EIA Registration – McAdam Wellfield Expansion Project

Village of McAdam

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EIA Registration – McAdam Wellfield Expansion Project, McAdam, NB

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1.1 Name of Proponent

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1.5 Property Ownership

The existing municipal wellfield which services the Village is comprised of four (4) production wells and located in an undeveloped wooded area approximately 2.5 km southeast of the Village. The wellfield and surrounding area are situated on Crown land which in the province of New Brunswick is managed/administered by the New Brunswick Department of Natural Resources and Energy Development (NBNRED).

The existing wellfield and water treatment building are located on a 2.54 ha land parcel identified as PID 75416198. The latter land parcel is currently leased by the Village of McAdam from NBNRED under the terms and conditions of a municipal services lease agreement between the Village and NBNRED. In 2018, EXP Services Inc. (EXP) completed an Abbreviated Municipal Groundwater Supply Source Investigation for the Village wherein eight (8) target drilling locations for a new municipal groundwater supply source were identified in the general vicinity (i.e. within 1 km) of the existing wellfield (EXP, 2018). Each of these target drilling locations is situated on the large (approximately 34,000 ha) parcel of Crown land identified as PID 75096693. It is noted that the majority of the latter property, which surrounds the Village proper and the current municipal wellfield property, is comprised of undeveloped woodland.

A relative ranking of each of the eight (8) target drilling locations identified in the 2018 groundwater supply source investigation was also completed in conjunction with this work. This ranking was based on a number of evaluation factors for each of the target drilling locations including but not limited to potential well yield and site access requirements. For the currently proposed wellfield expansion project, the Village intends to test and, if feasible, develop two new municipal production wells to obtain additional water supply capacity and provide operational redundancy. Therefore, the areal scope of the current Environmental Impact Assessment (EIA) includes the general area between the existing wellfield and the three top-ranked target drilling locations identified in our 2018 report. The approximate dimensions of the above defined EIA Assessment Area are approximately 625 m x 750 m which

equates to a footprint area of 46.9 ha. The EIA Assessment Area encompasses the existing wellfield property and a portion of the surrounding Crown land property respectively identified as PID 75416198 and PID 75096693. As previously indicated, these Crown land parcels are administered by NBNRED.

Pending the receipt of favourable results from future test well drilling and pump testing at one or more of the three (3) potential target drilling locations identified in the Assessment Area, the Village will need to apply for an additional municipal services lease of Crown land from NBNRED. The exact dimensions, shape and size of the area required for this lease cannot be determined at this time as it is dependent on a number of factors including the results of the proposed future test well drilling and pump testing program. However, in conjunction with the EIA process, the Village contacted NBNRED to confirm that the portion of the existing Crown land within the Assessment Area would likely be generally available to be leased by the Village should it prove feasible to complete the wellfield expansion project as currently envisioned and described herein. Based on this consultation, NBNRED advised that the Village would need to submit a License of Occupation (LOO) Application in order to obtain conditional approval from NBNRED to complete hydrogeological test well drilling and pump testing at up to three (3) target drilling locations in the Assessment Area. The Village submitted the above noted LOO Application to NBDNRED on July 22, 2020. The LOO was under review by NBDNRED at the time of the submission of this EIA registration document to the New Brunswick Department of the Environment and Local Government (NBDELG).

A copy of the above noted correspondence between the Village and NBDNRED related to the proposed hydrogeological drilling and pump testing on a portion of Crown land surrounding the existing wellfield and the potential future leasing of additional Crown land by the Village is provided in Appendix A.

2 Project Description

2.1 Project Name

McAdam Wellfield Expansion Project

2.2 Project Overview

The Village of McAdam intends to increase the capacity of its existing municipal groundwater supply source which consists of four production wells. In recent years, the Village has experienced considerable growth, which has resulted in their current requirement for additional groundwater supply capacity. This increase in water demand has been exacerbated by a decrease in the yield and water quality of one its four existing production wells. As such, the Village wishes to develop additional municipal production wells with a combined yield that will permit the replacement/decommissioning of the problematic well while still resulting in a net increase in the existing groundwater supply capacity. Ideally, the combined yield of the new production wells will be 700 m^3/day (107 Igpm) or greater which will result in a minimum increase of 35% in the yield of the existing wellfield. The existing wellfield and surrounding area are subject to protective land use restrictions in accordance with NB Regulation 2000-47 under the *Clean Water Act*.

The location of the study area in a regional context is indicated on Figure 1. In addition, an aerial site plan which illustrates the limits of the EIA Assessment Area in addition to the locations of the existing municipal production wells, the wellfield protected areas and the target drilling locations is provided as Figure 2.

The primary EIA trigger for the project relates to the requirement for "*all waterworks with a capacity greater than fifty cubic metres of water daily*" to be registered as an undertaking in accordance with NB Regulation 87-83 under the *Clean Environment Act.*

Referring to Figure 2, the scope of work for the proposed wellfield expansion project in general terms will include widening/upgrading an existing woods trail to provide access to target drilling locations C2 and C3; constructing a new road between the existing woods trail and C1 to provide access to the latter target drilling location; and completion of test well drilling and pump testing at up to three (3) of the above noted target drilling locations in accordance with the NBDELG Water Supply Source Assessment (WSSA) guidelines (NBDELG, 2017). Pending favorable results of the test well drilling and pump testing program, the Village intends to construct up to two (2) new municipal production wells and connect these wells to the existing municipal water distribution system. This would involve the construction of new water transmission mains to connect each of the new wells to the existing wellhouse/water treatment building and the completion of some infrastructure upgrades to this existing building. It is noted that the Village water supply source is subjected to chlorination for disinfection purposes at the existing wellhouse/treatment building and subsequently pumped via a transmission line to an elevated water storage reservoir which is situated in the Village proper on Georgia Pacific Drive.

In general, the provincial WSSA process consists of the completion of a Step 1 application form with the EIA registration document which provides background information on the proposed project including water quality and quantity requirements; the proposed test well drilling locations and the rationale for the proposed source development; a discussion of local hydrogeological conditions and existing area groundwater users; and a discussion of potential sources of contamination in the study area. Most of the information required in the Step 1 WSSA application is provided in a report on an Abbreviated Municipal Groundwater Supply Source Investigation which was completed by EXP for the Village in 2018. Therefore, a copy of the above noted report is provided in Appendix B in lieu of a Step 1 WSSA application.

Following their review of the EIA registration document which includes the information required for the Step 1 WSSA application, NBDELG will grant the proponent permission to proceed with well drilling and pump testing to identify the aquifer hydrogeological parameters and characterize the safe yield and water quality of the proposed groundwater source(s) at the target drilling location(s) if they are in agreement with the proposed WSSA work plan.

Following the completion of the test well drilling and pump testing program, a summary of this work which includes the key findings and recommendations for the future development of the proposed new groundwater supply source(s) is provided in the Step 2 WSSA report. The latter report is subsequently submitted to NBDELG for technical review in conjunction with the overall EIA Determination Review process.

For the current project, two 150 mm diameter test wells will initially be drilled at location C1 and the approximate yield of each of these wells will be estimated by the air lift method. Depending upon the findings of the drilling program at location C1, one to two additional 150 mm diameter test wells will be drilled and assessed by the air lift method at location C2 or C3. In the event that low well yields are identified for both wells at location C1 and the first well at location C2 or C3, two 150 mm diameter test wells will be drilled at the remaining target drilling location. Otherwise, the second 150 mm diameter test well will be drilled at the second target drilling location to be assessed.

The 150 mm diameter test well identified as having the highest potential yield based on air lift testing at each of two target drilling locations will be converted to a 200 mm diameter test well for hydrogeological pump testing purposes. The remaining 150 mm test well at each of these locations will be utilized as a water level observation well during the pump testing of the 200 mm diameter test well. One or more of the existing wells in the Assessment Area will be utilized as a supplemental water level observation well during pump testing.

If feasible, the 150 mm diameter test wells will be converted to 200 mm diameter wells by pulling the existing casing and reaming out the borehole to the required larger diameter. If this approach is not feasible, a new 200 mm diameter test well will be drilled approximately 5 m from the existing 150 mm well.

Both 200 mm test wells will be pump tested independently. For each pump testing program, the 200 mm diameter test well will be initially be subjected to a step-drawdown pumping test consisting of three pumping steps of 30 minutes to 60 minutes duration. The results of the step-drawdown testing will be utilized to select the pumping rate for the follow-up 72-hr constant rate pumping test. For each pump test, manual water level readings will be obtained from the pumping well and the primary water level observation well. Electronic water level dataloggers will also be placed in each of these wells in addition to the remaining 200 mm diameter test well. Following the completion of each constant rate test, water level recovery will be monitored in the pumping and observation wells for the lesser of the time required for 100% recovery or 36 hrs in accordance with the provincial WSSA guidelines.

The existing Village production wells are connected to a SCADA system which allows for the monitoring of several parameters including but not limited to the variation in water level elevation with time in each well. Therefore, it is planned to utilize the existing SCADA system to monitor the water levels in the existing Village production wells during the completion of the pump tests.

For each pump test, water quality samples will be collected from the pumping well at pumping times of 24-hrs, 48-hrs and 72-hrs and subjected to analysis for bacteriological (i.e. total and faecal colifirms and E. Coli) and inorganic (i.e. general chemistry and trace metals including mercury/fluoride) parameters. At 72-hr pumping time, an additional water quality sample will be collected from the pumping well for analysis for low-level petroleum hydrocarbons and methyl tert-butyl ether (MtBE).

Depending upon the findings (i.e. estimated safe yields, etc.) of the proposed pump testing program, the wellfield SCADA system may be programmed to pump each test well (i.e. new municipal production well) independently or concurrently with one or more other production wells for each operational pumping cycle. Therefore, since both test wells may be pumped concurrently, an analysis of their mutual drawdown interference effect on each other and the existing production wells will be completed in conjunction with the Step 2 WSSA assessment. For this project, the well interference assessment will be completed analytically. This assessment will employ the generalized Theis non-equilibrium well equation to calculate theoretical water level drawdowns; the analysis of pumping/observation well pump test data; the analysis of SCADA data water levels in the existing production wells; and other analytical techniques as and if required.

2.3 Purpose/Rationale/Need for Undertaking

Detailed project background information is provided in our 2018 Abbreviated Municipal Groundwater Supply Source Investigation report which is provided in Appendix B. A summary of the relevant project background information is provided below.

The existing wellfield, which is comprised of four production wells, was developed in the early 2000s to replace the previous production wells which were located within the Village proper due to concerns about the potential contamination of the latter wells from various nearby potential sources of contamination. We understand that the quality of groundwater produced by all four of the current production wells was initially in compliance with the applicable provincial drinking water guidelines. However, the manganese concentration and turbidity level of water from PW11 gradually increased with time to levels in excess of their respective guideline values. In 2012, PW11 was temporarily taken off-line due to the presence of significant iron and/or manganese biofouling, and this well was subjected to a successful well rehabilitation program developed for the Village by EXP. However, although the post re-habilitation manganese concentration was reduced, it still exceeded the drinking water criterion. Furthermore, the Village was advised that the well would likely require future rehabilitation for biofouling from time-to-time as part of on-going operational maintenance. Although the cause of the biofouling was not conclusively determined, it was believed to have been related to excessive water level drawdown in response to over-pumping during dry weather conditions.

Since the completion of the 2012 rehabilitation program, elevated manganese levels in PW11 and the formation of manganese precipitates in the water system have been on-going operational issues for the Village, and the manganese concentration in the well has been increasing. Currently, the manganese concentration in PW11 exceeds the health-based maximum acceptable concentration (MAC) recently established by Health Canada. This issue has been exacerbated by prolonged periods of abnormally low precipitation which have occurred in the McAdam area from time-to-time in recent years. As a result of these frequent periods of minimal groundwater recharge and operational issues related to the elevated manganese concentration, we understand that the pumping rate of PW11 has been reduced from the approved rate of 164 m^3/day (25 Igpm) to approximately 56 m^3/day (8.5 Igpm) to 98 m^3/day (15 Igpm) or lower. Until the recent announcement of the pending closure of the CertainTeed wallboard manufacturing plant as outlined below, this has been problematic for the Village, since the current water demand is near the capacity of the existing wellfield. It is estimated that the wallboard plant, which is the largest employer in the Village, can account for up to one third of the Village water demand depending upon the plant production capacity which varies with market conditions.

In July 2020, CertainTeed Canada Inc. announced that it was ceasing wallboard manufacturing operations at its McAdam facility by the end of August 2020 due to declining market conditions. Following the cessation of manufacturing operations, approximately 15% of the current 59-person workforce will remain on-hand to sell and ship the remaining product to market until the permanent closure of the plant which is scheduled for the end of February 2021. As the largest employer in a community with a population of about 1,300 people, the plant closure will have a significant detrimental effect on the local economy, including both the direct job losses and the anticipated indirect job losses in the service sector (e.g. contractors, restaurant workers, etc.). Given the magnitude of the economic impact of this plant closure, the Village and the Province are actively attempting to attract other industries to the area and, as such, are considering the potential re-purposing of the existing wallboard plant property. Given the vital importance of adequate water supply to most commercial industries, the marginal ability of the existing wellfield to support commercial enterprises and the immediate and pressing requirement for the recovery and growth of the local economy, the Village considers the development of additional water supply capacity to be a key component of its economic recovery plan.

Currently, the average demand on the existing water system is approximately 450 m^3/day (69 Igpm). Peak demand significantly exceeds this amount as is typical for municipal water systems. The majority of the demand is sourced from residential users as represented by the approximately 400 residential dwellings currently connected to the

system. Nearly all of the industrial/commercial water demand has historically been utilized by the wallboard manufacturing plant, which has typically used between 114 m^3/day (17 Igpm) to 190 m^3/day (29 Igpm) or about one third of the total water demand.

In recent years, there has been a significant uptake in the local residential real estate market, and the number of residential users connected to the system has grown from an initial 240 dwellings to approximately 400 dwellings. Over this period, there has also been a corresponding increase in the water demand of the wallboard manufacturing plant. As previously indicated, while the demand on the water system has been increasing, the pumping rate of PW11 has had to be significantly lowered from the regulatory approved rate in order to manage operational issues related to the elevated manganese concentration in this well. These operational issues include but are not limited to maintaining a suitable manganese concentration in the water storage reservoir and minimizing the potential for the formation of manganese precipitates in the distribution system.

As a result of the reduced capacity of the wellfield, the Village has had to limit the water supplied to the wallboard plant in recent years to as little as 75 m^3/day (11 Igpm). Consequently, before the recent downturn in the wallboard market which led to the announcement that the plant will be permanently closed next year, the plant had to place plans to hire more staff to accommodate an intended additional production shift on hold. This illustrates the marginal capacity of the existing wellfield to supply water to commercial and industrial users.

Based on the above considerations, in the late 2010s the Village identified the location and development of up to two new municipal production wells as a key priority for future infrastructure funding. With the pending closure of the wallboard plant, the Village now considers the securement of additional water supply to be of even greater strategic importance for the socio-economic health of the community. The securement of increased water supply capacity will help attract much needed new industries to the area to replace the wallboard plant, facilitate the recovery and growth of the local economy and ultimately allow for the current trend in increasing population to continue. Ideally, the combined yield of the new production wells will be 700 m^3/day (107 Igpm) or greater. This additional pumping capacity would allow for both a 35% increase in the existing wellfield capacity and the replacement and decommissioning of PW11 in order to alleviate the water quality issues associated with this well.

It is noted that the Village recently obtained a cost estimate for implementing a treatment system to lower the manganese concentration in the groundwater produced from PW11 to within the drinking water criterion. However, given the relatively low yield of this well, the Village concluded that it was not economically justifiable to proceed with the treatment option from a cost-benefit perspective. It does not make sense to assess the feasibility of securing the required additional water supply from a surface water source as the Village water demand is currently met by groundwater and much of the infrastructure required for the addition of new production wells is already in place. Furthermore, in general terms, the environmental permitting and treatment requirements are typically much more onerous for surface water-based water supply systems than groundwater systems. As such, there are no other reasonable alternatives to the proposed expansion of the existing municipal wellfield. The “do nothing” alternative is also considered to be unacceptable, since the existing water demand is near the capacity of the existing wellfield and additional water supply capacity is a prerequisite for the future socio-economic growth and development of the community. Although the closure of the wallboard plant may result in a temporary reduction in water demand, the Village and Province intend to attract one or more replacement industries to the area in the near future to off-set the significant impact to the local economy associated with the impending closure of the wallboard plant.

2.4 Project Location

Location/PID: As previously indicated, the Assessment Area is comprised of the existing wellfield property identified as PID 75416198 and a portion of the large land parcel identified as PID 75096693. The approximate co-ordinates of centre of the Assessment Area are Lat: 45^0-34’-17.04”N and Long: 67^0-17’-37.07”W.

Address: The Assessment Area is located approximately 2.5 km southeast of the Village proper in the McAdam Parish of York County. The Assessment Area including the existing wellfield is accessed via an existing road situated on the south side of NB Route 4. There is no civic address associated with the Assessment Area.

Location Map: The project location relative to communities, roads, existing environmental features, etc. is indicated on Figure 3a and Figure 3b which depict the overall study area and the EIA Assessment Area, respectively.

2.5 Siting Considerations

Eight potential target drilling locations for a new municipal groundwater production well were identified by means of a geophysical survey in conjunction with the aforementioned Abbreviated Municipal Groundwater Supply Source Investigation (EXP, 2018). A relative ranking of the interpreted quality of each of the identified target drilling locations was provided in this report, based on the aggregate consideration and evaluation of the data compiled for the report and economic factors. It is noted the three top ranked target drilling locations (i.e. C1, C2 and C3) identified based on this assessment are located within the Assessment Area for the current EIA.

The scope of the 2018 groundwater supply source investigation/target drilling location siting study was limited to the general vicinity of the existing McAdam Wellfield provided that existing hydrogeological conditions were deemed to be favorable for future municipal production well development. The rationale for this approach was to minimize the piping costs associated with connecting any new production wells to the existing water distribution system, and to allow for the potential use of the existing treatment building and water storage reservoir pending the completion of necessary engineering upgrades and/or modifications. Another advantage of identifying new production well targets on the wooded Crown land surrounding the existing wellfield was to avoid potential sources of groundwater contamination and minimize future wellfield protection requirements under NB Regulation 2000-47.

It is noted that the current Assessment Area is located within the Wellfield Protected Area associated with the existing wellfield. Since this protected is subject to a Wellfield Protected Area Designation Order in accordance with NB Regulation 2000-47 under the *Clean Water Act*, a few minor exemptions may be required under the exemption process (i.e. tree cutting, etc.) in order to complete the proposed wellfield expansion project. These minor exemptions may not be required, since the project purpose relates to the maintenance/expansion of the existing municipal water supply source. It is noted that target drilling location C2 is situated near the outer boundary of wellfield protection Zone B and that drilling targets C1 and C3 are situated in Zone C.

Since a mapped wetland was identified in the Assessment Area on GeoNB MapViewer, a Wetland Survey was completed to delineate the actual wetland limits on the subject property in accordance with NBDELG requirements. Based on the delineated wetland limits, it is expected that a Watercourse and Wetland Alteration (WAWA) permit will be required for the proposed test well drilling and pump testing program and related access road improvements as portions of the work will be completed in or within 30 m of a wetland. Concerning the potential for permanent wetland habitat loss subject to compensation, it is noted that the proposed undertaking will result in minimal to negligible loss of wetland habitat.

Based on the results of the siting study which included a detailed review of study area geological and hydrogeological conditions, it is concluded that there is a reasonable expectation that the Village will be able to secure the required additional groundwater supply capacity at the proposed target drilling locations identified for the proposed wellfield expansion. For complete details concerning the identification of the proposed target drilling locations, refer to our report on the Abbreviated Municipal Groundwater Supply Source Investigation which is provided in Appendix B.

2.6 Physical Components and Dimensions of the Project

The physical components of the project are indicated on Figure 2 in addition to the preliminary project engineering drawings which are provided in Appendix C.

The project will involve the drilling, pump testing and development (if merited) of up to two new municipal production wells and connecting each well to the existing water treatment building via two new high-density

polyethylene (HDPE) transmission mains. Related work will include access lane improvements and construction in addition to the completion of piping and other infrastructure upgrades at the existing treatment building to accommodate the proposed wellfield expansion. To minimize environmental impacts, the majority of the new access lanes will be constructed by upgrading and widening an existing woods trail and the new water transmission mains will follow the alignments of the new access lanes and the existing wellfield access road.

The approximate quantities and dimensions associated with the key physical components of the proposed undertaking are as follows:

- One 200 mm diameter production well and one 150 mm diameter water level observation well assumed to be constructed at each of target drilling locations C1 and C2 (**Note:** target drilling location C3 may be assessed and utilized, if required, pending the results of the test well drilling and pump testing program);
- Approximately 1300 m of 75 mm HDPE watermain to connect each of target drilling locations C1 and C2 to the existing treatment building (i.e. an estimated total of 2600 m of watermain);
- Approximately 900 m of 4 m wide gravel surfaced access lane complete with 1 m shoulders (i.e. 6 m total width) which will follow an existing woods trail with an approximate width of 3 m; and,
- Approximately 200 m of 4 m wide gravel surfaced access lane complete with 1 m shoulders (i.e. 6 m total width) which will connect C1 to the existing woods trail/upgraded access lane.

In addition to the above, it is noted that new utility poles will be required along the proposed access lane in order to connect the new production wells to the existing provincial power grid at the existing wellfield property via new overhead power lines.

Based on the proposed access lane cross section, it is estimated that approximately 6,600 m^2 of additional tree clearing/grubbing will be required to improve and widen the existing woods trail. In addition, approximately 2,300 m^2 of clearing and grubbing will be required to construct the 200 m access lane connecting C1 to the existing woods trail. Approximately 118 m of the estimated 1100 m total length of new access lane will be constructed along two portions of the existing woods trail which cross the mapped and field delineated wetland. It is estimated that this will result in approximately 0.0826 ha of permanent wetland habitat loss potentially subject to compensation.

