# 9.0 FOLLOW-UP AND MONITORING PROGRAM

## 9.1 OVERVIEW

This chapter describes the Follow-up and Monitoring Program proposed and recommended for the valued environmental components (VECs) presented in this Environmental Impact Assessment (EIA) Report. The program is an integral part of Northcliff's Environmental and Social Management System (ESMS) aimed at verifying environmental effects predictions and the effectiveness of mitigation (Section 2.7.2; Appendix D). The Follow-up and Monitoring Program also provides Northcliff with means of ensuring compliance with applicable laws and regulations, and targets and objectives for continuous improvement it has established for itself within its ESMS. The program also provides Northcliff the means for identifying undesirable change and a basis for adaptive management as required. The Follow-up and Monitoring Program is also proposed and recommended for consideration by the governments of New Brunswick and Canada in determining the follow-up and/or monitoring activities associated with approvals, permits and authorizations required before the Project can proceed, including particularly the formal follow-up that will be required under the *Canadian Environmental Assessment Act* (*CEAA*).

According to Section 16(2)(c) of the *CEAA,* a comprehensive study must consider "*the need for, and the requirements of, any follow-up program in respect of the Project"*. Section 38 of *CEAA* provides further direction and authority to Responsible Authorities (RAs) in the development and implementation of follow-up programs. Similarly, Section 2.6 of the Final Guidelines for the Project (NBENV 2009) requires that the EIA Report outline "*a well-defined program of monitoring and follow-up initiatives regarding environmental effects resulting or potentially resulting from the proposed project*".

Throughout this chapter, "follow-up" is defined, as in *CEAA,* as *"a program for (a) verifying the accuracy of the environmental assessment of a project, and (b) determining the effectiveness of any measures taken to mitigate the adverse environmental effects of the project"*. Though additional monitoring or other requirements may apply to the Project to verify compliance with environmental legislation (*e.g.,* compliance monitoring) or to achieve other goals, such requirements are not considered to be part of a formal follow-up program as defined in *CEAA* and as required to be implemented by Section 38 of *CEAA*. There are several circumstances, however, where monitoring activities are identified in this EIA Report, and these are presented in the appropriate sections below. For clarity to the reader, this chapter will distinguish between measures or recommendations that are defined as "follow-up" (*i.e.,* to verify the environmental effects predictions and/or the effectiveness of mitigation) as distinct from those that are related to "monitoring" (*i.e.,* for demonstrating compliance or for any other purpose outside of the meaning of "follow-up" as defined by *CEAA*).

A follow-up program is required where the limitations in, or scientific certainty of, the environmental effects predictions need to be verified, or where the effectiveness of mitigation requires confirmation. Follow-up measures are proposed where the EIA Report has identified a need to confirm the predictions of the EIA (*e.g.,* when the Study Team's confidence in the significance prediction is low or moderate), or where the effectiveness of mitigation needs to be verified (*e.g.,* for non-standard mitigation or where new technology is being proposed). The nature of and need for follow-up is also informed by the sensitivity of the VEC to potential Project-related environmental effects that may be greater than predicted or where mitigation may be found to be ineffective. Conversely, monitoring is

generally carried out to measure compliance with the requirements of environmental laws or regulations, or the conditions of permits, approvals or authorizations issued under such laws or regulations, or to otherwise measure the environmental performance of the Project. The central goal of monitoring programs is generally to demonstrate compliance.

If circumstances arise during the carrying out of the follow-up or monitoring program that identify a concern with respect to the predictions of the EIA Report or in the effectiveness of mitigation, then the inconsistencies are investigated and through the adaptive management measures (as described in the *CEAA* Operational Policy Statement on adaptive management measures (CEA Agency 2009)) instituted for the Project, additional mitigation can be developed and implemented or other corrective measures can be developed and implemented to address the situation.

This chapter outlines the follow-up or monitoring measures as recommended in the environmental effects assessment this EIA Report. Analysis of the results of follow-up or monitoring carried out during each Project phase will be compared to baseline conditions (established from the information gathered as part of EIA and/or pre-construction monitoring) to verify the accuracy of the EIA predictions and/or the effectiveness of the mitigation, or to demonstrate compliance with environmental requirements, as applicable.

Where required by legislation or permits/approvals/authorizations, the results of the follow-up or monitoring program will be submitted to the appropriate regulatory agencies for review and acceptance. Where follow-up or monitoring results fall outside of those predicted in the EIA Report or beyond an acceptable range, the appropriate regulatory authorities will be consulted to determine an appropriate course of action such as the development of additional mitigation, adaptive management, or further follow-up or monitoring as may be required.

It is noted that some elements of the follow-up or monitoring program described herein are conceptual and presented in this report at a relatively high level. As the Project advances through detailed design, permitting, construction, and into operation, and as follow-up or monitoring programs are carried out, the methodology for each program will be documented and adjusted as necessary to meet the environmental protection commitments made by Northcliff during the EIA review and/or approvals process or to meet the requirements of regulatory agencies, and in concert with updates to the ESMS in achieving Northcliff's commitment to continuous improvement.

## 9.2 ELEMENTS OF FOLLOW-UP AND MONITORING PROGRAM

The Follow-up and Monitoring Program has a number of elements and while the details of each will be specific to the feature of the environment the program is intended to evaluate, there are a number of common elements. Guidance on the elements of a follow-up program has been provided by the Canadian Environmental Assessment Agency (CEA Agency) in its document entitled "Operational Policy Statement: Follow-up Programs under the *Canadian Environmental Assessment Act*" (CEA Agency 2011).

The Follow-up and Monitoring Program is developed to verify the accuracy of the environmental assessment for the Project and can be implemented during any or all phases of the Project: Construction, Operation, and Decommissioning, Reclamation and Closure. Depending on the nature of a project, all phases may have the potential to interact with the environment and this interaction could

result in significant adverse environmental effects if not properly mitigated. Environmental effects can result from a change in the environment that is caused directly or indirectly by the activities associated with the Project.

In order to fully understand any potential changes in the environment, it is necessary to characterize the environmental conditions prior to any Project associated activities as described in the EIA Report. The information gathered to characterize the pre-Project conditions is referred to as "baseline" information. An appropriate level of baseline information must be collected for each VEC to determine the nature of any change in the environmental following the initiation of the Project activities. Baseline information for the measures described in the sections below is available in the Baseline Technical Reports for the Project (Stantec 2012b, 2012c, 2012d, 2012f, 2012g, 2012h, 2012i, 2012j; Knight Piésold 2012d and 2012e)). This information is further summarized in the VECs themselves within Chapter 8 of this EIA Report.

The follow-up component of the program must be designed to measure the changes on the environmental aspects that could result from Project activities. The central goal is to verify the environmental effects predictions of the EIA and most especially when there is uncertainty in those predictions. Based on the anticipated interactions between the various aspects of the environment and the Project, a prediction is made within the EIA Report as to the nature of any potential changes that may result from these activities, and from that the significance of those changes is presented. Follow-up must consider the predictions within the EIA and it must be designed to record parameters that are appropriate to measure and evaluate the accuracy of these predictions. In order to minimize the environmental effects of the change, follow-up must be designed to verify the predictions made in the EIA Report in consideration of the mitigation that will be implemented. The program should be clear as to its purpose. It should identify what will be measured and how that measurement will be made, the duration of the program, and how the results will be documented and reported to regulating agencies and the public, as appropriate.

Another central purpose of follow-up is to evaluate the effectiveness of the planned mitigation. This is accomplished by, where applicable, measuring the conditions in the receiving environment or otherwise evaluating the environment for any emissions or releases from the Project. These releases can take many forms and may include water, air, sediment, noise, or other releases from the Project.

The Project is anticipated to interact with a number of features of the environment as a result of the activities associated with Construction and Operation. This interaction will be more for some activities than for others, and as a result the comprehensiveness of the follow-up or monitoring programs for the specific elements of the environment (*e.g.,* plants, wetlands, groundwater) reflect the nature of the potential interaction with the environment, the anticipated magnitude or extent of the environmental effects, the expected effectiveness of mitigation, and the level of certainty in the environmental effects predictions. As the potential for and consequences of adverse environmental effects increases, so does the comprehensiveness of the follow-up and/or monitoring program in order to meet the requirements and objectives of each program. Within the context of each VEC, some programs will have elements of both follow-up and monitoring, and some will have elements of one or the other. These are described in the sections below.

## 9.3 FOLLOW-UP AND MONITORING PROGRAM IMPLEMENTATION

### 9.3.1 Responsibilities

Northcliff will have the overall responsibility to implement a Follow-up and Monitoring Program including all follow-up and monitoring measures recommended in this EIA Report and as confirmed in the requirements of any Conditions of Approval or other permits or authorizations received for the Project.

