | 4 | 3.22 | 3.7 | 5.6 | 2.19 | 2.43 | 2.9 | 3.2 | 1.82 | 1.75 | 2.1 | 1.8 | 4 | 4 | 5.4 | 4 | 10 | 11 |
| Sulphate | mg/L | - | <3 | 2.1 | 1.69 | 2.37 | 3.2 | 3.11 | 2.8 | 2.7 | 2.48 | <3 | 3 | 2.1 | 1.96 | 4 | <3 | 2.4 | 1.86 | 2.7 | 2.3 | 3.3 | 2.4 | 4.1 | 3.4 |
| **Organic/Inorganic Carbon** | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total Carbon | mg/L | - | 6 | 9 | 6.7 | 7.1 | 7.4 | 5.97 | 3 | 10 | 7 | 4 | 4.8 | 8 | 6.3 | 4 | 3.2 | 6 | 4.9 | - | 5 | - | 6 | 12 | 7 |
| Total Organic Carbon | mg/L | - | 2 | 4.5 | 2.9 | 2.7 | 2.9 | 2.64 | 3 | 5.1 | 2.9 | 1.4 | 1.8 | 3.9 | 3 | 1.6 | 1.2 | 4 | 2.8 | - | 2 | - | 3 | 5 | 3 |
| Dissolved Organic Carbon | mg/L | - | - | - | - | - | - | 2.5 | 2.8 | - | - | - | - | - | - | - | - | - | - | - | 2 | - | 2 | 4 | 3 |
| Total Inorganic Carbon | mg/L | - | 4 | 4.6 | 3.8 | 4.4 | 4.5 | 3.32 | 6 | 4.5 | 4.2 | 3 | 3 | 3.9 | 3.3 | 2 | 2 | 2.4 | 2 | - | 3 | - | 3 | 7 | 4 |
| Total Inorganic Carbon (Calculated) | mg/L | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Nutrients** | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total Ammonia as Nitrogen | mg/L | - [h] | 0.008 | <0.005 | <0.005 | <0.005 | <0.005 | <0.02 | <0.05 | 0.023 | 0.015 | 0.005 | 0.011 | 0.015 | <0.005 | 0.012 | 0.006 | <0.005 | 0.008 | - | <0.05 | - | <0.05 | <0.05 | <0.05 |
| Nitrate+Nitrite as Nitrogen | mg/L | - | 0.032 | <0.006 | <0.006 | 0.012 | <0.006 | <0.005 | <0.1 | 0.008 | 0.008 | <0.008 | 0.023 | <0.006 | <0.006 | <0.008 | 0.015 | <0.006 | <0.006 | - | <0.1 | - | <0.1 | <0.1 | <0.1 |
| Nitrate as Nitrogen | mg/L | 2.9 [i] | - | - | - | - | - | <0.001 | <0.05 | - | - | - | - | - | - | - | - | - | - | - | 0.07 | - | 0.06 | <0.05 | 0.08 |
| Nitrite as Nitrogen | mg/L | 0.06 | 0.032 | <0.006 | <0.006 | 0.012 | <0.006 | - | <0.1 | 0.008 | 0.008 | <0.008 | 0.023 | <0.006 | <0.006 | <0.008 | 0.015 | <0.006 | <0.006 | 0.012 | <0.1 | <0.005 | <0.1 | <0.1 | <0.1 |
| Phosphorus (P)-Dissolved | mg/L | - | 0.002 | 0.004 | 0.003 | 0.001 | 0.003 | <0.002 | 0.002 | 0.004 | 0.003 | 0.004 | 0.005 | 0.002 | 0.003 | 0.004 | 0.007 | 0.002 | 0.002 | - | 0.002 | - | 0.002 | 0.002 | 0.003 |
| Phosphorus, Total | mg/L | - [k] | 0.009 | 0.004 | 0.005 | 0.002 | 0.004 | 0.0025 | 0.004 | 0.005 | 0.004 | 0.005 | 0.008 | 0.002 | 0.003 | 0.004 | 0.007 | 0.002 | 0.004 | - | 0.007 | - | 0.01 | 0.01 | 0.009 |
| Phosphorus (P)-Total Reactive | mg/L | - | <0.002 | <0.001 | <0.001 | <0.001 | 0.002 | <0.001 | <0.001 | <0.001 | <0.001 | <0.002 | <0.002 | <0.001 | <0.001 | <0.002 | <0.002 | <0.001 | <0.001 | - | <0.001 | - | <0.001 | <0.001 | <0.001 |
| Total Kjeldahl Nitrogen | mg/L | - | 0.2 | 0.43 | 0.28 | 0.16 | 0.11 | 0.167 | <0.2 | 0.3 | 0.29 | 0.26 | 0.22 | 0.14 | 0.23 | 0.25 | 0.18 | 0.31 | 0.25 | - | <0.2 | - | <0.2 | 0.3 | <0.2 |
| **Total Metals** | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum (Al) | mg/L | 0.005 - 0.100 [n] | <0.0005 | 0.0014 | <0.0003 | 0.0022 | 0.003 | <0.005 | 0.0019 | 0.0033 | 0.0037 | <0.0005 | 0.0008 | 0.0017 | <0.0003 | <0.0005 | 0.0015 | 0.0039 | 0.003 | <0.2 | 0.0021 | <0.2 | 0.0075 | 0.0058 | 0.0038 |
| Antimony (Sb) | mg/L | - | 0.0002 | 0.00031 | 0.0002 | <0.00003 | 0.00018 | <0.0005 | <0.00003 | 0.0002 | 0.00009 | 0.0002 | 0.0003 | 0.00019 | 0.00007 | 0.0003 | 0.0003 | 0.00036 | 0.00019 | - | <0.0004 | - | <0.0004 | <0.0004 | <0.0004 |
| Arsenic (As) | mg/L | 0.005 | 0.0003 | 0.00029 | 0.00027 | 0.0003 | 0.00025 | <0.0005 | 0.00022 | 0.00025 | 0.00033 | <0.0003 | <0.00002 | 0.00016 | 0.00027 | <0.0003 | <0.0002 | 0.00009 | 0.00014 | 0.0001 | <0.0004 | 0.0001 | <0.0004 | 0.0012 | 0.0005 |
| Barium (Ba) | mg/L | - | 0.0061 | 0.0083 | 0.00066 | 0.00841 | 0.0082 | <0.02 | 0.00689 | 0.0103 | 0.0089 | 0.0054 | 0.0048 | 0.0079 | <0.00005 | 0.0083 | 0.0063 | 0.0112 | 0.00807 | 0.01 | 0.006 | <0.01 | 0.006 | 0.014 | 0.008 |
| Beryllium (Be) | mg/L | - | 0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.0002 | <0.001 | <0.0002 | <0.0002 | <0.0002 | 0.0003 | 0.0003 | <0.0002 | <0.0002 | <0.0001 | 0.0005 | <0.0002 | <0.0002 | - | <0.001 | - | <0.001 | <0.001 | <0.001 |
| Bismuth (Bi) | mg/L | - | <0.0001 | <0.00005 | <0.00003 | <0.00003 | - | - | - | <0.00005 | <0.00003 | <0.0001 | <0.0001 | <0.00005 | <0.00003 | <0.0001 | <0.0001 | <0.00005 | <0.00003 | - | - | - | - | - | - |
| Boron (B) | mg/L | - | - | - | - | - | 0.002 | <0.1 | 0.003 | - | - | - | - | - | - | - | - | - | - | <0.1 | <0.05 | <0.1 | <0.05 | <0.05 | <0.05 |
| Cadmium (Cd) | mg/L | 0.000017 [p] | <0.0001 | <0.00005 | <0.00005 | <0.00002 | <0.00005 | <0.000017 | <0.00005 | <0.00005 | <0.00005 | <0.0001 | 0.0001 | <0.00005 | <0.00005 | <0.0001 | 0.0001 | <0.00005 | 0.00005 | <0.0002 | <0.000017 | <0.0002 | <0.000017 | <0.000017 | <0.000017 |
| Calcium | mg/L | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Cesium (Cs) | mg/L | - | <0.0001 | <0.0001 | <0.0001 | <0.0001 | - | - | - | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | - | - | - | - | - | - |
| Chromium (Cr) | mg/L | 0.0089 / 0.001 [q] | <0.002 | <0.00006 | <0.00006 | 0.0011 | 0.00018 | <0.001 | <0.00006 | <0.00006 | 0.00191 | <0.0002 | <0.002 | <0.00006 | <0.00006 | 0.0007 | <0.002 | <0.00006 | 0.00091 | <0.015 | <0.00006 | <0.015 | <0.00006 | <0.00006 | <0.00006 |
| Cobalt (Co) | mg/L | - | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0003 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0003 | <0.0001 | <0.0001 | <0.0001 | 0.0001 | <0.0001 | <0.0001 | <0.015 | <0.002 | <0.015 | <0.002 | <0.002 | <0.002 |
| Copper (Cu) | mg/L | 0.002 - 0.004 [s] | 0.001 | 0.0008 | <0.0006 | 0.0008 | 0.0008 | <0.001 | 0.0007 | 0.001 | 0.001 | 0.001 | 0.0009 | 0.0008 | <0.0006 | 0.0016 | 0.0011 | 0.0008 | 0.001 | <0.01 | <0.001 | <0.01 | <0.001 | 0.001 | 0.001 |
| Iron (Fe) | mg/L | 0.3 | 0.025 | <0.01 | 0.005 | 0.006 | 0.039 | <0.03 | 0.01 | 0.01 | 0.012 | 0.019 | 0.019 | <0.01 | 0.005 | 0.041 | 0.022 | <0.01 | <0.005 | <0.03 | 0.013 | 0.059 | 0.044 | 0.094 | 0.059 |
| Lead (Pb) | mg/L | 0.001 - 0.007 [t] | 0.0002 | <0.00005 | <0.00005 | 0.00005 | <0.00005 | <0.0005 | <0.00005 | <0.00005 | <0.00005 | <0.0002 | <0.0002 | <0.00005 | 0.00006 | 0.0002 | <0.0002 | <0.00005 | <0.00005 | <0.001 | <0.0001 | <0.001 | <0.0001 | <0.0001 | <0.0001 |
| Lithium (Li) | mg/L | - | 0.0004 | 0.0006 | 0.0003 | 0.0005 | - | <0.005 | - | 0.0006 | <0.0001 | 0.0006 | 0.0005 | 0.0005 | 0.0008 | 0.0007 | 0.0003 | 0.0005 | <0.0001 | - | <0.01 | - | <0.01 | <0.01 | <0.01 |
| Magnesium | mg/L | - | - | - | - | - | - | 1.12 | 0.865 | - | - | - | - | - | - | - | - | - | - | 0.805 | 0.8 | 1.07 | 0.8 | 1.3 | 0.8 |
| Manganese (Mn) | mg/L | - | 0.0029 | 0.0035 | 0.0002 | 0.0051 | 0.0072 | 0.00204 | 0.0018 | 0.0015 | 0.0003 | 0.0015 | 0.0017 | 0.0016 | 0.0008 | 0.0019 | 0.0009 | 0.0032 | 0.001 | <0.005 | 0.002 | <0.005 | 0.001 | 0.007 | 0.002 |
| Mercury (Hg) | mg/L | 0.000026 [u] | <0.00001 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | <0.00002 | - | <0.00001 | <0.00002 | <0.00002 | - | <0.00001 | <0.00002 | <0.00002 | <0.00005 | <0.00002 | <0.00005 | <0.00002 | <0.00002 | <0.00002 |
| Molybdenum (Mo) | mg/L | 0.073 | 0.0001 | 0.00011 | 0.00007 | 0.00008 | 0.00008 | <0.001 | <0.00006 | 0.00012 | 0.00013 | 0.0001 | 0.0001 | 0.00009 | 0.00009 | <0.0001 | <0.0001 | 0.00009 | <0.00006 | <0.03 | <0.005 | <0.03 | <0.005 | <0.005 | <0.005 |
| Nickel (Ni) | mg/L | 0.025 - 0.15 [w] | 0.0003 | 0.0004 | 0.00011 | 0.00052 | 0.00048 | <0.001 | 0.0003 | 0.0006 | 0.00066 | <0.0001 | 0.0004 | 0.0005 | 0.00047 | <0.0001 | 0.0004 | 0.0004 | 0.00063 | <0.02 | <0.002 | <0.02 | <0.002 | <0.002 | <0.002 |
| Potassium | mg/L | - | - | - | - | - | - | <2 | 0.76 | - | - | - | - | - | - | - | - | - | - | <2 | 0.7 | <2 | 0.8 | 3.4 | 3.3 |
| Rubidium (Rb) | mg/L | - | - | - | 0 | - | - | - | - | - | - | 0.001 | - | - | - | 0.0012 | - | - | - | - | - | - | - | - | - |
| Selenium (Se) | mg/L | 0.001 [x] | <0.01 | <0.0001 | <0.0001 | 0.0001 | 0.0002 | <0.001 | <0.0001 | <0.0001 | 0.0003 | <0.01 | <0.01 | <0.0001 | <0.0001 | <0.01 | <0.01 | <0.0001 | 0.0002 | <0.0005 | <0.0004 | <0.0005 | <0.0004 | <0.0004 | <0.0004 |
| Silver (Ag) | mg/L | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.00002 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.015 | <0.0004 | <0.015 | <0.0004 | <0.0004 | <0.0004 |
| Sodium | mg/L | - | - | - | - | - | - | 3.9 | 3.22 | - | - | - | - | - | - | - | - | - | - | 4 | 4 | 5.4 | 4 | 10 | 11 |
| Strontium (Sr) | mg/L | - | 0.0251 | 0.0274 | 0.0002 | 0.0278 | 0.0269 | - | 0.028 | 0.0324 | 0.0364 | 0.021 | 0.0189 | 0.0252 | <0.0001 | 0.0174 | 0.0132 | 0.0177 | 0.0165 | - | - | - | - | - | - |
| Thallium (Tl) | mg/L | 0.0008 | <0.0001 | <0.00005 | <0.00003 | <0.00003 | - | <0.0002 | <0.00003 | <0.00005 | 0.00005 | <0.0001 | <0.0001 | <0.00005 | <0.00003 | <0.0001 | <0.0001 | <0.00005 | <0.00003 | - | <0.0001 | - | <0.0001 | <0.0001 | <0.0001 |
| Tin (Sn) | mg/L | - | - | - | - | - | - | <0.0005 | - | - | - | - | - | - | - | - | - | - | - | <0.3 | <0.05 | <0.3 | <0.05 | <0.05 | <0.05 |
| Titanium (Ti) | mg/L | - | <0.0001 | <0.0003 | <0.0001 | <0.0001 | - | <0.01 | - | <0.0003 | <0.0001 | <0.0001 | <0.0001 | <0.0003 | <0.0001 | 0.0004 | 0.0005 | <0.0003 | <0.0001 | - | <0.001 | - | <0.001 | <0.001 | <0.001 |
| Uranium (U) | mg/L | - | <0.0001 | <0.00005 | <0.00005 | <0.00005 | <0.00005 | <0.0002 | <0.00005 | <0.00005 | <0.00005 | <0.0001 | <0.0001 | <0.00005 | <0.00005 | <0.0001 | <0.0001 | <0.00005 | <0.00005 | - | <0.0001 | - | <0.0001 | <0.0001 | <0.0001 |
| Vanadium (V) | mg/L | - | 0.0001 | 0.0004 | 0.00026 | <0.00005 | <0.00005 | <0.001 | 0.00011 | 0.0004 | 0.0001 | 0.0001 | 0.0001 | 0.0003 | 0.0002 | 0.0001 | 0.0002 | 0.0002 | 0.00008 | - | <0.001 | - | <0.001 | <0.001 | <0.001 |
| Zinc (Zn) | mg/L | 0.03 | 0.001 | 0.0019 | <0.0008 | 0.0131 | <0.0008 | <0.005 | <0.0008 | 0.0033 | <0.0008 | <0.0005 | <0.0005 | 0.0048 | <0.0008 | <0.0005 | 0.0005 | 0.0045 | 0.0025 | <0.005 | <0.004 | <0.005 | <0.004 | <0.004 | <0.004 |
| **Dissolved Metals** | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum (Al) | mg/L | - | - | - | - | - | - | <0.005 | 0.0016 | - | - | - | - | - | - | - | - | - | - | - | 0.0094 | - | 0.0036 | 0.0042 | 0.0025 |
| Antimony (Sb) | mg/L | - | - | - | - | - | - | <0.0005 | <0.00003 | - | - | - | - | - | - | - | - | - | - | - | <0.0004 | - | <0.0004 | <0.0004 | <0.0004 |
| Arsenic (As) | mg/L | - | - | - | - | - | - | <0.0005 | 0.0002 | - | - | - | - | - | - | - | - | - | - | - | <0.0004 | - | <0.0004 | 0.001 | 0.0005 |
| Barium (Ba) | mg/L | - | - | - | - | - | - | <0.02 | 0.00691 | - | - | - | - | - | - | - | - | - | - | - | 0.007 | - | 0.006 | 0.014 | 0.008 |
| Beryllium (Be) | mg/L | - | - | - | - | - | - | <0.001 | <0.0002 | - | - | - | - | - | - | - | - | - | - | - | <0.001 | - | <0.001 | <0.001 | <0.001 |
| Bismuth (Bi) | mg/L | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

| | | | ML-MR | ML-MR | ML-MR | ML-MR | ML-MR | ML-MR | ML-MR | MR-L | MR-L | ML-PL | ML-PL | ML-PL | ML-PL | PL-DL | PL-DL | PL-DL | PL-DL | DI-6 | DI-6 | DI-7 | DI-7 | NEW-2 | NEW-3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream | Stream |
| | | | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water | water |
| | | | 24-Aug-97 (Dup) | 12-Jun-98 | 18-Jul-98 | 20-Jun-99 | 22-Jun-00 | 21-Jun-08 | 19-Jul-08 | 12-Jun-98 | 20-Jul-98 | 19-Jun-97 | 24-Aug-97 | 12-Jun-98 | 18-Jul-98 | 19-Jun-97 | 24-Aug-97 | 12-Jun-98 | 20-Jul-98 | 20-Jul-95 | 23-Jun-08 | 20-Jul-95 | 23-Jun-08 | 23-Jun-08 | 24-Jun-08 |
| | | | - | - | - | - | - | 0530714, 6989630 | 0530712, 6989681 | - | - | - | - | - | - | - | - | - | - | - | 0565841, 6972744 | - | 0574494, 6969739 | 0550631, 6981869 | 0553779, 6980992 |
| **Parameter** | **Units** | **Freshwater CWQG [a]** | RL&L 1998 | RL&L 1999 | RL&L 1999 | RL&L 2000 | RL&L 2000 | Golder | Golder | RL&L 1999 | RL&L 1999 | RL&L 1998 | RL&L 1998 | RL&L 1999 | RL&L 1999 | RL&L 1998 | RL&L 1998 | RL&L 1999 | RL&L 1999 | Dillon 1995 | Golder | Dillon 1995 | Golder | Golder | Golder |
| Boron (B) | mg/L | - | - | - | - | - | - | <0.1 | 0.003 | - | - | - | - | - | - | - | - | - | - | - | <0.05 | - | <0.05 | <0.05 | <0.05 |
| Cadmium (Cd) | mg/L | - | - | - | - | - | - | 0.000065 | <0.00005 | - | - | - | - | - | - | - | - | - | - | - | 0.000028 | - | <0.000017 | <0.000017 | <0.000017 |
| Chromium (Cr) | mg/L | - | - | - | - | - | - | <0.001 | <0.00006 | - | - | - | - | - | - | - | - | - | - | - | 0.00024 | - | <0.00006 | <0.00006 | <0.00006 |
| Cobalt (Co) | mg/L | - | - | - | - | - | - | <0.0003 | <0.0001 | - | - | - | - | - | - | - | - | - | - | - | <0.002 | - | <0.002 | <0.002 | <0.002 |
| Copper (Cu) | mg/L | - | - | - | - | - | - | <0.001 | <0.0006 | - | - | - | - | - | - | - | - | - | - | - | 0.006 | - | <0.001 | 0.001 | 0.001 |
| Iron (Fe) | mg/L | - | - | - | - | - | - | <0.03 | <0.005 | - | - | - | - | - | - | - | - | - | - | - | 0.048 | - | 0.032 | 0.04 | 0.023 |
| Lead (Pb) | mg/L | - | - | - | - | - | - | <0.0005 | <0.00005 | - | - | - | - | - | - | - | - | - | - | - | 0.106 | - | <0.0001 | <0.0001 | <0.0001 |
| Lithium (Li) | mg/L | - | - | - | - | - | - | <0.005 | - | - | - | - | - | - | - | - | - | - | - | - | <0.003 | - | <0.003 | <0.003 | <0.003 |
| Manganese (Mn) | mg/L | - | - | - | - | - | - | 0.00283 | 0.0011 | - | - | - | - | - | - | - | - | - | - | - | 0.002 | - | 0.001 | 0.003 | 0.001 |
| Mercury (Hg) | mg/L | - | - | - | - | - | - | <0.00002 | <0.00002 | - | - | - | - | - | - | - | - | - | - | - | <0.00002 | - | <0.00002 | <0.00002 | <0.00002 |
| Molybdenum (Mo) | mg/L | - | - | - | - | - | - | <0.001 | 0.00007 | - | - | - | - | - | - | - | - | - | - | - | <0.005 | - | <0.005 | <0.005 | <0.005 |
| Nickel (Ni) | mg/L | - | - | - | - | - | - | <0.001 | 0.00032 | - | - | - | - | - | - | - | - | - | - | - | <0.002 | - | <0.002 | <0.002 | <0.002 |
| Potassium (K) | mg/L | - | - | - | - | - | - | <2 | 0.75 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Selenium (Se) | mg/L | - | - | - | - | - | - | <0.001 | <0.0001 | - | - | - | - | - | - | - | - | - | - | - | <0.0004 | - | <0.0004 | <0.0004 | <0.0004 |
| Silver (Ag) | mg/L | - | - | - | - | - | - | <0.00002 | <0.0001 | - | - | - | - | - | - | - | - | - | - | - | <0.0001 | - | <0.0001 | <0.0001 | <0.0001 |
| Sodium (Na) | mg/L | - | - | - | - | - | - | 3.9 | 3.2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Strontium (Sr) | mg/L | - | - | - | - | - | - | - | 0.028 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Thallium (Tl) | mg/L | - | - | - | - | - | - | <0.0002 | <0.00003 | - | - | - | - | - | - | - | - | - | - | - | <0.0001 | - | <0.0001 | <0.0001 | <0.0001 |
| Tin (Sn) | mg/L | - | - | - | - | - | - | <0.0005 | - | - | - | - | - | - | - | - | - | - | - | - | <0.05 | - | <0.05 | <0.05 | <0.05 |
| Titanium (Ti) | mg/L | - | - | - | - | - | - | <0.01 | - | - | - | - | - | - | - | - | - | - | - | - | <0.001 | - | <0.001 | <0.001 | <0.001 |
| Tungsten (W) | mg/L | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Uranium (U) | mg/L | - | - | - | - | - | - | <0.0002 | <0.00005 | - | - | - | - | - | - | - | - | - | - | - | <0.0001 | - | <0.0001 | <0.0001 | <0.0001 |
| Vanadium (V) | mg/L | - | - | - | - | - | - | <0.001 | 0.0001 | - | - | - | - | - | - | - | - | - | - | - | <0.001 | - | <0.001 | <0.001 | <0.001 |
| Zinc (Zn) | mg/L | - | - | - | - | - | - | <0.005 | <0.0008 | - | - | - | - | - | - | - | - | - | - | - | 0.0035 | - | <0.002 | <0.002 | <0.002 |