2.7 Construction Details

It is intended to initiate construction to connect the new production wells to the existing water supply distribution system as soon as possible following the receipt of EIA approval provided that the necessary project funding has been secured. For preliminary project scheduling purposes, it is assumed that the WSSA and related preparatory work (i.e. drill rig access road improvements/construction) will be completed during the fall of 2020 and early winter of 2021. A description of the scope of work associated with the Step 2 WSSA field work was previously provided in **Section 2.2**.

Approximate duration: It is anticipated that the required construction work to connect the new production wells to the existing water system can be completed in about four to five months. Depending upon the timing of conditional project approval under the EIA process, the work may need to be completed in phases over a couple of construction seasons since water main construction work is typically not completed during the winter months.

Estimated Hours: The estimated working hours during construction are as follows: 7:00 hrs to 18:00 hrs, 5 days per week, Monday to Friday.

Anticipated Equipment: Excavators, boom truck (for submersible pump installation and well completion), dump trucks and compaction equipment. Ancillary items to include municipal infrastructure piping installation tools and equipment.

Date of First Physical Construction-Related Activity: Tentatively the summer of 2021 pending the attainment of EIA approval, environmental permits and the necessary funding arrangements.

Potential Sources of Pollutants: fugitive dust emissions, noise, suspended solids runoff, spillage of fluids used in equipment such as hydraulic fluid and fuels.

Fate of Wastes: Wastes associated with the project will be minimal and expected to potentially include some equipment and supplies packaging (e.g. metal or plastic bands to secure new pipe sections, wood pallets, etc.). Where not recycled, all waste materials will be collected and transported off-site for ultimate disposal at the nearest municipal solid waste landfill facility. Portable toilets will be provided on-site for construction workers and these units will be maintained as required by a qualified sub-contractor.

Access and Traffic Management: Access to the site and work areas will be via the existing wellfield access road situated off the south side of NB Route 4. Given the limited scale of the project and the remote nature of the work site (i.e. undeveloped woodland), it is anticipated that site construction related activities will not have any significant impact on local traffic.

Clearing and Grubbing: Some tree clearing and grubbing will be required to construct the access lane to C1 and widen the existing woods trail. It is expected that tree clearing will take place outside of the bird breeding period to avoid any potential impact on migratory bird species. Trees will most likely be cleared with a wood mulching machine or excavator attachment. Grubbed material will either be removed from the project site or buried on-site.

Fill Material: Clean on-site common fill and standard aggregate or granular fill (0-19 mm crushed gravel and Granular 'B') will be required for the construction of the access lanes. Free draining granular fill will also be required for the water transmission main pipe bedding. All fill materials will be obtained from existing sources.

Work Near Wetlands/Watercourses: There is one mapped and field delineated wetland within the project Assessment Area. As previously indicated, the project will result in approximately 0.0826 ha of permanent wetland habitat loss due to the upgrading (i.e. widening, etc.) of two sections of the existing woods trail that is required to construction a portion of the new access lanes. In addition, some additional road construction work and the drilling and pump testing work associated with the assessment of C1 will be completed within 30 m of the on-site wetland.

No other work within 30 m of a watercourse or wetland will be required. All necessary permits and approvals will be obtained prior to initiating any work in or within 30 m of the Assessment Area wetland.

2.8 Operation and Maintenance Details

General: The existing Village public works staff will be responsible for the day-to-day operation and maintenance of the existing water supply source. Qualified contractors (e.g. Licensed Well Drilling Contractor, electrical contractor, etc.) will be retained to conduct any necessary repairs and/or maintenance, as required (e.g. pump replacement, etc.).

Water Supply: As previously indicated, the current Village water demand is estimated to be 450 m^3/day (69 Igpm) which is near the capacity of the existing wellfield. Ideally, the combined yield of the new production wells will be 700 m^3/day (107 Igpm) or greater. This additional well yield would allow for an appreciable increase in the capacity of the existing wellfield and the decommissioning of PW11 which presents challenges to the operation and maintenance of the existing water system due to the elevated manganese concentration in the water produced by this well.

Operation and Maintenance: The existing Village public works staff will continue to be responsible for the operation and maintenance of the upgraded wellfield and the related water supply and distribution system components in accordance with the Approval to Operate. The existing Approval to Operate will need to be updated to reflect the proposed wellfield expansion. Village staff will also be responsible for the on-going maintenance of the new access lanes associated with the wellfield expansion project, as required.

Lifespan of Project: The lifespan of municipal production wells varies in accordance with site specific considerations, but a typical lifespan would be 40 years or greater. Associated mechanical equipment (e.g. well pumps) will need to be replaced on a more frequent basis.

Power Requirements: the proposed production wells will be connected to the NB Power electrical transmission grid via new utility poles and overhead power lines to be installed along the access lanes.

Fate of Wastes: No waste will be generated during the operation of the proposed new municipal production wells.

2.9 Future Modifications, Extensions or Abandonment

It is anticipated that the completion of the currently proposed work will provide the Village with adequate water supply capacity in the future for the near term. In the event that additional production wells are required in the future in response to increased demand, additional pump testing and assessment will be required under the NBDELG EIA and WSSA processes.

As previously indicated, it is planned to decommission the existing PW11 following the completion of the wellfield expansion project provided that sufficient additional groundwater supply capacity can be obtained. It is noted that any production wells to be abandoned at the end of their service lives will need to be decommissioned by a licensed well driller in accordance with the NBDELG Guidelines for the Decommissioning (Abandonment) of Water Wells.

2.10 Project Related Documents

Project related documents include a 2018 report on an Abbreviated Municipal Groundwater Supply Source Investigation completed by EXP for the Village. As previously indicated, a copy of this report is provided in Appendix B. No other project related documents are available.

As previously indicated, EXP submitted a LOO application to NBDNRED on behalf of the Village of McAdam on July 22, 2020 for the purpose of obtaining approval from NBDNRED to conduct the proposed test well drilling and pump testing program in the Assessment Area. It is noted that a response from NBDNRED had not been received at the time of EIA registration.

A WSSA permit will be also be required from NBDELG for the wellfield expansion project. It is noted that a WAWA permit application for the proposed access lane construction, drilling and pump testing work to be completed as part of the WSSA process will be submitted to NBDELG in the near future.

3 Description of the Existing Environment

The Assessment Area is predominately comprised of undeveloped woodland with the exception of the existing Village wellfield and woods trail. Within the Assessment Area limits, the existing wellfield includes approximately 550 m of access road; four active municipal production wells; and a water treatment building/wellhouse. Access to the wellfield and wellhouse are controlled by a gate and a wire fence and gate, respectively.

Existing land use adjoining the Assessment Area consists of undeveloped and wooded Crown land.

3.1 Physical and Natural Features

Topography and Surface Water Drainage: Key hydrological and topographic features in the study area are depicted on Figure 1. As indicated, the Assessment Area is located about 2.5 km southeast of the Village of McAdam near a local topographic high area. Based on a review of regional scale topographic mapping, the ground surface elevation in the vicinity of the Assessment Area typically ranges from 145 m to 160 m. The slope of the terrain is variable, but generally relatively flat-lying. In the eastern portion of the study area, the ground surface slopes to the east towards wetlands and White Beaver Brook. It is noted that the western portion of the study area generally drains to the west towards the NB Southern Railway line and a tributary to the Digdeguash River.

Geology and Hydrogeology: The surficial geology of the study area as depicted on regional scale mapping consists of hummocky, ribbed and rolling ablation moraines comprised of loamy ablation till; some lodgement till; and minor silt, sand, gravel and boulders (Rampton et al., 1984). The thickness of the overburden material generally exceeds 1.5 m.

Local scale (1:50,000) surficial geology mapping of the McAdam area indicates that the Assessment Area is underlain by hummocky till comprised of sandy or stoney diamicton with many sub-angular to sub-rounded cobbles and boulders (Allard, 2011). The thickness of the hummocky till typically ranges from 1 m to >10 m and it is noted that this unit locally obscures the local bedrock or till surface topography.

Concerning bedrock geology, regional scale mapping indicates that the study area is underlain by greywacke, slate, siltstone, sandstone, conglomerate and limestone with minor chert, argillite and volcanic rocks (Potter et al., 1968). The minor volcanic rocks consist of interbedded mafic and silicic rocks, gabbroic sills and dykes.

The majority of the Assessment Area including the existing production wells and each of the identified target drilling locations are underlain by the Shin Formation (EXP, 2018). This bedrock formation is typically comprised of greyish-red conglomerate, arkosic sandstone and mudstone. The southwest-northeast trending Fredericton Fault is a mapped as forming the northwestern boundary of the Shin Formation within the Assessment Area. Structural features such as faults and related fracturing and, to a lesser extent, geological formation contact lines can provide favorable locations for the development of higher yielding groundwater supply wells. In this regard, it is noted that Village's highest yielding production well (PW12) and target drilling location C1 are situated along or near the mapped location of the Fredericton Fault. However, it must be appreciated that the precise location of the Fredericton Fault in the study area is unknown and, as such, the actual location of the fault may vary from the inferred position portrayed on bedrock geology mapping.

As indicated in our previous water supply source investigation (EXP, 2018) and based on our review of existing geological mapping, the study area does not offer a good potential for the identification of unconsolidated (i.e. sand and gravel) aquifers capable of supporting high yielding municipal production wells. As such, the sedimentary bedrock units underlying the study area represent the best overall potential aquifers in the McAdam area. Groundwater flow in these bedrock units would be expected to be governed by secondary permeability features such as bedrock fractures, joints and faults. Of the sedimentary rock types potentially present in the study area based on current geological mapping, it is noted that sandstones and conglomerates typically offer the best aquifer potential, with shales, geywackes and to a greater extent siltstones and mudstones typically offering variable to poor aquifer

potential. As such, the Shin Formation with its high proportion of conglomerate bedrock would be expected to have the greatest potential of the study area rock formations for the development of new municipal production wells.

For a comprehensive discussion of geological and hydrogeological conditions in the study area, refer to our Abbreviated Municipal Groundwater Supply Source Investigation report in Appendix B.

Watercourses and Wetlands: There are no mapped watercourses in the Assessment Area based on a review of study area mapping in the GeoNB MapViewer on-line application. However, a review of the NBDNRED wetlands layer in the aforementioned application indicates the presence of a 10.4 ha regulated wetland within the Assessment Area limits. The majority of the mapped wetland is situated in the central portion of the study area between the existing wellfield access road and woods trail as indicated on Figure 3b.

The limits of the above noted wetland were delineated in accordance with NBDELG requirements by Boreal Environmental in June 2020. A site plan depicting the limits of this wetland as delineated in the field is provided as Figure 4. It is noted that the field-delineated wetland limits encompass a somewhat larger area than that depicted in the NBDNRED wetland mapping database. It is noted that Boreal classified the wetland as a coniferous swamp. As indicated on Figure 4, a portion of the existing woods trail which has a width of approximately 3 m passes through the on-site wetland and its associated 30 m development setback buffer.

Significant Fish/Wildlife Populations or Habitats: The Atlantic Canada Conservation Data Centre (ACCDC) was requested to search their databases for a 5 km buffer around the Assessment Area to complete a screening level assessment of the nature and extent of potential ecological receptors in the study area. The results of the ACCDC data request are provided in Appendix D. It is important to note that this data only provides information on the potential presence of rare flora or fauna in the vicinity of the proposed development area.

The 5 km buffer contained fourteen (14) records of eight (8) vascular flora and one (1) record of (1) non-vascular flora. Similarly, one hundred sixty-four (164) records of twenty-three (23) vertebrate fauna and three (3) records of three (3) invertebrate fauna were identified. The majority of the vertebrate fauna observations within the 5 km area were bird sightings. Wood turtles were not noted to be present in the study area. The above noted flora and fauna observations within the study area were assigned proximity estimates ranging from 2.2 km ± 0 km to 4.6 km ± 0 km. Identified "location sensitive" species within the 5 km buffer included the snapping turtle and bats (species unspecified).

Finally, the records review identified no managed areas (MAs) and two (2) Environmentally Significant Areas (ESAs). Managed areas typically have some degree of protected status and ESAs may or may not have legal status. The identified ESAs include the McAdam Bird Sanctuary/Railroad Station ESA (point location) and the large Oromocto Lake ESA (approximate location). It is noted that the former ESA is situated approximately 3 km northwest of the Assessment Area and, as such, it would not be affected by the proposed development. Concerning the very large (i.e. 153,185 ha) Oromocto Lake ESA, the ACCDC report indicates that the Assessment Area is situated near the southeastern boundary of this environmental feature. However, a review of the ACCDC data suggests that the area of concern associated with this ESA is Oromocto Lake proper for which historical observations of Bald Eagle and Great Blue Herron nesting sites have been recorded. Since Oromocto Lake is situated approximately 20 km east of the Assessment Area, the proposed undertaking would be expected to have any adverse effect on this ESA.

No species protected under the provincial *Species at Risk Act* were identified in the ACCDC data. Although one Eastern Cougar siting within 3.8 km ± 1.0 km of the Assessment Area was reported, it is noted that NBDNRED considers the Eastern Cougar to be extinct. To minimize the potential for exploitation or disturbance, no co-ordinate information was provided for the snapping turtle and unspecified bat species as NBDNRED considers these to be a "location sensitive" species.

Environmentally Sensitive Areas: No environmental sensitive areas (e.g. NB Protected Areas, Protected Natural Areas, etc.) are located in the general vicinity of the Assessment Area based on a desktop review of New Brunswick Crown Lands Conservation Areas mapping and other sources. Although the Assessment Area is not located near any

Watershed Protected Area, it is noted that portions of all three of the protection zones (i.e. Zone A, Zone B and Zone C) in the Wellfield Protected Area associated with the existing municipal wellfield are included within the entire Assessment Area Limits. The Wellfield Protected Area is subject to land use restrictions in accordance with the Wellfield Protected Area Designation Order (NB Regulation 2000-47) under the *Clean Water Act*.

3.2 Cultural Features

There are no known cultural features at or in the immediate vicinity of the proposed project. Furthermore, based on the project location in previously undeveloped woodland that is not situated near any watercourses or lakes, it is expected that the potential for encountering any items of archaeological significance during construction would be extremely low.

3.3 Existing and Historic Land Use

Existing and Previous Uses of the Subject Property and Adjoining Lands: As previously indicated, the existing municipal wellfield was developed in the early 2000's due to water quality concerns associated with the previous municipal production wells which were located within the Village limits. Currently, the Assessment Area consists of the existing wellfield, woods trail and undeveloped forested land. Prior to the development of the existing wellfield, the Assessment Area was comprised of undeveloped woodland.

Other than the Southern NB Railway line which is situated approximately 800 m southwest of the wellfield access road, the land surrounding the Assessment Area is comprised of Crown land that is also predominately characterized as undeveloped woodland.

Although the timber harvesting history of the study area is unknown, it is noted that AV Nackawic has cutting rights on selected tracts of Crown land in the general vicinity of the proposed wellfield expansion work. Consequently, the Village of McAdam met with AV Nackawic officials as a courtesy following the completion of the water supply source targeting study in 2018 (EXP, 2018) to advise them of their intention to conduct future groundwater supply source exploration work in the Assessment Area. It is our understanding that AV Nackawic staff were supportive of the Village's intentions at the time of this meeting. Note that this meeting was arranged by the Village only as a courtesy, as it is our understanding that commercial timber harvesting cannot be completed (i.e. is likely not permitted in all protection zones) in the Designated Wellfield Protected Area associated with the existing wellfield in which the Assessment Area is located. However, it is noted that if the proposed new production wells are developed, the boundaries of the existing wellfield protection zones in the study area will need to be updated within one year of the commissioning the new wells. This will likely result in an increase in the overall areal extent of the existing wellfield protected area.

Ownership of Adjoining Properties: The Assessment Area is comprised of the existing wellfield property (PID 75416198) and a small portion of the large (i.e. approximately 34,000 ha) Crown land parcel identified as PID 75096693. As such, all of the property adjoining the Assessment Area is Crown land identified as PID 75096693 and administered by NBDNRED.

Type and Extent of Any Known or Suspected Contamination Resulting from Previous Use of the Subject Property or Adjoining Property: The NBDELG maintains a PID-based database of environmental information pertaining to petroleum storage tank registrations and removals; historical solid waste landfill sites; PCB storage facilities; Ministerial orders; and contamination remediation files. It should be noted that the NBDELG petroleum storage tank database only goes back to 1987, and therefore information pertaining to any petroleum storage tank registrations and removals prior to this date is not available from NBDELG. Registration is only mandatory for tanks with a capacity in excess of 2000 L. Furthermore, it is noted that the NBDELG remediation database was not established until about the mid-1990s.

The Land Gazette feature of the SNB Real Property Information Website was used to screen the subject and adjoining properties (i.e. PID 75416198 and PID 75096693) for the presence of any environmental notices pertaining to the

above noted property-based environmental information maintained by NBDELG. Based on this review, an NBDELG remediation file flag was noted for the approximately 34,000 ha Crown land parcel identified as PID 75096693. Information received from NBDELG pertaining to this issue indicated that the remediation file, which was closed in 1993, relates to petroleum hydrocarbon contamination that was encountered and remediated during the removal of a petroleum storage tank from a Georgia Pacific timber office. Follow-up discussions with NBDELG staff confirmed that this historical contamination incident was far removed from the Assessment Area. Since the timber office was not located near the Assessment Area, the aforementioned historical contamination event does not represent a significant potential environmental concern to the proposed undertaking.

The results of the 2018 abbreviated municipal water supply source investigation indicated that there are no known potential sources of contamination within 500 m of the proposed target drilling locations (EXP, 2018). The nearest potential source of groundwater contamination is the Village's former municipal dumpsite situated on PID 75358960; however, since the latter property is located approximately 1.8 km to the northeast and downgradient of the Assessment Area, it is not considered to represent a significant potential source of contamination to the proposed development.

4 Summary of Environmental Impacts

General: The proposed undertaking will involve some clearing and grubbing related activities; widening and upgrading the existing woods trail and constructing approximately 200 m of new access lane to provide drill rig access to the proposed target drilling locations; test well drilling and follow-up hydrogeological pump testing; installation of underground services (i.e. new water transmission lines); and completion of piping and other infrastructure modifications to the existing water treatment building to accommodate the proposed wellfield expansion. In general terms, potential environmental impact considerations associated with this type of development project including socio-economic factors are sediment and erosion control; avoidance of heritage resources; avoidance of species at risk and environmentally sensitive areas; mitigation of potential impacts on groundwater quality; minimization of noise and air quality impacts during construction; and mitigation of construction related impacts on adjoining properties and businesses. It is noted that given the remote location of the proposed undertaking with respect to existing development, there is limited to no potential for the proposed construction work to adversely impact area businesses and properties. However, project-specific considerations for the proposed undertaking include the anticipated limited encroachment on regulated wetland habitat associated with widening/upgrading the portions of the existing woods trail that traverse the on-site wetland which will result in the requirement for a WAWA Permit in accordance with NB Regulation 90-80 under the *Clean Water Act*. As previously indicated, it is expected that the above noted encroachment will result in approximately 0.0826 ha of permanent wetland habitat loss subject to compensation at a 2:1 ratio. Finally, it is noted that an exemption under the current Wellfield Protected Area Designation Order may be required to complete the relatively small quantity of tree clearing required to provide access to the proposed target drilling locations which are located within the outer limits of Zone B and in Zone C. An exemption will also likely be required to complete a small amount of tree clearing in Zone A along the east side of the existing wellfield access road to accommodate the installation of the watermains that will connect the new production wells to the existing treatment building.

Potential project-environment interactions for the future operation and maintenance phase of the expanded wellfield would be identical to the current potential interactions with groundwater quality, land use and human-health. Standard mitigation measures will be required to protect groundwater quality/human health during wellfield operation and maintenance activities such as the replacement of existing submersible pumps, etc. When complete, the project in theory may result in land use changes in the study area (i.e. land use restrictions to protect groundwater quality in the wellfield) due to the requirement to update the existing wellfield protection zone boundaries in the Assessment Area to reflect the new municipal production wells within one year of commissioning the new wells. However, in practice, it is anticipated that the updating of the existing wellfield protection zone boundaries will not result in any changes to existing land use as existing and proposed future land use in the study area is limited to the operation of the existing municipal wellfield. Concerning socio-economic impacts, it is anticipated that the project will have a significant positive impact on the local economy due to the increased water supply capacity. This increased capacity will support the continued population growth that the Village has experienced in recent years and is expected to attract future commercial/industrial ventures to the area which, in turn, will result in a reduction in unemployment and economic growth (i.e. increased municipal tax base, disposal income, etc.). These socio-economic considerations are of paramount importance to the Village given the recently announced pending closure of the local wallboard plant which is the largest employer in the local area.

Concerning potential accidents and malfunctions, it is noted that hazardous materials spills (e.g. fuel, hydraulic oil, etc.) and accidental fires are a possibility during all phases of the project. However, the likelihood of the occurrence of these events for the current project is considered to be low in light of standard/existing mitigation measures and best management practices (BMPs).

A summary of the interpreted project related environmental interaction with key valued environmental components (VECs) for the construction and operation phases of the project in addition to potential accidents, malfunctions and unplanned events is provided in Table 1 which follows **Section 10** of this report. A qualitative rating system was

employed as outlined below to assist with the assessment which was based on the professional judgement and experience of the project team in addition to our current understanding of the project.

Rating	Interpretation
0	No interaction with this VEC is anticipated;
1	Interaction occurs, but it would not be expected to result in a significant effect even without mitigation; or the interaction would not be expected to result in a significant environmental effect upon the implementation of suitable mitigation measures (e.g. typical environmental "best practices", project specific mitigation, etc.); and,
2	Interaction occurs and may result in an environmental effect of concern even with mitigation (this would typically require compensation for habitat loss, etc.).