This responsibility starts at the highest level of the corporate structure, with the Chief Executive Officer (CEO) and Senior Managers within Northcliff having overall responsibility for the implementation of these initiatives. This responsibility includes ensuring that adequate resources (both personnel and financial) are available to implement the follow-up or monitoring measures. As described in Northcliff's Environmental and Social Management System (ESMS) (Appendix D), lines of authority, responsibility and accountability will be established by specifying and documenting the scope of area or activity for follow-up and monitoring under the control of each functional area or individual. The key roles and responsibilities include those of the General Manager and the various departmental managers.

### 9.3.2 Follow-Up and Monitoring Methods

This section describes the general methods that need to be implemented in order to complete the Follow-up and Monitoring Program as outlined in the EIA Report. Each follow-up measure will be tailored to the potential environmental effect that it is intended to address. Specific details for follow-up and/or monitoring for each VEC as currently conceived are provided in the sub-sections that follow. These measures and methods will be adjusted as necessary as the Project evolves through the regulatory review, approval and permitting processes, and through detailed design, Construction, Operation, and ultimately through Closure into Post-Closure.

#### 9.3.2.1 Collection of Baseline Data

In order to verify environmental effects predictions, and to evaluate the effectiveness of mitigation measures committed to during the EIA process, it is necessary to collect baseline data prior to the initiation of any Construction activities that may result in changes to the environment. Much of these data have been collected as part of the baseline technical studies for the Project, and are being collected though ongoing environmental monitoring programs.

Baseline monitoring is conducted prior to Construction to establish existing conditions for each VEC. Due to the nature of the Project, the natural environment within the PDA will be substantially altered by Construction activities. Therefore, baseline data have been and will be gathered, as appropriate, from locations outside of the PDA (*e.g.*, in particular watercourses, surface waters, and wetlands) in order to ensure the locations for the follow-up testing will remain after the Project is operational. Establishing baseline conditions allows for a comparison with conditions during Construction and Operation to help determine the extent of any Project-related environmental effects, the need for additional mitigation measures, and/or to confirm the effectiveness of mitigation measures that have been or are being implemented.

Details of baseline monitoring that have been or will be carried out for specific environmental features have been described generally in Chapter 8, and are elaborated in more detail in the Baseline Technical Reports (Stantec 2012b, 2012c, 2012d, 2012f, 2012g, 2012h, 2012i, 2012j; Knight Piésold 2012d and 2012e)). Additional baseline data will continue to be gathered as outlined in the sections below. The environmental features identified for follow-up or monitoring (*e.g.,* watercourses, wetlands) are presented on the figures in this EIA Report and will be included in the Project ESMS maps as appropriate. The results of any baseline monitoring not included in this EIA Report will be submitted to the applicable federal and provincial regulatory authorities as appropriate.

Should any new environmentally sensitive features, including species at risk or species of conservation concern, be encountered in the field during baseline monitoring and not covered in any of the monitoring programs described below, the appropriate regulatory authorities will be consulted through the adaptive management measures and additional monitoring or mitigation will be developed and implemented as necessary.

#### 9.3.2.2 Environmental Effects Assessment Predictions

In order to design an appropriate follow-up or monitoring program, the predictions within each of the VEC sections of the EIA Report must be clearly presented. Each environmental effects assessment section in Chapter 8 (*e.g.*, Aquatic Environment, Wetland Environment, and Water Resources) has outlined the predictions of the various study components of the EIA. Over the course of the EIA, mitigation strategies have been identified that require implementation in order to eliminate or minimize the potential adverse environmental effects of the Project to the point where the residual environmental effects are considered not significant.

In order to verify the successful implementation of mitigation or to verify the predictions of the EIA, the measurable parameters around these residual environmental effects must be documented during the development of the Project. This is the basis for the follow-up or monitoring recommendations made in this EIA Report.

Within each VEC, the parameters that warrant measuring in the follow-up program are identified and the measurement and analysis of these parameters form the follow-up methodology. In the follow-up recommendations for each VEC that are presented below, the predictions from the EIA are provided and tied into the follow-up program methodology.

#### 9.3.2.3 Identification of Parameters for Follow-Up or Monitoring

For each follow-up and monitoring recommendation, the specific parameters that require measurement and/or evaluation are described. The potential interactions of Project-related activities with the various features of the environment are well understood. For example, the potential environmental effects from the interactions between surface water and mine tailings are well documented, and chemical and biological indicators for an unanticipated interaction between these components are well known. Therefore, the follow-up or monitoring measures will be designed to measure any changes in the chemistry of surface waters that would indicate the presence of tailings. All follow-up or monitoring initiatives will identify the specific parameters to be measured during the collection of monitoring data and will describe how those same parameters will be measured and/or analyzed for each follow-up or monitoring recommendation.

#### 9.3.2.4 Determination of Frequency of Follow-Up or Monitoring

The follow-up or monitoring recommendations outlined for each VEC will describe the specific requirements for any data and/or parameter sampling, including the timing (*e.g.,* season, time of day, as applicable) and frequency of sampling, and any other requirements to ensure that all samples gathered will provide the sought after information. Different parameters will require different frequencies of monitoring or seasonally specific times for gathering data. The requirements for the timing of the collection of required data is well known and documented. These requirements will be presented in the follow-up or monitoring recommendations outlined in the sections below and confirmed by officials from the various provincial and federal regulatory agencies as warranted.

#### 9.3.2.5 Reproducibility of Follow-Up or Monitoring Results

In order to verify that the results of the follow-up program are providing the necessary information to confirm the EIA predictions and/or verify the effectiveness of mitigation, it will be vital that scientific rigour is applied to the development of the program as well as to the methods of gathering data and samples. The methodology for collecting samples has been or will be established prior to the gathering of the baseline or follow-up samples. Much of this methodology has already been established during the baseline study and monitoring programs instituted for the Project to date. This methodology will be reproduced during the gathering of the samples for the follow-up program in order to make certain that the results collected during Construction and Operation are appropriate for comparison with baseline data gathered either prior to any Project development or for data that is being gathered from an upstream, unaffected source for comparison with downstream receptors.

#### 9.3.2.6 Quality Assurance/Quality Control Procedures

Data gathered as part of any follow-up or monitoring recommendation will be rigorously evaluated to ensure the quality of the results. Each follow-up or monitoring measure will outline the methods required for information and data gathering. All results will be reviewed by appropriate professional personnel either from within Northcliff or its consultants in order to verify the quality of the data.

In the unlikely event that a sample being gathered exceeds the acceptable range for that particular parameter, a verification process will be initiated. This process will ensure that, as applicable, the equipment used to gather the sample was in proper working order and free of contamination. In addition to this, the methodology will be reviewed by knowledgeable professionals to verify that the sample was taken properly, at the correct time, and at the right location. Other quality assurance processes will be applied as applicable including verifying that any laboratory used to analyze the samples received them in a timely fashion and that there were no complications with the analysis. Once these are verified, and any inconsistencies with the prescribed data collection methods are remedied, another sample will be collected and analyzed as soon as possible, in order to verify the outlier reading and to identify and implement any corrective measures. Although a number of steps are described above, it is anticipated that all of these actions can be achieved in a matter of a few hours or days.

In the event that the initial results indicate a contamination issue that must be addressed in a timely fashion, the potential source of the outlier readings will be investigated and any required responses as outlined in Northcliff's ESMS will be implemented to address the nature of the contamination.

Additional samples will be collected until such time as it has been verified whether or not the sampling methodology was completed properly and it is determined that the required mitigation has been implemented and is effective.

### 9.3.3 Community/Stakeholder/Aboriginal Involvement

As described in Section 4.3 and in Northcliff's ESMS (Appendix D), Northcliff has established working relationships with a number of groups which will be continued through the Project EIA review, approval and permitting processes, and into Construction and Operation. Northcliff has committed to a Community Liaison Committee for the Project. Other means for building upon and continuing working relationships with interested groups may be developed as needed to ensure the responsible construction, operation and eventual closure of the Project.

Communication of the results of follow-up or monitoring initiatives to the general public, stakeholders, and First Nations is an essential component of the Follow-up and Monitoring Program to be implemented by Northcliff. Not only does this maintain communication with all parties and keeps them informed of the Project activities and their associated environmental effects, but it also offers the opportunity to incorporate public, stakeholder and First Nation input into the design of these programs and any consequential adaptive management, as applicable. The Community Liaison Committee, and other working groups as may be established, can play an important role in the Follow-up and Monitoring Program.