**Notes:**

(-)= No guideline available

values in bold and cell shaded yellow exceed CWQG

a = Canadian water quality guidelines for the protection of aquatic life - freshwater (CWQG; Canadian Council of Ministers for the Environment [CCME] 2007a).

b = Guidelines for Canadian Drinking Water Quality (GCDWQ; Health Canada 2008).

c = Dissolved oxgygen guideline for cold water freshwater biota is 9.5 mg/L for early life stages and 6.5 mg/L for other life stages.

d = Dissolved oxygen for marine species; see CCME 1999 for narrative.

e = Aesthetic objective.

f = Available GCDWQ are for filtration systems and not untreated water.

g = There may be a laxative effect in some individuals when sulphate concentrations exceed 500 mg/L.

h = Toxicity of ammonia relates primarily to concentration of the unionized form, which increases with increasing temperature and pH. Sample-specific total ammonia guidelines/objectives were calculated as per CCME 2009.

i = Guideline is for protection from direct toxic effects and does not consider effects due to eutrophication.

j = Where nitrate and nitrite are determined separately, levels of nitrite should not exceed 3.2 mg nitrite/L.

k = The Canadian Guidance Framework for Phosphorus is for developing phosphorus guidelines (CCME 2004). The following trigger values are applied to interpret the data but not for screening: ultra-oligotrophic <4 µg/L; oligotrophic 4-10 µg/L; mesotrophic 10-20 µg/L; meso-eutrophic 20-35 µg/L; eutrophic 35-100 µg/L; hyper-eutrophic >100 µg/L.

l = The Canadian Guidance Framework for the Management of Nearshore Marine Systems is for developing nutrient (phosphorus and nitrogen) guidelines for nearshore marine systems. Refer to the factsheet for details (CCME 2007b).

m = Guideline is for free cyanide.

n = Aluminum guideline/objective is pH dependent. At pH <6.5, guideline is 5 µg/L. At pH ≥6.5, guideline is 100 µg/L.

o = The GCDWQ for aluminum is an operational guidance value designed to apply only to drinking water treatments using aluminum-based coagulants and thus is not applicable to this study.

p = Cadmium guideline is hardness dependent and is calculated for each sample according to the following equation: CWQG(cadmium) = 10e{0.86[log(hardness)]-3.2}. The reported guideline value is for a hardness of 48.5 mg/L and was applied to samples with hardnesses of 48.5 mg/L or lower.

q = Chromium freshwater guideline is speciation dependent and is 8.9 µg/L for trivalent chromium and 1.0 µg/L for hexavalent chromium.

r = Chromium marine guideline is speciation dependent and is 56 µg/L for trivalent chromium and 1.5 µg/L for hexavalent chromium.

s = Copper guideline/objective is hardness dependent. At a hardness of 0-120 mg/L, the guideline is 2 µg/L; at a hardness of 120-180 mg/L, the guideline is 3 µg/L; at a hardness greater than 180 mg/L, the guideline is 4 µg/L.

t = Lead guideline/objective is hardness dependent. At a hardness of 0-60 mg/L, the guideline is 1 µg/L; at a hardness of 60-120 mg/L, the guideline is 2 µg/L; at a hardness of 120-180 mg/L, the guideline is 4 µg/L; at a hardness greater than 180 mg/L, the guideline is 7 µg/L.

u = Mercury freshwater guideline is for inorganic mercury; this guideline may not prevent accumulation of methylmercury in aquatic life and therefore may not protect wildlife that consume aquatic life.

v = Mercury marine guideline may not fully protect higher trophic level fish; see factsheet for details (CCME 2003).

w = Nickel guideline is hardness dependent. At a hardness of 0-60 mg/L, the guideline is 25 µg/L; at a hardness of 60-120 mg/L, the guideline is 65 µg/L; at a hardness of 120-180 mg/L , the guideline is 110 µg/L; at a hardness of greater than 180 mg/L, the guideline is 150 µg/L.

x = Selenium guideline is based on waterborne exposure. However, selenium has a bioaccumulation pathway similar to mercury; therefore, the guideline may not be protective of effects through reproductive impairment due to material transfer, resulting in embryotoxicity and teratogenicity.

y = The maximum acceptable concentration of *Escherichia coli* in public, semi-public, and private drinking water systems is none detectable per 100 mL.

**Attachment A. Table 2: Meliadine AWAR Water Quality at Watercourse Crossings, July-October, 2011**

**IR #12**
**12 December 2011**

| Parameter | Units | Freshwater CWQG [a] | DL | DL Metals (Aug-Oct) | CHAR RIVER 12-Jul-11 00:00 L1030929 Char River | 2.1 12-Jul-11 09:45 L1030929 Meliadine River (M2.1) | ROAD 3.0 29-Aug-11 18:10 L1052116 M3.0 | ROAD 3.0 14-Sep-11 16:25 M3.0 | ROAD 3.0 11-Oct-11 13:50 L1071353 M3.0 | ROAD 3.9 29-Aug-11 17:25 L1052116 M3.9 | ROAD 3.9 14-Sep-11 16:15 M3.9 | ROAD 3.9 11-Oct-11 13:50 L1071353 M3.9 | 5.0 12-Jul-11 09:45 L1030929 M5.0 | ROAD 5.0 29-Aug-11 17:10 L1052116 M5.0 | ROAD 5.0 14-Sep-11 16:10 M5.0 | ROAD 5.0 11-Oct-11 13:50 L1071353 M5.0 | ROAD 6.7 29-Aug-11 16:30 L1052116 M6.7 | ROAD 6.7 14-Sep-11 16:00 M6.7 | ROAD 6.7 11-Oct-11 13:50 L1071353 M6.7 | 8.6 12-Jul-11 09:45 L1030929 M8.6 | ROAD 8.6 29-Aug-11 16:00 L1052116 M8.6 | ROAD 8.6 14-Sep-11 15:55 M8.6 | ROAD 8.6 11-Oct-11 13:50 L1071353 M8.6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Conventional Parameters (Laboratory-Measured)** | | | | | | | | | | | | | | | | | | | | | | | |
| Total Alkalinity | mg/L | - | 1 | - | 27 | 21.5 | 62.5 | 58.2 | 59.8 | 50.3 | 47.4 | 47.6 | 33.2 | 43.9 | 40.7 | 37.1 | 17.6 | 16.4 | 16.8 | 23.8 | 33.9 | 26 | 32.5 |
| Specific Conductivity | µmhos/cm | - | 0.4 | - | 120 | 80.3 | 279 | 278 | 297 | 401 | 415 | 424 | 168 | 233 | 243 | 216 | 81.1 | 79 | 85.1 | 77.4 | 124 | 111 | 137 |
| Total Hardness | mg/L | - | 1 | - | - | - | - | - | 88 | - | - | 93.2 | - | - | - | 63.1 | - | - | 27.1 | - | - | - | 46.7 |
| Total Hardness | mg/L | - | 0.3 | - | 34.8 | 22.7 | 92 | 90.8 | 97.5 | 89.2 | 98.6 | 99.2 | 47.7 | 75.3 | 82 | 62.7 | 29.1 | 28.5 | 27.4 | 24.4 | 52.2 | 45.1 | 51.8 |
| pH | pH | 6.5-9 | 0.1 | - | 7.83 | 7.74 | 8.15 | 8.12 | 7.99 | 8.03 | 7.97 | 7.88 | 7.9 | 7.99 | 7.89 | 7.82 | 7.46 | 7.45 | 7.29 | 7.76 | 7.89 | 7.74 | 7.75 |
| Total Dissolved Solids (calculated) | mg/L | - | ? | - | - | - | - | - | 165 | - | - | 220 | - | - | - | 117 | - | - | 44.2 | - | - | - | 73.2 |
| Total Dissolved Solids (calculated) | mg/L | - | 5 | - | 64 | 39.7 | 170 | 157 | 172 | 216 | 213 | 225 | 89.1 | 137 | 136 | 116 | 44.2 | 41.4 | 44.3 | 38.7 | 73.4 | 60.2 | 75.7 |
| Total Suspended Solids | mg/L | - | 5 | - | <5.0 | <5.0 | - | - | 9 | - | - | <5.0 | <5.0 | - | - | 6 | - | - | <5.0 | <5.0 | - | - | <5.0 |
| Turbidity | NTU | - | 0.1 | - | 0.51 | 1.2 | 0.69 | 1.21 | 2.7 | 2.2 | 1.17 | 3.52 | 1.36 | 1.45 | 1.38 | 2.21 | 4.55 | 2.23 | 2.69 | 0.65 | 0.65 | 0.63 | 0.67 |
| **Major Ions** | | | | | | | | | | | | | | | | | | | | | | | |
| Anion Sum | mequiv/L | - | 0.1 | - | - | - | - | - | 2.97 | - | - | 3.86 | - | - | - | 2.08 | - | - | 0.76 | - | - | - | 1.32 |
| Bicarbonate | mg $CaCO_3$/L | - | 2 | - | 33 | 26.2 | 76.2 | 71.1 | 73 | 61.3 | 57.9 | 58.1 | 40.5 | 53.5 | 49.7 | 45.2 | 21.5 | 20 | 20.3 | 29 | 41.4 | 31.7 | 39.7 |
| Calcium (Ca)-Dissolved | mg/L | - | 0.2 | - | - | - | 28.3 | 25.5 | 27.1 | 22.6 | 22.1 | 24.4 | - | 21.6 | 22.2 | 19.2 | 8.76 | 8.24 | 8.66 | - | 17.7 | 12.6 | 15 |
| Carbonate | mg $CaCO_3$/L | - | 0.6 | - | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 |
| Cation - Anion Balance | % | | - | - | - | - | - | - | 1.9 | - | - | 2.3 | - | - | - | 0.3 | - | - | Low EC | - | - | - | -3 |
| Cation Sum | mequiv/L | - | 0.1 | - | - | - | - | - | 3.08 | - | - | 4.04 | - | - | - | 2.09 | - | - | 0.8 | - | - | - | 1.25 |
| Chloride | mg/L | - | 0.5 | - | 18.2 | 9.55 | 58 | 53.9 | 56.2 | 94.7 | 91.6 | 90.9 | 28 | 45.4 | 43.1 | 35.8 | 7.68 | 7 | 8.5 | 6.79 | 11 | 8.26 | 11.1 |
| Fluoride | mg/L | - | 0.1 | - | <0.10 | <0.10 | 0.11 | <0.10 | <0.10 | 0.1 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Hydroxide | mg/L | - | 0.4 | - | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 |
| Ion Balance | % | - | - | - | - | - | 105 | - | 104 | 99.3 | - | 105 | - | 100 | - | 101 | Low EC | - | Low EC | - | 111 | - | 94.1 |
| Magnesium (Mg)-Dissolved | mg/L | - | 0.05 | - | - | - | 4.6 | 4.5 | 4.93 | 7.13 | 7.26 | 7.83 | - | 4.25 | 4.44 | 3.68 | 1.3 | 1.26 | 1.34 | - | 2.18 | 1.86 | 2.24 |
| Potassium (K)-Dissolved | mg/L | - | 0.1 | - | - | - | 3.35 | 2.78 | 2.8 | 3.72 | 3.54 | 3.77 | - | 2.47 | 2.47 | 2.38 | 1.86 | 1.47 | 1.47 | - | 2.46 | 1.94 | 2.01 |
| Sodium (Na)-Dissolved | mg/L | - | 0.05 | - | - | - | 30.8 | 28.1 | 28.8 | 47.4 | 47.7 | 47.8 | - | 22.3 | 20.8 | 17.7 | 5.15 | 4.49 | 4.99 | - | 6.52 | 5.19 | 6.02 |
| Sulphate | mg/L | - | 0.5 | - | 4.99 | 3.32 | 7.87 | 7.62 | 8.86 | 10.4 | 12.4 | 16.5 | 8.66 | 14.2 | 18.1 | 15.7 | 8.84 | 9.1 | 9.2 | 3.89 | 13.3 | 14.8 | 17.3 |
| **Nutrients** | | | | | | | | | | | | | | | | | | | | | | | |
| Total Ammonia as Nitrogen | mg/L | - [h] | 0.05 | - | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| Nitrate+Nitrite as Nitrogen | mg/L | - | 0.071 | - | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 |
| Nitrate as Nitrogen | mg/L | 2.9 [i] | 0.05 | - | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| Nitrite as Nitrogen | mg/L | 0.06 | 0.05 | - | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| Phosphorus (P)-Dissolved | mg/L | | 0.1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Phosphorus, Total | mg/L | - [k] | 0.01 | - | 0.012 | <0.010 | - | - | 0.013 | - | - | 0.016 | 0.015 | - | - | <0.010 | - | - | <0.010 | 0.016 | - | - | <0.010 |
| Phosphorus (P)-Total Reactive | mg/L | | 0.01 | - | - | - | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | - | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | - | <0.010 | <0.010 | <0.010 |
| Total Kjeldahl Nitrogen | mg/L | | 0.2 | - | - | - | 0.85 | 0.81 | 0.72 | 0.51 | 0.47 | 0.5 | - | 0.55 | 0.56 | 0.46 | 1.57 | 0.73 | 0.53 | - | 0.65 | 0.38 | 0.31 |
| **Other** | | | | | | | | | | | | | | | | | | | | | | | |
| Biological Oxygen Demand (BOD) | mg/L | - | 1 | - | <1.0 | 1.3 | - | - | - | - | - | - | 1.7 | - | - | - | - | - | - | 1.6 | - | - | - |
| **Total Metals** | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum (Al) | mg/L | 0.005 - 0.100 [n] | 0.005 | 0.02 | 0.0114 | 0.0434 | 0.036 | 0.022 | 0.072 | **0.118** | 0.029 | **0.11** | 0.0145 | 0.05 | 0.039 | 0.066 | 0.091 | 0.068 | 0.036 | 0.0109 | 0.024 | 0.023 | <0.020 |
| Antimony (Sb) | mg/L | - | 0.0002 | 0.001 | <0.00020 | <0.00020 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.00020 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.00020 | <0.0010 | <0.0010 | <0.0010 |
| Arsenic (As) | mg/L | 0.005 | 0.0002 | 0.001 | 0.00032 | 0.00027 | 0.0012 | 0.001 | 0.0011 | <0.0010 | <0.0010 | <0.0010 | 0.0004 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.00022 | <0.0010 | <0.0010 | <0.0010 |
| Barium (Ba) | mg/L | - | 0.0002 | 0.0005 | 0.0145 | 0.0102 | 0.0247 | 0.0251 | 0.0267 | 0.0236 | 0.0255 | 0.0267 | 0.0221 | 0.0262 | 0.0284 | 0.0231 | 0.0176 | 0.0169 | 0.0147 | 0.0127 | 0.0192 | 0.0202 | 0.0218 |
| Beryllium (Be) | mg/L | - | 0.0002 | 0.001 | <0.00020 | <0.00020 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.00020 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.00020 | <0.0010 | <0.0010 | <0.0010 |
| Bismuth (Bi) | mg/L | - | 0.0002 | 0.0005 | <0.00020 | <0.00020 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00020 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00020 | <0.00050 | <0.00050 | <0.00050 |
| Boron (B) | mg/L | - | 0.01 | 0.03 | 0.014 | <0.010 | 0.042 | <0.030 | <0.030 | 0.056 | 0.033 | <0.030 | 0.014 | 0.035 | <0.030 | <0.030 | <0.030 | <0.030 | <0.030 | <0.010 | <0.030 | <0.030 | <0.030 |
| Cadmium (Cd) | mg/L | 0.000017 [p] | 0.00001 | 0.0002 | <0.000010 | <0.000010 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.000010 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.00020 | <0.000010 | <0.00020 | <0.00020 | <0.00020 |
| Calcium | mg/L | - | 0.1 | 0.2 | 10.5 | 7.24 | 28.4 | 28 | 30.5 | 23.2 | 25.5 | 26.7 | 14.4 | 22.2 | 24.4 | 19.2 | 9.27 | 8.95 | 8.71 | 7.89 | 17 | 14.3 | 16.7 |
| Cesium (Cs) | mg/L | - | 0.0001 | 0.0005 | <0.00010 | <0.00010 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00010 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00010 | <0.00050 | <0.00050 | <0.00050 |
| Chromium (Cr) | mg/L | 0.0089 / 0.001 [q] | 0.001 | 0.002 | <0.0010 | <0.0010 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0020 | <0.0020 | <0.0020 |
| Cobalt (Co) | mg/L | - | 0.0002 | 0.0005 | <0.00020 | <0.00020 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00020 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00020 | <0.00050 | <0.00050 | <0.00050 |
| Copper (Cu) | mg/L | 0.002 - 0.004 [s] | 0.0002 | 0.002 | 0.00119 | 0.00085 | <0.0020 | <0.0020 | <0.0020 | **0.005** | <0.0020 | **0.002** | 0.00122 | <0.0020 | <0.0020 | <0.0020 | **0.0032** | **0.0025** | <0.0020 | 0.00182 | **0.0021** | **0.0028** | <0.0020 |
| Iron (Fe) | mg/L | 0.3 | 0.1 | 0.1 | <0.10 | <0.10 | <0.10 | 0.2 | **0.34** | 0.19 | 0.18 | **0.34** | **0.3** | 0.17 | 0.23 | 0.24 | **0.56** | **0.46** | **0.37** | 0.18 | 0.14 | 0.17 | 0.15 |
| Lead (Pb) | mg/L | 0.001 - 0.007 [t] | 0.00009 | 0.001 | <0.000090 | <0.000090 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.000090 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | 0.000125 | <0.0010 | <0.0010 | <0.0010 |
| Lithium (Li) | mg/L | - | 0.002 | 0.002 | <0.0020 | <0.0020 | 0.0222 | 0.0035 | 0.0027 | 0.0205 | 0.0035 | 0.0025 | <0.0020 | 0.0161 | <0.0020 | <0.0020 | 0.0127 | <0.0020 | <0.0020 | <0.0020 | 0.0164 | <0.0020 | <0.0020 |
| Magnesium | mg/L | - | 0.01 | 0.05 | 2.09 | 1.12 | 5.12 | 5.06 | 5.15 | 7.57 | 8.51 | 7.89 | 2.85 | 4.83 | 5.12 | 3.61 | 1.45 | 1.5 | 1.38 | 1.13 | 2.36 | 2.29 | 2.46 |
| Manganese (Mn) | mg/L | - | 0.0003 | 0.001 | 0.0032 | 0.00382 | 0.0042 | 0.0062 | 0.0101 | 0.0046 | 0.0035 | 0.0045 | 0.00855 | 0.0047 | 0.0053 | 0.0041 | 0.005 | 0.0067 | 0.0054 | 0.0109 | 0.0094 | 0.0059 | 0.0078 |
| Mercury (Hg) | mg/L | 0.000026 [u] | 0.00005 | 0.00005 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Molybdenum (Mo) | mg/L | 0.073 | 0.0002 | 0.0005 | 0.00033 | <0.00020 | 0.00126 | 0.00082 | 0.00071 | 0.00173 | 0.00154 | 0.0013 | 0.00053 | 0.00062 | 0.00055 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00020 | <0.00050 | <0.00050 | <0.00050 |
| Nickel (Ni) | mg/L | 0.025 - 0.15 [w] | 0.002 | 0.002 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | 0.0021 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | 0.0022 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 |
| Phosphorus, Total | mg/L | - | 0.2 | 0.5 | <0.20 | <0.20 | <0.50 | <0.50 | <0.50 | 0.015 | 0.012 | <0.50 | <0.20 | 0.01 | 0.013 | <0.50 | 0.029 | 0.019 | <0.50 | <0.20 | <0.50 | <0.50 | <0.50 |
| Potassium | mg/L | - | 0.02 | 0.1 | 1.51 | 0.86 | 3.34 | 2.92 | 3.21 | 4.08 | 3.92 | 3.97 | 1.83 | 2.62 | 2.68 | 2.39 | 2.08 | 1.57 | 1.5 | 1.26 | 2.5 | 2.14 | 2.24 |
| Rubidium (Rb) | mg/L | - | 0.0002 | 0.0005 | 0.00199 | 0.00148 | 0.00422 | 0.00357 | 0.00398 | 0.00432 | 0.00402 | 0.0039 | 0.00217 | 0.00322 | 0.00299 | 0.00258 | 0.00339 | 0.00229 | 0.00213 | 0.00233 | 0.00392 | 0.00332 | 0.00326 |
| Selenium (Se) | mg/L | 0.001 [x] | 0.001 | 0.005 | <0.0010 | <0.0010 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0010 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0010 | <0.0050 | <0.0050 | <0.0050 |
| Silicon (Si) | mg/L | | 0.05 | 0.3 | 0.231 | 0.229 | 1.16 | 1.39 | 0.91 | 0.31 | 0.43 | 0.64 | 0.128 | <0.30 | 0.57 | 0.54 | 0.37 | 1.86 | 1.53 | 0.342 | 1.02 | 1.65 | 1.35 |
| Silver (Ag) | mg/L | 0.0001 | 0.0001 | 0.001 | <0.00010 | <0.00010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.00010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.00010 | <0.0010 | <0.0010 | <0.0010 |
| Sodium | mg/L | - | 0.03 | 0.05 | 10.5 | 4.68 | 32.3 | 31.5 | 32.1 | 51.9 | 49.8 | 50.4 | 13.4 | 23.6 | 23.8 | 17.4 | 5.41 | 5.01 | 4.94 | 3.49 | 6.84 | 6.09 | 6.42 |
| Strontium (Sr) | mg/L | - | 0.0001 | 0.0005 | 0.055 | 0.0348 | 0.168 | 0.158 | 0.168 | 0.149 | 0.152 | 0.155 | 0.0792 | 0.12 | 0.128 | 0.0982 | 0.0437 | 0.0379 | 0.0364 | 0.0269 | 0.0535 | 0.0426 | 0.0484 |
| Tellurium (Te) | mg/L | | 0.0002 | 0.001 | <0.00020 | <0.00020 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.00020 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.00020 | <0.0010 | <0.0010 | <0.0010 |
| Thallium (Tl) | mg/L | 0.0008 | 0.0001 | 0.005 | <0.00010 | <0.00010 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.00010 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.00010 | <0.0050 | <0.0050 | <0.0050 |
| Thorium (Th) | mg/L | | 0.0001 | 0.001 | <0.00010 | <0.00010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.00010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.00010 | <0.0010 | <0.0010 | <0.0010 |
| Tin (Sn) | mg/L | - | 0.0002 | 0.0006 | <0.00020 | <0.00020 | <0.00060 | <0.00060 | <0.00060 | <0.00060 | <0.00060 | <0.00060 | <0.00020 | <0.00060 | <0.00060 | <0.00060 | <0.00060 | <0.00060 | <0.00060 | <0.00020 | <0.00060 | <0.00060 | <0.00060 |