As indicated in Table 1, mitigation measures will be required for some potential impact categories (e.g. sedimentation and erosion control) as detailed in **Section 5.0**. As previously indicated, it is expected that compensation will be required for regulated wetland habitat loss associated with the limited wetland encroachment associated with the widening and upgrading of a couple of segments of the existing woods trail.

There are no known species at risk in the immediate vicinity of the project. In addition, no rare plants were identified in a Rare Plant Survey of the Assessment Area completed by Boreal Environmental in July 2020. It is currently anticipated that clearing and grubbing related activities associated with the construction/improvement of the site access lanes will be scheduled to occur outside of the bird breeding season to mitigate potential impacts on migratory birds. Should clearing need to occur during the nesting period, a nesting survey will be conducted and any identified areas to be avoided will be clearly flagged in the field.

Climate Change and Effects of Climate on the Project: Concerning the potential effects of the environment on the project, it is noted that sustainable well yields are generally expected to decrease in the future in response to diminishing groundwater supplies which is one of the predicted adverse effects of climate change in the province (NBDELG, 2020). It is noted that the completion of the proposed undertaking will serve to mitigate against this potential impact.

No other extraordinary potential adverse effects of the environment on the project are anticipated.

5 Summary of Proposed Mitigation

A summary of the proposed mitigation efforts associated with the undertaking are outlined herein. A tiered approach was utilized in developing the project mitigation measures as suggested in the technical guide to EIA in New Brunswick. Under this approach, environmental impact avoidance opportunities are implemented wherever possible. If it is not possible or practical to avoid some degree of environmental impact, impact reduction measures are stipulated. Finally, in occasional instances where more extensive impacts are unavoidable and justifiable (e.g. public good, etc.), compensation measures are proposed.

The main aspects of the work that may require mitigation include erosion control (re: suspended solids runoff); potential spills (e.g. fuel or oil leak from equipment) and related impacts on groundwater quality/human health; heritage resource encounters; fugitive dust emissions; fires; limited encroachment on wetland habitat; and effects of the environment on the project. These will be mitigated as follows:

Suspended Solids: Mitigative measures will include standard erosion control measures (e.g. silt fences, check dams, etc.) which will be employed and maintained as required during the construction phase of the project. For the pump testing of the test wells, the outlet of the discharge piping will be situated a suitable distance away from the wells to avoid artificial groundwater recharge. In addition, suitable erosion control structures will be put in place, as and if required, downstream of the point of discharge for sediment and erosion control prior to the initiation of pump testing.

Hazardous Materials Spills: Spills (if any) will be addressed by applicable regulatory requirements (e.g. notification and response). On-site construction and drilling equipment will be required to be in good condition and free of any known fluid leaks. During the operational phase of the project, a licensed well drilling contractor will also be retained to complete any necessary future well maintenance related work (e.g. replacement of well pump, etc.).

Heritage Resource Encounters: In the unlikely event that an item of cultural/archaeological significance is encountered during construction, all work in the vicinity of the discovery will be immediately halted and the Archaeological Services branch of the New Brunswick Department of Tourism, Heritage and Culture will be contacted to obtain further instructions and/or directives.

Fugitive Dust Emissions: For aspects of the work that may lead to an increase in fugitive dust emissions above ambient conditions, standard dust suppression techniques such as water application to work areas/roadways will be utilized.

Fires: Portable fire extinguishers will be required on the work site during construction and a no smoking policy will be permitted at the work site outside of designated areas. A portable fire extinguisher will also be made available within the existing water treatment building over the operational life of the wellfield.

Wetlands and Watercourses: The construction phase of the project will involve ground disturbance in or within 30 m of a wetland and, as such, a permit will be required under the provincial Watercourse and Wetland Alteration (WAWA) regulations. The WAWA permit will be included with the project tender documents and all on-site Contractors will be responsible for respecting the terms and conditions of this permit.

As previously indicated, it is expected that the widening of the existing woods trail will result in approximately 0.0826 ha of permanent wetland habitat loss subject to compensation at a 2:1 ratio.

Effects of the Environment on the Project: As previously indicated, over the long term, the sustainable yield of groundwater supply wells in the province including the proposed new municipal production wells associated with the current project may decrease due to the predicted adverse effects of climate change. To mitigate against this potential effect, water levels and/or flows; water quality information; and other operational data will be collected from the new production wells on a regular basis. In accordance with standard water supply engineering practice, it will be recommended in the Step 2 WSSA report that this operational data be periodically reviewed by a qualified

hydrogeologist. Based on these reviews, it may be recommended that the initial recommended safe well yields and/or pumping schedules be revised, as and if required. It is noted that the scope and frequency of the operational monitoring program could be reduced with time, pending the receipt of favorable results.

Other: In the event of a power outage, it is noted that there is a propane fueled emergency generator in the wellfield water treatment building.

It is expected that the project will not result in any significant residual adverse environmental impacts if the mitigation measures outlined herein are implemented.

The above discussion of proposed mitigation measures for the key environmental aspects of the project are intended to provide a general overview. More detailed mitigation measures will be outlined in an Environmental Protection Plan (EPP) which will be developed and included with the project tender documents.

6 Public and First Nations Involvement

The minimum public and First Nations consultation requirements outlined in Appendix C of the Provincial EIA registration guide will be followed (NBDELG, 2018). Stakeholders include the Village residents and AV Nackawic due to their cutting rights in the general study area. A public notice containing the information specified in the registration guide will be delivered to the above noted stakeholders in addition to the local Member of the Legislative Assembly (MLA) and nearby Wolastoqey First Nation communities subsequent to registering the undertaking under the Provincial EIA process.

As previously indicated herein, the proposed wellfield expansion project is located on Crown land. As such, this may trigger the province of New Brunswick's Duty to Consult Policy in the event that the proposed undertaking is determined to potentially adversely impact the exercise of Aboriginal or Treaty rights. In consideration of the Duty to Consult Policy and the importance of early engagement of First Nations with respect to their Aboriginal rights, project background information and an invitation to provide comments on the proposed work was sent to nearby Wolastoqey First Nation communities prior to EIA registration on June 24, 2020. The communities which were provided with a "Notice of Pending Environmental Impact Assessment Registration – McAdam Wellfield Expansion Project" included the Pilick, Welamukotuk, Sitansisk and Peskotomuhkati at Skutik First Nations. A copy of this project notice and covering letter is provided in Appendix E. The Village received an e-mail from Fred Sabattis (Welamukotuk First Nation Consultation Coordinator) on June 24, 2020 wherein Mr. Sabattis indicated that he did not foresee any problem with the project as long as Gordon Grey (Wolastoqey Nation in New Brunswick EIA Coordinator) is satisfied with the project EIA. With respect to this comment, each of the engaged First Nation communities will receive a copy of the project EIA registration document when complete and continue to have an opportunity to participate in the public and First Nation consultation process. Other than the above noted e-mail, the Village of McAdam had not received any responses from the above noted First Nation communities at the time of submission of this EIA registration document to NBDELG.

It is noted that a copy of the Public Notice which will be sent to the project stakeholders in conjunction with the public consultation process will also be sent to the New Brunswick Department of Aboriginal Affairs (NBDAA) in consideration of the provincial Duty to Consult requirements and in accordance with the Interim Proponent Guide on engaging Aboriginal peoples in New Brunswick (NBDAA, 2019).

7 Approval of the Project

The following permits and approvals will be required for the proposed project:

- License of Occupation (LOO) from NBDNRED to complete the proposed access road construction, test well drilling and Step 2 WSSA pump testing work in the Assessment Area (i.e. Crown land).
- Project approval from NBDELG under the WSSA process to proceed with test well drilling and a Step 2 WSSA Hydrogeological Assessment of the proposed test wells under the WSSA process.
- A Watercourse and Wetland Alteration (WAWA) permit from NBDELG to complete the portions of the above noted access road construction and test well drilling and assessment work situated in or within 30 m of the on-site wetland. As previously noted, it is expected that this work will result in approximately 0.0826 ha of permanent wetland habitat loss subject to compensation at a 2:1 ratio.
- Authorization/conditional approval of the undertaking under the Provincial EIA requirements as outlined in NB Regulation 87-83.

In addition to the above, it is noted that an exemption to the Wellfield Protected Area Designation Order pertaining to the existing wellfield may be required from NBDELG to complete the proposed construction work (i.e. tree clearing) within the existing Wellfield Protected Area.

8 Funding

The proposed wellfield expansion project has been selected by the provincial Regional Development Corporation (RDC) for application to Infrastructure Canada (INFC) for funding approval. At the time of the completion of the EIA registration document, the project funding application was under review by INFC.

Project funding for all project work completed to date has been provided by the Village of McAdam.

9 Signature

This EIA registration document was prepared by a team of professionals from EXP Services Inc. on behalf of the Village of McAdam.

12 August 2020

Date

Ken Stannix
Mayor
Village of McAdam, NB

10 References

EXP Services Inc. Abbreviated Municipal Groundwater Supply Source Investigation. Report to the Village of McAdam dated May 2018. EXP File No. MON-00244616-A0.

New Brunswick Department of the Environment and Local Government (NBDELG), 2003. Guidelines for the Management of Contaminated Sites – Version 2.0. November 2003.

NBDELG, 2017. Environmental Impact Assessment – Water Supply Source Assessment Guidelines. April 2017.

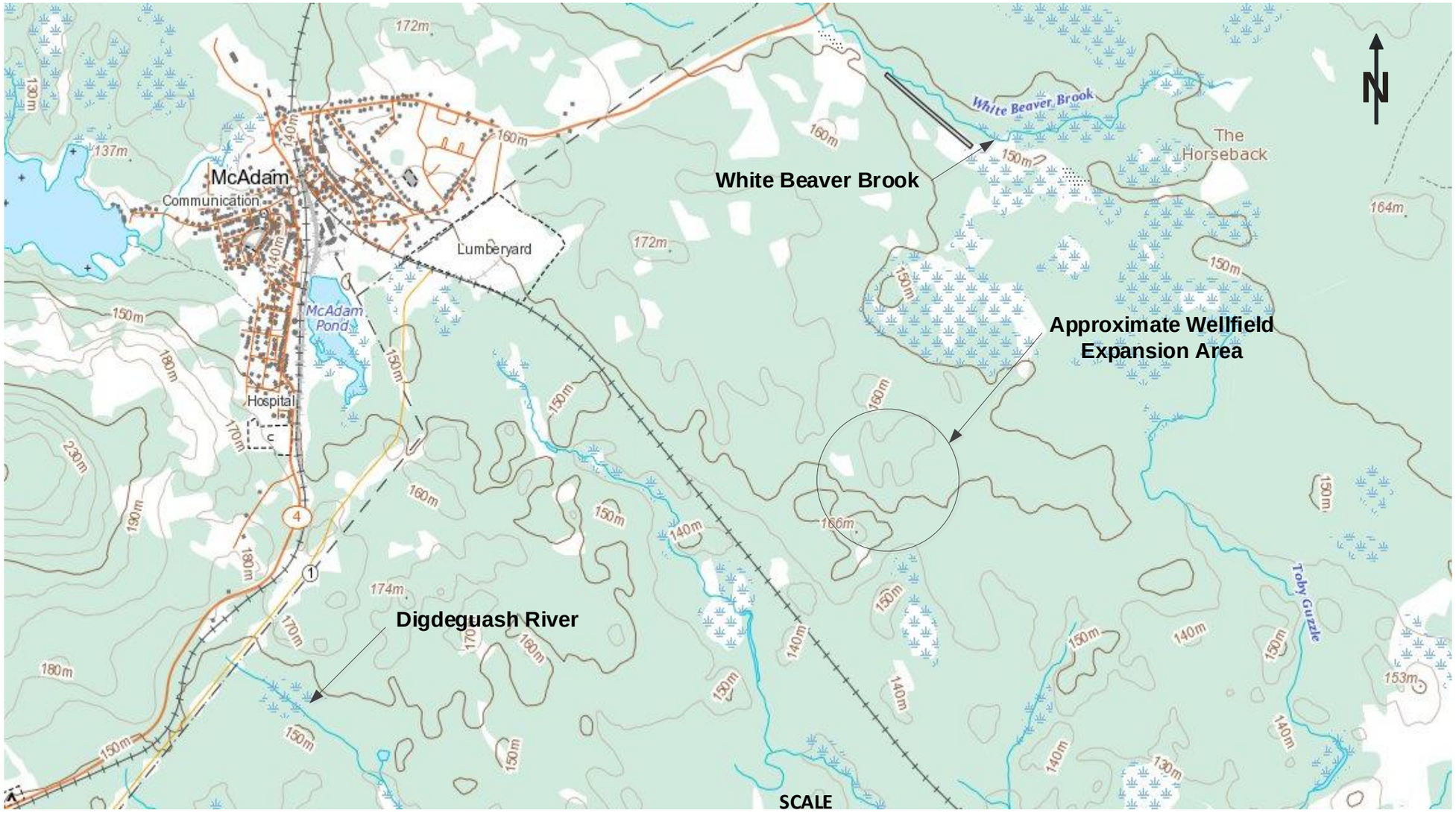
NBDELG, 2018. A Guide to Environmental Impact Assessment in New Brunswick. January 2018.

NBDELG, 2020. Summary of Predicted Impacts of Climate Change in New Brunswick - https://www2.gnb.ca/content/dam/gnb/Departments/env/pdf/Climate-Climatiques/SummaryPredictedImpacts.pdf. Accessed on July 24, 2020.

Potter, R. R., E. V. Jackson and J. L. Davies, 1968. Geological Map of New Brunswick, Map Number N.R.-1.

Rampton, V. N., R. C. Gauthier, J. Thibault and A. A. Seaman, 1984. Quaternary Geology of New Brunswick, Geological Survey of Canada, Memoir 416.

Figures and Tables



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Project Title

EIA REGISTRATION – McADAM WELLFIELD EXPANSION PROJECT

Dwg. Title:

SITE LOCATION PLAN

Drawn By: RSG	Project No. FRE-00259858-A0	
Dwg. Standards Ckd. By:	Dwg. No. **FIGURE 1**	
Designed By:	Dwg. Design Ckd. By:	Rev. No.

"FILE"
MODEL: "MODELNAME"
PLOTTED BY: "USER" DATE: "DATE" "TIME"

2437000 2437500 2438000 2438500 2439000

7397500 7397000 7396500

N

Existing Wellfield Access Roadoff NB Route 4

Village of McAdam

PID 75416198
(Existing Wellfield Property/Lease)

C1

Existing Woods Trail

PW13 PW12

C2

Existing Wellhouse

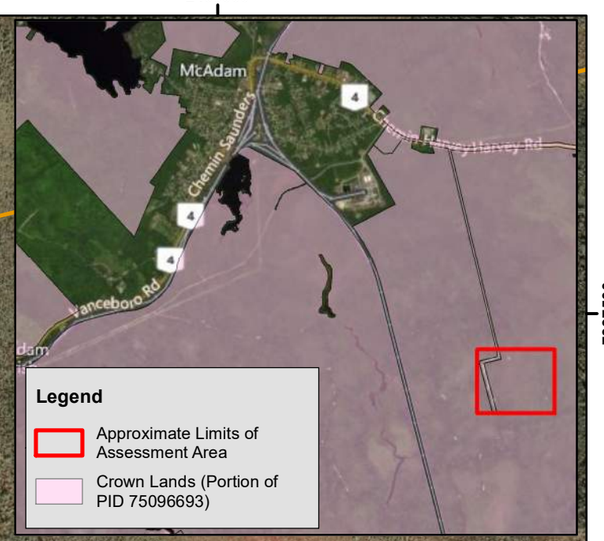
PW11

PW10

C3

Approximate Limits of Assessment Area

Railway Line



Legend
- Municipal Boundary
- Drill Targets
- McAdam Wells
- NBHN Watercourses
- Property Parcels

Figure 2 - Areal Site Plan

1:6,000
0 50 100 200 300
Meters

exp.

Figure 3a - Study Area Existing Environmental Features

Village of McAdam

Existing Wellfield Access Roadoff NB Route 4

PID 75416198 (Existing Wellfield Property/Lease)

Existing Wellhouse

Existing Woods Trail

Approximate Limits of Assessment Area

Village of McAdam

C1 C2 C3

PW10 PW11 PW12 PW13

Rail Line

1:22,000

0 200 400 800 1,200 Meters

Legend

- Municipal Boundary
- Drill Targets
- McAdam Wells
- NBHN Watercourses
- NBHN Waterbodies

Protected Wellfields

Zone

- A
- B
- C
- Wetlands Buffer (30m)
- Wetlands

Legend

- Approximate Limits of Assessment Area
- Crown Lands (Portion of PID 75096693)

2437000 2437500 2438000 2438500 2439000

7397500

7397000

7396500

Existing Wellfield Access Roadoff NB Route 4

Village of McAdam

PID 75416198 (Existing Wellfield Property/Lease)

C1

Existing Woods Trail

PW13 PW12

C2

Approximate Limits of Assessment Area

Existing Wellhouse

PW11

PW10

C3

Railway Line

McAdam

Chemin Saunders

Vanceboro Rd

Legend

- Approximate Limits of Assessment Area
- Crown Lands (Portion of PID 75096693)

Legend

- Municipal Boundary
- Drill Targets
- McAdam Wells
- NBHN Watercourses
- Wetlands Buffer (30m)
- Property Parcels

Protected Wellfields

Zone

- A
- B
- C
- Wetlands

1:6,000

0 50 100 200 300 Meters

Figure 3b - Assessment Area Existing Environmental Features

2437000 2437500 2438000 2438500 2439000

7397500 7397000 7396500

N

Existing Wellfield Access Roadoff NB Route 4

Village of McAdam

PID 75416198
(Existing Wellfield Property/Lease)

C1

Existing Woods Trail

PW13 PW12

C2

Approximate Limits of Assessment Area

Existing Wellhouse

PW11

PW10

C3

Railway Line

McAdam

Chemin Saunders

Vanceboro Rd

Legend

- Approximate Limits of Assessment Area
- Crown Lands (Portion of PID 75096693)

Legend

- Municipal Boundary
- Drill Targets
- McAdam Wells
- NBHN Watercourses
- Property Parcels
- Delineated WetLand 30m buffer
- Delineated WetLand (14.5 ha)

1:6,000

0 50 100 200 300 Meters

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Figure 4 - Assessment Area Delineated Limits of Regulated Wetland

Table 1: Project-Environment Interaction Matrix

Component	Air Quality	Sound Quality	Groundwater	Surface Water	Fish and Fish Habitat	Wildlife/Habitat	Species at Risk	Wetlands	Heritage/ Archaeology	Land Use	Land Use by First Nations	Human Health	Transportation and Navigation
Construction Activities													
Clearing, grubbing and grading	1	0	0	0	0	1	0	2	1	0	0	0	0
Woods trail widening and access lane construction	1	0	0	0	0	0	0	1	0	0	0	0	0
Well drilling and pump testing	1	0	1	0	0	0	0	1	0	0	0	0	0
Underground services installation	1	0	1	0	0	0	0	1	1	0	0	0	0
Water treatment plant modifications	0	0	0	0	0	0	0	0	0	0	0	0	0
Operation and Maintenance													
Well maintenance	0	0	1	0	0	0	0	0	0	1	0	1	0
Well monitoring	0	0	1	0	0	0	0	0	0	1	0	1	0
Potential Accidents/Malfunctions/Unplanned Events													
Hazardous material spills	0	0	1	0	0	0	0	1	0	0	0	1	0
Erosion & sediment control failure	0	0	0	1	0	0	0	1	0	0	0	0	0
Wildlife encounters	0	0	0	0	0	1	0	0	0	0	0	0	0
Fires	1	0	0	0	0	1	0	1	0	1	0	1	1

Appendix A –
Copy of License of Occupation (LOO) Application to NBDERD

Reset

LICENCE OF OCCUPATION APPLICATION

A **Licence of Occupation** is a legal agreement authorizing the non-exclusive occupation of Crown lands for a specific period of time under specific terms and conditions as the Minister of Energy and Resource Development determines to be appropriate. A licence and any renewal cannot exceed twenty years.

TYPES OF USES

SIGNS

Guide and Warning Signs

Individuals or organizations with authorization to construct, maintain or manage roads or trails on Crown lands are permitted to erect guide and warning signs rent-free without specific authorization.

A guide sign posted along a forest road and/or a trail provides information to locate a facility, a geographic feature or a point of interest, such as a nature trail or recreation facility. A warning sign provides advance indication of the conditions of a road or trail.

Advertising Signs

Signs that promote a product or service related to a business may be permitted within Department of Transportation and Infrastructure (DTI) regulated areas provided that authorization is obtained from DTI, where required.

Advertising signs may be permitted on Crown lands within municipalities and rural communities under the *Community Planning Act (http://laws.gnb.ca/en/ShowTdm/cs/C-12).*

Advertising signs are only permitted along provincial highways or municipal streets, not along any trails or environmentally sensitive areas.

The licenced area shall not exceed beyond 2 metres (m) of the footprint of the sign.

Business Directional Signs

Signs along a forest road and/or trail on Crown lands that provide the distance and direction to a business may be permitted provided that the business is accessible by forest roads or has direct access to a trail.

The sign must be within 100 m of an intersection on forest roads and/or trails and be within 1.5 m to 6 m from the travelled portion of the road or trail.

Educational/Information Signs

Educational and informational signs for non-profit organizations may be permitted on Crown lands provided the sign is related to the organization's purpose.

Note: The Department reserves the right to remove any signs that are deemed unnecessary, inappropriately placed, or not maintained in good repair.

For a copy of the *Highway Advertisements Regulation – Highway Act,* Regulation 97-143, visit http://laws.gnb.ca/en/showtdm/cr/97-143.

MAPLE SUGARY CORRIDORS

Sap pipelines are permitted outside lease boundaries for the purpose of transferring sap from one lease area to another, or to a substation. Unless otherwise indicated, the pipeline must not be permanently affixed to the ground to allow temporary removal, such as for a road crossing. The corridor width must be specified on the application and shall not exceed 10 metres.