### 9.3.4 Adaptive Management

As part of the ESMS and adaptive management plan Northcliff will have in place for this Project, the Follow-up and Monitoring Program will be periodically evaluated for effectiveness and appropriateness of the elements of the Program and the parameters being measured and reported. This evaluation will be done in consultation with the appropriate regulatory agencies and as the results of the Program are analyzed. Northcliff will adopt a "continuous improvement" approach and if any elements of the Program warrant adjustment to meet the aim and intent of the Program, then in consultation with regulatory agencies the Program may be adjusted.

### 9.3.5 Documentation and Reporting

It is anticipated that as a condition of approval of the Project, the results of the Follow-up and Monitoring Program or measures being conducted as part of it must be reported to the appropriate regulatory agencies, both federal and provincial, and in particular to the New Brunswick Department of Environment and Local Government (NBDELG). Further, the reporting requirements under the *Metal Mining Effluent Regulations* (*MMER*) are clearly defined within the Regulation and will be adhered to for the duration of the Follow-up and Monitoring Program related to *MMER.*

The Community Liaison Committee, and other working groups as may be established, will also provide opportunities for sharing the results of the Follow-up and Monitoring Program with communities, stakeholder groups and First Nations.

All data and information gathered as part of each follow-up or monitoring measure will be documented using the protocols established for each parameter. These protocols were established during the collection of baseline information and the manner by which they were recorded at that time will be used during the follow-up program to allow for a proper comparison of the results. The results of the baseline sampling are documented in the appropriate Baseline Technical Reports.

Reporting will continue so long as there are follow-up and monitoring activities in place. Once these activities have verified the environmental effects predictions and/or the effectiveness of mitigation, and compliance with required mitigation, the Follow-up and Monitoring Program will cease and reporting will no longer be required. Monitoring for compliance with regulatory permits will continue for as long as is required by the responsible permitting authorities.

Northcliff's commitment to documentation and reporting is further described in Section 2.3.4 of the ESMS for the Project (Appendix D).

## 9.4 PROPOSED FOLLOW-UP AND/OR MONITORING MEASURES

The sub-sections below describe the recommended follow-up and/or monitoring measures for each applicable VEC as recommended in Chapter 8 of this EIA Report.

### 9.4.1 VECs with No Follow-up or Monitoring

Based on the results of the EIA, not all VECs will require follow-up or monitoring. The VECs listed below were determined to not require any follow-up or monitoring measures. This is either because there is sufficient certainty in the environmental effects predictions or the planned mitigation so as to not require follow-up, or the respective environmental features are not present in proximity to the Project, or there will be no or very minimal interaction between the environmental feature and the Project such that follow-up or monitoring is not required. In some circumstances, while follow-up measures are not required, monitoring may be warranted. With the adaptive management plan that Northcliff will have in place for the Project, if there are any unanticipated interactions with any element of the environment that may warrant the development of follow-up or monitoring measures, they will be developed in consultation with the appropriate regulatory agency.

As described in the applicable sections of Chapter 8, no follow-up or monitoring is recommended for:

- Atmospheric Environment;
- Terrestrial Environment;
- Labour and Economy;
- Community Services and Infrastructure;
- Land and Resource Use;
- Current Use of Land and Resources for Traditional Purposes by Aboriginal Persons;
- Heritage Resources (pending results of shovel testing);

- Transportation; and
- Effects of the Environment on the Project.

### 9.4.2 VECs with Follow-up or Monitoring

The EIA recommended that various follow-up or monitoring measures should be established for the following VECs:

- Acoustic Environment;
- Water Resources;
- Aquatic Environment;
- Vegetated Environment;
- Wetland Environment;
- Public Health and Safety; and
- Accidents, Malfunctions, and Unplanned Events.

Further details on the elements of these follow-up or monitoring measures are provided in the following sub-sections.

### 9.4.3 Follow-Up

The follow-up measures from Chapter 8 of the EIA Report are described below for each applicable VEC for which they were recommended. These descriptions are provided in sufficient detail to allow independent judgment as to the likelihood that the measures will deliver the type, quantity and quality of information required to reliably fulfill the objectives of the program. These measures have been developed based on the professional expertise and experience of Northcliff and its consultant, and in consideration of the guidance provided in the Operational Policy Statement on Follow-up Programs (CEA Agency 2011). It is intended that follow-up measures be carried out as long as required to verify the environmental effects predictions or the effectiveness of mitigation, after which they would cease to be carried out, in consultation with regulatory authorities.

#### 9.4.3.1 Aquatic Environment

This section addresses follow-up specific to the Aquatic Environment. Follow-up regarding water quality that is relevant to the Aquatic Environment is addressed in Section 9.4.3.2 in relation to Water Resources.

##### 9.4.3.1.1 Verification of Temperature Modeling Predictions

To confirm the residual environmental effects of Project-related changes in water temperature on the Aquatic Environment, the predictions of the water temperature modeling will be verified. Using a

continuous temperature record from a reference station situated in East Branch Napadogan Brook, the "no-Project" case temperatures will be simulated for hydrometric station NB-2B (Figure 8.4.3) by using existing correlations in water temperature regime between the East and West Branch Napadogan Brook. The simulated "no-Project" temperature series will be compared to the observed temperature record collected at the NB-2B hydrometric station, and exceedances of critical temperature thresholds for different cold water fish species will be counted and compared between the two datasets.

As water temperatures naturally vary between years, and the Project environmental effects on water temperature are different during different periods of the mine life, the validation of temperature-related environmental effects will be carried out at two different time periods during the Operation phase. The first validation will be carried out during the period before discharge is released from the Project (*i.e.,* Years 1 to 7). The second validation period will consist of approximately 10 years of data collected during the Operation phase when potentially warmer discharge may be released from the Project (*i.e.,* after Year 8). The temperature validation will be carried out for the June-September period as this is the most likely time when higher water temperatures may result in physiological stress for cold-water fish.

#### 9.4.3.1.2 Verification of the Changes in Flow and the Predictions of Wetted Perimeter Modeling

Since the compensation for indirect habitat loss in Napadogan Brook is based on predictions of flow reductions resulting from Project activities (Section 7.4), the validity of the flow reduction predictions will be tested at various locations within the Napadogan Brook watershed. Existing hydrometric stations (namely Stations B-2, SB-1 and NB-2B; see Figure 8.4.3) will continue to be monitored throughout Construction and Operation in order to calculate the reductions in stream flow over time.

Stream flows vary with the distribution of precipitation from year to year. Therefore, a proxy station outside the LAA will be used to establish what the stream flow at these stations should be under a given precipitation distribution if there was no Project. Knight Piésold has demonstrated that there is a strong correlation between the flows observed at the Narrows Mountain Brook (NMB) station operated by the Water Survey of Canada to the flows observed at stations within the PDA (Knight Piésold 2012d). The equivalent "no-Project" stream flows at stations within the PDA (at Stations B-2, SB-1 and NB-2B) will be calculated from the NMB station records using equations prepared by Knight Piésold. The stream flow reduction predictions will be validated by comparing the flows calculated from NMB to those observed within the PDA.

The Project-related flow reductions will result in a net loss of wetted area in the Napadogan Brook, and the predicted loss of aquatic habitat has been estimated using a HEC-RAS model (see Section 7.4) for the maximum predicted flow reduction condition in Napadogan Brook. Therefore, the verification of wetted perimeter modeling will be carried out during the first two years of Operation when no surplus water from the Project is being released.

The validity of the wetted perimeter predictions will be tested by comparing model predicted wetted perimeter to field data that will be collected following Construction The validation will be carried out on approximately 20 transects, situated between Bird Brook and the mouth of Napadogan Brook, in order to capture the maximum range of flow alterations along the affected watercourse. The observed wetted perimeter will be compared to the wetted perimeter simulated for the closest equivalent stream flow rate

using the HEC-RAS model. The model-simulated pre-Project wetted perimeter will also be calculated, and used to estimate the Project-related change in wetted perimeter.

#### 9.4.3.1.3 Monitoring of Total Suspended Solids and Embeddedness During Construction

Active monitoring of total suspended solids (TSS) in surface water will be carried out to confirm the effectiveness of implemented mitigation related to the construction of the Project facilities (*e.g.,* TSF, Open pit). The monitoring will evaluate whether the erosion and sedimentation control techniques that are employed throughout the site preparation activities are effective in minimizing erosion of exposed areas and sedimentation of site surface water. For this purpose, grab samples of surface water will be collected and monitoring of TSS will be carried out at selected locations on or near the Project site prior to run-off entering watercourses, and along the Napadogan Brook, during active construction.