**Attachment A. Table 2: Meliadine AWAR Water Quality at Watercourse Crossings, July-October, 2011**

**IR #12**
**12 December 2011**

| Parameter | Units | Freshwater CWQG [a] | DL | DL Metals (Aug-Oct) | CHAR RIVER 12-Jul-11 00:00 L1030929 | 2.1 12-Jul-11 09:45 L1030929 | ROAD 3.0 29-Aug-11 18:10 L1052116 | ROAD 3.0 14-Sep-11 16:25 | ROAD 3.0 11-Oct-11 13:50 L1071353 | ROAD 3.9 29-Aug-11 17:25 L1052116 | ROAD 3.9 14-Sep-11 16:15 | ROAD 3.9 11-Oct-11 13:50 L1071353 | 5.0 12-Jul-11 09:45 L1030929 | ROAD 5.0 29-Aug-11 17:10 L1052116 | ROAD 5.0 14-Sep-11 16:10 | ROAD 5.0 11-Oct-11 13:50 L1071353 | ROAD 6.7 29-Aug-11 16:30 L1052116 | ROAD 6.7 14-Sep-11 16:00 | ROAD 6.7 11-Oct-11 13:50 L1071353 | 8.6 12-Jul-11 09:45 L1030929 | ROAD 8.6 29-Aug-11 16:00 L1052116 | ROAD 8.6 14-Sep-11 15:55 | ROAD 8.6 11-Oct-11 13:50 L1071353 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Char River | Meliadine River (M2.1) | M3.0 | M3.0 | M3.0 | M3.9 | M3.9 | M3.9 | M5.0 | M5.0 | M5.0 | M5.0 | M6.7 | M6.7 | M6.7 | M8.6 | M8.6 | M8.6 | M8.6 |
| Titanium (Ti) | mg/L | - | 0.0002 | 0.001 | 0.00055 | 0.0025 | <0.0010 | 0.0014 | 0.0042 | 0.0017 | 0.0014 | 0.0072 | 0.00078 | <0.0010 | 0.0022 | 0.0039 | 0.003 | 0.0031 | 0.002 | 0.00024 | <0.0010 | <0.0010 | <0.0010 |
| Tungsten (W) | mg/L | | 0.001 | 0.002 | <0.0010 | <0.0010 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0020 | <0.0020 | <0.0020 |
| Uranium (U) | mg/L | - | 0.0001 | 0.0005 | <0.00010 | <0.00010 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00010 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00050 | <0.00010 | <0.00050 | <0.00050 | <0.00050 |
| Vanadium (V) | mg/L | - | 0.0002 | 0.002 | <0.00020 | 0.00022 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | 0.00034 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.00020 | <0.0020 | <0.0020 | <0.0020 |
| Zinc (Zn) | mg/L | 0.03 | 0.005 | 0.02 | <0.0050 | <0.0050 | <0.020 | <0.020 | **0.106** | <0.020 | <0.020 | **0.03** | <0.0050 | <0.020 | <0.020 | <0.020 | <0.020 | <0.020 | <0.020 | <0.0050 | <0.020 | <0.020 | <0.020 |
| Zirconium (Zr) | | | 0.0004 | 0.001 | <0.00040 | <0.00040 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.00040 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.0010 | <0.00040 | <0.0010 | <0.0010 | <0.0010 |
| **Dissolved Metals** | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum (Al) | mg/L | | <0.0020 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Antimony (Sb) | mg/L | | <0.00020 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Arsenic (As) | mg/L | | <0.00020 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Barium (Ba) | mg/L | | <0.00020 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Beryllium (Be) | mg/L | | <0.00020 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bismuth (Bi) | mg/L | | <0.00020 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Boron (B) | mg/L | | <0.010 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Cadmium (Cd) | mg/L | | <0.000010 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Cesium (Cs) | mg/L | | <0.00010 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Chromium (Cr) | mg/L | | <0.0020 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Cobalt (Co) | mg/L | | <0.00020 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Copper (Cu) | mg/L | | <0.00020 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Iron (Fe) | mg/L | | <0.10 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Lead (Pb) | mg/L | | <0.000090 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Lithium (Li) | mg/L | | <0.0020 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Manganese (Mn) | mg/L | | <0.00010 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Molybdenum (Mo) | mg/L | | <0.00010 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Nickel (Ni) | mg/L | | <0.0010 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Rubidium (Rb) | mg/L | | <0.00020 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Selenium (Se) | mg/L | | <0.0010 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Silicon (Si) | mg/L | | <0.050 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Silver (Ag) | mg/L | | <0.00010 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Strontium (Sr) | mg/L | | <0.00010 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Tellurium (Te) | mg/L | | <0.00020 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Thallium (Tl) | mg/L | | <0.00010 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Thorium (Th) | mg/L | | <0.00010 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Tin (Sn) | mg/L | | <0.00020 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Titanium (Ti) | mg/L | | <0.00020 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Tungsten (W) | mg/L | | <0.00020 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Uranium (U) | mg/L | | <0.00010 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Vanadium (V) | mg/L | | <0.00020 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Zinc (Zn) | mg/L | | <0.0020 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Zirconium (Zr) | mg/L | | <0.00040 | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

**Notes:**
(-)= No guideline available
values in bold and cell shaded yellow exceed CWQG
a = Canadian water quality guidelines for the protection of aquatic
b = Guidelines for Canadian Drinking Water Quality (GCDWQ; Health Canada 2008).
c = Dissolved oxgygen guideline for cold water freshwater biota is
d = Dissolved oxygen for marine species; see CCME 1999 for narrative.
e = Aesthetic objective.
f = Available GCDWQ are for filtration systems and not untreated water.
g = There may be a laxative effect in some individuals when sulphate concentrations exceed 500 mg/L.
h = Toxicity of ammonia relates primarily to concentration of the
i = Guideline is for protection from direct toxic effects and does not consider effects due to eutrophication.
j = Where nitrate and nitrite are determined separately, levels of nitrite should not exceed 3.2 mg nitrite/L.
k = The Canadian Guidance Framework for Phosphorus is for
l = The Canadian Guidance Framework for the Management of
m = Guideline is for free cyanide.
n = Aluminum guideline/objective is pH dependent. At pH <6.5,
o = The GCDWQ for aluminum is an operational guidance value
p = Cadmium guideline is hardness dependent and is calculated
q = Chromium freshwater guideline is speciation dependent and is
r = Chromium marine guideline is speciation dependent and is 56
s = Copper guideline/objective is hardness dependent. At a
t = Lead guideline/objective is hardness dependent. At a
u = Mercury freshwater guideline is for inorganic mercury; this
v = Mercury marine guideline may not fully protect higher trophic
w = Nickel guideline is hardness dependent. At a hardness of 0-
x = Selenium guideline is based on waterborne exposure.
y = The maximum acceptable concentration of *Escherichia coli* in

**Attachment A. Table 2: Meliadine AWAR Water Quality at Watercourse Crossings, July-October, 2011**

**IR #12**
**12 December 2011**

| Parameter | Units | Freshwater CWQG [a] | DL | DL Metals (Aug-Oct) | 11.5 12-Jul-11 09:45 L1030929 M11.5 | ROAD 11.5 29-Aug-11 15:50 L1052116 M11.5 | ROAD 11.5 14-Sep-11 15:45 M11.5 | ROAD 11.5 11-Oct-11 13:50 L1071353 M11.5 | 13.3 12-Jul-11 09:45 L1030929 M13.3 | ROAD 13.3 29-Aug-11 15:40 L1052116 M13.3 | ROAD 13.3 14-Sep-11 15:35 M13.3 | ROAD 13.3 11-Oct-11 14:30 L1071374 M13.3 | 22.6 12-Jul-11 09:45 L1030929 M22.6 | ROAD 22.6 29-Aug-11 15:25 L1052116 M22.6 | ROAD 22.6 14-Sep-11 15:15 M22.6 | ROAD 22.6 11-Oct-11 14:30 L1071374 M22.6 | 23.6 12-Jul-11 14:00 L1030929 M23.6 | ROAD 23.6 29-Aug-11 15:15 L1052116 M23.6 | ROAD 23.6 14-Sep-11 15:00 M23.6 | ROAD 23.6 11-Oct-11 14:30 L1071374 M23.6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Conventional Parameters (Laboratory-Measured)** | | | | | | | | | | | | | | | | | | | | |
| Total Alkalinity | mg/L | - | 1 | - | 15.8 | 17.3 | 17.7 | 19.5 | 28.9 | 28 | 27.5 | 30.6 | 41.8 | 73.1 | 69.5 | 67.8 | 38.1 | 52.5 | 59 | 41.9 |
| Specific Conductivity | µmhos/cm | - | 0.4 | - | 46.6 | 55.4 | 63 | 69.9 | 75.5 | 81.5 | 87.6 | 102 | 92.4 | 165 | 168 | 168 | 176 | 213 | 229 | 161 |
| Total Hardness | mg/L | - | 1 | - | - | - | - | 24.6 | - | - | - | 36.6 | - | - | - | 76.9 | - | - | - | 59.9 |
| Total Hardness | mg/L | - | 0.3 | - | 15.5 | 20.9 | 25.1 | 26.2 | 27.6 | 33 | 36.4 | 39.2 | 44.9 | 79.9 | 83.7 | 80.6 | 78 | 101 | 111 | 69.6 |
| pH | pH | 6.5-9 | 0.1 | - | 7.49 | 7.59 | 7.56 | 7.54 | 7.8 | 7.81 | 7.79 | 7.74 | 7.87 | 8.25 | 8.2 | 8.03 | 7.99 | 8.13 | 8.12 | 7.83 |
| Total Dissolved Solids (calculated) | mg/L | - | ? | - | - | - | - | 35.7 | - | - | - | 52.6 | - | - | - | 91.9 | - | - | - | 80.2 |
| Total Dissolved Solids (calculated) | mg/L | - | 5 | - | 22.5 | 29.6 | 33.3 | 36.7 | 38 | 43.5 | 45.7 | 53.7 | 50.1 | 94 | 92.7 | 93.6 | 93 | 119 | 123 | 84.7 |
| Total Suspended Solids | mg/L | - | 5 | - | 28 | - | - | 6 | <5.0 | - | - | - | <5.0 | - | - | - | <5.0 | - | - | - |
| Turbidity | NTU | - | 0.1 | - | 0.78 | 0.51 | 0.48 | 0.56 | 1 | 0.63 | 0.74 | 0.68 | 0.3 | 0.83 | 1.32 | 1.04 | 0.56 | 0.5 | 0.57 | 1.14 |
| **Major Ions** | | | | | | | | | | | | | | | | | | | | |
| Anion Sum | mequiv/L | - | 0.1 | - | - | - | - | 0.66 | - | - | - | 0.98 | - | - | - | 1.76 | - | - | - | 1.57 |
| Bicarbonate | mg $CaCO_3$/L | - | 2 | - | 19.2 | 21.1 | 21.6 | 23.5 | 35.3 | 34.1 | 33.6 | 37.4 | 51 | 89.2 | 84.8 | 82.7 | 46.5 | 64 | 72 | 51.1 |
| Calcium (Ca)-Dissolved | mg/L | - | 0.2 | - | - | 7.13 | 7.61 | 8.23 | - | 10.4 | 10.9 | 11.8 | - | 25.7 | 25.9 | 26.3 | - | 32.4 | 33.1 | 20 |
| Carbonate | mg $CaCO_3$/L | - | 0.6 | - | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 | <0.60 |
| Cation - Anion Balance | % | | - | - | - | - | - | Low EC | - | - | - | -2.3 | - | - | - | -0.1 | - | - | - | -6 |
| Cation Sum | mequiv/L | - | 0.1 | - | - | - | - | 0.62 | - | - | - | 0.94 | - | - | - | 1.76 | - | - | - | 1.39 |
| Chloride | mg/L | - | 0.5 | - | 2.66 | 3.41 | 3.66 | 4.06 | 4.29 | 5.86 | 5.75 | 6.87 | 3.68 | 11 | 9.88 | 8.34 | 31.4 | 40.2 | 36.9 | 21.3 |
| Fluoride | mg/L | - | 0.1 | - | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| Hydroxide | mg/L | - | 0.4 | - | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 | <0.40 |
| Ion Balance | % | - | - | - | - | Low EC | - | Low EC | - | Low EC | - | 95.6 | - | 97.8 | - | 99.8 | - | 100 | - | 88.6 |
| Magnesium (Mg)-Dissolved | mg/L | - | 0.05 | - | - | 0.776 | 0.943 | 0.994 | - | 1.3 | 1.5 | 1.73 | - | 2.71 | 2.89 | 2.72 | - | 3.99 | 4.38 | 2.41 |
| Potassium (K)-Dissolved | mg/L | - | 0.1 | - | - | 0.96 | 0.96 | 0.856 | - | 1.49 | 1.3 | 1.31 | - | 1.87 | 1.63 | 1.33 | - | 1.82 | 1.63 | 0.98 |
| Sodium (Na)-Dissolved | mg/L | - | 0.05 | - | - | 2.03 | 2.23 | 2.37 | - | 3.11 | 3.34 | 4.02 | - | 5.65 | 5.19 | 4.33 | - | 6.03 | 5.99 | 3.93 |
| Sulphate | mg/L | - | 0.5 | - | 2.5 | 4.93 | 7.26 | 7.48 | 2.59 | 4.57 | 6.33 | 8.46 | 1.17 | 3.21 | 5.54 | 8.22 | 3.42 | 3.12 | 5.29 | 6.4 |
| **Nutrients** | | | | | | | | | | | | | | | | | | | | |
| Total Ammonia as Nitrogen | mg/L | - [h] | 0.05 | - | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| Nitrate+Nitrite as Nitrogen | mg/L | - | 0.071 | - | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 | <0.071 |
| Nitrate as Nitrogen | mg/L | 2.9 [i] | 0.05 | - | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| Nitrite as Nitrogen | mg/L | 0.06 | 0.05 | - | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| Phosphorus (P)-Dissolved | mg/L | | 0.1 | - | - | - | - | - | - | - | - | <0.10 | - | - | - | <0.10 | - | - | - | <0.10 |
| Phosphorus, Total | mg/L | - [k] | 0.01 | - | 0.013 | - | - | <0.010 | 0.016 | - | - | <0.010 | <0.010 | - | - | <0.010 | 0.014 | - | - | <0.010 |
| Phosphorus (P)-Total Reactive | mg/L | | 0.01 | - | - | <0.010 | <0.010 | <0.010 | - | <0.010 | <0.010 | <0.010 | - | <0.010 | <0.010 | <0.010 | - | <0.010 | <0.010 | <0.010 |
| Total Kjeldahl Nitrogen | mg/L | | 0.2 | - | - | 0.34 | 0.37 | 0.33 | - | 0.58 | 0.52 | 0.42 | - | 0.77 | 0.57 | 0.47 | - | 0.39 | 0.42 | 0.36 |
| **Other** | | | | | | | | | | | | | | | | | | | | |
| Biological Oxygen Demand (BOD) | mg/L | - | 1 | - | 1.2 | - | - | - | 1.5 | - | - | - | 1.2 | - | - | - | 1.2 | - | - | - |
| **Total Metals** | | | | | | | | | | | | | | | | | | | | |
| Aluminum (Al) | mg/L | 0.005 - 0.100 [n] | 0.005 | 0.02 | 0.0168 | 0.024 | <0.020 | 0.026 | 0.01 | 0.025 | <0.020 | <0.020 | <0.0050 | 0.02 | <0.020 | <0.020 | <0.0050 | 0.022 | <0.020 | <0.020 |
| Antimony (Sb) | mg/L | - | 0.0002 | 0.001 | <0.00020 | <0.0010 | <0.0010 | <0.0010 | <0.00020 | <0.0010 | <0.0010 | <0.0010 | <0.00020 | <0.0010 | <0.0010 | <0.0010 | <0.00020 | <0.0010 | <0.0010 | <0.0010 |
| Arsenic (As) | mg/L | 0.005 | 0.0002 | 0.001 | 0.00034 | <0.0010 | <0.0010 | <0.0010 | 0.00069 | <0.0010 | <0.0010 | <0.0010 | 0.00073 | 0.0044 | 0.0024 | 0.0015 | 0.00264 | 0.0041 | 0.0029 | 0.0021 |
| Barium (Ba) | mg/L | - | 0.0002 | 0.0005 | 0.0112 | 0.0102 | 0.0117 | 0.0129 | 0.0239 | 0.019 | 0.02 | 0.0215 | 0.0212 | 0.0325 | 0.0307 | 0.0274 | 0.0242 | 0.0255 | 0.0244 | 0.0175 |
| Beryllium (Be) | mg/L | - | 0.0002 | 0.001 | <0.00020 | <0.0010 | <0.0010 | <0.0010 | <0.00020 | <0.0010 | <0.0010 | <0.0010 | <0.00020 | <0.0010 | <0.0010 | <0.0010 | <0.00020 | <0.0010 | <0.0010 | <0.0010 |
| Bismuth (Bi) | mg/L | - | 0.0002 | 0.0005 | <0.00020 | <0.00050 | <0.00050 | <0.00050 | <0.00020 | <0.00050 | <0.00050 | <0.00050 | <0.00020 | <0.00050 | <0.00050 | <0.00050 | <0.00020 | <0.00050 | <0.00050 | <0.00050 |
| Boron (B) | mg/L | - | 0.01 | 0.03 | <0.010 | <0.030 | <0.030 | <0.030 | <0.010 | <0.030 | <0.030 | <0.030 | <0.010 | <0.030 | <0.030 | <0.030 | <0.010 | <0.030 | <0.030 | <0.030 |
| Cadmium (Cd) | mg/L | 0.000017 [p] | 0.00001 | 0.0002 | <0.000010 | <0.00020 | <0.00020 | <0.00020 | <0.000010 | <0.00020 | <0.00020 | <0.00020 | <0.000010 | <0.00020 | <0.00020 | <0.00020 | <0.000010 | <0.00020 | <0.00020 | <0.00020 |
| Calcium | mg/L | - | 0.1 | 0.2 | 5.24 | 6.99 | 8.22 | 8.71 | 9.25 | 10.8 | 11.7 | 12.8 | 15.7 | 26.9 | 28 | 27.6 | 26 | 33.2 | 36.4 | 23.1 |
| Cesium (Cs) | mg/L | - | 0.0001 | 0.0005 | <0.00010 | <0.00050 | <0.00050 | <0.00050 | <0.00010 | <0.00050 | <0.00050 | <0.00050 | <0.00010 | <0.00050 | <0.00050 | <0.00050 | <0.00010 | <0.00050 | <0.00050 | <0.00050 |
| Chromium (Cr) | mg/L | 0.0089 / 0.001 [q] | 0.001 | 0.002 | <0.0010 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0020 | <0.0020 | <0.0020 |
| Cobalt (Co) | mg/L | - | 0.0002 | 0.0005 | 0.00024 | <0.00050 | <0.00050 | <0.00050 | <0.00020 | <0.00050 | <0.00050 | <0.00050 | <0.00020 | <0.00050 | <0.00050 | <0.00050 | <0.00020 | <0.00050 | <0.00050 | <0.00050 |
| Copper (Cu) | mg/L | 0.002 - 0.004 [s] | 0.0002 | 0.002 | **0.00274** | <0.0020 | **0.0021** | **0.0023** | **0.00211** | <0.0020 | <0.0020 | <0.0020 | 0.00079 | <0.0020 | <0.0020 | <0.0020 | 0.00104 | <0.0020 | <0.0020 | <0.0020 |
| Iron (Fe) | mg/L | 0.3 | 0.1 | 0.1 | 0.24 | <0.10 | <0.10 | 0.15 | **0.41** | 0.17 | 0.21 | 0.13 | <0.10 | 0.24 | 0.29 | **0.3** | 0.12 | 0.21 | 0.16 | 0.14 |
| Lead (Pb) | mg/L | 0.001 - 0.007 [t] | 0.00009 | 0.001 | <0.000090 | <0.0010 | <0.0010 | <0.0010 | <0.000090 | <0.0010 | <0.0010 | <0.0010 | <0.000090 | <0.0010 | <0.0010 | <0.0010 | <0.000090 | <0.0010 | <0.0010 | <0.0010 |
| Lithium (Li) | mg/L | - | 0.002 | 0.002 | <0.0020 | 0.0082 | <0.0020 | <0.0020 | <0.0020 | 0.0121 | <0.0020 | <0.0020 | <0.0020 | 0.0126 | <0.0020 | <0.0020 | 0.0075 | 0.0235 | 0.0058 | 0.0042 |
| Magnesium | mg/L | - | 0.01 | 0.05 | 0.576 | 0.827 | 1.12 | 1.09 | 1.11 | 1.47 | 1.74 | 1.75 | 1.37 | 3.09 | 3.33 | 2.84 | 3.18 | 4.34 | 5.03 | 2.88 |
| Manganese (Mn) | mg/L | - | 0.0003 | 0.001 | 0.0188 | 0.0033 | 0.003 | 0.0101 | 0.0273 | 0.0045 | 0.0076 | 0.0039 | 0.0251 | 0.0212 | 0.0218 | 0.0114 | 0.0176 | 0.0261 | 0.0159 | 0.0217 |
| Mercury (Hg) | mg/L | 0.000026 [u] | 0.00005 | 0.00005 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 | <0.000050 |
| Molybdenum (Mo) | mg/L | 0.073 | 0.0002 | 0.0005 | <0.00020 | <0.00050 | <0.00050 | <0.00050 | <0.00020 | <0.00050 | <0.00050 | <0.00050 | <0.00020 | <0.00050 | <0.00050 | <0.00050 | <0.00020 | <0.00050 | <0.00050 | <0.00050 |
| Nickel (Ni) | mg/L | 0.025 - 0.15 [w] | 0.002 | 0.002 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 | <0.0020 |
| Phosphorus, Total | mg/L | - | 0.2 | 0.5 | <0.20 | <0.50 | <0.50 | <0.50 | <0.20 | <0.50 | <0.50 | <0.50 | <0.20 | <0.50 | <0.50 | <0.50 | <0.20 | <0.50 | <0.50 | <0.50 |
| Potassium | mg/L | - | 0.02 | 0.1 | 0.393 | 0.97 | 0.92 | 0.95 | 0.935 | 1.36 | 1.34 | 1.42 | 0.534 | 2.11 | 1.71 | 1.39 | 1.39 | 1.95 | 1.72 | 1.17 |
| Rubidium (Rb) | mg/L | - | 0.0002 | 0.0005 | 0.00109 | 0.00177 | 0.00181 | 0.00181 | 0.00149 | 0.00242 | 0.00229 | 0.00241 | 0.00082 | 0.00228 | 0.00191 | 0.00155 | 0.00162 | 0.0021 | 0.00192 | 0.00135 |
| Selenium (Se) | mg/L | 0.001 [x] | 0.001 | 0.005 | <0.0010 | <0.0050 | <0.0050 | <0.0050 | <0.0010 | <0.0050 | <0.0050 | <0.0050 | **0.0015** | <0.0050 | <0.0050 | <0.0050 | <0.0010 | <0.0050 | <0.0050 | <0.0050 |
| Silicon (Si) | mg/L | | 0.05 | 0.3 | 0.099 | <0.30 | 0.44 | 0.45 | 0.147 | 0.58 | 0.79 | 0.68 | 0.171 | 1.14 | 1.15 | 1.07 | 0.784 | 1.34 | 1.65 | 0.64 |
| Silver (Ag) | mg/L | 0.0001 | 0.0001 | 0.001 | <0.00010 | <0.0010 | <0.0010 | <0.0010 | <0.00010 | <0.0010 | <0.0010 | <0.0010 | <0.00010 | <0.0010 | <0.0010 | <0.0010 | <0.00010 | <0.0010 | <0.0010 | <0.0010 |
| Sodium | mg/L | - | 0.03 | 0.05 | 1.71 | 2.16 | 2.74 | 2.74 | 2.46 | 3.85 | 4.05 | 4.01 | 2.54 | 6.11 | 5.83 | 4.5 | 4.72 | 6.57 | 6.87 | 4.71 |
| Strontium (Sr) | mg/L | - | 0.0001 | 0.0005 | 0.0192 | 0.0269 | 0.0275 | 0.0285 | 0.0434 | 0.0473 | 0.0477 | 0.0529 | 0.058 | 0.103 | 0.0974 | 0.0844 | 0.154 | 0.194 | 0.178 | 0.106 |
| Tellurium (Te) | mg/L | | 0.0002 | 0.001 | <0.00020 | <0.0010 | <0.0010 | <0.0010 | <0.00020 | <0.0010 | <0.0010 | <0.0010 | <0.00020 | <0.0010 | <0.0010 | <0.0010 | <0.00020 | <0.0010 | <0.0010 | <0.0010 |
| Thallium (Tl) | mg/L | 0.0008 | 0.0001 | 0.005 | <0.00010 | <0.0050 | <0.0050 | <0.0050 | <0.00010 | <0.0050 | <0.0050 | <0.0050 | <0.00010 | <0.0050 | <0.0050 | <0.0050 | <0.00010 | <0.0050 | <0.0050 | <0.0050 |
| Thorium (Th) | mg/L | | 0.0001 | 0.001 | <0.00010 | <0.0010 | <0.0010 | <0.0010 | <0.00010 | <0.0010 | <0.0010 | <0.0010 | <0.00010 | <0.0010 | <0.0010 | <0.0010 | <0.00010 | <0.0010 | <0.0010 | <0.0010 |
| Tin (Sn) | mg/L | - | 0.0002 | 0.0006 | <0.00020 | <0.00060 | <0.00060 | <0.00060 | <0.00020 | <0.00060 | <0.00060 | <0.00060 | <0.00020 | <0.00060 | <0.00060 | <0.00060 | <0.00020 | <0.00060 | <0.00060 | <0.00060 |