UTILITY POLE AND ANCHOR

A Licence of Occupation may be issued to install electrical and telephone poles, and their anchors, on Crown lands.

ACCESS ROADS

A Licence of Occupation may be issued to construct a new access road or upgrade an existing access road. The location of the road will be verified by Departmental staff prior to work commencing. The road will be constructed and/or upgraded at the applicant's expense and in accordance with specifications to be determined by the Department.

COMMUNITY EVENT

A Licence of Occupation may be issued to a non-profit group for a community event of less than two weeks duration, which is open to the general public.

COASTAL WORK

A Licence of Occupation may be issued for structures, works or activities located below the Ordinary High Water Mark (OHWM) including improvements to existing structures or works.

The OHWM is the average or mean height or elevation of high tides or high water marks in lakes, rivers and streams which is used as the boundary defining the extent of Crown and freehold ownership in tidal areas and along non-tidal watercourses.

OTHER

A Licence of Occupation to occupy Crown lands may be issued for various reasons other than those noted above.

APPLICATION FEES

Community Event	$ 57.50 non-refundable ($50.00 plus $7.50 HST)
Access Roads	$172.50 non-refundable ($150.00 plus $22.50 HST)
Utility Pole and Anchor	$575.00 + $92.00 per pole non-refundable ($500.00 plus $75.00 HST + $80.00 plus $12.00 HST per pole)
All others	$345.00 non-refundable ($300.00 plus $45.00 HST)

*Fees are established in accordance with the *Lands Administration Regulation - Crown Lands and Forests Act* and are subject to change.

PROCESS

Your application will be reviewed by the Department of Energy and Resource Development (ERD) in consultation with other agencies. The review process is expected to take between 6 and 12 weeks and may take longer depending on the type of application.

Permits and Authorizations: Compliance is required with all laws whether rural community, municipal, provincial or federal, and may include obtaining all required permits and authorizations such as: building permit, harvesting permit, quarry permit, watercourse and wetlands alteration permit, and petroleum storage licence.

Information: Contact the ERD Land Use Application Service Centre at the toll-free number 1-888-312-5600 or at www.gnb.ca/naturalresources.

IF YOUR APPLICATION IS APPROVED

Once the application is evaluated and approved, a letter from the Department will inform the applicant of other requirements which will include the following:

Preparation Fee: $230.00 non-refundable ($200.00 plus $30.00 HST). Fee charged for all approved applications when the licence is issued.

Rent: Licences issued for a duration exceeding 6 months will be subject to an annual rent. Rent is based on the area in hectares of the approved licence.

Other terms and conditions may apply.

Application Form - Licence of Occupation

Department of Energy and Resource Development
Land Use Application Service Centre
P.O. Box 6000
Fredericton NB E3B 5H1
Courier Address: 1350 Regent St., Fredericton, NB, E3C 2G6
Tel: 1-888-312-5600 Fax: (506) 457-4802

APPLICANT

Please Print

☐ Mr. ☐ Mrs. ☐ Ms. **Name or Company Name**

Village of McAdam

Mailing address (Street-apartment, City/Town, Province, Postal Code)

146 Saunders Road, McAdam, NB E6J 1L2

Language Preference: ☑ English ☐ French **Contact Person:** **Ed Arsenault**

Correspondence Preference: ☐ Canada Post ☑ E-mail **Email Address:** **earsenault@mcadamnb.com**

Telephone (home)	**Telephone** (work)	**Fax**	**Cellular phone**
	506-784-2293		**506-784-7075**

Applicant Status: ☐ Individual ☑ Municipality ☐ Company (attach Certificate of Incorporation) ☐ Other, specify:

Charitable Registration # (if not-for-profit):

INTENDED USE OF THE LAND

☐ Utility Pole and Anchor
☑ Road Construction and/or Maintenance
☐ Sap Pipeline Corridor
☐ Other Specify:

☐ Coastal Work
☐ Community Event
☐ Bull Pens

☐ Business Directional Sign
☐ Advertising Sign
☐ Educational/Informational Sign

Indicate approximately how long the licence will be required, i.e. years 1; months _____; days _____

The proposed work will be completed in conjunction with the McAdam Wellfield Expansion Project which is currently under provincial EIA review. As such, it is not definitively known how long the LOO will be required. Following receipt of EIA approval, the Village will seek a Municipal Services Lease Agreeement for the project.

Provide a detailed description of planned activities and/or anticipated construction. Indicate any activities involving new or existing watercourse crossings. If work is proposed along the shore of inland or coastal waters, indicate how far it will extend below the Ordinary High Water Mark (OHWM). Show location of these planned improvements on the Site Plan attached (Appendix A).

Scope of work to include widening an existing woods trail to provide access to target drilling locations C2 & C3; constructing a new road to provide access from the woods trail to C1; and completion of test well drilling & pump testing at up to three of the above noted target drilling locations in accordance with NBDELG requirements. The objective of the work is to secure two new municipal production wells for the Village. Pending favorable well testing results and EIA approval, the Village would construct new watermains to connect the two new wells to the existing water treatment building and complete the piping modifications required at this building to accommodate the expanded wellfield. The proposed access road work will involve some clearing and grubbing.

Provide specific details about equipment and materials that will be used.

Excavators, dump trucks, compaction equipment, air rotary water well drilling rig, boom truck (to install pumps in test wells) and clean fill (roadway aggregate). Pending favorable well testing results and EIA approval, the new watermains (75 mm to 100 mm HDPE pipe) would be installed and the treatment building upgrades completed. It is expected that the latter part of the work may be completed under a Municipal Services Lease Agreeement.

Describe all potential effects on adjacent landowners, the environment or local area.

It is anticipated that there would be no adverse affects on adjacent landowners. A WAWA permit will be required from NBDELG as portions of the work will be completed in or within 30 of the on-site wetland which has been field delineated. The widening of the woods trail will result in about 0.1 ha of permanent wetland habitat loss.

LOCATION

Property Identification # (PID) http://geonb.snb.ca/geonb/ **Portion of PID 75096693**	**Area (ha)** **46.9**
Adjacent PID(s) **PID 75262451; various others**	**Length and Width (m)** **625 m x 750 m**

SITE DESCRIPTION

Describe the current use and condition of the subject Crown land. Describe other known land uses, services, utilities and/or seasonal activities located on or adjacent to the subject area.

The EIA Assessment Area has an approximate footprint area of 46.9 ha and is comprised of PID 75416198 (existing Village Wellfield) and a portion of the 34,000 ha parcel identified as PID 75096693. The subject property, which is predominately undeveloped woodland, contains the McAdam Wellfield (production wells; access road; water treatment bldg; and piping) and a woods trail. It is likely that the woods trail is used from time to time for recreational use by local residents (ATVs, hiking, etc.).

Is there access to the site?

☐ No ☑ Yes, specify: ☑ Public ☐ Private (If private, please provide written consent to use access)

PAYMENT AND SIGNATURE

☐ Money Order (made payable to the Minister of Finance)

☐ Cheque (made payable to the Minister of Finance)

☑ Visa ☐ MasterCard

Credit Card Numbe [redacted] Expiry date [redacted]

Name on Credit Card: **Edward Arsenault, Village of McAdam**

Signature of Cardholder: *Edward Arsenault*

☑ Yes I am 19 years of age or over

Signature of applicant

Date **July 21** 20**20** x *Edward Arsenault*

REQUIRED ATTACHMENTS

Application fees :

Community Event :	$ 57.50 non-refundable ($50.00 plus $7.50 HST)
Access Roads:	$172.50 non-refundable ($150.00 plus $22.50 HST)
Utility Pole and Anchor	$575.00 + $92.00 per pole non-refundable ($500.00 plus $75.00 HST + $80.00 plus $12.00 HST per pole)
All others:	$345.00 non-refundable ($300.00 plus $45.00 HST)

Map and/or aerial photo: available online at http://geonb.snb.ca/geonb/

For Maple Sugaries, GPS coordinates or data must be submitted with the application for sap pipeline corridors, road construction and electrical corridors.

Site Plan (see Appendix A)

APPENDIX A
Licence of Occupation

SITE PLAN

The Site Plan is a sketch describing the activities and improvements to the property. This sketch does not need to be to scale as it is meant to give a general overview of the developments.

Indicate by means of a sketch on the following page, the location of all of the existing and planned activities and improvements.

Show the following:

- North Arrow
- Property boundaries and PID #
- Anticipated construction layout (design/dimensions)
- All watercourses, please include their name(s)
- Roads (improvements or new construction)
- Removal of timber
- Trails
- Position of buildings (structures, storage facilities)
- Parking
- Water supply, if applicable (well, reservoir, underground pipes, etc.)
- Any fuel or hazardous product storage facilities
- Where possible, provide GPS coordinates using NAD 83 (CSRS) in the form of Eastings and Northings, or Latitude and Longitude

APPENDIX A
Licence of Occupation

Site Plan

Top

2437000 2437500 2438000 2438500 2439000

7397500

7397000

7396500

N

Existing Wellfield Access Roadoff NB Route 4

Village of McAdam

PID 75416198
(Existing Wellfield Property/Lease)

C1

Existing Woods Trail

PW13 PW12

C2

Approximate Limits of Assessment Area

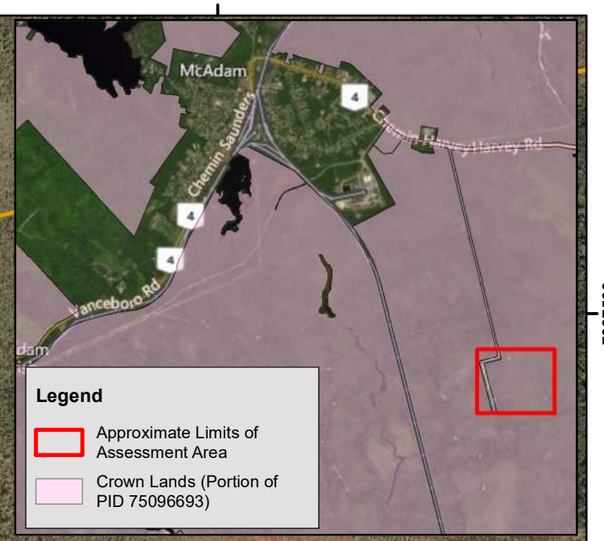
Existing Wellhouse

PW11

PW10

C3

Railway Line



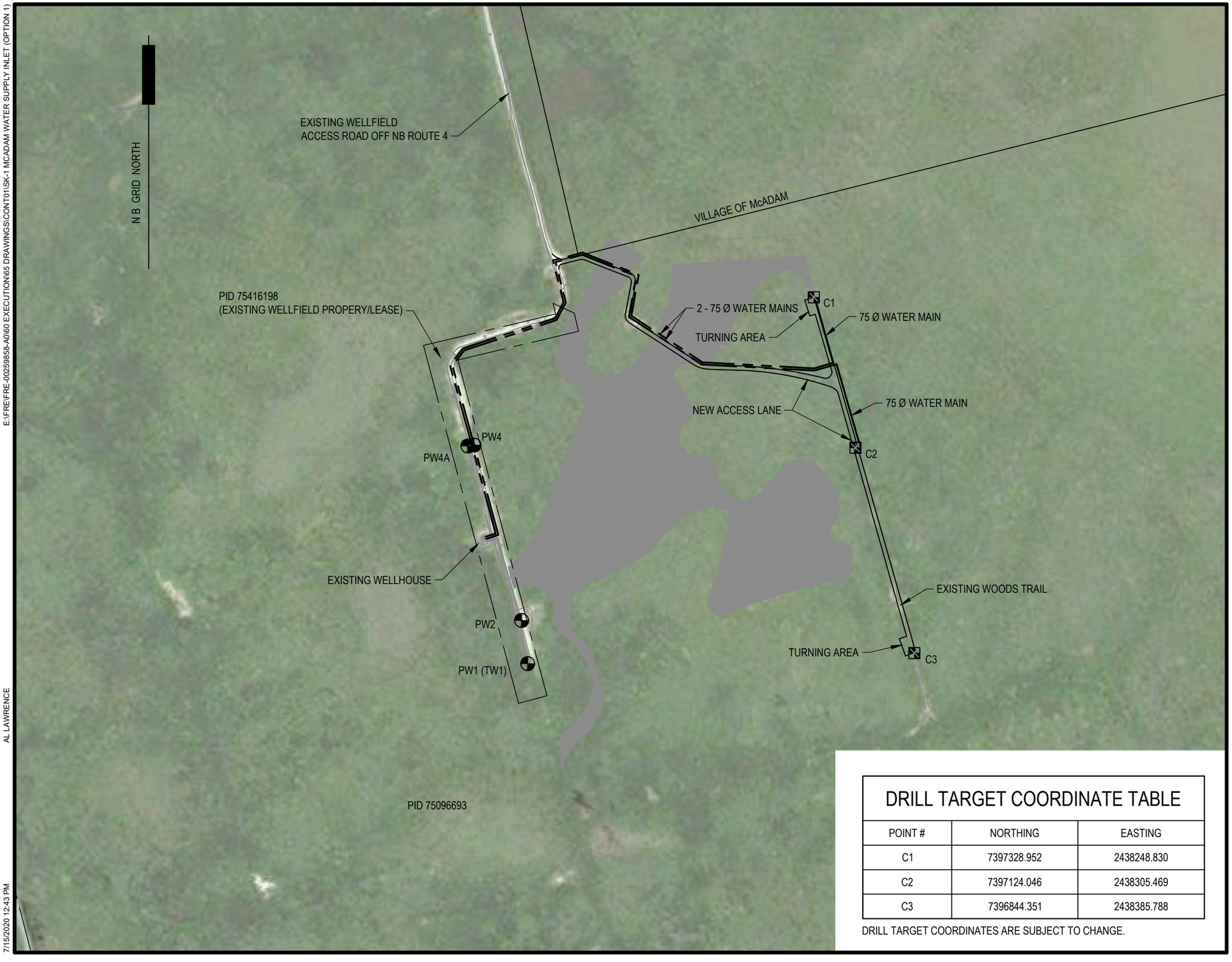
Legend

- Municipal Boundary
- Drill Targets
- McAdam Wells
- NBHN Watercourses
- Property Parcels
- Delineated WetLand 30m buffer
- Delineated WetLand (14.5 ha)

1:6,000

0 50 100 200 300 Meters

exp.



DRILL TARGET COORDINATE TABLE		
POINT #	NORTHING	EASTING
C1	7397328.952	2438248.830
C2	7397124.046	2438305.469
C3	7396844.351	2438385.788

DRILL TARGET COORDINATES ARE SUBJECT TO CHANGE.

EXP Services Inc.
t: +1.506.452.9000 | f: +1.506.459.3954
1133 Regent Street, Suite 300
Fredericton, NB, E3B 3Z2
CANADA
www.exp.com

BUILDINGS · EARTH & ENVIRONMENT · ENERGY · INDUSTRIAL · INFRASTRUCTURE · SUSTAINABILITY

No.	Issue	Date

No.	Revision	Date

FOR INFORMATION ONLY

Drawn By:	ARL
Dwg Standards Ckd By:	
Designed By:	MF
Design Checked By:	
Scale:	1:5000

Project Title

VILLAGE OF McADAM WATER SUPPLY UPGRADE

Dwg. Title

McADAM WATER SUPPLY INLET (OPTION 1)

Project No.

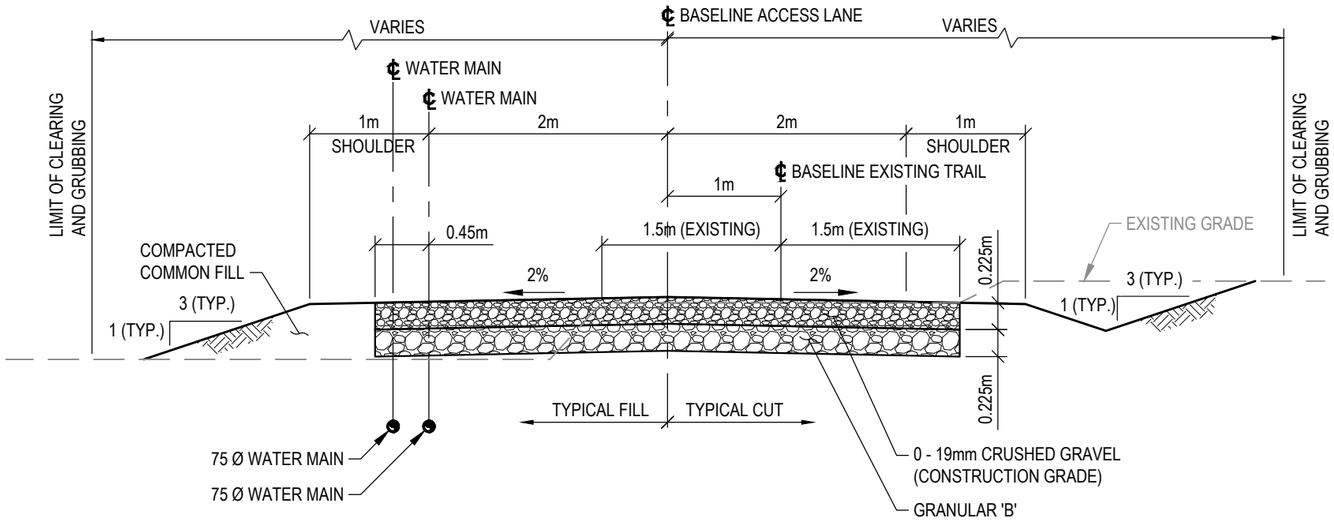
FRE-00259858-A0

Dwg. No. **SK-1**

Rev. No. ----

AL LAWRENCE

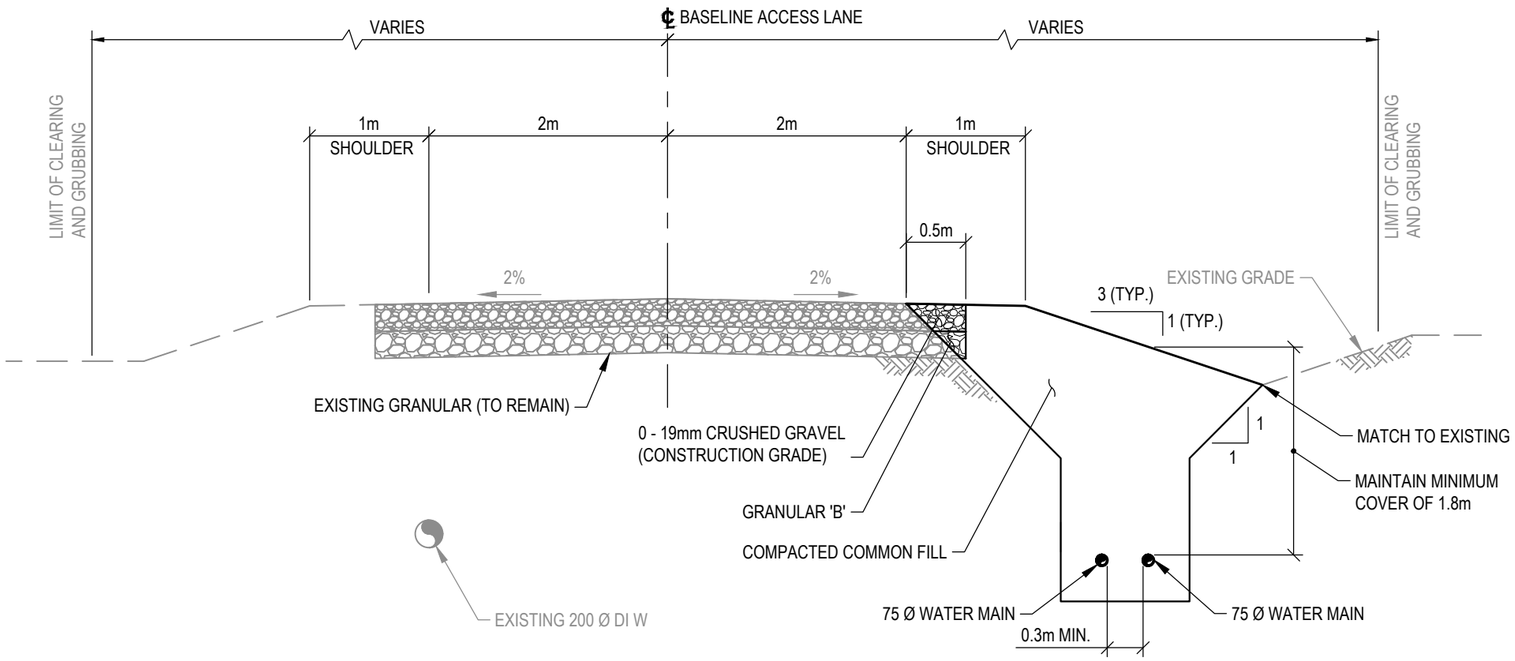
7/15/2020 12:43 PM



TYPICAL SECTION

ACCESS LANE

NOT TO SCALE



TYPICAL SECTION

EXISTING WELLFIELD ACCESS ROAD

NOT TO SCALE

AL LAWRENCE

7/15/2020 12:45 PM

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No.	Issue	Date

No.	Revision	Date

FOR INFORMATION ONLY

Drawn By:	ARL
Dwg Standards Ckd By:	
Designed By:	MF
Design Checked By:	
Scale:	AS SHOWN