The construction of the embankment of the TSF will require work directly in or across a waterbody. During this construction, the TSS levels will be monitored downstream of the construction activity, at intervals up to a distance of 45 times the bankfull width at the affected location. The monitoring during the active construction at each watercourse will occur daily using a portable probe and by collecting a water sample in the streams that are being directly affected. The intensive TSS monitoring is limited to the active Construction phase during the period when these activities are working directly in or adjacent to water. Monitoring of TSS, however, will be continuous, at monthly intervals, as part of the ongoing surface water quality program throughout the Construction phase (Section 9.4.3.2.1).

Similarly, TSS will be monitored daily using a probe during the active construction and/or relocation of the linear facilities whenever the work involves crossing a watercourse or culvert installation in the McBean Brook watershed. A daily water sample will be also collected for the TSS analysis during the active construction in each stream.

#### 9.4.3.1.4 Verification of Absence of Added Movement Barriers and Unaffected Substrate Embeddedness Due to the Lowered Flows

To verify the accuracy of the predictions related to pinch point analysis in the Napadogan Brook in the areas downstream of Bird Brook, as stated in the Aquatic Environment VEC, a walk-over will be carried out after construction of the Project, but before surplus water releases from the Project (*i.e.*, between Years 1-7 of Operation). The walk-over will be undertaken during low-water conditions (flows below $Q_{85}$) in lower parts of the Napadogan Brook to ensure that no unexpected pinch points are present. In the autumn of the same year, a spawner survey for adult Atlantic salmon will be carried out in Napadogan Brook to further confirm that the fish can ascend to the same areas as observed in baseline data that are to be collected prior to start of the Construction. .

To ensure that the lower flows have not resulted in accumulation of fine sediments in the Napadogan Brook, a survey of substrate embeddedness will be carried out during the first 7 years of Operation on the same transects as used during the collection of baseline data and during the Construction phase. Embeddedness will be visually assessed and compared to the baseline and Construction phase data. This survey will be carried out simultaneously with the pinch point survey.

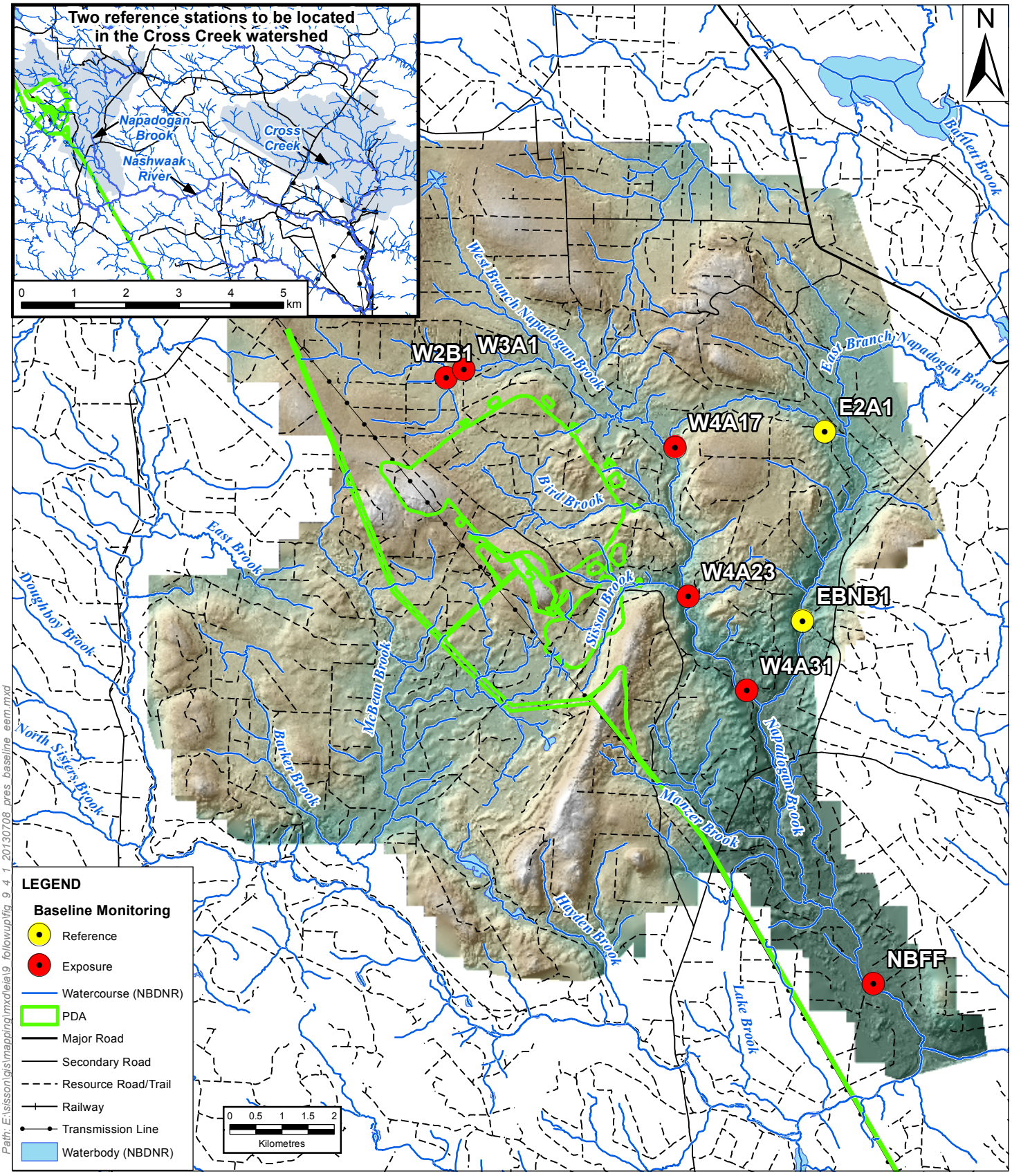
#### 9.4.3.1.5 Fish Tissue Analysis

Fish tissue studies will be undertaken to verify that potential changes in trace metal concentrations in water, as is predicted to occur during Operation, have not caused adverse environmental effects to fish (*i.e.*, their population, distribution, fecundity) to the extent that would be considered a significant change. While specific regulatory guidelines or threshold levels to define an "effect" on fish tissue do not currently exist for the trace metals apart from mercury (Section 9.4.4.3.5), the data will be collected so that trends can be analyzed against the known baseline information, and further actions can be taken if regulatory guidance regarding trace metals concentrations in fish tissue becomes available at a later time or if site-specific advice is defined. Brook trout will be used for the analysis as it is considered the only species for which a significant consumptive fishery may exist in the Project Area; the analysis of trace metals will be done separately for the carcass, the viscera and the liver. Brook trout are physiologically analogous to Atlantic salmon (*Salmo salar*) for a study of this nature and thus it is anticipated that if the brook trout are not affected by the activities related to the Project, then salmon will also not be affected. It is proposed that trace metal analysis in fish tissue initially include Aluminum, Antimony, Arsenic, Barium, Beryllium, Bismuth, Boron, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Lithium, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Rubidium, Selenium, Silver, Sodium, Strontium, Tellurium, Thallium, Tin, Tungsten, Uranium, Vanadium and Zinc.

Initial sampling will take place prior to the start of Construction of the Project, as a means to provide an update to the 2011 baseline levels of trace metals observed in fish tissue (Stantec 2012). The sampling will be carried out in ten study sites that will subsequently be used for compliance Environmental Effects Monitoring (EEM; see Section 9.4.4.3.5). Subsequent sampling of fish tissue in all of the ten EEM sites (Figure 9.4.1) will be carried out in Year 5 of Operation, corresponding roughly to the anticipated modelled time of arrival of TSF seepage to surrounding watercourses. The timing of the first sampling of fish tissue during Operation is contingent on the results of the monitoring of groundwater quality observed in the collection wells around the TSF. Should the water quality data in the collection wells indicate a faster (or slower) movement of the seepage through the TSF embankments, and therefore, an earlier (or later) arrival of the seepage to the surrounding watercourses, the timing of fish tissue sampling will be carried out earlier (or later) than Year 5. This procedure will allow for any potential environmental effects on fish tissue to be immediately observed. The frequency of subsequent fish tissue sampling for trace metals other than mercury will be determined with regulatory agencies following the analysis of data and the results of the initial sampling taken during Operation. The monitoring of mercury in fish tissue may continue throughout Operation as a requirement of *MMER*, as described in Section 9.4.4.3.5. Should a need arise to continue the analysis of other trace metals in fish tissue beyond the initial sampling in Year 5 of Operation, the sampling will be carried out in concert with the fish usability studies (*i.e.,* mercury levels in fish tissue, Section 9.4.4.3.5), and thus not require additional lethal sampling of brook trout.