**Attachment A. Table 2: Meliadine AWAR Water Quality at Watercourse Crossings, July-October, 2011**

**IR #12**
**12 December 2011**

| Parameter | Units | Freshwater CWQG [a] | DL | DL Metals (Aug-Oct) | 11.5 12-Jul-11 09:45 L1030929 M11.5 | ROAD 11.5 29-Aug-11 15:50 L1052116 M11.5 | ROAD 11.5 14-Sep-11 15:45 M11.5 | ROAD 11.5 11-Oct-11 13:50 L1071353 M11.5 | 13.3 12-Jul-11 09:45 L1030929 M13.3 | ROAD 13.3 29-Aug-11 15:40 L1052116 M13.3 | ROAD 13.3 14-Sep-11 15:35 M13.3 | ROAD 13.3 11-Oct-11 14:30 L1071374 M13.3 | 22.6 12-Jul-11 09:45 L1030929 M22.6 | ROAD 22.6 29-Aug-11 15:25 L1052116 M22.6 | ROAD 22.6 14-Sep-11 15:15 M22.6 | ROAD 22.6 11-Oct-11 14:30 L1071374 M22.6 | 23.6 12-Jul-11 14:00 L1030929 M23.6 | ROAD 23.6 29-Aug-11 15:15 L1052116 M23.6 | ROAD 23.6 14-Sep-11 15:00 M23.6 | ROAD 23.6 11-Oct-11 14:30 L1071374 M23.6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Titanium (Ti) | mg/L | - | 0.0002 | 0.001 | 0.00029 | <0.0010 | <0.0010 | 0.0015 | 0.00036 | <0.0010 | <0.0010 | <0.0010 | <0.00020 | <0.0010 | <0.0010 | <0.0010 | <0.00020 | <0.0010 | <0.0010 | <0.0010 |
| Tungsten (W) | mg/L | | 0.001 | 0.002 | <0.0010 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0020 | <0.0020 | <0.0020 | <0.0010 | <0.0020 | <0.0020 | <0.0020 |
| Uranium (U) | mg/L | - | 0.0001 | 0.0005 | <0.00010 | <0.00050 | <0.00050 | <0.00050 | <0.00010 | <0.00050 | <0.00050 | <0.00050 | <0.00010 | <0.00050 | <0.00050 | <0.00050 | <0.00010 | <0.00050 | <0.00050 | <0.00050 |
| Vanadium (V) | mg/L | - | 0.0002 | 0.002 | <0.00020 | <0.0020 | <0.0020 | <0.0020 | <0.00020 | <0.0020 | <0.0020 | <0.0020 | <0.00020 | <0.0020 | <0.0020 | <0.0020 | <0.00020 | <0.0020 | <0.0020 | <0.0020 |
| Zinc (Zn) | mg/L | 0.03 | 0.005 | 0.02 | <0.0050 | <0.020 | <0.020 | <0.020 | <0.0050 | <0.020 | <0.020 | <0.020 | 0.0092 | <0.020 | <0.020 | <0.020 | <0.0050 | <0.020 | <0.020 | <0.020 |
| Zirconium (Zr) | | | 0.0004 | 0.001 | <0.00040 | <0.0010 | <0.0010 | <0.0010 | <0.00040 | <0.0010 | <0.0010 | <0.0010 | <0.00040 | <0.0010 | <0.0010 | <0.0010 | <0.00040 | <0.0010 | <0.0010 | <0.0010 |
| **Dissolved Metals** | | | | | | | | | | | | | | | | | | | | |
| Aluminum (Al) | mg/L | | <0.0020 | | - | - | - | - | - | - | - | 0.0024 | - | - | - | <0.0020 | - | - | - | <0.0020 |
| Antimony (Sb) | mg/L | | <0.00020 | | - | - | - | - | - | - | - | <0.00020 | - | - | - | <0.00020 | - | - | - | <0.00020 |
| Arsenic (As) | mg/L | | <0.00020 | | - | - | - | - | - | - | - | 0.00029 | - | - | - | 0.00119 | - | - | - | 0.0012 |
| Barium (Ba) | mg/L | | <0.00020 | | - | - | - | - | - | - | - | 0.0211 | - | - | - | 0.0267 | - | - | - | 0.0152 |
| Beryllium (Be) | mg/L | | <0.00020 | | - | - | - | - | - | - | - | <0.00020 | - | - | - | <0.00020 | - | - | - | <0.00020 |
| Bismuth (Bi) | mg/L | | <0.00020 | | - | - | - | - | - | - | - | <0.00020 | - | - | - | <0.00020 | - | - | - | <0.00020 |
| Boron (B) | mg/L | | <0.010 | | - | - | - | - | - | - | - | <0.010 | - | - | - | <0.010 | - | - | - | <0.010 |
| Cadmium (Cd) | mg/L | | <0.000010 | | - | - | - | - | - | - | - | <0.000010 | - | - | - | <0.000010 | - | - | - | <0.000010 |
| Cesium (Cs) | mg/L | | <0.00010 | | - | - | - | - | - | - | - | <0.00010 | - | - | - | <0.00010 | - | - | - | <0.00010 |
| Chromium (Cr) | mg/L | | <0.0020 | | - | - | - | - | - | - | - | <0.0020 | - | - | - | <0.0020 | - | - | - | <0.0020 |
| Cobalt (Co) | mg/L | | <0.00020 | | - | - | - | - | - | - | - | <0.00020 | - | - | - | <0.00020 | - | - | - | <0.00020 |
| Copper (Cu) | mg/L | | <0.00020 | | - | - | - | - | - | - | - | 0.00151 | - | - | - | 0.00111 | - | - | - | 0.00069 |
| Iron (Fe) | mg/L | | <0.10 | | - | - | - | - | - | - | - | <0.10 | - | - | - | <0.10 | - | - | - | <0.10 |
| Lead (Pb) | mg/L | | <0.000090 | | - | - | - | - | - | - | - | <0.000090 | - | - | - | <0.000090 | - | - | - | <0.000090 |
| Lithium (Li) | mg/L | | <0.0020 | | - | - | - | - | - | - | - | <0.0020 | - | - | - | <0.0020 | - | - | - | 0.004 |
| Manganese (Mn) | mg/L | | <0.00010 | | - | - | - | - | - | - | - | 0.00136 | - | - | - | 0.00697 | - | - | - | 0.00319 |
| Molybdenum (Mo) | mg/L | | <0.00010 | | - | - | - | - | - | - | - | <0.00010 | - | - | - | 0.00019 | - | - | - | 0.00014 |
| Nickel (Ni) | mg/L | | <0.0010 | | - | - | - | - | - | - | - | <0.0010 | - | - | - | 0.0011 | - | - | - | <0.0010 |
| Rubidium (Rb) | mg/L | | <0.00020 | | - | - | - | - | - | - | - | 0.00227 | - | - | - | 0.00146 | - | - | - | 0.00118 |
| Selenium (Se) | mg/L | | <0.0010 | | - | - | - | - | - | - | - | <0.0010 | - | - | - | <0.0010 | - | - | - | <0.0010 |
| Silicon (Si) | mg/L | | <0.050 | | - | - | - | - | - | - | - | 0.658 | - | - | - | 1.1 | - | - | - | 0.582 |
| Silver (Ag) | mg/L | | <0.00010 | | - | - | - | - | - | - | - | <0.00010 | - | - | - | <0.00010 | - | - | - | <0.00010 |
| Strontium (Sr) | mg/L | | <0.00010 | | - | - | - | - | - | - | - | 0.0511 | - | - | - | 0.0787 | - | - | - | 0.0926 |
| Tellurium (Te) | mg/L | | <0.00020 | | - | - | - | - | - | - | - | <0.00020 | - | - | - | <0.00020 | - | - | - | <0.00020 |
| Thallium (Tl) | mg/L | | <0.00010 | | - | - | - | - | - | - | - | <0.00010 | - | - | - | <0.00010 | - | - | - | <0.00010 |
| Thorium (Th) | mg/L | | <0.00010 | | - | - | - | - | - | - | - | <0.00010 | - | - | - | <0.00010 | - | - | - | <0.00010 |
| Tin (Sn) | mg/L | | <0.00020 | | - | - | - | - | - | - | - | <0.00020 | - | - | - | <0.00020 | - | - | - | <0.00020 |
| Titanium (Ti) | mg/L | | <0.00020 | | - | - | - | - | - | - | - | <0.00020 | - | - | - | <0.00020 | - | - | - | <0.00020 |
| Tungsten (W) | mg/L | | <0.00020 | | - | - | - | - | - | - | - | <0.00020 | - | - | - | <0.00020 | - | - | - | <0.00020 |
| Uranium (U) | mg/L | | <0.00010 | | - | - | - | - | - | - | - | <0.00010 | - | - | - | <0.00010 | - | - | - | <0.00010 |
| Vanadium (V) | mg/L | | <0.00020 | | - | - | - | - | - | - | - | <0.00020 | - | - | - | 0.00029 | - | - | - | <0.00020 |
| Zinc (Zn) | mg/L | | <0.0020 | | - | - | - | - | - | - | - | <0.0020 | - | - | - | 0.0036 | - | - | - | <0.0020 |
| Zirconium (Zr) | mg/L | | <0.00040 | | - | - | - | - | - | - | - | <0.00040 | - | - | - | <0.00040 | - | - | - | <0.00040 |

**Notes:**
(-)= No guideline available
values in bold and cell shaded yellow exceed CWQG
a = Canadian water quality guidelines for the protection of aquatic
b = Guidelines for Canadian Drinking Water Quality (GCDWQ; Health Canada 2008).
c = Dissolved oxgygen guideline for cold water freshwater biota is
d = Dissolved oxygen for marine species; see CCME 1999 for narrative.
e = Aesthetic objective.
f = Available GCDWQ are for filtration systems and not untreated water.
g = There may be a laxative effect in some individuals when sulphate concentrations exceed 500 mg/L.
h = Toxicity of ammonia relates primarily to concentration of the
i = Guideline is for protection from direct toxic effects and does not consider effects due to eutrophication.
j = Where nitrate and nitrite are determined separately, levels of nitrite should not exceed 3.2 mg nitrite/L.
k = The Canadian Guidance Framework for Phosphorus is for
l = The Canadian Guidance Framework for the Management of
m = Guideline is for free cyanide.
n = Aluminum guideline/objective is pH dependent. At pH <6.5,
o = The GCDWQ for aluminum is an operational guidance value
p = Cadmium guideline is hardness dependent and is calculated
q = Chromium freshwater guideline is speciation dependent and is
r = Chromium marine guideline is speciation dependent and is 56
s = Copper guideline/objective is hardness dependent. At a
t = Lead guideline/objective is hardness dependent. At a
u = Mercury freshwater guideline is for inorganic mercury; this
v = Mercury marine guideline may not fully protect higher trophic
w = Nickel guideline is hardness dependent. At a hardness of 0-
x = Selenium guideline is based on waterborne exposure.
y = The maximum acceptable concentration of *Escherichia coli* in

**Comment made by Interested Party: Aboriginal Affairs and Northern Development Canada (AEM Reference: Information Request #13)**

*We suggest that the Proponent commit to managing ponded borrow pit water, if it occurs, so as to avoid potential deleterious effects to downstream surface water bodies due to release of this water (i.e. could have higher dissolved concentrations of metals or low pH).*

**AEM's Response to Information request:**

AEM commits to managing ponded quarries/borrow pit water so as to avoid potential deleterious effects to downstream surface water bodies.

**Comment made by Interested Party: Aboriginal Affairs and Northern Development Canada (AEM Reference: Information Request #14)**

*Predictions of potential hydrology and water quality effects were made in a qualitative manner resulting in a subjective pathway assessment. There are potential concerns about the uncertainty associated with the lack of topographic data within watersheds of ephemeral watercourses. This could affect culvert design and/or maintenance over time. The uncertainty of metal leaching of road material near water crossings may be another concern that should be noted by the Proponent and addressed through monitoring during construction.*

*Borrow material used to construct the road should be tested by the Proponent for ARD potential before use at any water crossings (multiple composites at minimum).*

**AEM's Response to Comment:**

As discussed in the Environmental Assessment report, under-estimation in drainage areas may result in minor and short-term surcharging of culvert head ponds and is not anticipated to represent a major environmental risk. However, watershed areas used in culvert design calculations will be reviewed as additional topographic data becomes available during road layout and construction. Culvert designs will be revised if significant discrepancies are found, although this is not anticipated.

As described in the Operations and Maintenance Manual available in Appendix A of the Environmental Assessment report, AEM is committed to a crossing inspection program to identify potential risks to structural integrity and ensure hydraulic function, following construction of the All-weather Access Road (AWAR). This program includes regular crossing inspection and maintenance, event crossing inspection and maintenance, and culvert location inspection. Culverts identified as being potentially undersized will be replaced as required.

The AWAR has the potential to impact water quality through leaching of trace metals from the road building material. The baseline geochemical assessment completed for the project was used to define borrow areas with suitable geochemistry for use in construction, including at water crossings. Confirmatory testing will be completed upon exploitation of the borrow areas, and water quality monitoring will further verify the suitability of the materials.

As stated in the EA report and in the monitoring plan, AEM has committed to monitoring water quality in the watercourses on a monthly basis over the open water period (i.e., late June to September). After the first year of sampling the monitoring program will be assessed and possibly scaled back for future years. Results will be reported to NWB monthly and yearly in an annual report.

**Comment made by Interested Party:** **Aboriginal Affairs and Northern Development Canada (AEM Reference: Information Request #15)**

*There is mention on Page 94 of how the detection limits varied with the chronological timing of the studies; however, there is no discussion on why laboratory detection limits intermittently exceed the guidelines and how this issue was addressed when interpreting the results. Although it is likely that this was addressed in the water quality monitoring study reports conducted in support of this EA and detailed in the analytical results from the lab, an explanation of this should be provided as part of the environmental assessment documentation. Further, since no conclusive statement can be made regarding parameters with detection limits that exceeded the guidelines, the Proponent should address how this will be considered in interpretation of monitoring results.*

**AEM's Response to Comment:**

**1.** ***Discussion on why the laboratory detection limits intermittently exceed the guidelines***

Water quality data in streams and lakes were collected during 10 studies performed between 1994 and 2011 (Table 1). Detection limits varied among the studies. In general, detection limits were higher in the older datasets (e.g., 1997) than in more recent datasets (e.g., 2008/2009). The detection limits used in each study are provided in Table 2.

In general, improvements in analytical procedures resulted in lower detection limits in more recent studies. Analytical methods for metals in water involved acid digestion and instrumental analysis by either atomic absorption spectrophotometry (AAS), inductively coupled argon plasma/atomic emission spectrophotometry (ICP-AES), inductively coupled plasma mass spectrophotometry (ICP-MS), or cold vapour atomic fluorescence spectrophotometry (CVAFS; mercury only). Detection limits were highest in Dillon (1994, 1995) and lowest in more recent studies (e.g., Golder 2008).

Phenols were analyzed by a colourimetric method using an ultraviolet-visible spectrophotometer. Other organic compounds, such as benzene, toluene, ethylbenzene, xylene (BTEX), or total extractable hydrocarbons, were analyzed with a liquid-liquid extraction using an organic solvent followed by capillary column gas chromatography with flame ionization detection (GC-FID) or gas chromatography mass spectrophotometry (GC-MS).

Analytical labs used during these various studies are listed in Table 3.

**Table 3. Water Quality Baseline Studies, 1994 to 2011**

| Report Author(s) | Publication Year | Report Title | Drainages Sampled – Streams | Drainages Sampled – Lakes |
|---|---|---|---|---|
| M.M. Dillon Ltd. (Dillon) | 1994 | Meliadine Project – Baseline Surface Water and Lake Sediment Sampling | None | Peninsula Basins A, B, C, D, E; Lake DI2; Atulik Lake |
| Dillon | 1995 | Discovery Project – Rankin Inlet Area 1995 Environmental Investigations | Atulik Lake | Meliadine Lake; Lake DI1; Atulik Lake |
| RL&L Environmental Services Ltd. (RL&L) | 1998 | Meliadine West Baseline Aquatic Studies: 1997 Data Report | Peninsula Basins A, B, D, G; Meliadine River; Peter Lake | Peninsula Basins A, B, D, G; Meliadine Lake; Peter Lake |
| RL&L | 1999 | Meliadine West Baseline Aquatic Studies: 1998 Data Report | Peninsula Basins A, B; Meliadine River; Peter Lake | Peninsula Basins A, B, D; Meliadine Lake; Peter Lake; Control Lake; Ocean |
| RL&L | 2000 | Meliadine West Baseline Aquatic Studies: 1999 Data Report | Peninsula Basins A, B; Meliadine River | Peninsula Basins A, B; Meliadine Lake; Control Lake |
| RL&L | 2001 | Meliadine West Baseline Aquatic Studies: 2000 Data Report | Peninsula Basins A, B; Meliadine River | Peninsula Basins A, B; Meliadine Lake; Control Lake |
| Comaplex Minerals Corporation (Comaplex) | 2007 - 2010 | Not applicable; data collected under water licence | Peninsula Basin A,B Meliadine River | Peninsula Basin A, B, Control Lake |
| Golder Associates Ltd. (Golder) | 2008 | Meliadine West Gold Project: Water Quality Baseline Studies 2008 | Peninsula Basins A, B; Meliadine River; Meliadine Lake; Atulik Lake | Peninsula Basins A, B; Meliadine Lake; Atulik Lake; Control Lake |
| Golder | 2009 | Meliadine Gold Project: Aquatics Baseline Synthesis | None (Summary of previous studies) | Peninsula Basins A, B; Meliadine Lake; Atulik Lake; Control Lake |
| Golder, | 2011 | Meliadine Gold Project: 2011 Field Program | Peninsula Basins B; Meliadine River; Char River; Watercourses along AWAR | Peninsula Basins B, D,E, H; Meliadine Lake; Control Lake |
| AEM | 2010 - 2011 | Not applicable; data collected under water licence | Peninsula Basins A, B; Meliadine River | Peninsula Basin A, B, Control Lake |

**Table 4. Detection Limits Used in the Baseline Studies**

| Parameter | Units | 1994/ 1995[a] | 1997[b] | 1998[c] | 1999[d] | 2000[e] | 2007[f] | 2008[g] | 2009 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Conventional Parameters (Laboratory-Measured)** | | | | | | | | | | |
| pH | pH units | 0.01 | 0.05 | N/A | N/A | N/A | 0.1 | 0.01 or 0.1 | 0.1 | 0.1 |
| Conductivity | µS/cm | 1 | 0.3 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 or 2 | 0.2 | 0.4 |
| Total Dissolved Solids | mg/L | N/A | 10 | 1 | 1 | N/A | N/A | 5 or 10 | 5 | 5 |
| Total Alkalinity | mg $CaCO_3$/L | N/A | 0.3 | 1 | 1 | 5 | 5 | 2 or 5 | 5 | 1 |
| Total Hardness | mg $CaCO_3$/L | 0.01 | 0.09 | 1 | 1 | 1 | N/A | 0.7 | N/A | 0.3 |
| Total Suspended Solids | mg/L | 1 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 5 |
| Turbidity | NTU | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | N/A | N/A | 0.1 |
| **Major Ions** | | | | | | | | | | |
| Bicarbonate | mg/L | N/A | 0.3 | 1 | 1 | 5 | 5 | 5 | 5 | 2 |
| Calcium | mg/L | 0.05 | 0.03 | 0.05 | 0.05 | 0.004 | 0.5 | 0.1 or 0.5 | 0.05 or 0.1 | 0.1 |
| Carbonate | mg/L | N/A | 0.3 | 1 | 1 | 5 | 5 | 5 | 5 | 0.6 |
| Chloride | mg/L | 0.5 | 0.08 | 0.05 | 0.05 | 1 | 1 | 0.5 or 1 | 0.5 | 0.5 |
| Fluoride | mg/L | 0.02 | N/A | N/A | N/A | N/A | N/A | 0.02 or 0.05 | N/A | 0.1 |
| Hydroxide | mg/L | N/A | N/A | 1 | 1 | 5 | 5 | 5 | 5 | 0.4 |
| Magnesium | mg/L | 0.01 | 0.005 | 0.01 | 0.01 | 0.004 | 0.1 | 0.1 | 0.05 or 0.1 | 0.01 |
| Potassium | mg/L | 0.010 or 2 | 0.002 | 0.01 | 0.01 | 0.005 | 0.5 | 0.5 or 2 | 0.05 or 2 | 0.02 |
| Reactive Silica | mg/L | N/A | 0.005 | 0.1 | 0.1 | 0.1 | 0.1 | N/A | N/A | N/A |
| Silicate | mg/L | 1 | N/A | N/A | 0.05 | N/A | 0.5 | N/A | N/A | N/A |
| Sodium | mg/L | 0.01 | 0.02 | 0.1 | 0.1 | 0.005 | 1 | 1 or 2 | 0.05 or 2 | 0.03 |
| Sulphate | mg/L | 1 | 3 | 0.05 | 0.05 | 0.05 or 0.5 | N/A | 0.5 | 0.5 | 0.5 |
| **Organic/Inorganic Carbon** | | | | | | | | | | |
| Total Carbon | mg/L | N/A | 0.2 | 0.5 | 0.5 | N/A | 1 | 0.5 or 1 | 1 | N/A |