Project Title

VILLAGE OF McADAM
WATER SUPPLY
UPGRADE

Dwg. Title

TYPICAL SECTIONS

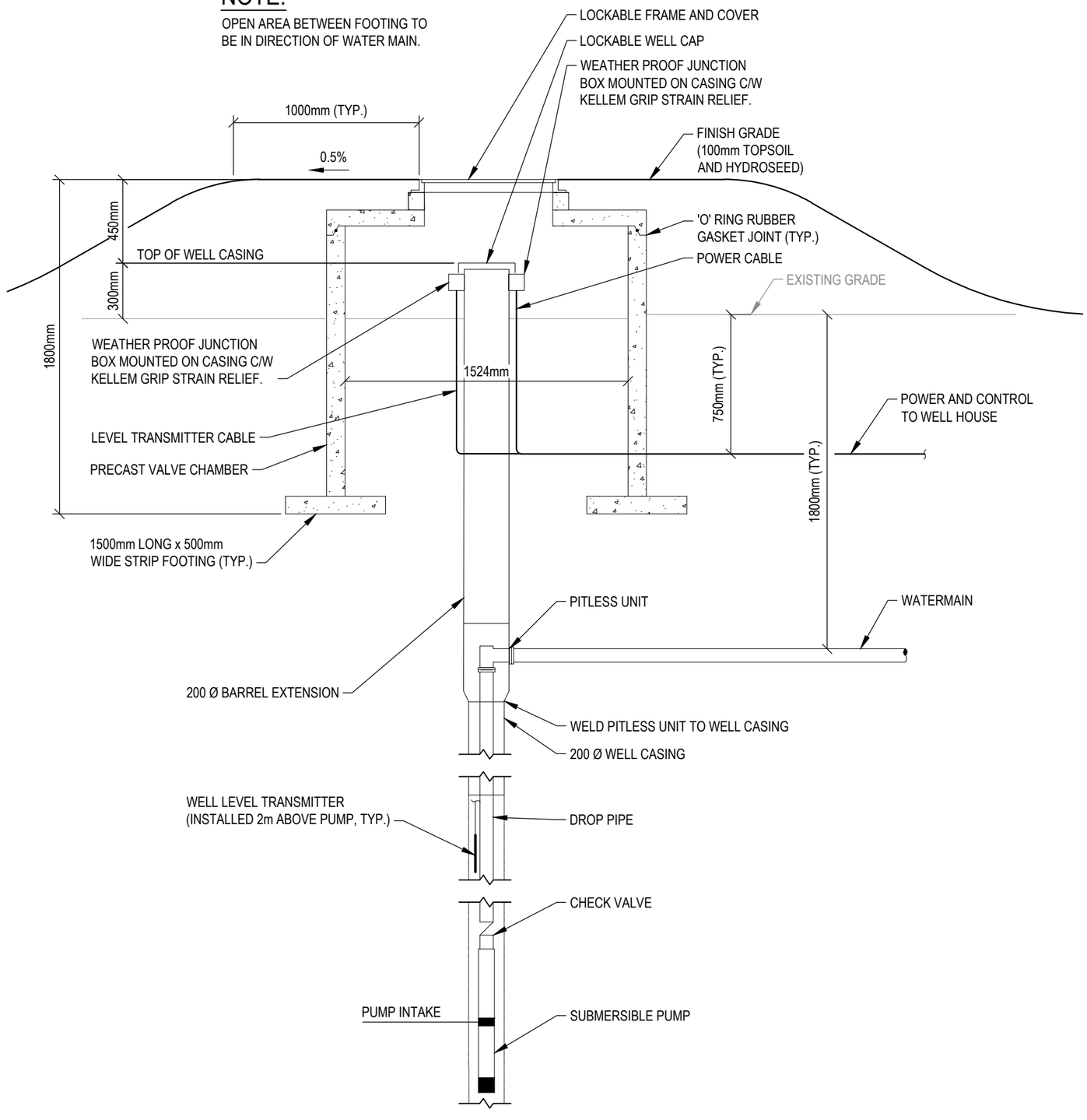
Project No.

FRE-00259858-A0

Dwg. No.	Rev. No.
SK-3	**----**

NOTE:

OPEN AREA BETWEEN FOOTING TO BE IN DIRECTION OF WATER MAIN.



TYPICAL DETAIL

WELL

NOT TO SCALE

AL LAWRENCE

7/8/2020 4:13 PM

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www.exp.com

No.	Issue	Date

No.	Revision	Date

FOR INFORMATION ONLY

Drawn By:	ARL
Dwg Standards Ckd By:	
Designed By:	MF
Design Checked By:	
Scale:	AS SHOWN

Project Title

VILLAGE OF McADAM WATER SUPPLY UPGRADE

Dwg. Title

TYPICAL WELL DETAIL

Project No.

FRE-00259858-A0

Dwg. No.	Rev. No.
SK-4	----

Appendix B –
Abbreviated Municipal Groundwater Supply Source Investigation

Village of McAdam

Abbreviated Municipal Groundwater Supply Source Investigation, McAdam, NB

Type of Document
Final Report

Project Number
MON-00244616-A0

Prepared By:

exp Services Inc.
40 Henri Dunant Street
Moncton, NB E1E 1E5
Canada

Date Submitted
May 2018

Village of McAdam

Abbreviated Municipal Groundwater Supply Source Investigation, McAdam, NB

Type of Document:
Final

Project Number:
MON-00244616-A0

Prepared By:
Robert Gallagher, M.Sc.Eng., P. Eng.

Reviewed By:
John Sims, M.Sc., P. Geo., P. Eng.

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F: +1.506.857.8315
www.exp.com

Date Submitted:
May 2018

May 11, 2018 MON-00244616-A0

Village of McAdam
146 Saunders Road
McAdam, NB
E6J 1L2

Attention: Ken Stannix, Mayor

Re: Abbreviated Municipal Groundwater Supply Source Investigation – McAdam, NB

EXP Services Inc (EXP) is pleased to submit two (2) copies of our report on the above referenced subject. The work was completed in general accordance with our proposal letter to the Village dated December 19, 2017 (EXP proposal no. 999-00055790-PP).

Based on the results of the geophysical survey, eight conductors representing potential target drilling locations for the development of new municipal groundwater production wells were identified on the large parcel of Crown land identified as PID 75096693. The majority of the latter property, which surrounds the Village proper and the current municipal wellfield property identified as PID 75416198, is comprised of undeveloped woodland. A relative ranking of the interpreted quality of each of the identified target drilling locations was provided, based on the aggregate consideration and evaluation of the data compiled for this report and economic factors.

It is important to note that prior to proceeding with any future groundwater exploration work (i.e. test well drilling and pump testing), the new water supply development project will require project registration and approval to proceed with field testing under the provincial Environmental Impact Assessment (EIA) and Water Supply Source Assessment (WSSA) processes. Since each of the eight identified potential drilling targets are located on Crown land administered by the New Brunswick Department of Energy and Resource Development (NBDERD), obtaining permission from NBDERD to access one or more of the target drilling locations for the purposes of completing the required follow up hydrogeological drilling and pump testing will be an important aspect of the EIA process.

Once a new production well is constructed, a wellfield protection study to identify the associated wellfield protection zones as defined in *NB Regulation 2000-47* under the *Clean Water Act* would typically need to be completed within one year of the commissioning of the new well.

We trust that this information satisfies your current requirements. If you have any questions regarding this report, please contact us at your convenience.

Sincerely,

Robert S. Gallagher

_____

Robert S. Gallagher, M.Sc.Eng., P. Eng.
Project Hydrogeologist

40 Henri Dunant Street, Moncton, NB E1E 1E5, Canada
T: +1.506.857.8889 • F: +1.506.857.8315 • www.exp.com

Legal Notification

This report was prepared by EXP Services Inc. for the account of the **Village of McAdam**.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. EXP Services Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

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List of Appendices

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EXP Quality System Checks	
Project No.: MON-00244616-A0	Date: 2018-05-11
Type of Document: Final	Revision No.: 0
Prepared By: Robert S. Gallagher, M.Sc.Eng., P. Eng.	Robert S. Gallagher
Reviewed By: John Sims, M.Sc., P. Geo., P. Eng.	

REGISTERED PROFESSIONAL ENGINEER
Province of New Brunswick
#M4889
Robert S. Gallagher
Signature
2018-05-11
Date
Province du Nouveau-Brunswick
INGÉNIEUR IMMATRICULÉ

Executive Summary

EXP Services Inc. (EXP) was retained by the Village of McAdam to conduct an Abbreviated Municipal Groundwater Supply Source Investigation to identify one or more potential drilling target locations for a new municipal groundwater supply well.

The current Village water demand is near the capacity of the existing wellfield. In recent years, there has been a significant uptake in the local residential real estate market, and the number of residential users connected to the system has grown. Over this period, there has also been a corresponding increase in the water demand of the local wallboard manufacturing plant, which uses about one third of the current Village water supply. Unfortunately, while the demand on the water system has been increasing, the pumping rate of one of the four existing municipal production wells (PW11) has had to be significantly lowered from the regulatory approved rate in order to manage a number of operational issues related to the elevated manganese concentration in this well.

As a result of the reduced capacity of the wellfield and existing demand, the Village has had to recently limit the water supplied to the wallboard plant to about 75 m^3/day (11 Igpm). Historically, this plant has typically used between 114 m^3/day (17 Igpm) to 190 m^3/day (29 Igpm) of Village water. Consequently, the plant has had to place plans to hire more staff to accommodate an intended additional production shift on hold.

Based on the above considerations, the Village has identified the location and development of up to two new municipal production wells as a key priority for future infrastructure funding. Ideally, the new well or wells would produce water of sufficient yield and quality to allow for both an increased wellfield capacity and the replacement and decommissioning of PW11 in order to alleviate the water quality issues associated with the latter well.

The current investigative study generally consisted of the collection and review of relevant and available background information, including a review of existing geological mapping and other data to assess local hydrogeological conditions and well development potential; completion of a site visit in the company of Village staff to review selected potential target drilling locations and sources of groundwater contamination; undertaking a geophysical survey to increase the likelihood for the identification of a higher yielding well; and preparation of a summary report on the findings of the work complete with recommendations for the next steps in the water supply development process. For this abbreviated groundwater supply investigation, the search area for new production well drilling targets was limited to the general vicinity of the existing wellfield, which is located in an undeveloped wooded area approximately 2.5 km southeast of the Village. The rationale for this approach was to minimize the piping costs associated with connecting any new production wells to the existing water distribution system, and to allow for the potential use of the existing treatment building and water storage reservoir pending the completion of necessary engineering upgrades and/or modifications. Another advantage of identifying new production well targets on the wooded Crown land property surrounding the existing wellfield was to avoid potential sources of groundwater contamination and minimize future wellfield protection requirements under *NB Regulation 2000-47*.

Based on the results of the geophysical survey, eight conductors representing potential target drilling locations for the development of new production wells were identified on the large parcel of Crown land identified as PID 75096693. The majority of the latter property, which surrounds the Village proper and the current municipal wellfield property identified as PID 75416198, is comprised of undeveloped woodland. A relative ranking of the interpreted quality of each of the identified target drilling locations was provided, based on the aggregate consideration and evaluation of the data

compiled for this report and economic factors. At this time, it is recommended that the Village prioritize the top two ranked conductors for future test well drilling.

Prior to proceeding with any future groundwater exploration work (i.e. test well drilling and pump testing), the new water supply development project will require project registration and approval to proceed with field testing under the provincial Environmental Impact Assessment (EIA) and Water Supply Source Assessment (WSSA) processes. Since each of the eight identified potential drilling targets are located on Crown land administered by the New Brunswick Department of Energy and Resource Development (NBDERD), obtaining permission from NBDERD to access one or more of the target drilling locations for the purposes of completing the required follow up hydrogeological drilling and pump testing will be an important aspect of the EIA process.

Once a new production well is constructed, a wellfield protection study to identify the associated wellfield protection zones as defined in *NB Regulation 2000-47* under the *Clean Water Act* would typically need to be completed within one year of the commissioning of the new well.

1 INTRODUCTION

EXP Services Inc. (EXP) was retained by the Village of McAdam to conduct an Abbreviated Municipal Groundwater Supply Source Investigation to identify one or more potential drilling target locations for a new municipal groundwater supply well(s). If suitably favorable well development conditions are encountered based on future test well drilling, we understand that the Village would prefer to convert two test wells in the new development area into production wells to obtain additional water supply capacity and provide operational redundancy.

For the purposes of this abbreviated study, the search area for a new production well drilling target(s) was limited to the general vicinity of the existing wellfield which is located in an undeveloped wooded area approximately 2.5 km southeast of the Village. The work was completed in general accordance with the Phase I work program for the development of a new production well as outlined in our December 19, 2017 letter proposal to the Village (EXP proposal no. 999-00055790-PP).

Project background information is summarized in **Section 2.0** followed by a description of the local groundwater resource setting in **Section 3.0.** Identification and discussion of the proposed municipal groundwater supply well target areas is presented in **Section 4.0** followed by conclusions and recommendations in **Section 5.0**. Closing statements and limitations in addition to a list of references may be found in **Section 6.0** and **Section 7.0**, respectively.

2 BACKGROUND

2.1 General

As previously indicated the current municipal wellfield, which is comprised of four (4) production wells, is located in an undeveloped wooded area approximately 2.5 km southeast of the Village. This wellfield was developed in the early 2000s to replace the previous production wells which were located within the Village proper due to concerns about the potential contamination of the latter wells from various nearby potential sources of contamination. The wellfield is surrounded by a large (approximately 34,000 ha) tract of Crown land administered by the New Brunswick Department of Energy and Resource Development (NBDERD) and identified as property identification number PID 75096693. The existing production wells and water treatment building are located on a 2.54 ha land parcel identified as PID 75416198. The latter property is leased by the Village from NBDERD.

We understand that the quality of groundwater produced by all four of the existing wells was initially in compliance with the Health Canada Guidelines for the Protection of Canadian Drinking Water Quality (GPCDWQ) and the provincial Heath Advisory Levels (HALs), where applicable. However, the manganese concentration and turbidity level of water from PW11 gradually increased with time to levels in excess of their respective guideline values. In 2012, PW11 was temporarily taken off-line due to the presence of significant iron and/or manganese biofouling, and this well was subjected to a successful well rehabilitation program developed for the Village by EXP. However, although the post re-habilitation manganese concentration was reduced, it still exceeded the drinking water criterion. Furthermore, the Village was notified that the well would likely require future rehabilitation for biofouling from time-to-time as part of on-going operational maintenance. Although the cause of the biofouling was not conclusively determined, it was believed to have been related to the drawdown of the water level in the pumping well below the elevation of one or more water bearing fractures in response to over-pumping during dry weather conditions.

Since the completion of the 2012 rehabilitation program, it is understood that elevated manganese levels in PW11 and the formation of manganese precipitates in the water system have been on-going operational issues for the Village, and the manganese concentration in the well has been increasing. This issue was exacerbated by a prolonged period of abnormally low precipitation which was again experienced in the McAdam area and much of the province last summer. During this period, we understand that the pumping rate of PW11 had to be reduced to approximately 56 m^3/day (8.5 Igpm) to 98 m^3/day (15 Igpm). This was problematic for the Village, since the current water demand is near the capacity of the existing wellfield.

The Village obtained pricing in 2012 for implementing a treatment system to lower the manganese concentration in the groundwater produced from PW11 to within the drinking water criterion. However, given the relatively low yield of PW11 (maximum approved pumping rate of 164 m^3/day) which is the lowest of the four existing production wells, the Village decided that it was not economically justifiable to proceed with the treatment option from a cost-benefit perspective. The Village water demand has increased since 2012 and is currently near the capacity of the existing wellfield, such that additional production wells are required to meet the current and projected future water demand. Given the relatively low yield of PW11 and local hydrogeological conditions, it is believed that there is good potential for replacing the water supplied by PW11 and providing additional yield over and above the capacity of PW11 by developing one or two additional production wells in the general vicinity of the existing wells.

Detailed information concerning the existing water demand is provided in the following section.

2.2 Existing Water Demand

We understand that the demand on the existing water system is approximately 450 m^3/day (69 Igpm). The majority of the demand is sourced from residential users as represented by the approximately 400 residential dwellings currently connected to the system. Nearly all of the industrial/commercial water demand has historically been utilized by the local Certainteed wallboard manufacturing plant, which has typically used between 114 m^3/day (17 Igpm) to 190 m^3/day (29 Igpm) or about one third of the total water demand.

As indicated above, the current water demand is near the capacity of the existing wellfield. In recent years, there has been a significant uptake in the local residential real estate market, and the number of residential users connected to the system has grown from an initial 240 dwellings to approximately 400 dwellings. Over this period, there has also been a corresponding increase in the water demand of the wallboard manufacturing plant. Unfortunately, while the demand on the water system has been increasing, the pumping rate of PW11 has had to be significantly lowered from the approved rate of 164 m^3/day (25 Igpm) to as low as 56 m^3/day (8.5 Igpm) in order to manage a number of operational issues related to the elevated manganese concentration in this well. These operational issues include but are not limited to maintaining a suitable manganese concentration in the water storage reservoir and minimizing the potential for the formation of manganese precipitates in the distribution system.

As a result of the reduced capacity of the wellfield, the Village has had to recently limit the water supplied to the wallboard plant to about 75 m^3/day (11 Igpm). Consequently, the plant has had to place plans to hire more staff to accommodate an intended additional production shift on hold.

Based on the above considerations, the Village has identified the location and development of up to two new municipal production wells as a key priority for future infrastructure funding. Ideally, the new well(s) would produce water of sufficient yield and quality to allow for both an increased wellfield capacity and the replacement and decommissioning of PW11 in order to alleviate the water quality issues associated with the latter well.

As previously indicated, the groundwater supply source investigation was limited to the identification of potential drilling targets in the general vicinity of the existing wellfield. The rationale for this approach was to minimize the piping costs associated with connecting any new production wells to the existing water distribution system, and to allow for the potential use of the existing treatment building and water storage reservoir pending the completion of necessary engineering upgrades and/or modifications. Another advantage of identifying new production well targets on the wooded Crown land property surrounding the existing wellfield was to avoid potential sources of groundwater contamination based on historical land use and to facilitate and minimize future wellfield protection requirements under *NB Regulation 2000-47*.

3 GROUNDWATER RESOURCE SETTING

3.1 Physiography and Drainage

The location of the study area in a regional context is indicated on Figure 3.1. Key hydrological and topographic features are also shown on this figure.

The Village of McAdam is located in southwestern New Brunswick approximately 60 minutes southwest of Fredericton along NB Route 4. The wellfield is located about 2.5 km southeast of the community near a local topographic high area. Based on a review of regional scale topographic mapping, the ground surface elevation in the production well search area near the existing wellfield typically ranges from 145 m to 160 m. The slope of the terrain is variable, but generally relatively flat-lying. In the eastern portion of the study area, the ground surface slopes to the east towards wetlands and White Beaver Brook. The western portion of the study area generally drains to the west towards the NB Southern Railway line and a tributary to the Digdeguash River.

3.2 Geology

3.2.1 Surficial Geology

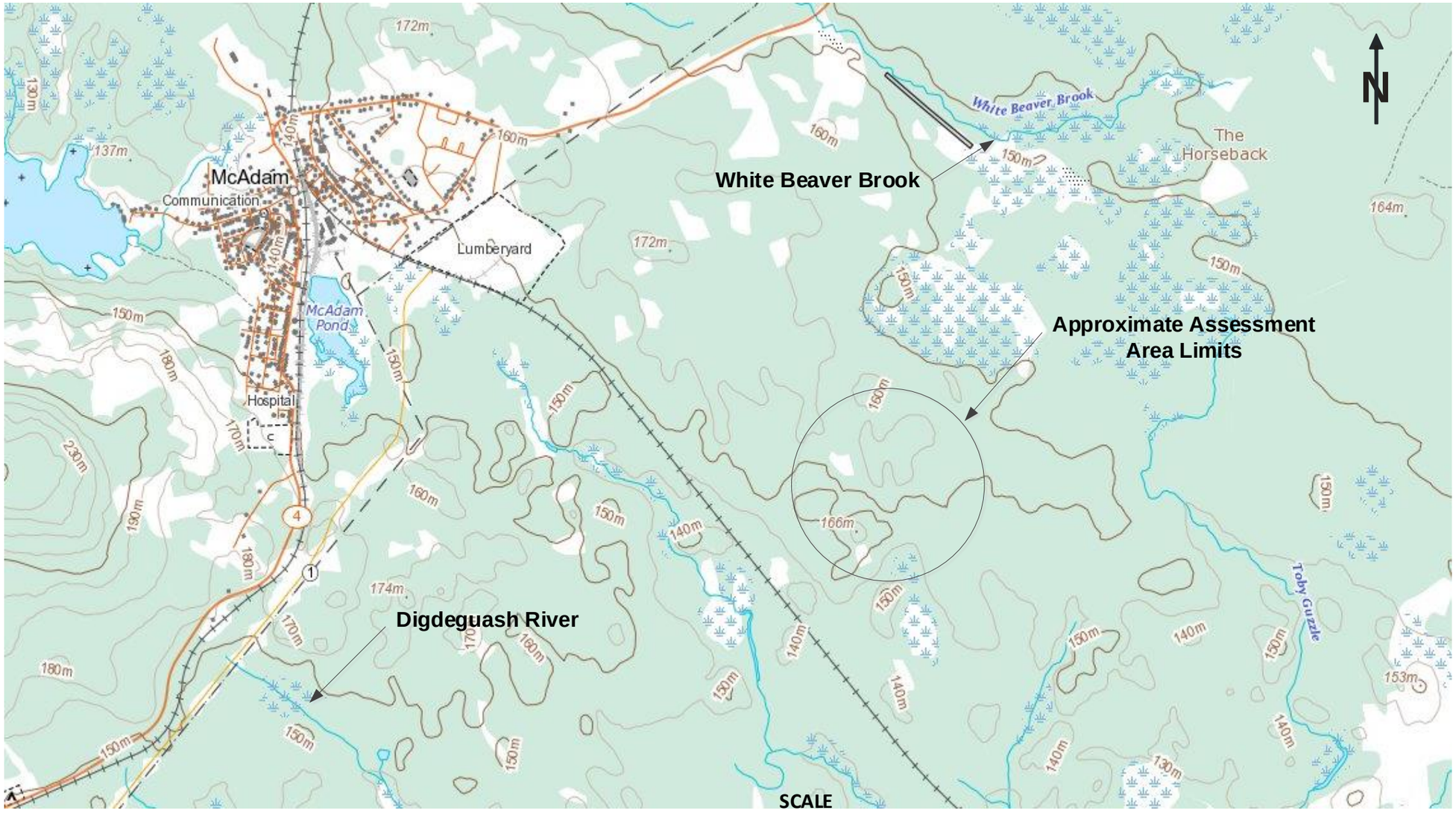
The surficial geology of the study area as depicted on regional scale mapping consists of hummocky, ribbed and rolling ablation moraines comprised of loamy ablation till; some lodgement till; and minor silt, sand, gravel and boulders (Rampton et al., 1984). The thickness of the overburden material generally exceeds 1.5 m.