### 9.4.3.2 Water Resources

Chapter 8.4, Water Resources, found that changes in the availability and quality of surface water and groundwater resources will not be significant as a result of the Construction and Operation of the Project. Follow-up measures will be implemented for Water Resources as presented in Table 8.4.15 and as discussed below. This follow-up is relevant to and supports the consideration of the environmental effects of the Project on the Aquatic Environment and Public Health and Safety.




NOTE: THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC PROJECT AND SHOULD NOT BE USED FOR OTHER PURPOSES.

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| Baseline EEM Monitoring Locations<br>Sisson Project:<br>Environmental Impact Assessment (EIA) Report, Napadogan, N.B.<br>Client: Northcliff Resources Ltd. | Scale: 1:100,000 | Project No.: 121810356 | Data Sources: NBDNR<br>Leading Edge Geomatics Ltd. | Fig. No.: 9.4.1 | Stantec |
| | Date: (dd/mm/yyyy) 08/07/2013 | Dwn. By: JAB | Appd. By: DLM | | |



Map: NAD83 CSRS NB Double Stereographic

#### 9.4.3.2.1 Surface Water

Follow-up to verify the environmental effects predictions or the effectiveness of mitigation for surface water will be conducted as follows.

- Sample the water released from the starter pit for quality to determine if there will be a requirement for water treatment during Construction. This will include the collection of water samples from the outlet of the sedimentation pond, which will be submitted for laboratory analysis of general chemistry and metals.

- Measure the stream flow at the existing hydrometric stations (B-2, SB-1, and NB-2B, TL-2 and MBB-2) to confirm the predicted changes in flow. Compare the measured flows to the equivalent pre-Project stream flow rates calculated from the Narrows Mountain Brook (NMB) station operated by Environment Canada. Knight Piésold (2012d) has demonstrated a strong correlation of pre-Project flows at the Project hydrometric stations to the NMB station.

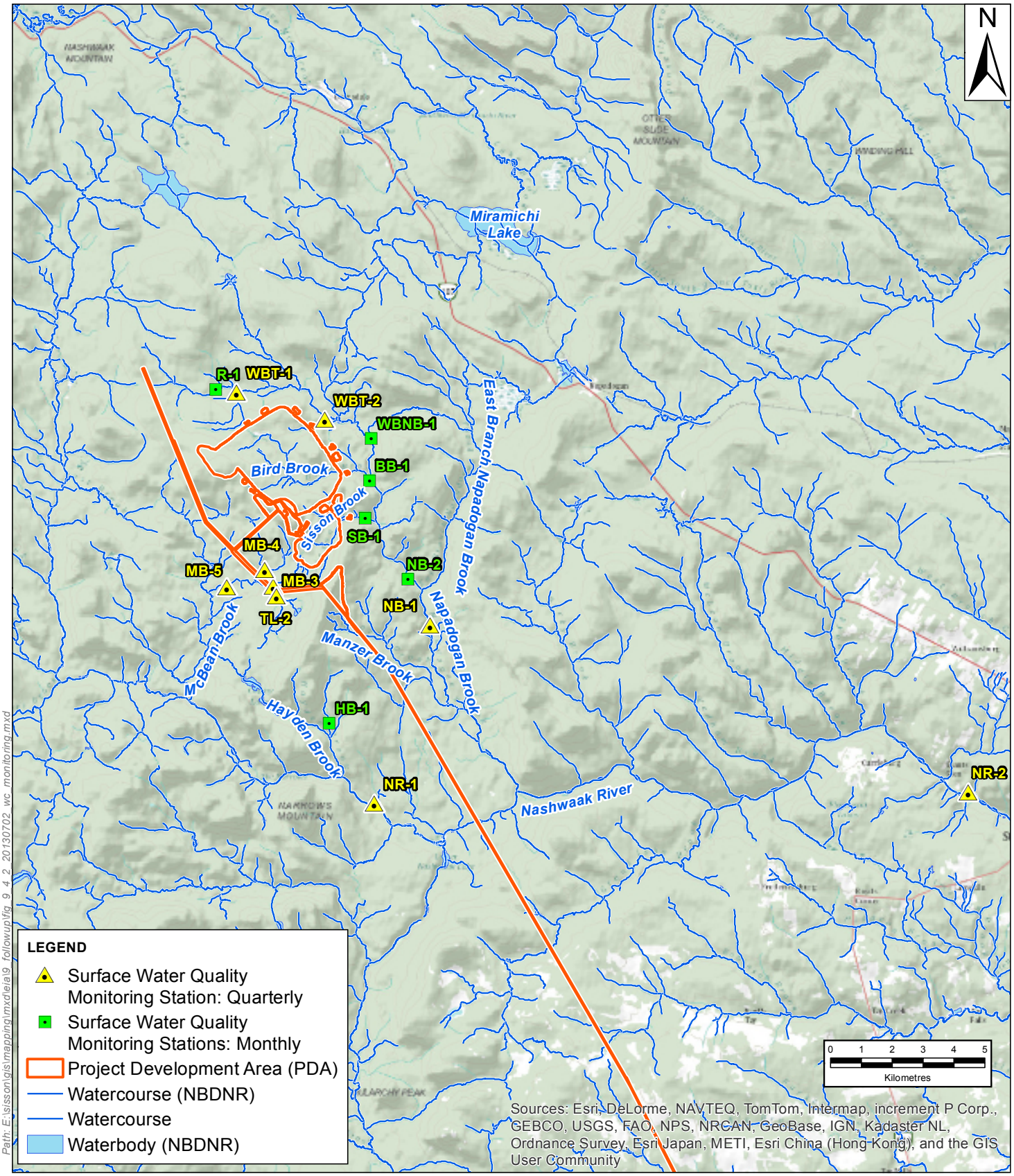
- Sample the surface water quality in McBean and Napadogan brooks to confirm the predicted water quality in the receiving environments, with comparison to Health Canada Guidelines for Canadian Drinking Water Quality ("GCDWQ"; Health Canada 2012) and the CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life (Freshwater) (the "CCME FAL guidelines" (CCME 1999)) or other applicable guidelines. A well-defined water quality monitoring plan is required as part of the regulatory requirements of *MMER*, as described in relation to the Aquatic Environment. The monitoring of drinking water quality would be complimentary to this program, and therefore only the addition of any drinking water parameters for which GCDWQ exist would be required to be added to this program.

It is proposed to continue the current water quality monitoring program at 15 locations (Figure 9.4.2) to ensure a robust design to detect any potential environmental effects of the Project on water quality in various locations in the Napadogan and McBean watersheds and selected reference locations. The proposed sites, sampling frequency, and rationale for selecting the specific sites are listed in Table 9.4.1 below. The frequency of sampling will be a minimum of four times per year, but more or less frequent sampling may be carried out at selected locations depending on actual water releases from the Project, by agreement with the NBDELG. The concentrations of aluminum, ammonia, arsenic, boron, cadmium, copper, iron, lead, mercury (contingent on *MMER*, Schedule 5, Section 4(3)); molybdenum, nickel, nitrate, radium-226 (contingent on *MMER* Section 13(2)); and selenium, thallium, total suspended solids and zinc will be determined. In addition, temperature and dissolved oxygen concentrations will be measured *in situ*, and hardness, alkalinity and electrical conductivity of the samples will be recorded. The sampling will continue throughout the Operation phase of the mine, while the frequency of sampling may be adjusted based on monitoring results and subsequent agreements with regulators.

Additional water quality monitoring will be carried out in connection with the fish studies described below in Section 9.4.4.3.5.