| Parameter | Units | 1994/ 1995[a] | 1997[b] | 1998[c] | 1999[d] | 2000[e] | 2007[f] | 2008[g] | 2009 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|
| Total Organic Carbon | mg/L | N/A | 0.2 | 0.2 | 0.5 | 0.5 | 1 | 0.5 or 1 | 1 | N/A |
| Dissolved Organic Carbon | mg/L | N/A | N/A | N/A | N/A | N/A | N/A | 0.5 | 1 | N/A |
| Total Inorganic Carbon | mg/L | N/A | 0.2 | 0.2 | 0.5 | 0.5 | N/A | 0.5 or 1 | 1 | N/A |
| **Nutrients and Chlorophyll *a*** | | | | | | | | | | |
| Total Ammonia | mg N/L | N/A | 0.002 | 0.005 | 0.005 | 0.005 | 0.05 | 0.02 or 0.05 | 0.05 | 0.05 |
| Nitrate | mg N/L | 0.005 | 0.008 | 0.006 | 0.006 | 0.006 | 0.1 | 0.005 to 0.1 | 0.05 | 0.05 |
| Nitrite | mg N/L | 0.001 | N/A | N/A | N/A | N/A | 0.05 | 0.001 to 0.05 | 0.05 | 0.05 |
| Nitrate-Nitrite | mg N/L | 0.005 | 0.008 | 0.006 | 0.006 | 0.006 | 0.1 | 0.1 | 0.071 | 0.071 |
| Total Kjeldahl Nitrogen | mg/L | N/A | 0.01 | 0.05 | 0.05 | 0.05 | 0.2 | 0.05 to 0.2 | 0.2 | N/A |
| Total Phosphorus | mg/L | 0.3 | 0.002 | 0.001 | 0.001 | 0.001 | 0.02 | 0.001 or 0.002 | 0.001 | 0.01 |
| Dissolved Phosphorus | mg/L | N/A | 0.002 | 0.001 | 0.001 | 0.001 | 0.02 | 0.001 or 0.002 | 0.001 | N/A |
| Orthophosphate | mg/L | N/A | 0.002 | 0.001 | 0.001 | 0.001 | 0.01 | 0.001 | 0.001 | N/A |
| Chlorophyll *a* | µg/L | N/A | 0.01 | 0.01 | 0.01 | 0.01 | N/A | 1 | N/A | N/A |
| **Cyanides** | | | | | | | | | | |
| Total Cyanide | µg/L | N/A | N/A | 1 | 2 | 2 | N/A | 2 or 5 | 2 | 2 |
| **Total Metals** | | | | | | | | | | |
| Aluminum | µg/L | 200 | 0.5 or 5 | 0.3 | 0.3 | 0.3 | 10 | 0.3 or 5 | 5 or 8 | 5 |
| Antimony | µg/L | 200 | 0.1 | 0.03 | 0.03 | 0.03 | 0.4 | 0.03 to 0.5 | 0.2 to 0.5 | 0.2 |
| Arsenic | µg/L | 0.1 | 0.2 | 0.03 | 0.03 | 0.03 | 0.4 | 0.03 to 0.5 | 0.02 to 3 | 0.2 |
| Barium | µg/L | 10 | 0.1 | 0.05 | 0.05 | 0.05 | 3 | 0.05 to 20 | 1 or 20 | 0.2 |
| Beryllium | µg/L | 5 | 0.1 | 0.2 | 0.2 | 0.2 | 1 | 0.2 or 1 | 1 | 0.2 |
| Bismuth | µg/L | 100 | 0.1 | 0.05 | 0.03 | N/A | N/A | N/A | 1 | 0.2 |
| Boron | µg/L | 100 | N/A | N/A | N/A | 1 | 50 | 1 to 100 | 50 to 100 | 10 |
| Cadmium | µg/L | 0.2 | 0.1 | 0.1 | 0.02 | 0.05 | 0.1 | 0.017 or 0.05 | 0.01 | 0.01 |

| Parameter | Units | 1994/ 1995[a] | 1997[b] | 1998[c] | 1999[d] | 2000[e] | 2007[f] | 2008[g] | 2009 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|
| Cesium | µg/L | N/A | 0.1 | 0.1 | 0.1 | N/A | N/A | N/A | N/A | 0.1 |
| Chromium | µg/L | 15 | 0.2 | 0.06 | 0.06 | 0.06 | 5 | 0.06 or 1 | 1 or 4 | 1 |
| Cobalt | µg/L | 15 | 0.1 | 0.1 | 0.1 | 0.1 | 2 | 0.1 to 2 | 0.3 | 0.2 |
| Copper | µg/L | 10 | 0.1 | 0.6 | 0.6 | 0.6 | 1 | 0.6 or 1 | 1 | 0.2 |
| Iron | µg/L | 30 | 12 | 10 | 5 | 5 | 5 | 5 or 30 | 30 | 100 |
| Lead | µg/L | 1 | 0.2 | 0.05 | 0.05 | 0.05 | 0.1 | 0.05 to 0.5 | 0.5 | 0.09 |
| Lithium | µg/L | 15 | 0.1 | 0.1 | 0.1 | N/A | 3 | 5 or 10 | 5 or 10 | 2 |
| Manganese | µg/L | 5 | 0.1 | 0.1 | 0.1 | 0.1 | 1 | 0.1 to 1 | 0.3 or 1 | 0.3 |
| Mercury | µg/L | 0.05 | 0.01 | 0.01 | 0.02 | 0.02 | 0.1 | 0.02 or 0.002 | 0.02 | 0.05 |
| Molybdenum | µg/L | 30 | 0.1 | 0.06 | 0.06 | 0.06 | 5 | 0.06 to 5 | 1 | 0.2 |
| Nickel | µg/L | 20 | 0.1 | 0.1 | 0.06 | 0.06 | 2 | 0.06 to 2 | 1 | 2 |
| Selenium | µg/L | 0.5 | 1 to 10 | 0.1 | 0.1 | 0.1 | 0.4 | 0.1 to 1 | 0.5 or 1 | 1 |
| Silicon | µg/L | 50 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 50 |
| Silver | µg/L | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.02 to 0.4 | 0.02 | 0.1 |
| Strontium | µg/L | 1 | 0.1 | 0.1 | 0.1 | 0.1 | N/A | 0.1 | 1 | 0.1 |
| Thallium | µg/L | 100 | 0.1 | 0.05 | 0.03 | N/A | 0.1 | 0.03 to 0.2 | 0.2 | 0.1 |
| Tin | µg/L | 300 | N/A | N/A | N/A | N/A | 50 | 0.5 or 50 | 0.5 | 0.2 |
| Titanium | µg/L | 10 | 0.1 | 0.1 | 0.1 | N/A | 1 | 1 or 10 | 10 | 0.2 |
| Tungsten | µg/L | 100 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 1 |
| Uranium | µg/L | N/A | 0.1 | 0.05 | 0.05 | 0.05 | 0.1 | 0.05 to 0.2 | 0.01 or 0.2 | 0.2 |
| Vanadium | µg/L | 30 | 0.1 | 0.1 | 0.05 | 0.05 | 1 | 0.05 to 1 | 1 | 5 |
| Zinc | µg/L | 5 | 0.5 or 5 | 0.8 | 0.8 | 0.8 | 2 | 0.8 to 5 | 5 | 5 |
| **Organic Compounds** | | | | | | | | | | |
| Oil and Grease | µg/L | N/A | N/A | N/A | N/A | N/A | 1 | 500 | N/A | N/A |
| Phenols | µg/L | N/A | 2 | 1 | 1 | 1 | N/A | 1 | N/A | N/A |

| Parameter | Units | 1994/ 1995[a] | 1997[b] | 1998[c] | 1999[d] | 2000[e] | 2007[f] | 2008[g] | 2009 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|
| Benzene | µg/L | N/A | 0.5 | 0.5 | N/A | N/A | N/A | 0.5 | N/A | N/A |
| Toluene | µg/L | N/A | 0.5 | 0.5 | N/A | N/A | N/A | 0.5 | N/A | N/A |
| Ethylbenzene | µg/L | N/A | 0.5 | 0.5 | N/A | N/A | N/A | 0.5 | N/A | N/A |
| Xylenes | µg/L | N/A | 0.5 | 0.5 | N/A | N/A | N/A | 0.5 | N/A | N/A |
| F1 (C6-C10) | µg/L | N/A | N/A | N/A | N/A | N/A | N/A | 100 | N/A | N/A |
| F1 -BTEX | µg/L | N/A | N/A | N/A | N/A | N/A | N/A | 100 | N/A | N/A |
| F2 (>C10-C16) | µg/L | N/A | N/A | N/A | N/A | N/A | N/A | 50 | N/A | N/A |
| F3 (C16-C34) | µg/L | N/A | N/A | N/A | N/A | N/A | N/A | 50 | N/A | N/A |
| F4 (C34-C50) | µg/L | N/A | N/A | N/A | N/A | N/A | N/A | 50 | N/A | N/A |
| Total Volatile Hydrocarbons | µg/L | N/A | 100 | 100 | N/A | N/A | N/A | N/A | N/A | N/A |
| Total Extractable Hydrocarbons | µg/L | N/A | 50 | 50 | N/A | N/A | N/A | N/A | N/A | N/A |
| **Other** | | | | | | | | | | |
| Biological Oxygen Demand | mg/L | N/A | N/A | N/A | N/A | N/A | 2 | N/A | N/A | N/A |
| Fecal Coliforms | CFU/100 mL | N/A | N/A | N/A | N/A | N/A | 1 | N/A | N/A | N/A |

Notes: µS/cm = microSiemens per centimetre; mg/L= milligrams per litre; mg $CaCO_3$/L = milligrams per litre as calcium carbonate; NTU= nephelometric turbidity unit; mg N/L= milligrams per litre as nitrogen; µg/L = micrograms per litre; CFU/100 mL = colony forming unit per 100 millilitres

[a] Source: Dillon 1994/1995. Not all parameters were analyzed in the 1995 samples.

[b] Source: Table 2.2 in RL&L 1998.

[c] Source: Table 2.2 in RL&L 1999.

[d] Source: Table 2.2 in RL&L 2000.

[e] Source: Table 2.2 in RL&L 2001.

[f] Source: S. Barham, Comaplex, 2008, pers. comm.

[g] Source: Golder 2008. Detection limits varied among sample batches (samples were submitted in multiple batches during the spring and summer sampling events).

N/A = parameter not measured or detection limit not provided.

**Table 5. Analytical Laboratories Used in the Baseline Studies**

| Year | Laboratory | Reference |
|---|---|---|
| 1994, 1995 | Analytical Service Laboratories Ltd., Vancouver, BC[a] | Dillon 1994, 1995 |
| 1997 | Taiga Environmental Laboratory, Yellowknife, NT | RL&L 1998 |
| 1998, 1999, 2000 | Enviro-Test Laboratories, Edmonton, AB[b] | R&L 1999, 2000, 2001 |
| 2007 | ALS Laboratory Group, Edmonton, AB | S. Barham, Comaplex, 2008, pers. comm. |
| 2008, 2009, 2011 | ALS Laboratory Group, Edmonton, AB, Vancouver, BC, and Winnipeg, MB | Golder 2008, 2009, 2011 |

[a] Now ALS Laboratory Group, Vancouver, BC.
[b] ALS Laboratory Group, Edmonton, AB.

**2. *Discussion on how lab detection limits that were above guidelines were addressed when interpreting the results***

There was no standardized approach followed for interpretation of results that were less than the detection limit when the detection limit was more than the current water quality guideline. The data were discussed individually.

Historical data for the Meliadine River were considered in this environmental assessment. Detection limits did not exceed guidelines for pH, ammonia-nitrogen, nitrate-nitrogen, nitrite-nitrogen, or total phosphorus. Detection limits for total metals were at or below the Canadian water quality guidelines (CWQG) (CCME 2011) for all metals except cadmium, chromium, and selenium:

- Cadmium was not detected in most samples, although detection limits ranged from 0.017 to 0.1 µg/L, which were at or higher than the CWQG of 0.017 µg/L.
- Chromium was not detected in 7 samples (detection limits ranged from 0.06 to 2 µg/L). One sample from station ML-MR had a detection limit of 2.0 µg/L, which was higher than the CWQG of 1.0 µg/L for hexavalent chromium.
- Selenium was not detected in 9 samples (detection limits ranged from 0.1 to 10 µg/L). Three samples from station ML-MR had a detection limit of 10 µg/L, which was higher than the CWQG of 1.0 µg/L.

***3. How the issue of non-detect will be considered in interpretation of monitoring results***

Water quality guidelines are nationally endorsed indicators of environmental quality for the protection of aquatic ecosystems and designated water uses (CCME 2011; Health Canada 2008). The aquatic life guidelines are based on the most current, scientifically defensible toxicological data and are intended to be protective of all forms and life stages of aquatic life (CCME 2011). Exceedance of a guideline does not, therefore, automatically imply unacceptable or harmful conditions. Guideline exceedances observed during baseline investigations are a result of naturally occurring conditions and thus are not of concern as local flora and fauna will be adapted to these natural conditions in the environment.

These baseline data will be one tool used in future monitoring programs as a means to assess post-development effects and changes to surface water quality. Historical results that were reported as more than the detection limit (where the detection limit is higher than the current CWQG) will be removed from future data interpretations. Only historical data that returned concentrations greater than the detection limit, or where the non-detect was less than the CWQG, will be used to assist in interpreting monitoring results.

Monitoring of the potential effects of the watercourse crossings on water quality will involve the comparison of water quality samples collected upstream of the road watercourse crossing to samples collected downstream of the crossing, to allow detection of differences in water quality directly related to the road construction or operations. It is AEM's belief that this will provide a more robust and powerful analytical method for detection of any changes in water quality directly related to the road, in comparison to pre- versus post- development comparisons.

**References - Reports**

CCME (Canadian Council of Ministers of the Environment). 2011. Canadian Water Quality Guidelines for the Protection of Aquatic Life: Summary Table. Available at http://ceqg-rcqe.ccme.ca/. Accessed September 2011. In: *Canadian Environmental Quality Guidelines, 1999*. Canadian Council of Ministers of the Environment, Winnipeg, MB.

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**References – Personal Communications**

Barham S. 2008. Personal Communication. E-mail from Sandy Barham (Comaplex Mineral Corporation) to Lasha Young (Golder) regarding 2007 water sampling results. October 30, 2008.

**Comment made by Interested Party: Aboriginal Affairs and Northern Development Canada (AEM Reference: Information Request #16)**

*It is recommended that a spill response plan be developed for this project. AANDC would also like to note that all transportation of a Class 3 flammable substances must be conducted in compliance with Transport Canada's Transportation of Dangerous Goods Regulations. Further, vehicles transporting fuel should carry at least 10 square metres of polyethylene material (for lining a trench or depression), a spark-proof shovel & oil absorbent blankets or squares.*

**AEM's Response to Information request:**

A spill contingency plan for the AWAR is attached. The transportation of class 3 flammable substances will be in compliance with regulations under the TDGA. Spill response material in the form of 10 $m^2$ of polyethylene, a spark-proof shovel, and oil absorbent blankets or squares will be carried in the vehicles transporting fuel.

**Comment made by Interested Party: Aboriginal Affairs and Northern Development Canada (AEM Reference: Information Request #17)**

*The report provides no information on the potential impacts on surface water quality related to the use and discharge of water associated with the road construction and maintenance. This should be included in the impact analysis and monitoring plan.*

*The report does not mention using water as a dust suppressant. In drier climates, like the North or in extended times without precipitation, reducing speeds and maintaining the roads alone will not be adequate in suppressing the dust from road traffic. It is recommended that the use of water as a dust suppressant be included in the analysis described above.*

**AEM's Response to Information request:**

Water will not be used in constructing the road and will only be used for dust suppression during operations.

Report section 5.4.4.1 *Pathways with No Linkage* states, *"Dust suppression methods to manage emissions include watering of the road surface in areas prone to high dust levels during post-winter construction and operation, regular maintenance of the road surface, and enforcing the posted speed limits. These management methods should reduce and control emissions, and subsequent potential effects of dust deposition."*

Best practices will be used when applying water as a dust suppressant at select locations along the road. The water will be applied at a rate where it wets the driving surface with little running onto the shoulders. The water will readily evaporate and not reach the surrounding terrestrial environment or nearby water bodies. The use of water as a dust suppressant will have a positive impact in reducing dust.

**Comment made by Interested Party:** **Aboriginal Affairs and Northern Development Canada (AEM Reference: Information Request #18)**

*It does not appear that mitigation measures during installation of culverts to minimize sediment loading at spring freshet (from debris accumulating on snow and ice during winter installation of culverts) have been provided for in the report. It is requested that this be addressed by the Proponent.*

**AEM's Response to Comment:**

Winter construction of the All-weather Access Road will assist in minimizing sediment loading to the channels from installation of the culverts. Nevertheless, Best Management Practices for erosion and sediment control will be applied during construction and installation to prevent entry of sediment into the stream channel during the spring freshet. This would include run-off management techniques, such as the removal of silt-laden debris accumulations from areas with a direct drainage connection to the channel, and isolation of potential sediment sources through strategically placed silt fencing. As described in the Operations and Maintenance Manual provided in Appendix A of the Environmental Assessment report, regular inspections will be carried out at the road crossing structures, particularly prior to and during the critical fish habitat period (1 May to 15 July), to ensure that adequate sediment control measures are in place and working effectively.

**Comment made by Interested Party: Aboriginal Affairs and Northern Development Canada**
**(AEM Reference: Information Request #19)**

*Specific vegetation field survey methods were not provided in the report. Vegetation surveys can provide a range of information depending on the chosen method. The chosen methodology can impact the ability to accurately assess impacts to vegetation as this assessment is dependent on the level of information provided from the field surveys. Details on the vegetation survey should be provided in order to assess the accuracy of the effects assessment.*

*In the effects assessment for vegetation it is stated that no impacts to listed species (species listed under SARA or CESCC) are expected as none were identified in the project footprint. The report does not provide evidence backing this statement as it is not clear where the vegetation survey took place in context of the project footprint. More detail regarding the vegetation survey methods and a location map should be provided.*

**AEM's Response to Comment:**

As noted in Section 5.3.3.2 of the Environmental Assessment, baseline vegetation surveys along the initial All-weather Access Road (AWAR) alignment were carried out in the summer of 2008 (29 to 31 July and 1 to 6 September). Additional baseline vegetation surveys were completed in 1998 and 2009 to collect vegetation data in the Meliadine West Gold Project area and F-Zone pit area, respectively. A total of 416 plots were established, including 337 plots in 1998 in the Meliadine West Gold Project area, 59 plots along the AWAR in 2008, and 20 plots in F-Zone pit area in 2009. A location map of the vegetation surveys is provided in Figure 4-1 (attached) of the Terrestrial and Vegetation Baseline Synthesis Report.

Field survey methods followed previously established protocols that were developed for the Diavik Project (Burt 1997) and other projects, including the Meadowbank Gold Project and the Baffinland Iron Mines Mary River Project (unpublished data). Prior to undertaking the vegetation surveys, preliminary plot locations were identified through a review of 1:50 000 topographical and 1:10 000 airphotos. Vegetation plots were established in a representative location within a given plant association type, and care was taken to avoid transitional areas. A 5x5 m plot size was used to collect vegetation data, including plant species and percent cover information, and a Global Positioning System (GPS) coordinate was taken at the centre of each plot. Information collected at each plot included the following variables:

- plant community association;
- plant species composition and percent cover;
- slope and aspect;
- terrain and microtopography;
- percent surface substrate;
- moisture and nutrient regime;

- incidental wildlife observations (e.g., sightings, signs, habitat use);
- archaeological features;
- site photos (landscape and close-up); and
- other comments.

Wherever possible, vascular plants were identified to the species level in the field; however, reference specimens were collected from the field for some species and later verified using Porsild and Cody (1980) or other references (Vitt et al. 1998; Burt 1991; Aiken et. al. 2007). Lichens were collected and identified using Mosses, Lichens, and Ferns of Northwest North America (Vitt et al. 1998) and On the Lichens of North America (Brodo et al. 2001).

More specific information on the baseline vegetation surveys completed for the Meliadine Project are described in the Terrestrial and Vegetation Baseline Synthesis Report (Golder 2009)

**References:**

Aiken S.G., M.J. Dallwitz, L.L. Consaul, C.L. McJannet, R.L. Boles, G.W. Argus, J.M. Gillett, P.J. Scott, R. Elven, M.C. LeBlanc, L.J. Gillespie, A.K. Brystring, H. Solstad, and J.G. Harris. 2007. Flora of the Canadian Arctic archipelago: descriptions, illustrations, identification, and information retrieval. [CD-ROM] NRC Research Press, National Research Council of Canada, Ottawa

Brodo, I.M., S.D. Sharnoff, and S. Sharnoff. 2001. Lichens of North America Yale University Press. New Haven, Connecticut.

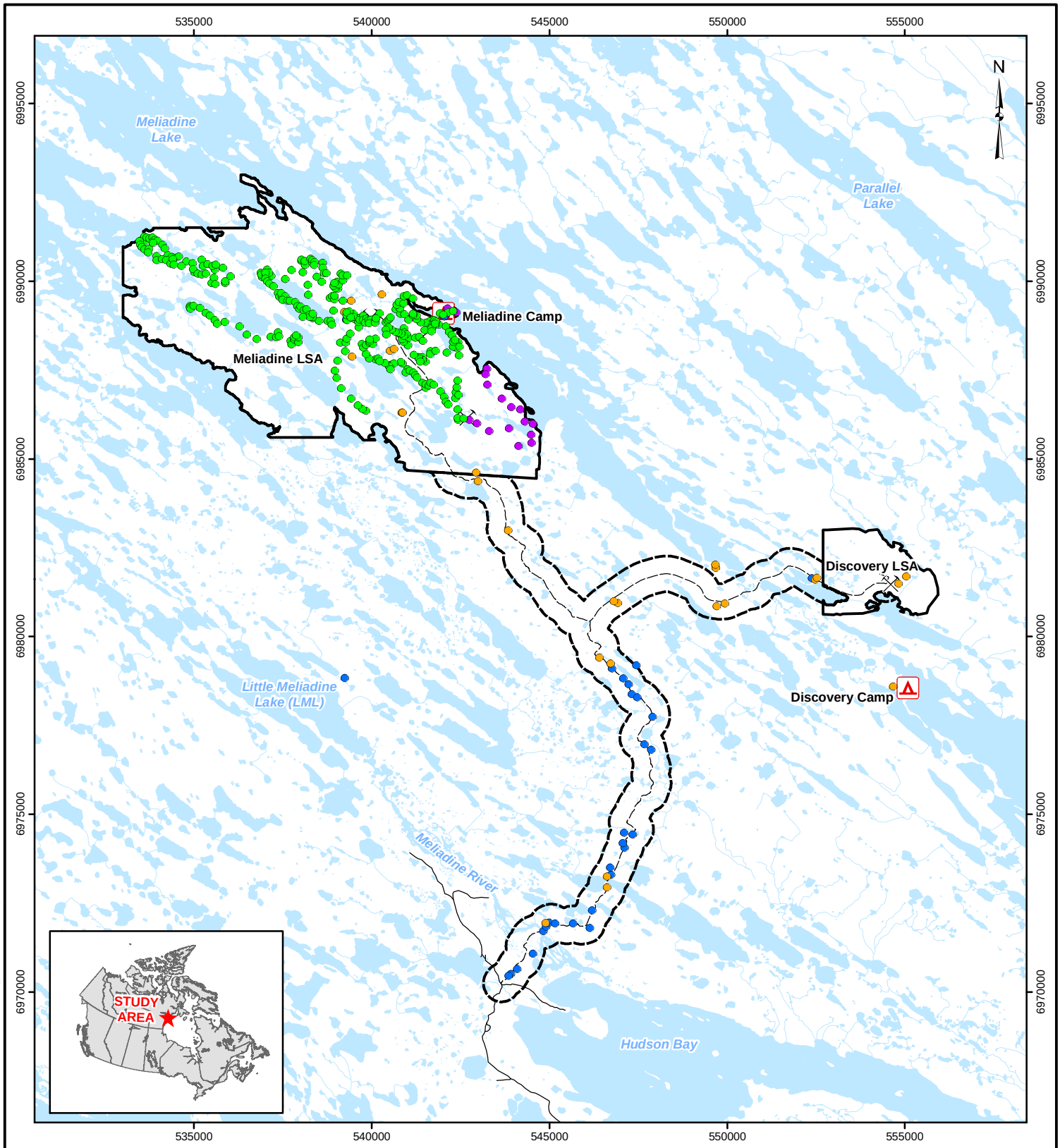
Burt, P. 1991. Barrenland beauties; a field guide to showy plants of the Arctic coast. Outcrop; the Northern Publishers, Yellowknife, NT. 245 p.

Burt, P. 1997. Plant associations and habitat types, and plant species lists. Vegetation Baseline Studies, Diavik Diamond Project, 56 pp. plus Appendices, photos, maps.