A recent local scale (1:50,000) surficial geology map of the McAdam area was obtained from the NBDERD website (Allard, 2011). On this mapping, the study area is depicted as being underlain by hummocky till comprised of sandy or stoney diamicton with many sub-angular to sub-rounded cobbles and boulders. The thickness of the hummocky till typically ranges from 1 m to >10 m and it is noted that this unit locally obscures the local bedrock or till surface topography (Allard, 2011).

3.2.2 Bedrock Geology

Regional scale bedrock mapping indicates that the study area is underlain by greywacke, slate, siltstone, sandstone, conglomerate and limestone with minor chert, argillite and volcanic rocks (Potter et al., 1968). The minor volcanic rocks consist of interbedded mafic and silicic rocks, gabbroic sills and dykes.

A bedrock geology site plan of the study area was prepared based upon the most recent local scale (1:50,000) geological mapping from NBDERD and is provided as Figure 3.2 (Fyffe et al., 2005). As indicated on this figure, the existing production wells are located in the same clastic sedimentary rock formation (Shin Formation) along or within about 340 m of the mapped position of the southwest-northeast trending Fredericton Fault. Faults and related fracturing and, to a lesser extent, geological formation contact lines can provide favourable conditions for the development of higher yielding groundwater wells. Referring to Figure 3.2, it is also noted that several other bedrock formations are shown to be located within the project study area. A descriptive summary of the various rock formations encountered in the study area as indicated on the above noted site plan is provided below in Table 3.1.



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Project Title

ABBREVIATED GROUNDWATER SUPPLY SOURCE INVESTIGATION – MCADAM, NB

Dwg. Title:

SITE LOCATION PLAN

Drawn By: RSG	Project No. MON-00244616-A0	
Dwg. Standards Ckd. By:	Dwg. No. **FIGURE 3.1**	
Designed By:	Dwg. Design Ckd. By:	Rev. No.

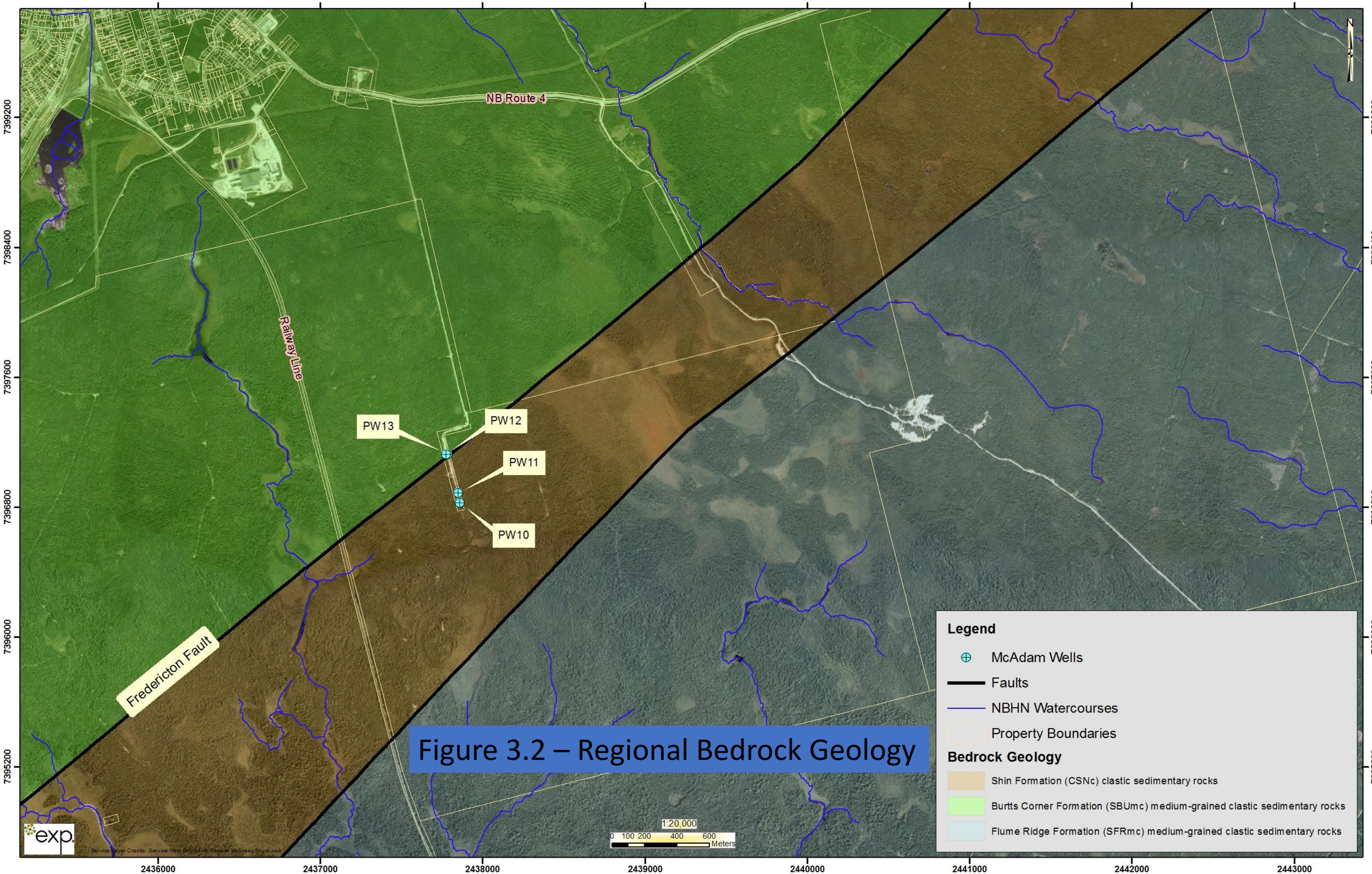


Figure 3.2 – Regional Bedrock Geology

Table 3.1

Descriptive Summary of Study Area Bedrock Formations

Formation Name	Symbol on Site Plan	Description
Burtts Corner Formation	S_{BU-mc}	-Light gray, medium to coarse-grained, generally non-calcareous, lithic and feldspathic wacke grading to dark gray, interlaminated, generally non-calcareous siltstone and shale.
Shin Formation	C_{SN-c}	-Greyish red conglomerate, arkosic sandstone and mudstone. Fine to medium grained sandstone and minor calcrete.
Flume Ridge Formation	S_{FR-mc}	-Light grey to greyish green, fine to medium-grained, micaceous generally calcareous, feldspathic wacke grading to dark gray, interlaminated non-calcareous siltstone and shale. Beds commonly contain brown-weathered spots of siderite and cubes of pyrite.

Note: fc = fine-grained clastic sedimentary rocks; mc = medium-grained clastic sedimentary rocks; cc = coarse-grained clastic sedimentary rocks; and c = clastic sedimentary rocks (undivided).

It is important to note that the exact location of the geological formation boundaries may vary considerably from the inferred locations indicated on the site plan due to the general absence of bedrock outcrops in the study area. Similarly, it must be appreciated that precise location of the Fredericton fault in the study area is also unknown, and as such its actual location may vary somewhat from the inferred position shown on the site plan.

3.3 Hydrogeology

3.3.1 Hydrologic Setting

The direction of deep or regional scale groundwater flow in the study area would be expected to be towards St. Croix River or Digdeguash River systems. Superimposed on these regional flow systems would be intermediate and shallow groundwater flow systems whose character (e.g. flow direction, groundwater quality, etc.) would be a function of topography, soil/bedrock type and geologic structure.

Shallow groundwater flow systems are typically controlled by topographic conditions. Therefore, shallow groundwater flow in the study area would be expected to be locally influenced by area watercourses such as the Digdeguash River and White Beaver Brook.

Several freshwater wetlands are located in the general vicinity of the study area, including a larger wetland complex situated near the eastern boundary of the study area.

The approximate locations of key hydrological (i.e. watercourses and wetlands) and other environmental features in the study area are indicated on Figure 3.3.

3.3.2 Regional Aquifer Potential

Based on a review of the regional surficial geology as outlined in ***Section 3.2.1***, it is expected that the study area does not offer a good potential for the identification of unconsolidated (e.g. sand and gravel) aquifers capable of supporting high yielding municipal production wells. Typically, these aquifers are comprised of granular alluvial materials deposited in the valleys of rivers and streams and such deposits are not known to exist in the study area based on available information. Although

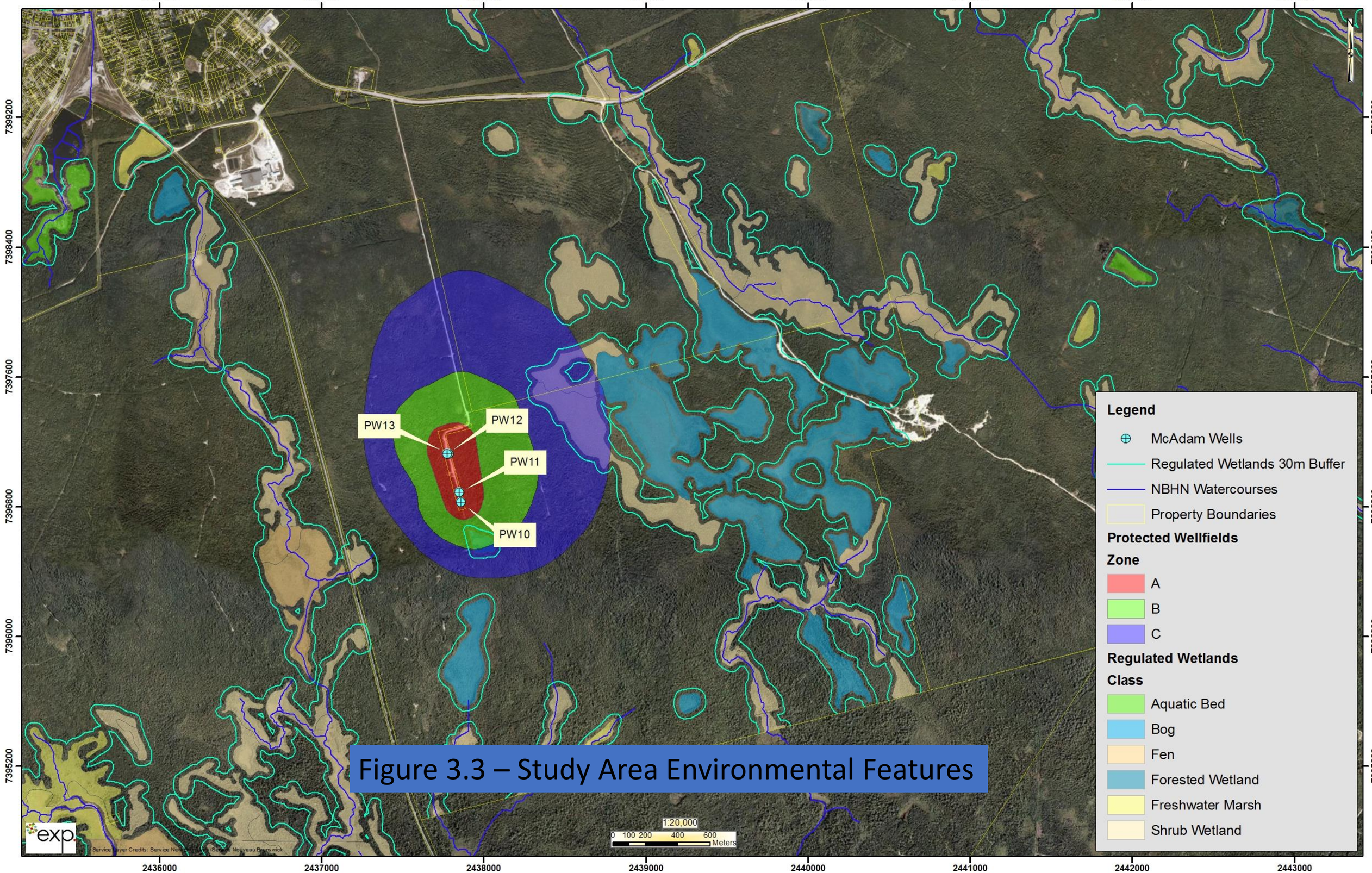


Figure 3.3 – Study Area Environmental Features

localized deposits of sand and/or gravel may be present in the study area, it is unlikely that the thickness and/or aerial extent of any such deposits would support commercial or municipal scale well yields. Furthermore, in the absence of any overlying aquitard, these aquifers tend to be more susceptible to the presence of groundwater under the direct influence of surface water (GUDI) and related potential water quality issues.

As previously indicated in ***Section 3.2.2***, the bedrock geology in the study area consists of various sedimentary bedrock units. The northern portion of the study area is underlain by the Burtts Corner Formation, which generally consists of feldspathic greywacke grading to siltstone and shale. Similarly, the southern portion of the study area is also underlain by a unit of feldspathic greywacke grading to siltstone and shale known as the Flume Ridge Formation. The greywacke in the Burtts Corner Formation tends to be medium to coarse-grained and generally non-calcareous, whereas the greywacke in the more southerly Flume Ridge Formation tends to be fine to medium-grained and typically calcareous. The Shin Formation is situated between two above noted bedrock formations in the study area. Based on exploratory test well drilling related to the development of the existing McAdam wellfield which was completed in the late 1990's and early 2000's, the upper portion of the Shin Formation within the study area is expected to be predominately comprised of conglomerate bedrock with minor sandstone and mudstone units. It is noted that each of the existing municipal production wells have been completed in the Shin Formation.

Of the individual sedimentary rock types potentially present within the study area based on current geological mapping, it is noted that sandstones and conglomerates typically offer the best aquifer potential, with shales, greywackes and to a greater extent siltstones and mudstones typically offering variable to poor aquifer potential. As such, the Shin Formation with its high proportion of conglomerate bedrock would be expected to have the greatest potential for the development of new municipal production wells. However, since groundwater flow in bedrock aquifers is dominated by fractures, the nature, frequency and distribution of fractures at a local scale is of paramount importance in assessing aquifer potential, regardless of the rock type. For this reason, it is possible that high yielding wells could also be encountered in the Burtts Corner and Flume Ridge formations, even though these formations are comprised of rock types which are generally associated with fair to poor water supply development potential.

It is also noted that granitic rocks are also known to underlie portions of the Village and surrounding areas. In general terms, this rock type is considered to have variable to poor aquifer potential. However, as indicated above, high yielding wells can be encountered in this rock type in more highly fractured zones.

Bedrock fracture and fault zones and, to a lesser extent, the contact boundaries between different bedrock formations may represent areas of increased potential for the development of higher yielding bedrock wells. It is noted that the Fredericton Fault which is a significant structural feature in the regional bedrock is mapped as forming the northern boundary between the Shin and Burtts Corner formations in the study area. The Village's highest yielding existing production well, PW12, is located along the Fredericton Fault. However, it is important to note that the mapped location of the fault is approximate, and that the precise location of the fault is unknown along most of its length. Furthermore, any new wells developed along the fault line should be adequately spaced in an effort to avoid excessive drawdown interference related to the potential "two straws in the same glass" effect.

3.3.3 NBDELG Water Well Records

Water quantity - to gain insight into potential well yields and hydrogeologic conditions in the study area, an on-line search of the New Brunswick Department of the Environment and Local Government

(NBDELG) Water Well Database which was established in the 1990s was conducted to obtain all available water well records within 5 km of the large NBDERD property which surrounds the Village of McAdam proper in addition to the existing wellfield identified as PID 75096693. The majority of the latter Crown land property is undeveloped woodland. Note that well records can only be searched in aggregate for a specified search radius and that the records cannot be linked to individual land parcels or their owners due to protection of privacy related regulatory requirements.

The results of the records search provided information on twenty-eight (28) wells. Based on the descriptions of the sub-surface stratigraphy included with the well records, these wells were completed in various rock formations with individual rock types described as granite, shale, slate, and sandstone. Several wells were completed in unconsolidated sand and gravel overburden. Well depths ranged from 15 m to 123 m with an average of 53 m. The estimated yield of these wells ranged from 3.3 m^3/day (0.5 Igpm) to 328 m^3/day (50 Igpm) with an average of 59 m^3/day (9 Igpm). It is important to note that the well yields reported for these wells are typically based on short term test methods such as the air lift method and, therefore, these yield estimates must be interpreted as relatively crude approximations of the actual safe well yields. Furthermore, it is significant to note that given the rural nature of the study area, it would be expected that most of the above noted wells were drilled for individual domestic dwellings which have relatively low water demands (i.e. 2 Igpm to 5 Igpm). For residential developments, once the well driller is satisfied that the required yield has been obtained, the drilling work is typically terminated at this point and the well is completed even though higher yields may be encountered at greater depth.

Based on the above noted review of local water well records, it can be seen that some higher yielding wells are located in the McAdam area. In general, higher well yields were observed in the overburden wells and the slate/shale wells, with lower yields typically noted for the wells completed in granite. Based on the rock descriptions on the well logs, it is expected that very few (if any) of the wells for which records were obtained were completed in the Shin Formation which underlies the existing wellfield and is the primary target aquifer for the current study.

Copies of the NBDELG water well records for the above noted database search are provided in Appendix A.

Water quality – Based on the above noted search of the provincial water well database, inorganic and microbiological water quality data were obtained for fifteen (15) wells in the study area which is a relatively small sample size. The water quality results in the database are for samples typically taken immediately following well construction. Concentrations or parameter values in excess of the Guidelines for the Protection of Canadian Drinking Water Quality (GPCDWQ) as established by Health Canada were observed for several parameters. However, many of these occurrences are considered to be anomalous in that the elevated concentrations were observed for in a small percentage (≤15%) of samples. More prevalent guideline exceedances were noted for arsenic (20%), iron (40%), manganese (53%) and turbidity (73%). Total coliforms were also present in about one third (33%) of the sample results, and the calcium carbonate hardness of the water was classified in the hard to very hard range for 53% of the samples.

Concerning arsenic, the guideline value for this parameter has been established on the basis of the protection of human health as this parameter has been classified as a carcinogen. It is noted that very high arsenic concentrations were reported for two of the eighteen sample results which were reviewed. Water treatment systems are available for arsenic, and it is noted that naturally elevated arsenic concentrations in groundwater can be associated with certain rock formations.

The guideline values for iron and manganese have been established on the basis of aesthetic considerations such as the control of encrustation and staining. However, potential health effects

have reportedly been associated with manganese concentrations in excess of the aesthetic based drinking water criterion. Naturally occurring elevated concentrations of these parameters are common in New Brunswick groundwater and it is noted that if required, water with elevated iron and manganese levels can generally be treated to reduce concentrations to within the applicable guideline value.

The guideline value for turbidity has been established on the basis of both aesthetic and indirect human-health related considerations. Regarding potential health concerns, it is noted that excessively turbid water has an increased potential for poor micro-biological quality and elevated concentrations of trace metals. Elevated turbidity can also reduce the efficiency of chlorination and other disinfection technologies. Since most of the water quality data in the water well database would be expected to be for newly drilled wells, it is likely that turbidity concentrations are skewed high due to the presence of post-drilling residual rock cuttings in the well bore and inadequate well development. Turbidity levels in new wells typically tend to substantially decrease with additional well development shortly after the construction and commissioning of these wells.

Although not harmful in itself, the presence of total coliforms in a water sample is an indicator of the potential presence of other microorganisms which can promote sickness and/or disease. Similar to the elevated turbidity levels observed in a larger percentage of samples, the elevated coliform levels are likely at least partially attributable to inadequate well development and the presence of residual rock cuttings in the newly drilled wells. Unlike residential wells, groundwater from municipal production wells is typically disinfected by chlorination or other means prior to distribution to the community.

Finally, it is noted that hard to very hard water was reported for about 53% of the samples. Hard water is associated with increased soap consumption and the formation of scale deposits in pipeworks. Household or commercial water softeners may be used to reduce hardness levels in potable water.

3.3.4 Water Quality of Existing Municipal Groundwater Source

We understand based on discussions with Village staff that, historically, the water quality of the existing Village production wells has been good, with the exception of the elevated manganese and occasional turbidity issues with PW11 which have been prevalent since 2012. The manganese concentration at PW11 is measured frequently and can be subject to considerable temporal variation throughout the year, depending upon the pumping rate of the well and other factors. With the exception of manganese levels at location PW11, we understand that the source groundwater quality has typically been in compliance with the Guidelines for the Protection of Canadian Drinking Water Quality (GPCDWQ) established by Health Canada. However, manganese concentrations in excess of the drinking water criterion have periodically been observed for selected other production wells.

When initially drilled, it is understood that the manganese concentration in groundwater from PW11 was within the drinking water criterion, and that the concentration of manages gradually increased with time thereafter. The very high manganese levels observed in this well in 2012 were related to a biofouling issue with the wells. The biofouling is believed to have been related to the drawdown of the water level in the pumping well below the elevation of one or more water bearing fractures in response to over-pumping during dry weather conditions. As such, the pumping times of the existing and future production wells in the target development aquifer (i.e. Shin Formation) should be minimized to the extent practical through SCADA controlled well cycling and the overall safe yield of the existing wellfield should be increased in order to reduce the strain of the existing and anticipated near future demands on the water supply system which is currently operating at or near capacity.