### Table 9.4.1 Proposed Water Quality Stations for Long-Term Monitoring

| Station | Sampling Frequency | Rationale |
|---|---|---|
| R-1 | Monthly (reference location) | Located in the headwaters of West Branch Napadogan Brook, outside of footprint of present project options. This station will provide a long-term baseline for the headwaters of this watercourse. |
| WBNB-1 | Monthly | West Branch Napadogan Brook, above confluence with Bird Brook. There is some potential for this station to be affected by TSF seepage. Monthly sampling in order to match other downstream stations for Bird Brook, Sisson Brook and Napadogan Brook. |
| BB-1 | Monthly | This station is to monitor water quality in Bird Brook, before discharge to Napadogan Brook. In future, it will potentially be affected by seepage from TSF. |
| NB-2 | Monthly | This station provides a long-term record, upstream of the confluence of the West and East Branches of Napadogan Brook. It will establish water quality trends prior to mixing and dilution with water from East Branch Napadogan Brook. |
| NB-1 | Quarterly | This station is located downstream of the confluence of the West and East Branches of Napadogan Brook. It will help to determine environmental effects on water quality after mixing and dilution with water from East Branch Napadogan Brook. |
| NR-1 | Quarterly (reference location) | This station is located on the Nashwaak River, upstream of its confluence with Napadogan Brook, and provides a baseline for water quality in the Nashwaak River. |
| NR-2 | Quarterly (reference location) | This station is located on the Nashwaak River, downstream of its confluence with Napadogan Brook, and will provide information on water quality in the Nashwaak River, should it be affected by the Project. |
| HB-1 | Monthly (reference location) | This station is located on Hayden Brook, outside of the project footprint. Project area reference site. |
| WBT-1 | Quarterly | This station is located in a tributary to West Branch Napadogan Brook below the TSF, and will monitor for seepage from the TSF. |
| WBT-2 | Quarterly | This station is located in a tributary to West Branch Napadogan Brook below the TSF, and will monitor for seepage from the TSF. |
| SB-1 | Monthly | This station is located in the residual segment of Sisson Brook below the water treatment facility. |
| MB-3 | Quarterly | This station is located in tributary originating near the open pit prior to flowing into McBean Brook. |
| MB-4 | Quarterly | This station is located in tributary originating near the open pit prior to flowing into McBean Brook. |
| MB-5 | Quarterly | This station is located in McBean Brook, downstream of tributaries represented by MB-3 and MB-4. |
| TL-2 | Quarterly | This station is located at the outlet of Trouser Lake, and will be used to monitor the potential effects of the Project on wetlands and water quality near Trouser and Christmas lakes. |

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NOTE: THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC PROJECT AND SHOULD NOT BE USED FOR OTHER PURPOSES.

| | | | | | |
|---|---|---|---|---|---|
| Location of Surface Water Quality Monitoring<br>Sisson Project:<br>Environmental Impact Assessment (EIA) Report, Napadogan, N.B.<br>Client: Northcliff Resources Ltd. | Scale: 1:170,000 | Project No.: 121810356 | Data Sources: NBDNR | Fig. No.: 9.4.2 | Stantec |
| | Date: (dd/mm/yyyy) 02/07/2013 | Dwn. By: JAB | Appd. By: DLM | | |



Map: NAD83 CSRS NB Double Stereographic

#### 9.4.3.2.2 Groundwater

Follow-up to verify the environmental effects predictions or the effectiveness of mitigation will be conducted for groundwater as follows.

- Install and instrument monitoring wells to record groundwater seepage quality from beneath the TSF, and below the WMPs, to the Napadogan Brook watershed. Conduct quarterly groundwater quality sampling to detect trends in key water quality parameters relative to the GCDWQ, and trends that may jeopardize downstream water quality. A reference groundwater monitoring location in the East Branch Napadogan Brook watershed is also proposed to identify possible regional trends in groundwater quality.

The location of the monitoring wells will be selected to ensure a good understanding of the progress and quality of groundwater seepage emanating from the TSF. It will provide an early warning mechanism to identify any undesirable or unexpected changes that would trigger the need for adaptive management, including more frequent or intense sampling, or the implementation of additional mitigation. The data may also inform or trigger the need for additional follow-up in other programs (*e.g.,* fish tissue analysis).

### 9.4.3.3 Wetland Environment

In Section 8.8 (Wetland Environment), it was predicted that the extent of indirect loss of GeoNB-mapped and unmapped wetlands in areas outside of the PDA will not be substantive. Follow-up measures for the Wetland Environment will be designed to assess the indirect change to the Wetland Environment (both GeoNB-mapped and unmapped) within the LAA, targeting areas of likely, but unknown environmental effects (*e.g.,* within the groundwater drawdown zone of the open pit, and down-gradient of the TSF area where surface flow to wetlands outside the PDA will be reduced). The objective of this work will be to assess the extent and nature of any changes in area and/or function of wetlands outside of the PDA through indirect interaction with the Project, and to determine the need for adaptive management.

Given the extensive and interconnected nature of the wetland complexes in the LAA, the follow-up measures for the Wetland Environment will include both GeoNB-mapped and unmapped wetlands as well as small adjacent upland conditions. The program will consist of the establishment and subsequent monitoring of plots arranged in transects extending from within the boundary of GeoNB-mapped wetlands through unmapped wetlands (if present), to the upland area beyond the wetland edge. Transects will be established along a gradient of potential environmental effects with increasing distance from the open pit area, and also at wetlands downstream of watercourses formerly originating within the TSF area. Similar transects will also be established and monitored in wetlands within the same watersheds, but outside of the LAA, to be used as controls to interpret any natural variability in water levels in the general area. These plots will be used to evaluate vegetation (including the relative amount of hydrophytic vegetation) and hydrology as indicators of wetland function. Water quality and flow characteristics in downstream watercourses will also be tracked during the Operation phase as an indication of potential changes in the wetlands that feed them.

#### 9.4.3.4 Public Health and Safety

As was discussed in Section 8.4.6 (Water Resources) and Section 8.5.6 (Aquatic Environment), follow-up to verify that the potential changes in trace metal concentrations in fish tissue concentrations, as is predicted to occur due to the predicted changes in trace metal concentrations in water, will be conducted as follows.

- Sample the surface water quality in McBean and Napadogan brooks to confirm the water quality in the receiving environments. Increasing trends in arsenic, boron, thallium, or zinc that approach the water quality predictions will result in a review of the fish tissue concentrations. Details of the water quality monitoring program are described in Section 9.4.3.2.1.

- If surface water quality monitoring indicates that concentrations of arsenic, boron, thallium, or zinc are approaching the water quality predictions, fish tissue studies will be undertaken to confirm that the measured concentrations in fish tissues would not result in adverse environmental effects to people who consume fish. Details of the fish tissue studies are described in Section 9.4.3.1.4.

These follow-up measures are also relevant to Public Health and Safety.

### 9.4.4 Monitoring

#### 9.4.4.1 Atmospheric Environment

While the EIA did not identify any requirements for follow-up or monitoring for any elements of the Atmospheric Environment, it is possible that NBDELG may require emissions permits and air quality monitoring as a Condition of Approval for the Project. If this is the case, a monitoring program will be developed by Northcliff in consultation with NBDELG.

During Construction, if complaints are received, monitoring of ambient particulate matter may be carried out to determine if concentrations at the nearest receptors are below the significance criteria.

Confirmatory monitoring of the mitigation related to dust control during the Operation phase may be required. Such monitoring may consist of monitoring of PM, $PM_{10}$, or $PM_{2.5}$, or other air contaminants at the discretion of NBDELG. If complaints are received, Northcliff may carry out ambient monitoring to determine if ambient air quality objectives are being exceeded.

For greenhouse gas (GHG) emissions, volumes of fuel combusted in stationary and mobile equipment during the Operation phase should be tracked for the estimation of annual GHG emissions. This information can be used to evaluate whether federal reporting thresholds are reached and to evaluate potential provincial reporting requirements if they are established.

#### 9.4.4.2 Acoustic Environment

During Construction, monitoring sound or vibration will confirm that sound pressure levels and peak particle velocities (PPVs) at receptors are below the significance criteria where there are complaints. During Operation, Northcliff will conduct periodic sound and vibration monitoring at the recreational campsites to verify that levels are within acceptable ranges in accordance with Approval requirements.

If noise complaints are received, sound monitoring may be conducted and activities modified to reduce noise.

#### 9.4.4.3 Aquatic Environment

The activities described below constitute the monitoring program for the Aquatic Environment. It should be noted that while some activities meet the definition of follow-up as defined by *CEAA*, all elements of the *MMER* described below are part of the regulatory compliance monitoring and as such are presented in this monitoring section. The Province of New Brunswick may impose other or additional requirements in permits and authorizations and these will be incorporated into the program as appropriate.

The regulatory compliance monitoring studies will consist of three main components, pursuant to *MMER*, as follows:

- deleterious substance, pH, and acute lethality testing (*MMER* Sections 12-17);
- effluent and water quality monitoring studies comprising of effluent characterization, sub-lethal toxicity testing and water quality monitoring (*MMER*, Schedule 5, Part 1); and
- biological monitoring studies in the aquatic receiving environment to determine if mine effluent is having an effect on fish, fish habitat or the use of fisheries resources (*MMER*, Schedule 5, Part 2).

The regulations under *MMER* apply in respect to the Project after an effluent flow rate exceeding 50 $m^3$ per day is exceeded, which is anticipated to start around Year 8 of Operation. However, monitoring of some of the regulatory compliance components, as would be pursuant to *MMER*, will already be initiated starting in Year 0 as part of the follow-up program (specifically, verification of changes in fish populations, usability and benthos). The water quality monitoring program (Section 9.4.3.2.1) is described above, and will meet or exceed the requirements of compliance monitoring under *MMER.*

All reporting for regulatory compliance monitoring will be undertaken as is indicated in *MMER.*

The “final discharge point” for the purposes of this section is defined as a location in Sisson Brook, upstream from its confluence with Napadogan Brook, with precise location to be defined in consultation with the applicable regulatory authorities prior to Operation of the Project.