Golder (Golder Assoicates Ltd.). 2009. Terrestrial and Vegetation Baseline Synthesis Report. Draft Report Prepared for Comaplex Minerals Corporation.

Porsild, A.E., W.J. Cody. 1980. Vascular plants of continental Northwest Territories, Canada. National Museum of Natural Sciences, National Museums of Canada, Ottawa. 667 p.

Vitt, D.H., J.E. Marsh, and R.B. Bovey. 1998. Mosses, lichens, and ferns of Northwest North America. Lone Pine Publishing, Edmonton, AB. 296 p.




**LEGEND**

- Tissue Sampling Plot
- Vegetation Plot 1998
- Vegetation Plot 2008
- Vegetation Plot 2009
- Camp
- Proposed Mine Site
- Road - Existing
- Proposed Road
- Watercourse
- Local Study Area - Mine
- Local Study Area - Road
- Waterbody

**REFERENCE**

Base data obtained from Comaplex Minerals Corporation. Vegetation data obtained from field survey.
Projection: UTM Zone 15 Datum: NAD 83

DRAFT

PROJECT

COMAPLEX MINERALS CORP

COMAPLEX MINERALS CORPORATION
MELIADINE GOLD PROJECT
NUNAVUT

TITLE

# DISTRIBUTION OF VEGETATION SAMPLE PLOTS IN THE LOCAL STUDY AREA

Golder Associates
Edmonton, Alberta

| PROJECT NO. 09-1373-0010 | | | PHASE No. 1000 | |
|---|---|---|---|---|
| DESIGN | LV | 29 Oct. 2009 | SCALE AS SHOWN | REV. 0 |
| GIS | CDB | 29 Oct. 2009 | | |
| CHECK | LV | 22 Nov. 2009 | | |
| REVIEW | CO | 22 Nov. 2009 | | |

FIGURE 4-1

N:\Bur-Graphics\Projects\2007\1373\07-1373-0055\Mapping\MXD\2009\Vegetation\figure-04-01_sample-plots-vegetation.mxd

**Comment made by Interested Party: Aboriginal Affairs and Northern Development Canada (AEM Reference: Information Request #20)**

*Mitigation measures discussed for reducing impacts to vegetation resulting from dust only refer to selected areas and do not cover the full extent of the AWAR footprint. As such, there may be residual impacts to vegetation within the project boundary but outside the selected areas that have not been included in the assessment.*

*With the absence of mitigation measures within part of the project footprint, this pathway should be changed to "primary" during the construction and operation phases of the project and the resulting impacts to vegetation should be included in the vegetation effects analysis. The potential impacts to vegetation resulting from dust occurring outside the identified mitigation areas will lead to changes in the impact assessment as the loss of vegetation will increase beyond the actual AWAR footprint. Alternatively, mitigation measures that address dust impacts along the entire AWAR should be developed.*

**AEM's Response to Comment:**

Direct and indirect effects of sensory disturbances, as well as dust, from the AWAR are captured as a primary pathway under the wildlife effects assessment in Section 5.3.7.3.2 of the Environmental Assessment. A Zone of Influence (ZOI) of 5 km was used to estimate the potential incremental changes in wildlife habitat (as defined by the regional Ecological Land Cover (ELC) classes) from the AWAR Project, within which a 50% reduction in habitat quality was expected to occur. Thus, indirect effects measured changes in habitat area (i.e., regional ELC classes) as a decline in habitat quality from dust deposition and sensory disturbances (i.e., the ZOI). As discussed in Section 5.1.4.2 of the Environmental Assessment, dust fallout (measured as Total Suspended Particulates) primarily occurs within one kilometre of the source, with the largest depositions occurring within 100 m. Thus, the presented results provide a very conservative estimate of potential indirect effects of dust on vegetation that falls within the ZOI.

Based on the results in Section 5.3.7.3.2 of the Environmental Assessment, indirect incremental changes to vegetation are expected to be less than 1.6% per regional ELC class with the application of the AWAR (Table 5.3.7-4). The heath tundra ELC class will be affected the most by the AWAR and it's ZOI, with a predicted decrease in area of 1.5%. Other regional ELC classes were characterized by incremental declines of about 1% or less with the application of the AWAR. Direct and indirect impacts from the AWAR Project are anticipated to decrease all regional ELC classes by less than 1% (negligible magnitude), with the exception of the heath tundra ELC class (by 1.5%; low magnitude). These effects will be local in regional extent, reversible, and will be continuous over the life of the Project.

**Comment made by Interested Party: Aboriginal Affairs and Northern Development Canada (AEM Reference: Information Request #21)**

*This section discusses mitigation measures designed to reduce direct impacts to wetland habitats (potential habitat for listed plant species) but does not address potential indirect impacts to wetland habitat such as alterations to hydrology (e.g. water drawdown, or flooding) that may also impact potential habitat for listed plant species. The Proponent is requested to discuss impacts to wetland habitat caused by alterations to hydrology, including potential impact to listed plant species.*

**AEM's Response to Comment:**

Indirect impacts to wetland habitat caused by alterations to hydrology from the construction of the All-weather Access Road (AWAR) include the disruption of surface and subsurface water flow, increased sedimentation loading, and changes to nutrient levels. However, it is expected that any impacts to wetland habitat and associated habitats for listed plant species will be minimized through the implementation of current industry accepted best management practices and mitigation during Project construction and operation. By timing the construction of all watercourse crossings and the initial road base over winter when the ground is frozen and water flow is minimal to nonexistent, there is reduced potential for increased ground disturbances (e.g., rutting and compaction), sedimentation, interference with shallow groundwater movement or any other associated hydrological changes that may arise from impediments to surface and sub-surface water flow.

Addition information on effects to hydrology is provided in Section 5.2.4.2 of the Environmental Assessment, which concluded that there were negligible impacts to hydrology. This is also discussed in Sections 5.3.4.1 of the Environmental Assessment under the following pathway:

- Loss or alteration of local flows, drainage patterns (distribution), and drainage areas from the AWAR Project footprint can cause changes to terrain and soils, vegetation, and wildlife habitat.

Water diversions are not required for the development of the AWAR Project footprint. However, the AWAR will require culvert installations for 8 ephemeral streams and the installation of 3 single span bridges (at Char, Meliadine, and M5.0 watercourses) (see Section 5.2 of the Environmental Assessment). The installation of these cross-drainage structures to prevent roads from impeding water flow should not affect soils, vegetation, and wildlife habitat outside of the road and borrow area footprints. They will provide a design conveyance for 1:25 year event without overtopping the roadway, which will result in minor changes in local stream velocities at the cross-drainage structures, but no measurable affect to broader patterns in drainage and drainage areas.

The alteration to local flows from the cross-drainage structures are predicted to result in no detectable changes to terrain and soils, vegetation, and wildlife habitat upstream or downstream of the road footprint. This pathway was determined to have no linkage to effects on the terrestrial environment.

As noted in Section 3.2.1 of the Environmental Assessment, the road will be inspected by the AEM Road Supervisor during operations to identify any areas where unexpected ponding of water occurs and, if any areas of substantial ponding of water along the road are observed, corrective actions will be taken to address the problem (e.g., additional cross-drainage structure added).

**Comment made by Interested Party: Aboriginal Affairs and Northern Development Canada (AEM Reference: Information Request #22)**

*This section states that impacts to listed plant species is predicted to be negligible as none were recorded, however the report does not confirm that vegetation surveys included the higher quality habitat located within the AWAR footprint such as Tussock-Hummock or Low Shrub Ecological Land Classification classes. The Proponent should clarify and adjust conclusions in consequence.*

**AEM's Response to Comment:**

Vegetation surveys were completed in a variety of habitats along the All-weather Access Road (AWAR) footprint, including the Tussock-Hummock and Low Shrub Ecological Land Classification Classes, which are associated with a higher potential for supporting listed plant species. Specific details on the baseline vegetation surveys are provided in the Terrestrial Baseline Synthesis Report (Golder 2009).

As stated in Section 5.3.6.3 of the Environmental Assessment, the predicted effects to listed plant species is considered to be negligible to low, as no populations of listed plant species were noted during the vegetation surveys along the AWAR, and the alignment of the AWAR and associated borrow / quarry sites has been designed to avoid wetlands and riparian areas as much as possible.

**References**

Golder (Golder Assoicates Ltd.). 2009. Terrestrial and Vegetation Baseline Synthesis Report. Draft Report Prepared for Comaplex Minerals Corporation.

**Comment made by Interested Party: Aboriginal Affairs and Northern Development Canada (AEM Reference: Information Request #23)**

*Monitoring programs for vegetation do not include monitoring for the presence of listed species within the AWAR footprint. Where suitable habitat has been identified with the footprint, pre-construction surveys should be undertaken targeting potential listed species within key Ecological Land Classification classes. Monitoring programs should also include effects monitoring to assess potential indirect impacts to wetland habitat located adjacent to the AWAR footprint.*

**AEM's Response to Comment:**

As mentioned in IR#22, vegetation surveys were completed in a variety of habitats along the All-weather Access Road (AWAR) footprint, including the Tussock-Hummock and Low Shrub Ecological Land Classification Classes, which are associated with a higher potential for supporting listed plant species. Specific details on the baseline vegetation surveys are provided in the Terrestrial Baseline Synthesis Report (Golder 2009). As no populations of listed plant species were noted during these surveys, AEM feels that additional pre-construction monitoring is not warranted at this time.

As stated in Section 5.3.6.7 of the Environmental Assessment, the vegetation monitoring program includes provisions for monitoring to track conditions and implement further mitigation as required. This includes monitoring for invasive plant species (weeds) not indigenous to the pre- AWAR area where the plant was introduced as a result of the construction and operation of the AWAR, and implementation of a weed management plan, if required. In addition, follow-up monitoring programs for listed plant species and indirect impacts to wetlands adjacent to the AWAR footprint will be implemented, as required. The follow-up monitoring to assess potential indirect impacts to wetlands adjacent to the AWAR footprint will include the development of a post-construction monitoring program to assess changes in wetland function and develop appropriate mitigation measures based on current best practices and adaptive management strategies. A follow-up monitoring program for listed plant species to confirm if any listed plant species may be present adjacent to the road footprint in high potential areas such as the Tussock-Hummock and Low Shrub Ecological Land Classification Classes will be undertaken once the road has been completed.

A protocol to address any listed plants identified adjacent to the road footprint will be developed as follow-up monitoring programs progress. These protocols will adhere to current best practices for listed (rare) plant species conservation and management, and will incorporate adaptive management strategies. In cases where mitigation measures have been implemented to avoid or minimize impacts to listed plant species, a monitoring program will be implemented to monitor listed species populations during the post-construction period.

**Comment made by Interested Party: Aboriginal Affairs and Northern Development Canada (AEM Reference: Information Request #24)**

*This section states that the route for the road was selected "to minimize possible effects on the environment". Although it appears that many factors in relation to this were considered for the routing, permafrost parameters (such as mean annual permafrost temperature, ice content, and thickness of the active layer) appear not to have been considered.*

*While the report does indicate that two thicknesses of the road embankment will be considered, depending on permafrost conditions (1 m for stable permafrost and 1.3 m for unstable (thaw susceptible) permafrost), the risk of destroying permafrost is considerably higher if the road follows ice rich permafrost. It is recommended that the Proponent describe how the choice of alignment considered avoidance of crossing terrain with ice rich permafrost.*

*Also, the design provides quantitative assessment of both the 1m and 1.3 m embankment thicknesses. Quantitative assessment should also be provided for both stable permafrost and unstable permafrost situations, and definitions for these conditions should be included in the assessments.*

**AEM's Response to Comment:**

The proposed AWAR alignment was selected to minimize construction on thaw susceptible soil (based on the terrain mapping study results). The following additional criteria were considered as part of the route selection process:

- potential quarry locations;
- archaeology;
- minimise watercourse crossings; and
- geometric road design parameters.

Thermal analyses were carried out to assess the minimum road fill thickness to maintain frozen soil conditions given that construction will be carried out during the winter season. The thermal analyses were based on geothermal data collected at the Meliadine Project site since 1998 from thermistors installed to define the permafrost thermal profile in the project area. To date, 37 thermistors have been installed in the project area, in areas proximal to much of the route alignment (Tiriganiaq, F-Zone, Pump, and Discovery deposit areas). The data from these studies have been compared with regional data from the Rankin Inlet area, and are consistent with permafrost conditions there.

The permafrost setting and regional permafrost conditions have been described, and the site conditions are consistent with the Permafrost Map of Canada, which indicates the ground ice content in the region is expected to be between 0% and 10% (dry permafrost). The mean annual surface temperature in the

project area is approximately -7 degrees Celsius. Permafrost having a mean annual temperature less than approximately -4 degrees Celsius is classified as 'cold' permafrost, whereas permafrost having a mean annual temperature greater than approximately -4 degrees Celsius is classified as 'warm' permafrost.

In addition to thermistor installations, specific geotechnical investigations to sample active layer, ice lenses, and permafrost have been undertaken. Ice lenses and ice wedges are locally present on land as indicated by local permafrost features such as palsas. These areas of local ground ice are generally associated with low lying areas of poor drainage.

The thermal analyses indicated a minimum road fill thickness of 1.0 m is required above ice poor subgrade soil or thaw stable soil to maintain the soil in a frozen condition. Similarly, a minimum road fill thickness of at least 1.3 m is required above ice rich subgrade soil or thaw unstable soil.

The results of the thermal analyses and the location of the 1.0 m thick road fill and the 1.3 m thick road fill are provided in "Report on All Weather Access Road Meliadine Gold Project Feasibility Level Design", a supporting document to the Road Environmental Assessment prepared Golder Associates, dated 20 January 2011.

It is expected that on-going, routine maintenance of the road will be required during operations, as is common practice for northern roads. Annual road inspections and maintenance work will be carried out during operation.

**Comment made by Interested Party: Aboriginal Affairs and Northern Development Canada (AEM Reference: Information Request #25)**

*The criteria for selection of the required embankment thickness (1.3 m and 1 m) are not clear from the document. The selection criteria should be clearly described in the text otherwise it is difficult for reviewers to determine if the proposed thickness of the embankment is sufficient to protect permafrost against thawing.*

*Furthermore, the intervals of the road route with the embankment thickness of 1.3 m and 1 m are not shown on any of the maps (routing map and terrain unit route).*

**AEM's Response to Comment:**

A terrain mapping study based on air photo interpretation and field assessment was carried out by Golder Associates (Golder) to describe the geomorphology and surficial geology along the proposed All-Weather Access Road (AWAR) alignment and was summarized in the Golder report, "Geomorphology and Soils – Meliadine Access Road Meliadine Gold Project, Nunavut" dated February 2010.

The report describes the site geomorphology, soils, and permafrost conditions anticipated along the proposed AWAR route. The various periglacial processes to be considered in the selection of the appropriate route alignment are described. The susceptibility of the various terrain units to these processes are defined, and recommendations for route selection in terms of geotechnical considerations and subrade preparation are presented, with consideration given to active layer thickness, and ice content as indicated by the periglacial processes mapped.

Detailed plan maps are provided as appendices to the report, and include the terrain types mapped, as well as classification of these according to their susceptibility to freeze and thaw induced displacement hazard. Low to medium displacement hazard ratings were considered "thaw stable" and included well drained soil, ice poor to frost shattered bedrock material. Medium-high to very high displacement hazard ratings were considered "thaw susceptible" or "thaw unstable" and included poorly-drained, ice-rich, organic, or bog material.

Thermal analyses were carried out to assess the minimum road fill thickness to maintain frozen soil conditions across thaw unstable and thaw stable soils given that construction will be carried out during the winter season. The thermal analyses were based on geothermal data collected at the Meliadine Project site since 1998 from thermistors installed to define the permafrost thermal profile in the project area. To date, 37 thermistors have been installed in the project area, in areas proximal to much of the route alignment (Tiriganiaq, F-Zone, Pump, and Discovery deposit areas). The data from these studies

have been compared with regional data from the Rankin Inlet area, and are consistent with permafrost conditions there. The results of the thermal analyses and the location of the 1.0 m thick road fill and the 1.3 m thick road fill along the proposed AWAR alignment are provided in "Report on All Weather Access Road Meliadine Gold Project Feasibility Level Design", a supporting document to the Road Environmental Assessment by Golder, dated 20 January 2011. (Section 2.0 p. 5, Section 4.4 p. 11-12 and Appendix A figures).

The thermal analyses were carried out using TEMP/W, a 2-dimensional (2-D) finite element thermal modeling package produced by GEOSLOPE International Ltd. The thermal analysis was based on the following:

- estimated thermal properties of the construction materials;
- estimated surface temperature conditions;
- estimated geothermal gradient; and
- 2 simplified cross-sections at a typical location for thaw stable and thaw unstable soils.

The maximum thaw depth at the center of the road based on the analyses was estimated one year and 10 years after road fill placement. The estimated maximum thaw depth in the road fill is 1.0 m for the ice rich subgrade soils and 0.85 m for the ice poor subgrade soils both after the first year, and after 10 years.

Based on the above, a minimum road fill thickness of 1 m was specified above ice poor subgrade soil or thaw stable soil to maintain the soil in a frozen condition. Similarly, a minimum road fill thickness of at least 1.3 m was specified above ice rich subgrade soil or thaw unstable soil.

**Comment made by Interested Party: Aboriginal Affairs and Northern Development Canada (AEM Reference: Information Request #26)**

*It is stated that "to the greatest extent possible, the construction of the AWAR will be carried out during winter months". It should be clarified when winter months start (i.e., when daily air temperature is below $0^{o}C$, or active layer is frozen for full depth?). The winter method of construction is widely used in permafrost regions; however, for the climate conditions of Rankin Inlet area, the winter construction may be limited only to ice rich portions of the road alignment.*

*The report implies that everything will be constructed in winter months, while only road maintenance will be done in summer months. If construction is undertaken during the winter, then methodology for embankment construction/compaction should be described. Based on past experience it is known that proper compaction of frozen granular material will not occur during winter construction, and significant volumes of granular materials will need to be placed during the following summer or subsequent summers to complete construction and properly compact the embankment. Since proper compaction does not occur during winter time, the road will be hardly passable during the summer following winter construction. The road will then require considerable compaction and placement of additional granular material which will require access in summer time to borrow sites, which can lead to undetermined potential impact on the environment, (e.g., wildlife disturbance, dust generation etc). This has been a typical issue for winter construction of northern roads. Construction for stable permafrost can likely be carried out in summer months. As the quality of construction is typically higher for roads built during summer months, the Proponent should further discuss and justify the choice to build the road during winter months.*

*It is not clear that the size of the culverts as currently proposed by the Proponent in construction of the road will be adequate. It is recommended that the Proponent further consider and discuss the likely performance of the small culverts currently proposed, in the severe climate conditions of the project area. The proposed culverts would be at risk of being blocked with ice and snow in winter months, and it is expected that the ice and snow in these culverts would not melt promptly in spring time, impeding a flow of the water through the culvert. This discussion should include consideration of the possibility of using larger culverts as well as the expected monitoring and maintenance, especially in spring, prior to snow melt, to be undertaken to ensure effectiveness of the culverts that are used.*

**AEM's Response to Comment:**

For the purpose of road construction, 'winter months' refers to the period when the active layer is fully frozen. During the onset of winter, the active layer will freeze predominantly from the ground surface, down. Travelling on the tundra before the active layer is fully frozen presents the risk of 'punching

through' of the frozen layer that is initially formed on the surface, and into the non-frozen active layer beneath. In thaw susceptible ice rich or moisture laden soils, this disturbance can result in loss of bearing capacity of the soil materials. Overall, it is anticipated that winter construction will minimize potential disturbances to the tundra, the active layer, and permafrost as described below.

Agnico-Eagle Mines (AEM) has extensive experience with the construction, operation, and maintenance of all weather roads in Nunavut. Examples of such roads are the mine site roads at AEM's Meadowbank Mine, and the Meadowbank Mine all-weather access road, currently the longest all-weather road in Nunavut extending from Baker Lake Nunavut to the Meadowbank Mine. The experience that AEM has gained through the operation and management of the Meadowbank all-weather road has been strongly considered in the selection of the proposed winter construction methodology for the proposed Meliadine all weather access road.

AEM acknowledges that construction during winter months presents unique challenges, specifically relating to quality control of the construction process, which includes the placement and compaction of granular materials, as well as the placement culverts and associates support and compaction around them. Nevertheless, the preferred methodology is to construct during the winter period when the active layer is fully frozen. The expectation is that this methodology will minimize environmental impacts, particularly to the tundra, active layer, and permafrost relative to the alternative of constructing all, or portions of, the road during summer months.

Although a detailed geomorphological evaluation of the proposed route has been developed, and the route itself has been adjusted as much as possible to minimize crossing of thaw sensitive and potentially ice rich soils, while respecting other criteria such as archaeological sites, and wildlife, there is still the potential to encounter thaw sensitive soils. The impact of disturbing ice rich, water laden, thaw sensitive soils during summer construction will be greater than during winter construction, and arguably winter construction will have less impact on such areas. Furthermore, it is anticipated that construction during the winter period will result in less disturbance to wildlife, and potentially less dust generation due to natural mitigation by snow cover. Constructing during summer using dump and doze construction methods, combined with running of large dump trucks from quarries on coarse road fills will result in dust generation, which will fall directly on the tundra, as well as into waterbodies; however this can be mitigated using reduced speed limits and dust suppression methods. Since the road alignment has been selected to minimize thaw susceptible soils, this means that summer construction over thaw stable soils would comprise a significant portion of the overall road length, resulting in a more prolonged and sustained release of dust during construction.

Based on the above, AEM will initially lay down the base layer of the road over its entire length and this will be completed while temperatures remain below freezing. This has the advantage of placing the base

layer on frozen ground and ensuring the active layer remains frozen. It will also alleviate the possibility of thawing and possible problems in ice rich zones. Next the top layer will be added over its length to bring the road up to its specified thickness. This will occur in part when temperatures are above freezing.

The proper compaction of frozen granular material during winter is hampered by the presence of snow drifts and snow accumulation. Efforts will be made to clear snow prior to dumping granular materials. As a precursor to this, however, the current route alignment has been selected in part to follow ridge lines where possible, and to avoid the lee of slopes where snow will accumulate. A study presenting potential areas of snow drifting and snow accumulation along the proposed road alignment has been documented in "Preliminary Snow Drift Assessment of Meliadine All Weather Road from Rankin Inlet to Meliadine Site, Nunavut" dated 30 August 2011. This was forwarded to the NIRB as a separate document.

Although some settlement of the granular materials that have been less than adequately placed and compacted is anticipated, the degree to which thaw subsidence occurs is anticipated to be minimal where these materials overlie thaw stable materials. In areas of thaw susceptible ice rich or saturated soils, the road design requires fills of sufficient thickness to encourage the migration of the active layer into the road fill materials, thus maintaining the underlying thaw susceptible materials in a frozen state. Again, it is understood that less than adequate placement and compaction of the fill materials will result in some thaw subsidence, however it is expected that this can be managed during the first summer season through appropriate road maintenance.

AEM recognizes that the installation of culverts in severe climate conditions may result in potential risks of freezing and plugging during winter. The use of staggered culvert configurations and regular inspection of the road will alleviate some of these risks. Staggered culvert configurations are typical for road construction in the north. The staggered configuration provides multiple flow paths through the road embankment should one of the culverts become blocked with snow or ice.

It is recognized that partial plugging or ice build up from fall freeze-up and snow accumulation is a possibility, particularly within the bottom culverts of a staggered installation. However, the accumulation of melt water in the spring is expected to be drained by the upper culverts as the stage rises from surcharge of bottom culvert. This rise in stage will attenuate inflows and permit drainage of the crossing until thawing of the bottom culvert occurs, minimizing risks of overtopping the road.