3.3.5 Water Well Driller Information

A few local well drillers were interviewed concerning the groundwater supply potential of the study area. Given the predominance of residential land use, the majority of the wells drilled in the area have been for single family dwellings. As such, it must be appreciated that the predominance of residential land use in the study area and the associated low water demand is undoubtedly a limiting factor on the reported typical yield of existing wells.

The Shin Formation in the which the existing Village production wells are located has been identified as the preferred geological formation for aquifer development in the study area. However, as indicated in **Section 3.2.2**, much of the McAdam area is underlain by other rock formations considered to generally have lower potential for the development of a municipal groundwater supply. Therefore, local well drillers were queried concerning the potential yields of wells drilled in nearby developed areas mapped as being underlain by the Shin Formation including Thomaston Corner and Upper Brockway/Brockway areas. It was confirmed that a few higher yielding wells have been drilled in these areas. For example, a 90 m deep well with an estimated yield of 390 m^3/day to 460 m^3/day (60 Igpm to 70 Igpm) was reportedly drilled for a fish hatchery near Thomaston Corner. Furthermore, residential well yields on the order of 65 m^3/day to 130 m^3/day (10 Igpm to 20 Igpm) are reportedly not uncommon in the Upper Brockway/Brockway areas. Concerning water quality, none of the interviewed local well drillers had any information concerning extraordinary issues in the above noted areas.

Prior to the establishment of the initial central municipal water supply system in the 1980s, Village residences and businesses obtained water from various private groundwater wells. Well yields were typically somewhat marginal and issues with coliform and petroleum hydrocarbon contamination were relatively common (NBDOE, 1980). As previously indicated, the initial production wells which were located within the Village limits were replaced with the current wellfield in the early 2000s due to contamination concerns and/or issues. Additional wells continue to be drilled in the same bedrock unit which underlies the Village outside of the municipal water system service area. Well yields have been typically low, but it is noted that most of these wells have been drilled for private household and other low water demand land uses. There have been water quality issues with elevated fluoride and uranium. Based on his recollection of typical well yields prior to the establishment of a central water supply system in the 1980s, one local well driller indicated that typical well yields in the Village proper were on the order of 30 m^3/day to 50 m^3/day (5 Igpm to 8 Igpm) and likely somewhat higher than those drilled just outside of the Village limits and in the same rock formation.

3.4 Potential Sources of Contamination and Groundwater Source Protection

As previously indicated, the groundwater supply source investigation was limited to the identification of potential drilling targets in the general vicinity (i.e. within approximately 1 km) of the existing wellfield. This area forms a portion of a large (33,000 ha) tract of Crown land identified as PID 7509669, and is generally comprised of undeveloped woodland with a few woods trails. As such, there are no known potential sources of groundwater contamination within 500 m of the identified potential drilling targets which are presented in **Section 4.0**. Under the provincial Water Supply Source Assessment (WSSA) process which is completed in conjunction with the Environmental Impact Assessment (EIA) application for new municipal production wells, all potential contaminant sources within 500 m of the proposed target drilling locations must be identified. It is understood that the existing well house, which is located within 500 m of the existing production wells, does not have

a permanent stationary backup generator to provide emergency power in the event of a power outage. Therefore, the nearest known potential source of groundwater contamination is the Village's former municipal dumpsite located about 1.8 km to the northeast of the wellfield on PID 75358960. This former dumpsite is not considered to represent a significant potential source of contamination to any future production wells developed in the study area based on the remote and downgradient location of the former dumpsite relative to the proposed target drilling locations.

The Land Gazette feature of the Service New Brunswick (SNB) on-line real property information website was used to check selected properties for the presence of an associated NBDELG remediation file or petroleum storage notice in order to gain additional information on potential contaminated sites in the study area. It should be noted that a remediation file notification on the SNB Land Gazette feature only indicates the presence of a registered remediation file. A fee-based search of the NBDELG environmental records database is required to provide detailed information concerning each remediation file, including whether or not the file is currently active (i.e. on-going remediation) or closed. The results of this screening exercise indicated the presence of petroleum storage and remediation file notices for the large tract of Crown land surrounding the existing wellfield identified as PID 7509669. Concerning the remediation file notice, the Village have indicated that they are not aware of any past environmental incidents in the vicinity of the wellfield and, as such, it is assumed that this remediation file and the petroleum storage notice does not relate to an area near the existing wellfield. However, it is recommended that the environmental database records for this PID be ordered from NBDELG to obtain additional information on the petroleum storage and remediation file notices.

It should be noted that NBDELG requires that a Wellfield Protection Study be completed for all new municipal production wells within one year of the commissioning of each well. These studies determine theoretical time-of-travel based hydraulic capture zones for each well and result in the identification of the land area around each well that is most susceptible to the contamination of the underlying aquifer. Certain land use restrictions are therefore placed on this sensitive land area surrounding the well to protect the well from future contamination. The sensitive land area is divided into three zones (A, B and C), and the protective land use restrictions for each zone becomes progressively stricter with decreasing distances to the wellhead. Once the wellfield protection zones are identified, NBDELG requires that this sensitive area be formally designated as a protected area in accordance with *NB Regulation 2000-47* under the *Clean Water Act*. Therefore, in order to minimize the potential for future land use conflicts under the provincial Wellfield Protection Program, consideration should be given to locating potential groundwater development targets in undeveloped or lightly developed areas, or in areas with minimal commercial development. Given the large number of variables involved in the selection and ranking of potential municipal well drilling targets, it is recognized that it may not be practical to avoid commercial development areas during the drilling target site selection process. However, it is noted that the search area for potential water supply drilling targets for the current abbreviated assessment (i.e. within about 1 km of the existing wellfield) is characterized by undeveloped and treed Crown land with no known significant potential sources of groundwater contamination. Therefore, the current water supply search area is considered to be ideal from a wellfield protection perspective.

4 POTENTIAL TARGET DRILLING LOCATIONS

4.1 General Considerations

A number of factors must be considered in the selection of potential target areas for municipal water supply test well drilling, including the local geological conditions and hydrologic setting which are the key considerations for potential water availability and quality. Other economic considerations include the distance from the potential source area to the existing water supply infrastructure; property ownership; proximity to potential sources of contamination; and site access conditions. Regulatory issues related to the requirement for the identification of wellfield protection areas under the provincial wellfield protection regulations (i.e. *NB Regulation 2000-47*) for any new wells include the consideration of potential conflicts with existing land uses. Each of the above factors must be weighed in assessing the overall water supply potential of a given site. However, the scope of the assessment for the current abbreviated water supply source assessment was limited to the general vicinity of the existing wellfield for the reasons previously cited in **Section 2.0**.

Based on the above noted criteria, the large tract of crown land identified as PID 75096693 which surrounds the existing wellfield was the focus of the current investigation as there are no Village-owned properties located in close proximity to the existing wellfield. As previously indicated, the portion of the latter property near the existing wellfield (i.e. within about 800 m) is predominately undeveloped woodland. Several existing trails in varying condition are located on this portion of the property, most notably including a woods trail situated about 500 m east of the existing production wells. A large area of wetland complexes is located approximately 600 m to 900 m east of the wellfield, and a small wetland is situated about 180 m south of PW10. Finally, it is noted that a northwest/southeast trending railway line which is utilized by the New Brunswick Southern Railway to supply gypsum to the Certainteed plant is located about 700 m west of the existing wellfield.

4.2 Geophysical Survey

A very low frequency (VLF) electromagnetic (EM) geophysical survey was conducted with a Geonics EM-16 instrument on the portion of the subject property (PID 75096693) within the study area limits from February 14-16, 2018 by a geophysics sub-contractor (Mark D. Connell and Donald Hattie – Prospecting Geologists). Three geophysics traverse lines with a cumulative length of approximately 3.2 km were completed during the survey. Two survey lines (Line 1 and Line 2) were completed to the east of the access road to the existing wellfield and one survey line (Line 3) was completed to the west of the wellfield access road. The compass orientation of each survey line was variable, but the lines generally trended in a northwest/southeast direction and the overall length of each survey line ranged from 1.0 km to 1.1 km. Instrument readings were typically obtained every 12.5 m along each line. Where possible, distance stationing along each line was marked on flagging tape tied to tree branches at the approximate instrument reading locations. Orange tape was used to mark line station locations every 25 m, with blue tape used to mark the 12.5 m intermediate station locations. Both orange and blue tape was placed on trees at 100 m stationing intervals.

A copy of the report on the geophysics survey is provided in Appendix B.

A brief discussion of the nature and limitations of VLF EM surveys in the context of water supply source investigations is provided in **Section 4.2.1**, followed by a discussion of the potential drilling targets identified from the survey in **Section 4.2.2**.

4.2.1 General

VLF EM geophysical surveys are often conducted to assist with identifying potential drilling targets for municipal groundwater supply wells and other applications. This geophysical method can identify anomalies (i.e. conductors) in the electrical field induced in the sub-surface by interaction with powerful radio transmitters such as those used for communication with military submarines. For the current survey, the VLF (24 kHz) radio wave source was the United States Navy shore radio station in Cutler, ME.

Since long linear conductor-type EM anomalies may correspond to conductive bedrock fault and fracture zones, VLF EM can be an effective tool in refining target drilling locations for higher yielding fractured bedrock water supply wells. However, these anomalous readings can also correspond to the presence of various rock/clay minerals or other items, so the presence of a linear anomaly does not necessarily correspond to the presence of water filled bedrock faults or fractures. Therefore, in assessing and ranking the water supply potential of various target locations, it is important to adopt a "multiple lines of evidence approach", wherein all the relevant data for a given target area (e.g. geological conditions, geophysics results, etc.) is considered in aggregate form. The more favorable indicators for a given target area (i.e. promising geophysical results in combination with favorable geological conditions, etc.), the higher the probably that test well drilling in the area will result in a higher well yield.

In surveying a given area, several survey lines are typically run, with EM readings taken at multiple intervals along each line. Since the method is electro-magnetic and not seismic in nature, there are no explosive charges used. The survey has no impact on the environment, and the only remnants of the survey are flagging tape on trees or small survey flags on the ground to mark the survey lines every few metres. Typically, markers are placed every 6 to 12 m, although the spacing may vary. The vertical depth of the survey typically ranges from 25 m to 50 m, depending upon the frequency utilized and other factors.

4.2.2 Potential Drilling Targets

A total of eight (8) geophysical anomalies (i.e. conductors) which may represent water-filled fractures were identified during the geophysical survey. A total of five conductors were identified along Line 1 and Line 2 which were established to the east of the wellfield access road, and three conductors were identified along Line 3 to the west of the main access road. Each conductor was staked and/or flagged in the field, and UTM NAD 83 co-ordinates were obtained with a hand-held GPS unit. The co-ordinates of each conductor are tabulated in the geophysics report provided in Appendix B.

The approximate location of each of these conductors, which represent potential drilling targets for a new municipal production well, is indicated on Figure 4.1. Wetland mapping for the study area obtained from the province including the 30 m development setback buffers under the provincial Watercourse and Wetland Alteration (WAWA) regulations (NB Regulation 90-80 under the *Clean Water Act*) has been superimposed on this figure to assist in the evaluation of the potential drilling targets.

It is understood that the Village would ideally prefer to augment the existing wellfield with two new production wells. Therefore, each of the identified conductors were qualitatively evaluated based on the geophysical survey results in addition to their distance from the existing wellhouse and other key factors outlined in **Section 4.1**. The purpose of the evaluation was to identify the first and second ranked target drilling locations for initial assessment. The completed evaluation matrix is provided herein as Table 4.1.

2437000 2437500 2438000 2438500

7397500 7397000 7396500

C4 C1 C5 C2 C6 PW13 PW12 PW11 PW10 C3 C7 C8

Railway Line

Legend

- Drill Targets
- McAdam Wells
- Regulated Wetlands 30m Buffer
- NBHN Watercourses
- Property Boundaries

Regulated Wetlands

Class

- Bog
- Fen
- Forested Wetland
- Shrub Wetland

1:5,000

0 100 200 400 600 Meters

exp.

Figure 4.1 – Target Drilling Locations

Table 4.1

Relative Ranking of the Identified Potential Target Drilling Locations

Conductor	Overall Ranking	Distance to Existing Wellhouse (m)	Qualitative Assessment Criteria[1]				
			Potential for Higher than Average Well Yield (Based EM Survey & Geology Mapping)	Site Access	Land Ownership	Environmental Issues (Potential Contamination or Wetlands)	Compatibility with Wellfield Protection Regulations
C1	1	545	Good to Very Good (Fredericton Fault?)	Fair (Treed)	Good (Crown land)	Very Good	Very Good
C2	2	500	Good	Fair to Good (Treed but Conductor on Woods Road)	Good (Crown land)	Very Good	Very Good
C3	3	585	Good	Fair to Good (Treed but Conductor on Woods Road)	Good (Crown land)	Very Good	Very Good
C4	5	700	Good to Very Good (Fredericton Fault?)	Fair (Treed)	Good (Crown land)	Fair to Good (near wetland)	Very Good
C5	4	755	Good	Fair (Treed)	Good (Crown land)	Fair to Good (near wetland)	Very Good
C6	6	620	Fair to Good (Burtts Corner Formation[2])	Poor to Fair (Treed & Conductor on Steep Side Hill)	Good (Crown land)	Very Good	Very Good
C7	7	550	Fair (weaker conductor)	Fair (Treed)	Good (Crown land)	Very Good	Very Good
C8	8	560	Fair (weaker conductor)	Fair (Treed)	Good (Crown land)	Very Good	Very Good

Notes: 1) Qualitative rankings of “Very Good; Good; Fair; Poor; or Very Poor”.

2) Note that the mapped locations of the boundaries between geological formations as shown on regional scale bedrock geology mapping are approximations (i.e. actual boundary locations will vary).

As indicated in Table 4.1, each of the qualitative assessment criteria were subjectively assigned rankings ranging from “Very Poor” to “Very Good”. Based on the evaluation criteria and the potential cost of connect to the existing water system as measured by the distance between each conductor and the wellhouse, conductors C1 and C2 were selected as the first and second ranked potential drilling targets. It is noted the distance to the existing water supply infrastructure was an important consideration in ranking the conductors, since conductor strengths and other evaluation factors were typically similar for the potential target drilling locations, except where otherwise indicated in the table. Compatibility with provincial wellfield protection regulations was ranked as “Very Good” for all conductors since each of them is located on undeveloped woodland. Similarly, land ownership was not an influencing factor in the overall assessment, as each conductor is located on the same parcel of Crown land. Conductors C4 and C5 were assigned lower overall rankings in consideration of higher costs related to connection to the existing distribution system and based on their proximity to mapped wetlands (i.e. in or within the 30 m setback buffer). The location of these conductors near wetlands may pose additional challenges and/or costs related to obtain approval to drill at these locations under the Environmental Impact Assessment (EIA) process. Regarding conductor C6, this potential drilling location was given a lower ranking based on its location within the mapped range of the Burtts Corner Formation. However, as indicated on Table 4.1, it must be appreciated that the boundaries between different geological formations as depicted on regional scale mapping are approximations, and that the actual boundaries locations will vary. Finally, it is noted that C7 and C8 were assigned low rankings based on the fact that the results of the geophysical survey indicated that these may be somewhat weaker conductive bodies compared with the other conductors.

Based on the above noted evaluation, it is recommended that the Village prioritize conductor locations C1 and C2 for test well drilling. The relative ranking of the remaining conductors in terms of the assessed water supply development potential is as indicated in Table 4.1.

5 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions are provided based on the findings of the current study:

- In recent years, the pumping rate of existing production well PW11 has been reduced from an approved rate of 164 m^3/day (25 Igpm) to as low as 56 m^3/day (8.5 Igpm) in order to manage a number of operational issues related to elevated manganese concentrations in this well. Unfortunately, this issue has been compounded by a significant increase in the Village water demand over this time period, such that the existing water demand is near the capacity of the wellfield. As such, production at the local wallboard manufacturing plant which uses about one third of the water supplied by the Village has been limited by the current wellfield capacity. Based on the above considerations, the Village has identified the development of up to two new municipal production wells as a key priority for future infrastructure funding.

- The elevated manganese issue with PW11 manifested during a bio-fouling incident which occurred in 2012 during a period of dry weather. Although a successful well rehabilitation program was subsequently implemented for this well, elevated manganese levels have persisted since that time. Although the exact cause of the bio-fouling was not determined, it is believed to have been related to or exacerbated by over pumping during dry weather conditions. Since periods of prolonged drought appear to be occurring with greater frequency in the province and the current wellfield is operating near capacity, the efficiency of the existing pumping cycle should be maximized in terms of minimizing the daily pumping times of individual wells and the capacity of the existing wellfield should be increased to better accommodate existing demand.

- For the purpose of this assessment, the search area for a new production well was limited to general vicinity of the existing wellfield in consideration of the relatively favorable hydrogeological setting in this area; the anticipated lower piping and treatment costs related to the development of new wells; the low likelihood of encountering potential sources of contamination based on the current land use (undeveloped woodland); and the relative ease of implementing future wellfield protection measures under the provincial wellfield protection program.

- Based on a review of the NBDELG water well database and the known yields of the current and historical municipal production wells, higher yielding wells are known to exist in the vicinity of the Village. Although the average yield of thirteen wells drilled within 5 km of PID 75096693 in the central portion of the assessment area was 59 m^3/day (9 Igpm), it is noted that this average well yield is likely significantly influenced by the residential nature of the existing development in this area.

- Based on water quality information in the NBDELG water well database for a very limited number of samples, the groundwater quality in the study area appears to generally be good and no major concerns were identified other than elevated arsenic levels reported for some samples. Parameters for which more prevalent guideline exceedances were observed include arsenic, iron, manganese and turbidity. Elevated hardness levels and total coliform counts were also observed in a relatively high percentage of the reviewed sample results. In general, these findings are typical for New Brunswick groundwater and/or newly drilled water wells on which the majority of the water quality database is based.

- A geophysical survey was conducted on the large tract of Crown land identified by PID 75096693 which surrounds the existing wellfield property in order to identify geophysical

anomalies (i.e. conductors) which may correspond to significant zones of water filled bedrock fractures.

- Based on the results of the geophysical survey and the aggregate consideration and evaluation of the data compiled in this report, eight conductors representing potential target drilling locations for the development of new municipal groundwater supplies were identified within about 1 km of the existing wellfield.

- No potential sources of contamination were identified in close proximity to the identified potential target drilling locations, which are located on undeveloped woodland.

Based on the collective assessment of economic considerations and the development potential of the eight target drilling locations identified during the current study, it is recommended that geophysical conductor locations C1 and C2 be prioritized for future test well drilling.

It is important to note that prior to proceeding with any future groundwater exploration work (i.e. test well drilling and pump testing), the new water supply development project will require project registration and approval to proceed with field testing under the provincial EIA and Water Supply Source Assessment (WSSA) processes. Since each of the eight identified potential drilling targets are located on Crown land administered by NBDERD, obtaining permission from NBDERD to access one or more of the target drilling locations for the purposes of completing the required following up hydrogeological drilling and pump testing will be an important aspect of the EIA process.

Once a new production well is constructed, a wellfield protection study to identify the associated wellfield protection zones as defined in *NB Regulation 2000-47* under the *Clean Water Act* would typically need to be completed within one year of the commissioning of the new well.

6 CLOSURE

This report was prepared by Robert Gallagher, M.Sc.Eng., P. Eng. and reviewed by John Sims, M.Sc., P. Geo., P. Eng.

7 REFERENCES

Allard, S. 2011. Surficial Geology of the McAdam Area (NTS 21 G/11), York and Charlotte counties, New Brunswick. New Brunswick Department of Natural Resources; Land, Minerals and Petroleum Division, Plate 2011-13 (revised April 2016).

Fyffe, L.R., Lutes, G. G. and St. Peter, C. J. 2005. Bedrock Geology of the McAdam Area (NTS 21 G/11), York County, New Brunswick. New Brunswick Department of Natural Resources, Minerals, Policty and Planning Division, Plate 2005-34.

New Brunswick Department of the Environment, 1980. Fredericton Planning Region Water Resources Review. Report I-8001. Water Resources Branch.

Potter, R. R., E. V. Jackson and J. L. Davies, 1968. Geological Map of New Brunswick, Map Number N.R.-1.

Rampton, V. N., R. C. Gauthier, J. Thibault and A. A. Seaman, 1984. Quaternary Geology of New Brunswick, Geological Survey of Canada, Memoir 416.