Since the Project will not be in a surplus water condition until approximately Year 8 of Operation, monitoring of the components directly related to mine effluent will not begin until that time.

Further details on the compliance monitoring measures are provided below for the components that have not yet been described.

##### 9.4.4.3.1 Deleterious Substance, pH and Acute Lethality Testing

To ensure the authority to deposit (*MMER* Section 4) is not violated and that the well-being of aquatic environment is not compromised, the effluent released at the final discharge point in Sisson Brook will be monitored for the concentrations of deleterious substances and pH. The concentrations of arsenic, copper, lead, nickel, zinc, total suspended solids, and radium-226, as well as pH will be recorded within a range of weekly to quarterly as is required by *MMER* Sections 12 and 13, unless more specific timing

is defined by NBDELG. The monitoring will continue until Closure of the mine. Cyanide is not used as a process reagent or generated by the Project, and thus is not monitored.

The acute lethality tests are carried out to confirm that the effluent released to the receiving environment does not include substances or reagents that would cause immediate negative environmental effects on the survival of aquatic biota. The samples used for acute lethality testing will be collected at the final discharge point in Sisson Brook. The acute lethality testing will be conducted on rainbow trout (*Oncorhynchus mykiss*) and *Daphnia magna* using Reference Methods EPS 1/RM/13 (Environment Canada 2000a) and EPS 1/RM/14 (Environment Canada 2000b), respectively. The frequency of sampling will be as determined by *MMER,* Sections 14-16, unless a more frequent schedule is defined by NBDELG, and the testing will continue until Closure of the mine. The results of the testing will be reported as required by *MMER* Section 18 and Sections 21-24.

#### 9.4.4.3.2 Effluent and Water Quality Monitoring Studies

Effluent characterization and water quality monitoring will be carried out to understand the estimated mine-related change in contaminant concentrations in the exposed area. The objective of the effluent and water quality monitoring studies is to document temporal variability and changes in the quality of the effluent and environmental conditions in the receiving environment and to provide supporting environmental variables to help interpret results from the biological monitoring (fish and benthic invertebrate community survey; Sections 9.4.4.3.5 and 9.4.3.1.6) and the sub-lethal toxicity testing.

#### 9.4.4.3.3 Effluent Characterization

To characterize the effluent, an undiluted grab sample will be collected directly from the final discharge point in Sisson Brook and the total values of aluminum, cadmium, iron, mercury, molybdenum, selenium, ammonia and nitrate will be analyzed (as per *MMER* Schedule 5, Section 4). In addition, temperature, hardness, alkalinity, electrical conductivity of the sample will be recorded. Other parameters may be added if required by NBDELG. The samples for effluent characterization purposes will be collected quarterly starting within six months after effluent is first released and will continue for as long as effluent is discharged.

#### 9.4.4.3.4 Sub-lethal Toxicity Testing

Sub-lethal toxicity testing will be carried out to provide an estimate of the potential environmental effects on biological components (*e.g.,* phytoplankton, benthic invertebrates, fish, macrophytes) in the exposure area. The sub-lethal toxicity samples will be collected at the final discharge point. Four sub-lethal toxicity tests will be performed using standard laboratory test protocols as referred to in *MMER* Schedule 5:

- a fish species (fathead minnow, *MMER* Schedule 5, Section 5(3)(a)(i));
- an invertebrate species (cladoceran, *Ceriodaphnia dubia*, *MMER* Schedule 5, Section 5(3)(b));
- a macrophyte species (*Lemna minor*, *MMER* Schedule 5, Section 5(3)(c)); and
- an algal species (*Selenastrum capricornutum*, *MMER* Schedule 5, Section 5(3)(d)(i)).

The sub-lethal toxicity tests will be carried out twice a year after the discharge from the Project to the receiving environment starts (predicted to start around Year 8 of Operation). The sub-lethal toxicity tests will be carried out twice a year for the first three years following the start of release and will be reduced to once every year after the three year period if no sub-lethal environmental effects are observed. The samples will be collected in spring (before main snow-melt flood; a period when energy reserves of aquatic biota are at the lowest and prior to the spawning of many cyprinid fishes) and in fall (end of growing season); the latter sampling timing will be used for the annual sampling during years when the sub-lethal testing is carried out only once.

#### 9.4.4.3.5 Verification of Changes in Fish Populations, Fish Usability, and Benthic Macroinvertebrate Community

The verification of the residual environmental effects predictions on aquatic biological receptors will consist of fish population and usability studies, and studies respecting benthic macroinvertebrate community structure. As the Project will be subject to the requirements of a regulatory compliance monitoring program pursuant to *MMER* (predicted starting around Year 8 of Operation when the release of effluent from the TSF will begin), the follow-up program confirming the predictions of EIA for aquatic biota is designed to meet or exceed the requirements of *MMER.* This approach will ensure that the study design used during the follow-up (Year 1-7 of Operation) can be carried forward as part of the regulatory compliance program after the start of effluent release (Year 8 of Operation onward). The general sampling layout for this study will be based on ten sampling locations, considering eventual *MMER* requirements where: three test sites are situated upstream of the eventual effluent discharge point in Sisson Brook to examine the environmental effects of metal enriched seepage from the TSF ("seepage exposed sites") in the absence of effluent-related environmental effects; three test sites are situated downstream from the eventual effluent discharge point ("effluent exposed sites"); and four reference sites. These sites are proposed to be located as follows (Figure 9.4.1):

- a site (W2B1) to examine the environmental effects of metal enriched seepage from the TSF; located in a second order tributary to West Branch Napadogan Brook;
- a site (W3A1) to examine the environmental effects of metal enriched seepage from the TSF with a higher freshwater dilution; located in a third order section of West Branch Napadogan Brook;
- a site (W4A17) to examine the environmental effects of metal enriched seepage from the TSF with a higher freshwater dilution located in a fourth order section of West Branch Napadogan Brook upstream of confluence of Bird Brook;
- a near-field exposure site (W4A23), located in West Branch Napadogan Brook immediately downstream of the confluence of Sisson Brook, and as such, downstream of the discharge point of effluent;
- a mid-field exposure site (W4A31), located in West Branch Napadogan Brook further downstream from the discharge point of effluent;
- a far-field exposure site (NBFF), located in Napadogan Brook;

- reference site located in an unexposed tributary within the Napadogan Brook watercourse (E2A1); located in a second order tributary to East Branch Napadogan Brook;
- reference site located in an unexposed tributary within the Napadogan Brook watercourse (EBNB1); located in the East Branch Napadogan Brook; and
- two reference sites located in a separate watercourse that provides similar characteristics and habitat as Napadogan Brook; located in second and fourth order stream sections in Cross Creek.

This study will be carried out every three years, beginning in Year 1, until the release of effluent from the Project commences (approximately Year 8). Following the start of effluent release, the biological monitoring will continue in three-year cycles for the first two cycles. In this regard, an "effect" is defined as a statistically significant difference in specific endpoints between measurements taken in exposure and reference areas of similar stream order. If no effects on fish populations, fish tissue, or the benthic macroinvertebrate community are observed in the first two cycles, the monitoring frequency will be decreased to every six years (as per *MMER*, Schedule 5, Section 22). This study will be undertaken throughout the Operation phase regardless of effluent concentration over a three or six year cycle, pending the results and the presence or absence of environmental effects. The reporting schedule and content will follow the guidelines set forth in Schedule 5 of *MMER*.

**Fish Population Studies**

Fish population studies will be undertaken in three to six year cycles, depending on the presence/absence of environmental effects, to determine if the Project is affecting fish and fisheries resources. Effects on growth, condition, reproduction and survival will be examined. The sampling will be carried out on the ten sites indicated above (Figure 9.4.1). The approach will be based on non-lethal collection of fish using non-quantitative (*i.e.,* catch per unit effort) electrofishing surveys as the baseline data has shown that fish population sizes will not allow lethal sampling without potential negative effects on target fish populations.

The sampling will target two fish species following the general guidance outlined in the Environment Canada documents "Metal Mining Technical Guidance for Environmental Effects Monitoring" (Environment Canada 2012f) and "Further Guidance for Non-Lethal Sampling" (Environment Canada 2005) protocol. Potential candidate species include juvenile Atlantic salmon, blacknose dace, and brook trout. In absence of two fish species in suitable quantities across all monitored sites, survival studies may be supplemented by using caged amphipod *Hyalella azteca* as a proxy for fish.