As described in the Operations and Maintenance Manual available in Appendix A of the Environmental Assessment for the road, AEM has committed to a crossing inspection and monitoring program including regular crossing inspection and maintenance, event crossing inspection and maintenance, and culvert

location inspection to ensure that cross-drainage structures are adequate and identify potential risks to structural integrity, following construction of the all-weather access road.

**Comment made by Interested Party: Aboriginal Affairs and Northern Development Canada (AEM Reference: Information Request #27)**

*Report Reference: Section 3.1.3, p.19. This section provides cross sections of the bridge design for the Meliadine and Char Rivers. The report states that single span bridges are recommended with the use of piles to support bridge structures. Due to the scale of the drawings in the EA, it difficult to examine detailed information on the cross sections and, as a result, reviewers are unable to assess and comment on the specific designs.*

*It was noted on the drawings, however, that permafrost cuts are expected at the bridge abutments. This contradicts the report's conceptual principle of the road construction which states that there will be no permafrost cuts. Cuts at the river banks can lead to significant development of processes which can potentially lead to damage of bridges and create muddiness at the river banks, change river hydrology, water quality and other related environmental impacts. It is recommended that this apparent contradiction be clarified and conclusions adjusted accordingly.*

**AEM's Response to Information request:**

On December 8th, AEM forwarded to Aboriginal Affairs and Northern Development Canada a CD having a complete set of stamped design drawings for the road, bridges and culverts. These were signed by a professional engineer registered in the NWT/Nunavut. The CD was sent in advance of submitting this information response to the NIRB. These design drawings should provide the information the reviewers were seeking.

The use of bin walls capped with a concrete footing represents a change from the bridge design presented in the Phase 1 – Meliadine All-weather Access Road Project Description and Environmental Assessment. Here piles were depicted supporting the bridges. The exposed bin walls for the bridge and all ancillary structures will be above the ordinary high water mark. The bin walls will serve the same purpose as the piles in supporting the bridge. This design was recommended by an engineer having extensive experience in bridge installation in the north.

While the road itself will not have any permafrost cuts, this is not possible when installing the bin walls. Installation of the bin walls will require excavating and leveling the area in order to have a stable foundation for their placement. The material removed will be included in the road base a minimum of 100 metres from the river. As this work is being done in winter, the bin walls will be placed on frozen ground, which will subsequently remain frozen year round. A geotextile will be placed around the bin wall to cover any exposed fine sediment/soil prior to capping the disturbed and adjoining area with riprap. The riprap will protect the bin walls during major floods as well as ensuring the underlying

permafrost remains permanently frozen. As a result, neither permafrost degradation nor impacts on the rivers/stream are expected.

**Comment made by Interested Party: Aboriginal Affairs and Northern Development Canada**
**(AEM Reference: Information Request #28)**

*In Section 4.2, Valued Components, permafrost is determined as a valued component. Accordingly, it is recommended that a permafrost map of the road alignment be created in which the main quantitative characteristics of the permafrost will be shown (such as mean annual permafrost temperature, thickness of the active layer, and ice content). It is recommended that this estimation should be based on the ice content of permafrost and that ice content together with other permafrost parameters should be shown on a permafrost map which can be used as a basis for determining the thickness of the embankment for the various road sections. Presently, the terrain units map do not provide sufficient information to determine where embankment thickness will be 1 m, where 1.3 m or why the different thickness have been selected. The permafrost map should be a base for determination of the road intervals with embankment thickness of 1 m and 1.3 m. Potential zones of thermo-erosion, thaw settlement and land sliding should also be shown on the permafrost map (this information can be based on the terrain units map).*

**AEM's Response to Comment:**

A terrain mapping study based on air photo interpretation and field assessment was carried out by Golder Associates (Golder) to describe the geomorphology and surficial geology along the proposed All-Weather Access Road (AWAR) alignment and was summarized in the Golder report, "Geomorphology and Soils – Meliadine Access Road Meliadine Gold Project, Nunavut" dated February 2010.

The report describes the site geomorphology, soils, and permafrost conditions anticipated along the proposed AWAR route. The various periglacial processes to be considered in the selection of the appropriate route alignment are described. The susceptibility of the various terrain units to these processes are defined, and recommendations for route selection in terms of geotechnical considerations and subgrade preparation are presented, with consideration given to active layer thickness, and ice content as indicated by the periglacial processes mapped.

Detailed plan maps are provided as appendices to the report, and include the terrain types mapped, as well as classification of these according to their susceptibility to freeze and thaw induced displacement hazard.

The terrain mapping study classified the subgrade soil along the AWAR by displacement hazard ratings based on visual observations of ground ice conditions, soil drainage conditions, and geotechnical testing results on soil samples from hand-dug excavations. Low to medium displacement hazard ratings were considered "thaw stable" and included well drained soil, ice poor to frost shattered bedrock material.

Medium-high to very high displacement hazard ratings were considered “thaw susceptible” or “thaw unstable” and included poorly-drained, ice-rich, organic, or bog material.

Thermal analyses were carried out to assess the minimum road fill thickness to maintain frozen soil conditions across thaw unstable and thaw stable soils given that construction will be carried out during the winter season. The thermal analyses were based on geothermal data collected at the Meliadine Project site since 1998 from thermistors installed to define the permafrost thermal profile in the project area. To date, 37 thermistors have been installed in the project area, in areas proximal to much of the route alignment (Tiriganiaq, F-Zone, Pump, and Discovery deposit areas). The data from these studies have been compared with regional data from the Rankin Inlet area, and are consistent with permafrost conditions there.

The thermal analyses indicated a minimum road fill thickness of 1 m is required above ice poor subgrade soil or thaw stable soil to maintain the soil in a frozen condition. Similarly, a minimum road fill thickness of at least 1.3 m is required above ice rich subgrade soil or thaw unstable soil.

The location of the 1.0 m thick road fill and the 1.3 m thick road fill along the proposed AWAR alignment based on the location of thaw stable and thaw unstable soils are provided “Report on All Weather Access Road Meliadine Gold Project Feasibility Level Design”, a supporting document to the Road Environmental Assessment by Golder, dated 20 January 2011 (Appendix A figures).

**Comment made by Interested Party: Aboriginal Affairs and Northern Development Canada (AEM Reference: Information Request #29)**

*This section is lacking in quantitative information on permafrost temperature, thickness of active layer, and ice content along the road alignment. The report implies that these permafrost characteristics were taken into account when the Proponent determined the required embankment thickness (1 m and 1.3 m), however this is not described or demonstrated in the report. Further, there is no quantitative definition for poor ice permafrost or ice rich permafrost, and these areas are not shown along the road alignment on any of the maps provided in the report.*

*It was also stated on page 223, that the active layer thickness will likely be re-equilibrated in quarries. This is possible in rock quarries, but may not happen in borrow sources containing granular materials, such as esker sand and gravel where presence of ice rich glacio-fluvial deposits or massive ice may result in progressive increase of the active layer and even formation of a talik or thermokarst pond.*

*The Proponent's conclusion is that the effect of snow drifts may result "in deepening of the active layer at the toe of the side-slope" may only be partially accurate. Significant snow drifts in the given severe climate conditions, where snow melting will only occur in part of summer, may result in swamping of the snow drift areas and degradation of the ground vegetation.*

*It is stated on page 226 that "accumulation of water within quarries will result in a deepening of the active layer". This is likely, however, the accumulation of the water, as noted above, may result in formation of taliks or thermokarst ponds. It is recommended that calculations be carried out to assess the maximum water depth in the quarries as a function of quarry dimension and expected snow thickness, which will not result in formation of the taliks.*

*It is therefore recommended that the following be added to the report:*

1. *Produce a permafrost map for the road alignment which provides information on quantitative permafrost characteristics such as thickness of active layer, mean annual permafrost temperature, and ice content below the active layer.*
2. *Provide a map to show the locations of borrow sites where ice rich permafrost can be encountered, requiring specific methods of excavation.*
3. *Determine and map locations along the proposed road where significant snow drifts can be accumulated resulting in swamping and degradation of ground vegetation.*
4. *Provide an estimation of the maximum water depth within excavated borrow sites which will not result in formation of taliks. Also provide recommendations on how to maintain this water depth, without enabling the depth to increase (water management plan).*

**AEM's Response to Comment:**

Ice rich permafrost, as defined by van Everdingen (1998), is thaw-sensitive permafrost containing excess ice. It is recognized as a qualitative term. Van Everdingen defines thaw sensitive permafrost as "... perennially frozen ground, which, upon thawing, will experience significant thaw settlement and suffer loss of strength to a value significantly lower than that for similar material in an unfrozen condition...." Excess ice refers to the volume of ice in the ground exceeding the total pore volume that the ground would have if it were to exist in its natural unfrozen condition. A soil containing excess ice will experience thaw settlement under its own weight until consolidation is reached.

Responding in order of the numbered information requests above:

1. See responses to IR's 24, 26, 31.
2. See response to IR 35.
3. See response to IR 33.
    a. Excerpt from IR 33.
        i. A study presenting potential areas of snow drifting and snow accumulation along the proposed road alignment has been documented in "Preliminary Snow Drift Assessment of Meliadine All Weather Road from Rankin Inlet to Meliadine Site, Nunavut" dated 30 August 2011. This document presents the potential locations for snow drift accumulation along the proposed route. The information presented in the document will be used to operate and maintain the road, along with the geomorphology report and experience gained by Agnico-Eagle Mines in the operation and maintenance of the all weather access road to the Meadowbank Mine, north of Baker Lake. The Meadowbank Mine access road is currently the longest road constructed, operated, and maintained in Nunavut.
4. The maximum water depth within the excavated borrow sites that will not result in formation of a talik can be estimated based on knowledge and understanding of the thickness of ice that typically forms on lakes in the project area. As an estimate, lakes which freeze to their bottom annually will not form a talik. Studies of ice thickness in the project area date to 1998. Based on these studies, ice thicknesses of lakes in the project area range from about 1.5m to about 2.0 m. Therefore, the maximum water depth that will not result in the formation of a talik is estimated to be between 1.5 m and 2.0 m. Water depths greater than this will form taliks.

    The development of the potential excavated sites will consider the general topographic relief, and should be planned in such a way that they may be graded so that the base promotes drainage away from the base of the excavation. For example, a borrow excavation on a side

slope could be designed with a down-slope access and the highest wall on the up-slope side — essentially a side-hill cut with an open entrance. This would promote drainage from the excavation and minimize ponding of water. Of course there would need to be other considerations, such as downstream receiving environment, proximity to fish bearing streams, and geochemistry of the expose quarry materials, amongst others. Where necessary, these additional considerations will be included during the detailed engineering design of the excavations.

**Comment made by Interested Party: Aboriginal Affairs and Northern Development Canada**
**(AEM Reference: Information Request #30)**

*It is noted that the appendices provide detailed description of terrain units encountered along the road alignment. The terrain unit description and interpretation include such information as ground ice conditions (not quantitative), typical active layer processes, thaw stability, freezing stability, frozen stability, potential need for permafrost design and construction methods, and hazard for thaw and/or freezing induced displacement/aggregate suitability.*

*However, as for the body of the report, the map/legend provided in appendix does not provide quantitative characteristics of the permafrost (mean annual permafrost temperature, thickness of the active layer, and ice content). Furthermore, the scale on the map provided makes it difficult to determine which parts of the road have embankment thickness of 1 m or 1. 3 m. It is recommended that the appropriate mapping be provided as part of the report*

**AEM's Response to Comment:**

Permafrost conditions for the Meliadine Gold Project were assessed based on the results of the mapping of geomorphology and periglacial processes presented in "Geomorphology and Soils – Meliadine Access Road Meliadine Gold Project, Nunavut" dated February 2010, on previous field investigations, on thermal analyses, and on measured ground temperatures.

Geothermal data have been collected at the Meliadine Project site since 1998 from thermistors installed to define the permafrost thermal profile in the project area. To date, 37 thermistors have been installed in the project area, in areas proximal to much of the route alignment (Tiriganiaq, F-Zone, Pump, and Discovery deposit areas). The data from these studies have been compared with regional data from the Rankin Inlet area, and are consistent with permafrost conditions there.

The Meliadine Gold Project is located within the zone of continuous permafrost and has an annual average air temperature of -10.4 ºC based on climate data from Rankin Inlet. The mean annual surface temperature in the project area, based on thermistor installations and the projection of the geothermal gradient, is approximately -7 degrees Celsius. Permafrost having a mean annual temperature less than approximately -4 degrees Celsius is classified as 'cold' permafrost, whereas permafrost having a mean annual temperature greater than approximately -4 degrees Celsius is classified as 'warm' permafrost.

Knowledge of the regional permafrost regime in the project area indicates that the project area is underlain by permafrost, with intervening taliks and thaw bulbs induced by lakes. The assessment indicated that the active layer at Meliadine Gold Project ranges from approximately 1.0 to 3.0 m. (Golder 2011, Section 7.0 p. 49) Therefore, it was assumed that the active layer along the All-Weather Access Road (AWAR) ranges between 1.0 to 3.0 m, since it would be very difficult to obtain ground

measurements at regular intervals along the AWAR alignment at various depths over an appropriate length of time.

A terrain mapping study based on air photo interpretation and field assessment was carried out by Golder to describe the geomorphology and surficial geology along the proposed AWAR alignment and was summarized in the Golder report, "Geomorphology and Soils – Meliadine Access Road Meliadine Gold Project, Nunavut" dated February 2010. The terrain mapping study classified the subgrade soil along the AWAR by displacement hazard ratings based on visual observations of ground ice conditions, soil drainage conditions and geotechnical testing results on soil samples from hand-dug excavations. Low to medium displacement hazard ratings were considered "thaw stable" and included well drained soil, ice poor to frost shattered bedrock material. Medium-high to very high displacement hazard ratings were considered "thaw susceptible" or "thaw unstable" and included poorly-drained, ice-rich, organic or bog material.

Two cross-sections for the road fill were recommended depending on the subgrade soil based on the thermal analyses. A minimum road fill thickness of 1 m is required above ice poor subgrade soil or thaw stable soil to maintain the soil in a frozen condition. Similarly, a minimum road fill thickness of at least 1.3 m is required above ice rich subgrade soil or thaw unstable soil.

The location of the 1.0 m thick road fill and the 1.3 m thick road fill along the proposed AWAR alignment based on the location of thaw stable and thaw unstable soils are provided in "Report on All Weather Access Road Meliadine Gold Project Feasibility Level Design" (Golder 20 January 2011; Appendix A figures), a support document to the Road Environmental Assessment.

**References**

Golder (Golder Associates Ltd.). 2011. Draft - Permafrost Thermal Regime Baseline Studies, Meliadine Golder Project. Submitted to Agnico-Eagle Mines Limited.

**Comment made by Interested Party: Aboriginal Affairs and Northern Development Canada (AEM Reference: Information Request #31)**

*Report Reference: Appendix F-IT3E "Terrain Unit Description and Interpretation" Ground Ice Conditions. Information on the depth to which ice conditions are characterized is not provided? The meaning of the terms "possible near surface" and "limited near surface" related to ice conditions is not clear. The definitions should be provided in the Report.*

*Furthermore the ice content should be shown to some depth below the active layer, not only for active layer, as it was done in the report.*

**AEM's Response to Comment:**

A terrain mapping study based on air photo interpretation and field assessment was carried out by Golder Associates (Golder) to describe the geomorphology and surficial geology along the proposed All-Weather Access Road (AWAR) alignment and was summarized in the Golder report, "Geomorphology and Soils – Meliadine Access Road Meliadine Gold Project, Nunavut" dated February 2010 (Golder 2010).

The terrain mapping study classified the subgrade soils along the AWAR based on visual observations of ground ice conditions, soil drainage conditions, and geotechnical testing results on soil samples from hand-dug excavations. The various periglacial processes to be considered in the selection of the appropriate route alignment were described, and the susceptibility of the various terrain units to these processes were defined. Recommendations for route selection in terms of geotechnical considerations and subgrade preparation were presented, with consideration given to active layer thickness, and ice content as indicated by the periglacial processes mapped.

The mapping study was confined to classifying surficial soils (depth from ground surface of less than 0.6 m) since frozen ground was encountered at depths of 0.30 to 0.60 m in a number of hand-dug pits excavated in late July 2009 (Golder 2010, Section 2.2 p. 4).

Ground ice conditions were also described based on observations from the hand-excavated test pits for the various terrains encountered during the terrain mapping study. The term "limited near surface" was used to indicate areas where ground ice was not readily observed at near surface depths and was not anticipated given observed terrain conditions and vegetation, wheras "possible near surface" was used to indicate where ground ice was not observed at near surface depths but may be present based on the observed terrain conditions and vegetation (Golder 2010, Appendix A). Ice lenses and ice wedges may

be present as indicated by local permafrost features, such as palsas. These areas of local ground ice are generally associated with low lying areas of poor drainage.

The permafrost setting and regional permafrost conditions have been described, and the site conditions are consistent with the Permafrost Map of Canada, which indicates the ground ice content in the region is expected to be between 0 and 10% (dry permafrost). The mean annual surface temperature in the project area is approximately -7 degrees Celsius; permafrost having a mean annual temperature less than approximately -4 degrees Celsius is classified as 'cold' permafrost, whereas permafrost having a mean annual temperature greater than approximately -4 degrees Celsius is classified as 'warm' permafrost.

Ice lenses and ice rich soils typically occur near the base of the active layer. Ice lenses are commonly associated with poorly drained soils, but may also occur in well drained soils if the shape of the base of the active layer does not allow drainage of free water to occur during periods of freezing. The presence of ground ice in fine grained poorly drained soils can have significant implications from the perspective of design of infrastructure, as disturbance of the active layer may cause these materials to subside or flow. This is less a concern with free draining soils, as free water, will drain from these soils as they are loaded. For this reason, thaw susceptible, fine grained soils, are avoided where possible during construction activities.

In addition to thermistor installations, specific geotechnical drilling investigations to sample active layer, ice rich soils, and permafrost have been undertaken in the Meliadine project area. Excess soil moisture content has been measured and evaluated according to depth, and shows a pattern of increasing moisture content near the base of the active layer, suggestive of increasing ice content, followed by a decrease in moisture content. This suggests that the most likely location for ice rich soils and ice lenses to occur is at or near the base of the active layer.

The presence of ice lenses and ice rich soils deeper than the base of the active layer, although possible, is less likely. The basic requirements for the formation of ice rich, ice bonded soils, or ice lenses (a freezing front and a supply of free water) do not typically exist below the base of the active layer, which by definition exists in a physical state below 0 degrees Celsius, and is, therefore, typically frozen. Nevertheless, the possibility exists for historical or relict ice rich soils and ice lenses to exist where changes in active layer thickness may have resulted in these being 'trapped' within the permafrost. However, the likelihood of this is considered to be low, particularly given that the permafrost of the region is classified as 'dry', having less than 10% ground ice content.

**Comment made by Interested Party: Aboriginal Affairs and Northern Development Canada (AEM Reference: Information Request #32)**

*Report Reference: Appendix F-IT3E "Terrain Unit Description and Interpretation" Typical Active Layer Processes. It is implied that there is a difference between frost heave and frost jacking (terms which are synonymous). These terms should be clearly defined so the differences understood by reviewers.*

**AEM's Response to Comment:**

A terrain mapping study based on air photo interpretation and field assessment was carried out by Golder Associates (Golder) to describe the geomorphology and surficial geology along the proposed All-Weather Access Road (AWAR) alignment and was summarized in the Golder report, "Geomorphology and Soils – Meliadine Access Road Meliadine Gold Project, Nunavut" dated February 2010 (Golder 2010).

The terrain mapping study classified the subgrade soil along the AWAR based on visual observations of ground ice conditions, soil drainage conditions, and geotechnical testing results on soil samples from hand-dug excavations. Typical active layer processes were described for various terrains encountered during the terrain mapping study (Golder 2010, Appendix A). Frost Heave and frost jacking as defined in the 1988 National Research Council of Canada document, "Glossary of Permafrost and Related Ground-Ice Terms" (NRC 1998) were used to describe some of the anticipated active layer processes.

Frost heave is defined as the upward or outward movement of the ground surface (or object on, or in, the ground) caused by the formation of ice in the soil. (NRC 1998 p. 35)

Frost jacking is defined as the cumulative upward displacement of objects embedded in the ground by frost action. (NRC 1998 p. 36).

**Comment made by Interested Party: Aboriginal Affairs and Northern Development Canada (AEM Reference: Information Request #33)**

*The report should clearly describe the consequences and expected management of possible improper determination of the stability of the permafrost, and therefore improper choice of thickness of embankment. If there is no change in the thickness of the active layer as a result of the road construction, the processes in the active layer will provide negligible impact on the road stability. A problem for the road stability will however occur if thawing of permafrost to some depth occurs resulting in development of such processes as thaw settlement, sliding, and thermo-erosion.*

**AEM's Response to Comment:**

The construction of the All-Weather Access Road (AWAR) will be carried out based on the engineering design and construction recommendations provided in the supporting document to the Road Environmental Impact Assessment by Golder Associates, "Report on All Weather Access Road Meliadine Gold Project Feasibility Level Design", dated 20 January 2011. The areas of potential thaw stable and thaw susceptible soils have been identified in "Geomorphology and Soils – Meliadine Access Road Meliadine Gold Project, Nunavut" dated February 2010 to the level of detail required for feasibility level engineering design. The construction of the road may require adjustments to be made to the road alignment, fill thicknesses, and fill materials based on the actual ground conditions encountered during construction.

A key requirement for the construction of the road will be to place an appropriate thickness of road fill material according to the subgrade soils and terrain type. A minimum road fill thickness of 1.0 m is required above ice poor, thaw stable subgrade soil to maintain the soil in a frozen condition after winter construction. Similarly, a minimum road fill thickness of at least 1.3 m is required above ice rich, thaw susceptible subgrade soil to maintain the soil in frozen condition after winter construction. The objective of winter road construction is to place a sufficient thickness of road fill over the frozen active layer to insulate it from thawing during summer. By using a sufficient minimum thickness, as determined by thermal modelling, the active layer will migrate into the thaw stable fill materials.

It is possible that in certain areas, fill thicknesses less than recommended or required may be placed. The consequence of this is that the subgrade materials may not remain frozen after winter construction or construction that extends into the summer period (a layer of rock fill will be placed on the entire alignment during winter, immediately followed by placement of the top layer during the spring and summer period), and so may experience thaw subsidence or settlement. In areas of thaw stable soil materials, thaw subsidence may be minor to insignificant, and may include some slumping of the road

edges. Settlement and minor slumping can be managed by annual maintenance of the road, including grading and filling of areas that have settled.

In areas of thaw susceptible soils, the consequence could be more significant thaw settlement, rutting and cracking of the road surface, lateral displacement and settlement of the road embankment fills, water ponding due to interrupted drainage, and subsequent thermal erosion. Management of such events would include annual maintenance of the road, including grading and placement of additional fill materials if necessary to increase the road fill to an appropriate thickness. Thaw susceptible soils often occur in low lying areas, particularly if poorly drained. This can result in the formation of ground ice, which when thawed or disturbed, may result in settlement.

Where possible, water management through the appropriate design and use of culverts will be employed to direct water away from the toe of road embankment areas to avoid ponding at the road edges. Ponding of water can result in thermal degradation of the permafrost and deepening of the active layer, and hence additional embankment instability. This effect can be exacerbated by snow drifting, which typically forms in the lee of raised structures, such as roads, and has the effect of insulating the toe areas of the road embankments, thus preventing penetration of freezing temperatures during winter. Proper snow management and snow clearing methods can be used to reduce the presence and hence impact of snow drifting on the performance of the road structure. In extreme cases, snow fencing may be considered up-wind of certain road sections. However, this would need to be evaluated once the road has been constructed.