**Fish Usability Studies**

Fish usability studies will be undertaken to determine if the mine effluent has altered fish in such a way as to limit their use by human consumers. Mercury is the only trace metal for which there is a standard Health Canada tissue consumption guideline for humans. The fish usability studies will be undertaken if the concentration of total mercury in the effluent is identified being equal to or greater than 0.10 µg/L. Effects on fish tissue are considered as concentrations of total mercury that exceed 0.5 µg/g wet weight in fish tissue taken in an exposure area and that are statistically different from and higher than the measurements of concentrations of total mercury in fish tissue taken in a reference area (based on the approach described in *MMER*, Schedule 5, Section 1).

If the effluent characterization indicates that the threshold of 0.10 µg/L for mercury is equaled or exceeded, brook trout larger than 10 cm in total length (the current minimum size limit for fish retention in recreational fisheries; NBDNR 2013) will be collected for conducting the fish usability studies. The fish collection will take place in concert with other fish population studies, using the same sampling stations, and will be carried out during the next available fish population monitoring cycle that follows the collection of effluent sample that equaled or exceeded the threshold of 0.10 µg/L for mercury.

**Benthic Invertebrate Community Studies**

Sampling of benthic macroinvertebrates (BMI) will be carried out to assess potential environmental effects of the Project on fish habitat quality. The sampling will be carried out as per the recommendations of the "Metal Mining Technical Guidance for Environmental Effects Monitoring" (Environment Canada 2012f) document using standard kick-net sampling. The monitoring will occur simultaneously with fish population studies; the sample collection will take place in the fall (September/October) when the majority of taxa are present and are large enough to be sampled. The frequency of sampling will be similar to the fish population sampling, and will last throughout the Operation phase of the Project. During each sampling cycle, BMI will be collected in the ten study sites as indicated above, and within each sampling site, five replicate samples will be collected (*i.e.,* five subsequent riffles), each sample further consisting of three sub-samples that are pooled together.

Sediment samples will be collected in conjunction with the BMI sampling (*MMER*, Schedule 5, Section 16(a)(iii)) to answer the question: are there habitat differences that may contribute to effects in the benthic invertebrate community? Total organic carbon and particle size will be analyzed (*MMER*, Schedule 5, Section 16(a)(iii)) and the follow-up program will also include the analysis of trace metals and mercury in the sediment for two initial monitoring cycles following the start of the effluent release after about Year 8, and every second cycle thereafter, unless consistent, significant increases in comparison with the baseline data are observed.

Water quality samples will also be collected during the BMI sampling at each of the ten sites. Temperature and dissolved oxygen will be measured *in situ*, and concentrations of the parameters indicated in Section 9.4.3.2.1 will be analyzed. Fish habitat quality will be further monitored by using NBDNR/DFO stream survey and habitat assessment forms on all ten sampled sites.

### 9.4.4.4 Water Resources

**Surface Water**

Monitoring will be conducted to ensure the Project meets applicable legislation, regulations and guidelines. Construction sites will generate TSS in run-off, and best management practices will be instituted to prevent the discharge of excess TSS to the streams as outlined in the EPP. Water quality monitoring from TSF WMPs and groundwater wells will begin during Operation, and continue Post-Closure until such time that the water quality is of acceptable quality that can justify the termination of monitoring.

**Groundwater**

Monitoring will be conducted to ensure the Project meets applicable government permits. Careful siting of the fresh water supply will be done to prevent interactions with Project activities, and routine monitoring will be conducted to ensure it is within Project quality requirements.

#### 9.4.4.5 Vegetated Environment

The Vegetated Environment VEC did not identify the need for follow-up to verify the environmental effects predictions or to verify the effectiveness of mitigation for the protection of rare species. However, an SOCC plant, nodding ladies'-tresses (*Spiranthes cernua*), was identified within the LAA and monitoring is recommended for its protection. This population of nodding ladies'-tresses (*Spiranthes cernua*) will be flagged using florescent tape and/or snow fencing to maintain avoidance of this area during Construction. Confirmatory monitoring of this plant population will occur at Years 1, 3, and 5 following the completion of Construction to confirm the effectiveness of mitigation. If at Year 3 or 5, the population appears to be declining, a mitigation plan will be developed at that time. If the population appears to be stable after Year 5, no further work will be recommended.

#### 9.4.4.6 Wetland Environment

Monitoring programs will occur as a part of the wetland compensation program for GeoNB-mapped wetlands directly affected by the PDA, and described in the Wetland Compensation Plan to be developed in consultation with NBDELG. In addition, compliance monitoring in accordance with the WAWA permit for the Project will be conducted to confirm the proper implementation of other mitigation measures.

#### 9.4.4.7 Public Health and Safety

The EIA did not recommend any specific monitoring for Public Health and Safety.

#### 9.4.4.8 Heritage Resources

The EIA did not recommend any follow-up or monitoring for Heritage Resources. Mitigation in the form of shovel testing of areas having elevated potential for archaeological resources will be conducted in accordance with the Archaeological Guidelines (Archaeological Services 2012) and as described in Northcliff's ESMS (Appendix D). A portion of this shovel testing has already been completed and no archaeological resources were identified. If the results for the remainder of the shovel testing also do not identify any heritage resources, there will be no need for any archaeological monitoring. Should any archaeological sites or other heritage resources be identified through shovel testing or other measures, a monitoring program may be required, and would be developed in consultation with Archaeological Services and First Nations, as appropriate.

The results of the shovel testing mitigation to be completed prior to groundbreaking construction activities in areas recommended for shovel testing will be reported to Archaeological Services following completion of the mitigation in the case where no heritage resources are identified. Should a heritage resource be encountered during the mitigation, the reporting requirements as outlined in the Archaeological Guidelines (Archaeological Services 2012) will be followed.

#### 9.4.4.9 Accidents, Malfunctions or Unplanned Events

As Accidents, Malfunctions or Unplanned Events are by definition unplanned and unintended, there is no follow-up required to verify the EIA predictions. However, in the unlikely event that an accident or other unplanned event occurs, monitoring would be conducted to verify the magnitude or extent of environmental effects or the effectiveness of the response or restoration efforts, as applicable and appropriate. Such monitoring will be described in the EPRP.

### 9.4.5 Follow-up or Monitoring during Decommissioning, Reclamation and Closure

Operation of the Project is anticipated to end at Year 28, after which the mine will become a recognized closed mine as defined in the *MMER* Section 32. At Closure, there will be no discharge of effluent from the Project to the receiving environment since surplus water from the quarry and TSF will be directed to the open pit until the open pit is full (anticipated to take about 12 years, by the end of Year 39). As no effluent will be released during the closure period, no deleterious substance monitoring, acute lethality testing, effluent characterization, or sub-lethal toxicity testing of effluent will be carried out.

Although effluent release will not occur during the period when the open pit is being filled (Years 28-39), the biological and water quality monitoring programs will be continued during this period. Water quality monitoring will be continued to ensure that the water quality continues to meet the EIA predictions. The water quality will be sampled twice a year at all sampling stations and the analysis will include the same parameters monitored during Operation. Biological monitoring studies will also follow the same *MMER* EEM process used during Operation to ensure that no harmful effects occur while the open pit is being filled. The frequency of the biological monitoring during the filling of the open pit will be 72 months.

A final spawning survey of adult Atlantic salmon will also be carried out during the filling of the open pit. Similarly to the survey implemented during the baseline and Operation period, the objective of the survey will be to ensure that adult Atlantic salmon that spawn in Napadogan Brook will be able to migrate up the brook as they did before Construction. If expected spawning activity is not observed, the survey will include a full walkover of Napadogan Brook to confirm that the lack of spawning activity is not caused by movement barriers that may be the result of anticipated lowered water levels.

Prior to initiation of water releases from the open pit lake, the prevailing water quality conditions in the lake will be established via limnological studies; the timeline and specific content of such studies will be determined with the regulator during the Closure phase. The water management system will be reconfigured to ensure that all water discharged from the open pit lake can be treated, if needed, to meet discharge permit requirements for as long as is required. Water quality monitoring, both in the open pit lake and in the water quality stations situated in the adjacent rivers and streams, will be discontinued after a five year period if the results of the water quality monitoring indicate that the applicable water quality guidelines are being continuously met.

Final biological monitoring surveys (fish population and benthic macroinvertebrate surveys) using the *MMER* EEM model will be carried out after one, three, and six years after discharge resumes from the filled open pit lake (*i.e.,* approximately Years 40, 42, and 44 of the Project life, in the Post-Closure phase). If no significant effects are observed after the event carried out six years after discharge resumes from the open pit lake (*i.e.,* Year 45), the biological monitoring studies will be discontinued.