A study presenting potential areas of snow drifting and snow accumulation along the proposed road alignment has been documented in “Preliminary Snow Drift Assessment of Meliadine All Weather Road from Rankin Inlet to Meliadine Site, Nunavut” dated 30 August 2011. The Technical Memorandum presents the potential locations for snow drift accumulation along the proposed route. The information presented in the document will be used to operate and maintain the proposed road, along with the geomorphology report and experience gained by Agnico Eagle Mines in the operation and maintenance of the all-weather access road to the Meadowbank Mine, north of Baker Lake. The Meadowbank Mine access road is currently the longest road constructed, operated, and maintained in Nunavut.

All of the potential consequences described above, and the potential construction, management, and maintenance requirements, are common to road construction in the north.

**Comment made by Interested Party: Aboriginal Affairs and Northern Development Canada (AEM Reference: Information Request #34)**

*Report Reference: Appendix F-IT3E "Terrain Unit Description and Interpretation" Potential Need for Permafrost Design and Construction Methods. This title introduces a new term "permafrost design". The meaning of this term is unclear. If it is defined as winter construction then there may be little need for "permafrost design" to be a consideration for construction during summer months. An explanation of the term should be provided.*

**AEM's Response to Comment:**

There was no intention to introduce a new term. The term "Permafrost Design and Construction Methods" is a misnomer; perhaps a more appropriate term is "Design and Construction Methods used in Permafrost Terrain". The term refers to common methods and practices for the construction of infrastructure using design and construction methods that are appropriate for permafrost terrain, irrespective of whether construction occurs during summer or winter months. "Construction during summer" or "construction during winter" can be considered as 2 'methods' of construction in permafrost areas. Construction during summer still must consider permafrost, as permafrost is intimately in contact with the active layer. A benefit of winter construction for certain infrastructure is that the active layer is frozen, and if preserved properly through an insulating layer of appropriate thickness, such as a designed road structure, will remain frozen.

**Comment made by Interested Party: Aboriginal Affairs and Northern Development Canada (AEM Reference: Information Request #35)**

*Report Reference: Appendix F-IT3E "Terrain Unit Description and Interpretation" Hazard for Thaw and/or Freezing Induced Displacement. Aggregate Suitability. Areas where there is high potential for thaw and freezing displacement are not identified. In areas where this potential is high, use of improper road construction methods could lead to permafrost thawing. It is recommended that the permafrost map requested above identify two risk categories: low risk for stable permafrost areas and high for unstable permafrost areas. It is recommended that information on aggregate suitability be taken out from the legend because the embankment will be built over the undisturbed surface (unless cuts are recommended) irrespective of the aggregate suitability.*

**AEM's Response to Comment:**

A terrain mapping study based on air photo interpretation and field assessment was carried out by Golder Associates (Golder) to describe the geomorphology and surficial geology along the proposed All-Weather Access Road (AWAR) alignment and was summarized in the Golder report, "Geomorphology and Soils – Meliadine Access Road Meliadine Gold Project, Nunavut" dated February 2010 (Golder 2010). The terrain types mapped along the proposed access route are tabulated in Appendix A, Terrain Unit Descriptions and Interpretations. The Terrain Classification Codes and Terminology, which follow accepted terrain classification systems, are described in Appendix B. Specific photographs of the terrain types are presented in Appendix C, Site Photographs Terrain Types. Gravel and till sampling locations are presented along with photographs, terrain notes, and particle size distributions in Appendix D. The Terrain Type Map Unit Figures are presented in Appendix E, and finally the susceptibility of the various terrain type to freeze and thaw induced displacement is summarized on a series of figures contained in Appendix F.

The terrain mapping study classified the subgrade soil along the AWAR based on visual observations of ground ice conditions, soil drainage conditions, and geotechnical testing results on soils samples from hand-dug excavations. As part of classifying the terrain types, the suitability of specific areas for aggregate or borrow material source was also assessed (Golder 2010, Appendix A). Terrain types identified in the assessment as potentially suitable aggregate or borrow material sources are 1, 2A, 2B, 3A, 3B, 4A, 4B, 5A, 5B, 6A, 6B, 8, 9A, 9B, 10, 11, 12A, and 12B.

The terrain types associated with the potential aggregate areas can be related to the Terrain Unit Descriptions and Interpretations Table in Appendix A, which provides a qualitative evaluation of the potential for thaw and/or freezing induced displacement. The thaw stability, freezing stability, and

frozen stability of the terrain types are also assessed, and the typical active layer processes expected for each terrain type are described.

Although this is not strictly a risk evaluation, the cumulative information presented in the document, in consideration with the classification of the terrain susceptibility hazard into 'Low', 'Medium', and 'High' categories, can be viewed as an indirect measure of risk to identify 'stable' permafrost (areas of 'Low' freeze and thaw induced displacement hazard), marginally 'stable' permafrost (areas of 'Medium' freeze and thaw induced displacement hazard), and 'unstable' permafrost areas (areas of 'High' freeze and thaw induced displacement hazard). A 'risk' based permafrost map would have a similar appearance to the existing displacement hazard maps, and that sufficient detail already exists to evaluate risk as is presented in the geomorphology report.

**Comment made by Interested Party: Aboriginal Affairs and Northern Development Canada (AEM Reference: Information Request #36)**

*Report Reference: Section 8.0, p. 264 It is not clear that the time between March 2012 and when the ice bearing capacity is lost (i.e. April) will be sufficient to assemble and place the bridges. The Proponent should identify alternatives for the event that this is not possible.*

**AEM's Response to Information request:**

The time between March 1, 2012 and late April was considered adequate by the contractor to build the three bridges. If this proves wrong, the bridges will not be built in early 2012; instead they would be constructed during the winter of 2012 – 2013. This would be a significant setback for the advanced exploration program.

**Comment made by Interested Party: Aboriginal Affairs and Northern Development Canada (AEM Reference: Information Request #37)**

*Report Reference: Section 6.27, p. 254 The proposed road will replace existing trails used as access for traditional activities. The Proponent concludes this effect to be low because 'other trails will be easily established'. Additional discussion is warranted on how re-establishment of the trails (i.e., when, by whom, potential effects) fits in the context of the proposed project.*

**AEM's Response to Information request:**

New trails replacing those covered by the AWAR would only be established should the road be reclaimed. After the road has been scarified, culverts and bridges removed, new trials could still be established on the former road surface.

The draft Reclamation and closure plan for the AWAR[1] states:

> *Decommissioning of the AWAR will be accomplished by loosening compacted surfaces (ripping surface with a dozer mounted ripping unit), flattening side slopes, removing all culverts, and bridges (not including the Char River bridge as this would become the property of the Municipality), and other potential obstructions to drainages paths. The objective is to make the road surface impassable by vehicular traffic by ripping the entire road bed and removing all bridges and culverts along the route. The ripping of the road bed will be accomplished utilizing a CAT D8 dozer with a "ripper" attachment on the back. Successive passes with the dozer longitudinally along the road bed will eliminate the level road surface and make travel difficult (Figure 2). It is anticipated that, in this way, the abandoned former all-weather access road will not be useable by wheeled vehicles (i.e., cars, trucks, and pickups).* ***The road bed would still be useable by ATV or snowmobile and, thus, even after final reclamation, the reclaimed road bed would offer similar passage to the existing set of trails that currently exist and are used by the residents of Rankin Inlet for traditional use purposes.***

[1] The draft Reclamation and Closure Plan for the AWAR was submitted to the Nunavut Water Board on 9 November 2011.

**Comment made by Interested Party: Government of Nunavut – Economic Development & Transportation**
**(AEM Reference: Information Request #38)**

*Socio-economic monitoring: The GN expects that, if the AWAR application is approved by NIRB, AEM will continue to work in conjunction with the Kivalliq Socio-Economic Monitoring Committee (SEMC) on monitoring for relevant socio-economic effects. In their application, AEM has indicated the contractor hired to construct the road has made commitments to the KIA to meet a 50% target for local Inuit employees (section 6.3.3.2). The GN suggests that, where applicable, this and other project-specific socio-economic effects be monitored (local employment for both construction and operations phase of the road; potential impacts that increased income may have on substance abuse; success of proposed training programs; etc.). Monitoring for the AWAR project should be designed to continue to align with current regional monitoring efforts and should be coordinated with any socio-economic monitoring plan that may be established for the proposed Meliadine Gold Project.*

*In Section 6.3.3.5, AEM states a low expectation that the AWAR will bring social change or will have any significant adverse or negative socio-economic effects. However, in their cumulative effects discussion (section 6.3.4), at the bottom of page 261, AEM suggests that people may not make wise decisions with an increased income, leading to potentially negative social issues. AEM has suggested, in Table 6.3.3-1, to work with the Municipality to monitor and develop mitigation for any adverse impacts. The GN suggests also working with government service providers to develop these mitigation measures. For example, through the Kivalliq SEMC, identifying impacts could lead to discussing possible recommendations with key government service providers, such as health and social services or the RCMP.*

**AEM's Response to Information request:**

AEM has always found the Kivalliq Socio-Economic Monitoring Committee to be valuable, and it is our intent to remain an active participant working with other companies and government departments.

AEM commits to monitoring local employment for both construction and operations phase of the road. The bulk of the employment will occur during the construction of the road, which will take approximately six months. Although remaining a possibility, negative social issues will be difficult to monitor over such a short time period. However, AEM sees it important to develop the basis for such monitoring by working with the municipality and other key service providers. This could serve as a proactive step in being prepared should the mine be approved by the Nunavut Impact Review Board. Once the mine is approved, AEM would move quickly to build and operate it, both stages offering considerable employment to the Kivalliq region. It is with this in mind that AEM proposed to monitor adverse social impacts.

**Comment made by Interested Party: Government of Nunavut, Department of Environment (AEM Reference: Information Request #39)**

*The Proponent reminded to inform staff through training that they will not harass wildlife (subsection 71(1) of the Wildlife Act)). This includes persistently worrying or chasing animals, disturbing large groups of animals, and attempting to photograph an animal from an aircraft. Also, the proponent's staff shall not intentionally feed wildlife (subsection 90(1) of the Wildlife Act). This includes leaving food in unsecured locations that wildlife can access (e.g., inside site vehicles).*

**AEM's Response to Information request:**

AEM will ensure its staff and contractors are trained to not harass or feed wildlife.

**Comment made by Interested Party: Government of Nunavut, Department of Environment (AEM Reference: Information Request #40)**

*It is unclear how the Proponent plans to identify and address the potential establishment and spreading of invasive species from the proposed AWAR. Mitigation measures presented in Section 5.3.4.2 provide little information should such species be transported to the region.*

*It should be further noted that the Nunavut Wildlife Act (S.Nu. 2003,c.26) applies to —(a) all terrestrial, aquatic, avian and amphibian flora and fauna that are wild by nature or wild by disposition. At present, the EIS does not adequately demonstrate how the Proponent intends to comply with the invasive species provisions of the Act, Subsection 91(2), which states that —No person shall release a member of a species into a habitat in which that species does not belong or never naturally occurred. Therefore, the DOE is seeking a clarification from the proponent on their intent to be in compliance with the Nunavut Wildlife Act?*

**AEM's Response to Information request:**

Invasive plant species will readily establish on disturbed ground. The shoulders of the road and the borrow pits/quarries will be surveyed for plants establishing shortly after the completion of construction. If they are identified as an invasive species, they will be removed.

AEM intends to remain in compliance with the Nunavut Wildlife Act.

**Comment made by Interested Party:** **Government of Nunavut – Department of Environment (AEM Reference: Information Request #41)**

*While Peregrine Falcons were assessed by the proponent within their application, the location of nest within the Territorial Parks was neglected (Section. 5.3.7.4; Figure 5.3.7-2). The DOE request that the proponent include the location of nests within the Territorial Park in their Impact Assessment for the exemption application.*

**AEM's Response to Comment:**

Raptor nest G98-01, illustrated on Figure5.3.7-2, is within the Territorial Park boundary, and nest G08-02 is on the Park boundary. Any other raptor nests within the Park are outside the local study area, and thus will not be affected by the Project.

**Comment made by Interested Party: Government of Nunavut, Department of Environment (AEM Reference: Information Request #42)**

*It is the DOE's expectation that a standalone wildlife management plan will be developed by the proponent submitted and agreed to by the DOE before the commencement of the exemption Application activities.*

**AEM's Response to Information request:**

AEM remains prepared to develop an AWAR wildlife management plan that meets the satisfaction of the Department of Environment. AEM foresees a basic document at this time, which will be improved over time.

An earlier commitment by AEM to the Department of Environment has been met:

> *AEM commits to developing a wildlife monitoring plan as part of the overall road management plan; this plan will cover all aspects of the road including wildlife interactions. The presence of wolves and other animals along the road will be monitored and recorded.*

AEM recently developed a wildlife monitoring program as one element of an overall monitoring program for the AWAR. This monitoring plan was distributed by the Nunavut Water Board for review and AEM is awaiting comments. It can be found following Information Response #8. Wildlife monitoring is the first component of the wildlife management plan as it is important to know what wildlife will be managed before developing a management plan for the same. This would be combined with residual effects and mitigation measures to protect wildlife to form an overall Plan. As such a wildlife management plan should be a living document which will incrementally be improved as monitoring data is collected and mitigation measures implemented.

**Comment made by Interested Party: Government of Nunavut, Department of Environment (AEM Reference: Information Request #43)**

*With regards to using a specific setback distance for reducing the speed of traffic when wildlife is present within 250m and 100m (Section 3.3.7 pg. 42), the DOE would rather the proponent use a 'line of sight' method, to prevent confusing staff with specific distances. Also, staff should be instructed not to exit a vehicle while on the road to approach and/or photograph wildlife. In addition, attention should be paid to the potential for human encounters with predators. While the proponent has identified that Polar bears are not common in their Local Study Area, observations by community members indicate an increase in Polar bear activity in and around Rankin Inlet. Within the Territorial Park four bears were spotted near the Thule site in the summer of 2011. Interactions with predators are always a possibility. Mortality as a result of an emergency kill can be a significant loss to the community who can request compensation for the loss (Article 6 of the NLCA; subsection 97(3) of the Wildlife Act).*

**AEM's Response to Information request:**

AEM will use the "line of site" method in the future. Also, all employees and contractors will be reminded to remain in their vehicle should wildlife be on or near the road, and to be mindful of predators such as polar bears.

**Comment made by Interested Party: Government of Nunavut - Nunavut Territorial Parks**
**(AEM Reference: Information Request #44)**

*The proponent has identified in Section 3.1 of the Application that the Rock quarry R19 (approximately 500m from the Park boundary) and Borrow pits B19 (approx 800m) and B15 (approx 1200m) as the closest sources to the park boundaries. However, the Feasibility Level Design Report for the AWAR dated Jan 20 2011 identifies an additional quarry R17 (less than 400m away from boundary) on Figure A-1.*

*In close proximity to the proposed road and within park boundaries are archaeological sites KfJm-3 (historical site and popular park attraction), KfJm-31, 32 and KfJm-6, and Park facilities that could be potentially impacted. DoE, Nunavut Parks, is seeking clarification on how many quarries/borrow pits are within the vicinity of the Territorial Park boundaries as well as a mitigation plan to address the potential impacts to historical sites, attractions and facilities within Park boundaries.*

**AEM's Response to Information request:**

The proposed quarries/borrow pits were surveyed this past summer to finalize the selections. No new quarries or pits were proposed but some of the existing sites were dropped. The quarries mentioned in the application and being close to the Park remain unchanged. Quarry R17 was proposed in January 2011 and soon after rejected. While borrow pit B15 is scheduled to be used, B19 is not.

The archaeological sites mentioned are well within the Territorial Park. AEM and its contractors will not enter the Park in constructing the road and bridges, and no significant impacts are foreseen on the Park.

**Comment made by Interested Party:** **Government of Nunavut – Nunavut Territorial Parks (AEM Reference: Information Request #45 & 46)**

*Section 5.1.5.5 outlines a monitoring program; DOE is requesting the development of a noise abatement plan. With that, the DOE (Parks and Special Places Division) is willing to work with the proponent to ensure that monitoring is properly carried out.*

*The DOE is concerned about the increase of dust from the AWAR and its impacts to the Territorial Park, its visitors and natural, cultural and historic features and attractions. The DOE is requesting the development of a dust management plan. The DOE (Parks and Special Places Division) is willing to work with the AEM road supervisor to ensure that monitoring is properly carried out.*

**AEM's Response to Information request:**

Noise abatement and dust management plans are attached to this information request.

**MELIADINE GOLD PROJECT**

# MANGEMENT AND MONITORING PLAN FOR NOISE AND DUST

**for the Phase 1 All-weather Access Road between Rankin Inlet and the Meliadine site**

**December 2011**

**DOCUMENT CONTROL**

| Version | Date | Section | Page | Revision |
|---|---|---|---|---|
| 1 | 11 Dec 2011 | | | First Draft of the Plan |
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## 1. Noise Management and Monitoring Plan

The Phase 1 – Meliadine All-weather Access Road Project Description and Environmental Assessment notes the following:

> *To help verify acceptable construction noise levels are maintained, noise emissions for construction vehicles should be minimized as part of a best management practices plan by ensuring noise control features installed on construction vehicles are maintained and operating according to specifications.*
>
> *For road traffic usage, noise emissions should be maintained by enforced of posted speed limits, maintaining manufacturer's noise control features (i.e., mufflers) for AWAR Project vehicles, and maintaining the road surface to minimize the occurrence of pot holes and ruts.*
>
> *Given the isolated location of the AWAR, it is unlikely that noise from the road will affect human receptors (i.e., permanent residences). There may be areas along the AWAR route (e.g., Iqalugaarjuup Nunanga Territorial Park) where increased noise levels could be a concern from an aesthetic or ecological perspective.*

AEM committed to a *"focused monitoring program will be implemented to collect noise data at the park during the period when construction activities occur in the area. In addition, a limited monitoring program will be undertaken to demonstrate that the predicted noise effects during operations are restricted to the areas immediately adjacent to the AWAR."*

Noise levels are expected to be highest during blasting at quarries, movement of dump truck, loaders and dozers. Many noise sources such as equipment will have built in mitigation features, as provided by manufacturers. Construction will largely during the winter period when Park use is low while road operations will be year round. Construction equipment will be replaced by graders and other maintenance vehicles; trucks, buses and other vehicles delivering materials, fuel and personnel to the Meliadine site.

The mitigation measures that will be applied to all noise sources during construction are summarized as follows:

- schedule noisy construction activities at normal working hours to the extent possible;
- perform regular inspection and maintenance of construction vehicles and equipment to ensure that quality mufflers are installed and worn parts are promptly replaced limit on-site equipment; and
- place rock crushers and other stationary equipment on the floor of the quarry and/or borrow pit as the walls of the quarries will reduce sound transmission.

While road construction is in the immediate vicinity of the Park, AEM will carry out noise monitoring[1] at three select locations along the road. Measurements will be taken immediately next to the road, and at distances perpendicular to it, this being 50, 100, 200, 300 and 400 metres from the road in the direction

[1] Noise measurements will not be taken when the wind speed exceeds 18 km/hr. The noise of the wind above speeds above 18 km/hr will mask any sounds coming from road activities.

of the Park. The noise survey will be repeated up to five times with the climatic conditions and decibel noise readings tabulated.

The following items will be included in a noise monitoring report:

- type of monitoring test conducted (i.e., the construction stage or operation)
- daytime noise limits daytime for the road
- description of the nearest affected receivers
- monitoring locations
- noise instrumentation used
- weather conditions during noise survey
- time and duration of monitoring, including dates
- results of noise monitoring at each monitoring location
- strategies to manage the noise.

The noise monitoring results will be used for the evaluation and review of the noise management plan.

The results of the noise surveys will be filed with the NIRB and Nunavut's Department of the Environment as part of the annual report.

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## 2. Dust Management Plan & Monitoring Plan

The amount of dust generated along the road is dependent on the dryness of the road surface, the number of vehicles, weight and speed, and maintenance of the driving surface. Regular grading of the road combined with the addition of granular material to the driving surface will be needed. This will improve road safety and also reduce the amount of dust. Best management practices will be employed in maintaining and operating the road.

Dust will be monitored through regular inspections of the road dust conditions by the AEM road supervisor during both construction and operation. Dust will be mitigated partly by maintaining posted speed limits. In areas or times identified by the AEM road supervisor as being prone to high dust levels, or areas where safe road visibility is impaired, or in areas where dust deposition is impacting fish habitat and/or water quality, the road supervisor will arrange mitigation measures as appropriate. This could involve actions such as grading of the road surface, placement of new coarser topping, and/or watering of the road surface.

### Monitoring of Dust

The prevailing wind direction at Rankin Inlet is from the north-northwest (NNW), this being away from the Park in relation to the AWAR. This prevailing wind direction is consistent for all months of the year and would blow most road dust away from the Park. All wind directions that could carry dust towards the Park occur on average 25 to 35 percent of the time.

AEM proposes to monitor dust deposition in a similar or equivalent manner as Male and Nol [2], this being:

1. Clean pans of a known size, approximately 34 cm square and 5 cm deep, will be placed on the ground at distances of 0, 5, 10, 25, 50, 75, 100 metres from the road;
2. The pans will be half filled with water and checked daily to ensure they do not go dry;
3. The pans will be left for 72 hours;
4. After 72 hours the water will be collected, which will be filtered through a pre-weighed 5.5. cm Grade 696 VWR filter or its equivalent;
5. The filters will be dried in an oven for 24 hours; and
6. The filters will be re-weighed to determine the mass of dust trapped on the filter.

Dust monitoring in this manner will be carried out three times over the summer period at locations control locations outside the zone of dusting influence and upstream stations selected and downstream stations selected within the potential zone of influence.

As a surrogate, water quality sampling at all water crossings will be carried out upstream and downstream of the road. The downstream water quality will be compared to that upstream of the road and any differences could be due water coming in contact with road building materials or from dust

[2] Male, S.K., and E. Nol. 2005. Impacts of roads associated with the Ekati Diamond Mine, Northwest Territories, Canada, on Reproductive Success and Breeding Habitat of Lapland Longspurs. Canadian Journal of Zoology. 83:1286-1296.

deposited downstream of the road. The upstream sampling location will be at least 100 metres from the road as the dust monitoring results from Male and Nol showed dust measured at 100 metres from a road approaching that measured at control stations. However there is drawback, if there are differences in water quality measured downstream versus upstream, there would not be any way to distinguish between what differences were caused by water contact with road building materials and that by dust.

The results of the dust surveys will be filed with the NIRB and Nunavut's Department of the Environment as part of the annual report.

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**Comment made by Interested Party: Government of Nunavut – Nunavut Parks and Special Locations**
**(AEM Reference: Information Request #47)**

*Presently, the Application does not adequately demonstrate how the Proponent intends to comply with Section 13(e) of The Territorial Parks Act which states - No person shall, in a Territorial Park, operate a motor vehicle, motorcycle or snowmobile except in an area designated for that purpose. With that, Nunavut Parks is requesting the development of a management plan that addresses the potential creation of unauthorized trails/access routes from the proposed AWAR into the Territorial Park.*

**AEM's Response to Information request:**

AEM will not create any unauthorized trails or access routes from the AWAR into the Territorial Park nor allow others to create any part of one on its road land leases.

AEM will have no authority outside of its road leases with the municipality, federal government and Kivalliq Inuit Association, nor will it have the authority to tell residents of Nunavut where they can and cannot go. The enforcement of territorial laws and regulations rests with the Government of Nunavut.