Appendix A –
NBDELG Water Well Records

Well No.	Depth (ft)	Casing Depth (ft)	Depth b/r (ft)	Yield (lgpm)	Comments
1	245	40	35	3.5	slate
2	403	29	20	0.5	shale
3	290	20	14	0.5	slate
4	124	70	68	12	granite
5	84	60	56	4	granite
6	210	24	18	8	slate
7	185	51	48	3	slate
8	302	40	31	2	granite
9	67	65		30	sand and gravel
10	185	20	12	3	slate
11	145	20	4	3	granite
12	85	50		10	granite
13	290	20	0	7	slate
14	120	52	50	25	granite
15	50	50		30	sand and gravel
16	140	38	35	6	granite
17	290	38	36	3	granite
18	125	20	12	6	granite
19	125	60	60	2	granite
20	165	64	60	5	granite
21			Deepened Well		
22	210	20	12	3	granite and sandstone
23	105	20	14	20	slate
24	125	20	10	50	shale
25	140	30	8	2	sandstone
26	210	20	4	1	granite
27			Deepened Well		
28	125	20	17	4	granite
29	230	37	35	2	granite
30	80	32	17	8	sandstone
avg	173	37	27	9	
min	50	20	0	0.5	
max	403	70	68	50	

New Nouveau Brunswick

Environment

Report Number **2525** (6)

Well Driller's Report

Date printed **4/15/2018**

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**New Well**	**Cable Tool**	**12/21/2001**

Casing Information

Casing above ground **2ft** — Drive Shoe Used? **Yes**

Well Log	Casing Type	Diameter	From	End	Slotted?
2525	Steel	6 inch	0ft	40ft	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	**0ft**	**4 igpm**	**1hr**	**0ft**	**3.5 igpm**	**No**	**0 igpm**

(BTC - Below top of casing)

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
N/A

Qty **0 ig**

Pump Installed
Submersible
Intake Setting (BTC)
0ft

Driller's Log

Well Log	From	End	Colour	Rock Type
2525	0ft	35ft	Brown	Till
2525	35ft	245ft	Grey	Shale

Overall Well Depth
245ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
2525	150ft	1 igpm
2525	230ft	3 igpm

Setbacks

Well Log	Distance	Setback From
2525	55ft	Septic Tank
2525	150ft	Septic Tank
2525	175ft	Leach Field
2525	75ft	Leach Field

New Nouveau Brunswick

Environment

Report Number **11874**

Well Driller's Report

Date printed **4/15/2018**

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**New Well**	**Rotary**	**12/30/2005**

Casing Information

Casing above ground **1ft 6in** Drive Shoe Used? **Yes**

Well Log	Casing Type	Diameter	From	End	Slotted?
11874	Steel	6 inch	0ft	29ft	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	**0ft**	**0 igpm**	**0hr**	**0ft**	**0.5 igpm**	**No**	**0 igpm**
	(BTC - Below top of casing)						

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
N/A

Qty **0 ig**

Pump Installed
Submersible
Intake Setting (BTC)
306ft

Driller's Log

Well Log	From	End	Colour	Rock Type
11874	0ft	20ft	Brown	Till and Rock
11874	20ft	54ft	Red	Shale
11874	54ft	148ft	Dark grey	Rock
11874	148ft	153ft	EMPTY VALUE	EMPTY VALUE
11874	153ft	403ft	Brown and grey	Rock

Overall Well Depth
403ft

Bedrock Level
20ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
11874	250ft	0.25 igpm
11874	350ft	0.25 igpm

Setbacks

Well Log	Distance	Setback From
11874	60ft	Septic Tank
11874	80ft	Leach Field
11874	100ft	Right of any Public Way Road

New Nouveau Brunswick

Environment

Report Number **12123** (3)

Well Driller's Report

Date printed **4/15/2018**

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**New Well**	**Rotary**	**10/11/2005**

Casing Information

Casing above ground **2ft** — Drive Shoe Used? **Yes**

Well Log	Casing Type	Diameter	From	End	Slotted?
12123	Steel	6 inch	0ft	20ft	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	**0ft**	**0.5 igpm**	**1hr**	**18ft**	**0.5 igpm**	**No**	**0 igpm**
	(BTC - Below top of casing)						

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
Bleach (Javex)
Qty **0 ig**

Pump Installed
Submersible
Intake Setting (BTC)
260ft

Driller's Log

Well Log	From	End	Colour	Rock Type
12123	0ft	14ft	Brown	Till
12123	14ft	290ft	Grey and black	Slate

Overall Well Depth
290ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
12123	180ft	60 igpm

Setbacks

Well Log	Distance	Setback From
12123	744ft	Right of any Public Way Road
12123	65ft	Septic Tank
12123	75ft	Leach Field

New Nouveau Brunswick

Environment

Report Number **13269** (4)

Well Driller's Report

Date printed **4/15/2018**

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**New Well**	**Rotary**	**05/22/2006**

Casing Information — Casing above ground **2ft** — Drive Shoe Used? **Yes**

Well Log	Casing Type	Diameter	From	End	Slotted?
13269	Steel	6 inch	0ft	70ft	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	**25ft** *(BTC - Below top of casing)*	**4 igpm**	**1hr 30min**	**25ft**	**12 igpm**	**No**	**0 igpm**

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
Chlorine Pucks
Qty **0 ig**

Pump Installed
Submersible
Intake Setting (BTC)
100ft

Driller's Log

Well Log	From	End	Colour	Rock Type
13269	0ft	68ft	Brown	Sand
13269	68ft	124ft	Grey	Granite

Overall Well Depth
124ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
13269	100ft	2 igpm
13269	110ft	10 igpm

Setbacks

Well Log	Distance	Setback From
13269	2000ft	Right of any Public Way Road

New Nouveau Brunswick

Environment

Report Number **13274**

Well Driller's Report

Date printed **4/15/2018**

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**New Well**	**Rotary**	**06/01/2006**

Casing Information

Casing above ground **2ft** — Drive Shoe Used? **Yes**

Well Log	Casing Type	Diameter	From	End	Slotted?
13274	Steel	6 inch	0ft	60ft	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	**20ft** *(BTC - Below top of casing)*	**4 igpm**	**1hr 30min**	**20ft**	**4 igpm**	**No**	**0 igpm**

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
Chlorine Pucks
Qty **0 ig**

Pump Installed
N/A
Intake Setting (BTC)
70ft

Driller's Log

Well Log	From	End	Colour	Rock Type
13274	0ft	10ft	Brown	Sand
13274	10ft	56ft	Red	Sand
13274	56ft	84ft	Red	Granite

Overall Well Depth
84ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
13274	70ft	4 igpm

Setbacks

Well Log	Distance	Setback From
13274	5000ft	Right of any Public Way Road

New Nouveau Brunswick

Environment

Report Number **15976** (6)

Well Driller's Report

Date printed **4/15/2018**

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**New Well**	**Rotary**	**10/16/2007**

Casing Information

Casing above ground **2ft** — Drive Shoe Used? **Yes**

Well Log	Casing Type	Diameter	From	End	Slotted?
15976	Steel	6 inch	0ft	24ft	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	**18ft** *(BTC - Below top of casing)*	**8 igpm**	**1hr**	**18ft**	**8 igpm**	**No**	**0 igpm**

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
Bleach (Javex)
Qty **0 ig**

Pump Installed
Submersible
Intake Setting (BTC)
175ft

Driller's Log

Well Log	From	End	Colour	Rock Type
15976	0ft	18ft	Brown	Till
15976	18ft	210ft	Brown and grey	Slate

Overall Well Depth
210ft

Bedrock Level
18ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
15976	65ft	3 igpm
15976	170ft	5 igpm

Setbacks

Well Log	Distance	Setback From
15976	65ft	Septic Tank
15976	85ft	Leach Field
15976	100ft	Right of any Public Way Road

New Nouveau Brunswick

Environment

Report Number **16019**

Well Driller's Report

Date printed **4/15/2018**

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**New Well**	**Rotary**	**09/27/2007**

Casing Information — Casing above ground **2ft** — Drive Shoe Used? **Yes**

Well Log	Casing Type	Diameter	From	End	Slotted?
16019	Steel	6 inch	0ft	51ft	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	**40ft**	**3 igpm**	**1hr**	**40ft**	**3 igpm**	**No**	**0 igpm**
	(BTC - Below top of casing)						

Well Grouting

There is no Grout Information.

Drilling Fluids Used
None

Disinfectant
Bleach (Javex)
Qty **0 ig**

Pump Installed
Submersible
Intake Setting (BTC)
150ft

Driller's Log

Well Log	From	End	Colour	Rock Type
16019	0ft	12ft	Brown	Sand
16019	12ft	48ft	Brown	Sand and Gravel
16019	48ft	185ft	Black	Slate

Overall Well Depth
185ft

Bedrock Level
48ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
16019	78ft	3 igpm

Setbacks

Well Log	Distance	Setback From
16019	65ft	Septic Tank
16019	85ft	Leach Field
16019	100ft	Right of any Public Way Road

New Nouveau Brunswick

Environment

Report Number **16452** (8)

Well Driller's Report

Date printed **4/15/2018**

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**New Well**	**Rotary**	**11/01/2007**

Casing Information — Casing above ground **1ft 6in** — Drive Shoe Used? **Yes**

Well Log	Casing Type	Diameter	From	End	Slotted?
16452	Steel	6 inch	0ft	40ft	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	**25ft** *(BTC - Below top of casing)*	**7 igpm**	**1hr**	**290ft**	**2 igpm**	**No**	**0 igpm**

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
Bleach (Javex)
Qty **0 ig**

Pump Installed
Submersible
Intake Setting (BTC)
275ft

Driller's Log

Well Log	From	End	Colour	Rock Type
16452	0ft	31ft	Brown	Overburden
16452	31ft	302ft	Grey	Granite

Overall Well Depth
302ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
16452	85ft	1 igpm
16452	110ft	1 igpm

Setbacks

Well Log	Distance	Setback From
16452	60ft	Septic Tank
16452	80ft	Leach Field
16452	95ft	Right of any Public Way Road

New Nouveau Brunswick

Environment

Report Number **16472**

Well Driller's Report

Date printed **4/15/2018**

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**New Well**	**Rotary**	**05/13/2008**

Casing Information

Casing above ground **1ft 6in** Drive Shoe Used? **Yes**

Well Log	Casing Type	Diameter	From	End	Slotted?
16472	Steel	6 inch	0ft	65ft	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	33ft *(BTC - Below top of casing)*	10 igpm	1hr	38ft	30 igpm	No	0 igpm

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
Bleach (Javex)
Qty **0 ig**

Pump Installed
Submersible
Intake Setting (BTC)
50ft

Driller's Log

Well Log	From	End	Colour	Rock Type
16472	0ft	67ft	Brown	Sand and Gravel

Overall Well Depth
67ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
16472	67ft	30 igpm

Setbacks

Well Log	Distance	Setback From
16472	65ft	Septic Tank

New Nouveau Brunswick

Environment

Report Number **18662**

Well Driller's Report

Date printed **4/15/2018**

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**New Well**	**Rotary**	**10/16/2006**

Casing Information

Casing above ground **2ft** — Drive Shoe Used? **Yes**

Well Log	Casing Type	Diameter	From	End	Slotted?
18662	Steel	6 inch	0ft	20ft	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	**14ft** *(BTC - Below top of casing)*	**3 igpm**	**1hr**	**14ft**	**3 igpm**	**No**	**0 igpm**

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
Bleach (Javex)
Qty **0 ig**

Pump Installed
Submersible
Intake Setting (BTC)
160ft

Driller's Log

Well Log	From	End	Colour	Rock Type
18662	0ft	12ft	Brown	Till
18662	12ft	185ft	Grey and black	Slate

Overall Well Depth
185ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
18662	41ft	2 igpm
18662	60ft	1 igpm

Setbacks

Well Log	Distance	Setback From
18662	68ft	Septic Tank
18662	80ft	Leach Field
18662	78ft	Right of any Public Way Road

(11)

New Nouveau Brunswick

Environment

Report Number **25806**

Well Driller's Report

Date printed **4/15/2018**

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**New Well**	**Rotary**	**09/17/2010**

Casing Information — Casing above ground **1ft 6in** — Drive Shoe Used? **Yes**

Well Log	Casing Type	Diameter	From	End	Slotted?
25806	Steel	6 Inch	0ft	20ft	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Bailer	**15ft** *(BTC - Below top of casing)*	**4 igpm**	**1hr 10min**	**90ft**	**3 igpm**	**No**	**0 igpm**

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
Other
Qty **0 ig**

Pump Installed
N/A
Intake Setting (BTC)
125ft

Driller's Log

Well Log	From	End	Colour	Rock Type
25806	0ft	4ft	Brown	Till
25806	4ft	145ft	Black	Granite

Overall Well Depth
145ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
25806	85ft	3.5 igpm

Setbacks

Well Log	Distance	Setback From
25806	200ft	Right of any Public Way Road

(17)

New Nouveau Brunswick

Environment

Report Number **26947**

Well Driller's Report

Date printed **4/15/2018**

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**Other - Not Specified**	**Rotary**	**08/25/2009**

Casing Information

Casing above ground **1ft 6in** Drive Shoe Used? **Yes**

Well Log	Casing Type	Diameter	From	End	Slotted?
26947	Steel	6 inch	0ft	50ft	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	**15ft** *(BTC - Below top of casing)*	**4 igpm**	**1hr 30min**	**15ft**	**10 igpm**	**No**	**0 igpm**

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
12% NaOCl
Qty **0 ig**

Pump Installed
N/A
Intake Setting (BTC)
60ft

Driller's Log

Well Log	From	End	Colour	Rock Type
26947	0ft	35ft	Grey	Clay
26947	35ft	85ft	Red	Gravel

Overall Well Depth
85ft

Bedrock Level
35ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
26947	20ft	10 igpm

Setbacks

Well Log	Distance	Setback From
26947	57ft	Septic Tank
26947	78ft	Leach Field
26947	1004ft	Right of any Public Way Road

(13)

New Nouveau Brunswick

Environment

Report Number **30632**

Well Driller's Report

Date printed **4/15/2018**

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**Deepened**	**Rotary**	**09/11/2014**

Casing Information — Casing above ground **2ft** — Drive Shoe Used? **Yes**

There is no casing information.

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	**25ft** *(BTC - Below top of casing)*	**7 igpm**	**1hr**	**25ft**	**7 igpm**	**No**	**0 igpm**

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
Bleach (Javex)
Qty **0 ig**

Pump Installed
Submersible
Intake Setting (BTC)
220ft

Driller's Log

Well Log	From	End	Colour	Rock Type
30632	0ft	290ft	Grey	Slate

Overall Well Depth
290ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
30632	235ft	6 igpm

Setbacks

Well Log	Distance	Setback From
30632	80ft	Septic Tank
30632	90ft	Leach Field
30632	300ft	Right of any Public Way Road

New Nouveau Brunswick

Environment

Report Number **38033**

Well Driller's Report

Date printed **4/15/2018**

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**New Well**	**Rotary**	**05/25/2017**

Casing Information — Casing above ground **1ft 6in** — Drive Shoe Used? **Yes**

Well Log	Casing Type	Diameter	From	End	Slotted?
38033	Steel	6 inch	0ft	52ft	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	**10ft** *(BTC - Below top of casing)*	**4 igpm**	**1hr 30min**	**10ft**	**25 igpm**	**No**	**0 igpm**

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
Chlorine pellets
Qty **0 ig**

Pump Installed
Submersible
Intake Setting (BTC)
100ft

Driller's Log

Well Log	From	End	Colour	Rock Type
38033	0ft	50ft	Brown	Fill Sand
38033	50ft	120ft	Red	Granite

Overall Well Depth
120ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
38033	60ft	5 igpm
38033	90ft	10 igpm
38033	110ft	10 igpm

Setbacks

Well Log	Distance	Setback From
38033	2640ft	Right of any Public Way Road
38033	65ft	Septic Tank
38033	85ft	Leach Field

(15)

New Nouveau Brunswick

Environment

Report Number **38687**

Well Driller's Report

Date printed **4/15/2018**

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**New Well**	**Rotary**	**06/08/2015**

Casing Information

Casing above ground **2ft** — Drive Shoe Used? **Yes**

Well Log	Casing Type	Diameter	From	End	Slotted?
38687	Steel	6 inch	0ft	50ft	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	**25ft**	**30 igpm**	**1hr**	**25ft**	**30 igpm**	**No**	**0 igpm**

(BTC - Below top of casing)

Well Grouting

There is no Grout Information.

Drilling Fluids Used
None

Disinfectant
Bleach (Javex)
Qty **0 ig**

Pump Installed
Submersible
Intake Setting (BTC)
40ft

Driller's Log

Well Log	From	End	Colour	Rock Type
38687	0ft	50ft	Grey	Gravel and Fine Sand

Overall Well Depth
50ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
38687	50ft	30 igpm

Setbacks

Well Log	Distance	Setback From
38687	26400ft	Right of any Public Way Road
38687	75ft	Septic Tank
38687	80ft	Leach Field

(16)

New Nouveau Brunswick

Environment

Report Number **39813**

Well Driller's Report

Date printed **4/15/2018**

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**New Well**	**Rotary**	**05/21/2015**

Casing Information — Casing above ground **2ft** — Drive Shoe Used? **Yes**

Well Log	Casing Type	Diameter	From	End	Slotted?
39813	Steel	6 Inch	0ft	38ft	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	20ft *(BTC - Below top of casing)*	4 igpm	1hr 30min	40ft	6 igpm	No	0 igpm

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
Chlorine pellets
Qty **0 ig**

Pump Installed
Submersible
Intake Setting (BTC)
120ft

Driller's Log

Well Log	From	End	Colour	Rock Type
39813	0ft	35ft	Brown	Till
39813	35ft	140ft	Grey	Granite

Overall Well Depth
140ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
39813	130ft	6 igpm

Setbacks

Well Log	Distance	Setback From
39813	60ft	Septic Tank
39813	80ft	Leach Field
39813	500ft	Right of any Public Way Road

(a)

New Nouveau Brunswick

Environment

Report Number **40037**

Well Driller's Report

Date printed **4/15/2018**

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**New Well**	**Rotary**	**07/21/2015**

Casing Information — Casing above ground **2ft** — Drive Shoe Used? **Yes**

Well Log	Casing Type	Diameter	From	End	Slotted?
40037	Steel	6 inch	0ft	38ft	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	**18ft** *(BTC - Below top of casing)*	**1 igpm**	**1hr**	**18ft**	**3 igpm**	**No**	**0 igpm**

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
Bleach (Javex)
Qty **0 ig**

Pump Installed
Submersible
Intake Setting (BTC)
280ft

Driller's Log

Well Log	From	End	Colour	Rock Type
40037	0ft	36ft	Black	Till
40037	36ft	290ft	Black	Granite

Overall Well Depth
290ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
40037	260ft	1 igpm

Setbacks

Well Log	Distance	Setback From
40037	90ft	Septic Tank
40037	80ft	Leach Field

(18)

New Nouveau Brunswick

Environment

Report Number **90064500**

Well Driller's Report

Date printed **4/15/2018**

Drilled by			
Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**New Well (NEW WELL)**	**Rotary (ROTARY)**	**12/03/1994**

Casing Information	Casing above ground **0ft**	Drive Shoe Used? **Yes**
There is no casing information.		

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
	0ft	**0 igpm**	**0hr**	**0ft**	**6 igpm**	**No**	**0 igpm**
	(BTC - Below top of casing)						

Well Grouting	Drilling Fluids Used	Disinfectant	Pump Installed
There is no Grout information.	None	**Bleach (Javex)**	**Submersible**
		Qty **1.0 ig**	Intake Setting (BTC) **80ft**

Driller's Log

Well Log	From	End	Colour	Rock Type
90064500	0ft	12ft	Brown	Topsoil
90064500	12ft	125ft	Grey	Granite

Overall Well Depth **125ft**

Bedrock Level **0ft**

Water Bearing Fracture Zone

Well Log	Depth	Rate
90064500	60ft	3 igpm
90064500	110ft	3 igpm

Setbacks

There is no Setback information.

(19)

New Nouveau Brunswick

Environment

Report Number **90068000**

Well Driller's Report

Date printed **4/15/2018**

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**New Well (NEW WELL)**	**Rotary (ROTARY)**	**11/14/1994**

Casing Information

Casing above ground **0ft** Drive Shoe Used? **Yes**

Well Log	Casing Type	Diameter	From	End	Slotted?
90068000	Steel	6 inch	0ft	60ft	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	**0ft**	**0 igpm**	**0hr**	**0ft**	**2 igpm**	**No**	**0 igpm**
	(BTC - Below top of casing)						

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
12% NaOCl
Qty **1.0 ig**

Pump Installed
N/A
Intake Setting (BTC)
105ft

Driller's Log

Well Log	From	End	Colour	Rock Type
90068000	0ft	20ft	Brown	Slate and Clay
90068000	20ft	30ft	Brown	Sand
90068000	30ft	60ft	Black	Till
90068000	60ft	125ft	Black	Granite

Overall Well Depth
125ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
90068000	105ft	2 igpm

Setbacks

There is no Setback information.

(20)

New Nouveau Brunswick

Environment

Report Number **90909200**

Well Driller's Report

Date printed **4/15/2018**

Drilled by			
Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**New Well (NEW WELL)**	**Rotary (ROTARY)**	**09/05/1997**

Casing Information

Casing above ground **1ft** — Drive Shoe Used? **Yes**

Well Log	Casing Type	Diameter	From	End	Slotted?
90909200	Steel	6 inch	0ft	64ft	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	**0ft**	**5 igpm**	**1hr 30min**	**0ft**	**5 igpm**	**No**	**0 igpm**
	(BTC - Below top of casing)						

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
12% NaOCl
Qty **1.0 ig**

Pump Installed
N/A
Intake Setting (BTC)
145ft

Driller's Log

Well Log	From	End	Colour	Rock Type
90909200	60ft	165ft	Red	Granite
90909200	0ft	60ft	Grey	Clay

Overall Well Depth
165ft

Bedrock Level
60ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
90909200	150ft	5 igpm

Setbacks

There is no Setback information.

(21)

New Nouveau Brunswick

Environment

Report Number **90980500**

Well Driller's Report

Date printed **4/15/2018**

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**Deepened ~~(DEEPENED)~~**	**Rotary (ROTARY)**	**11/08/1997**

Casing Information

Casing above ground **0ft** | Drive Shoe Used? **Yes**

There is no casing information.

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	**0ft**	**30 igpm**	**0hr**	**80ft**	**30 igpm**	**No**	**0 igpm**
	(BTC - Below top of casing)						

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
Bleach (Javex)
Qty **1.0 ig**

Pump Installed
Submersible
Intake Setting (BTC)
405ft

Driller's Log

There is no rock layer information.

Overall Well Depth
0ft

Bedrock Level
0ft

Water Bearing Fracture Zone

There is no water bearing fracture zone information.

Setbacks

There is no Setback information.

(22)

New Nouveau Brunswick

Environment

Report Number **91385200**

Well Driller's Report

Date printed **4/15/2018**

Drilled by			
Well Use	Work Type	Drill Method	Work Completed
Non-Drinking Water, Industrial	**New Well (NEW WELL)**	**Rotary (ROTARY)**	**02/08/1999**

Casing Information

Casing above ground **2ft** — Drive Shoe Used? **Yes**

Well Log	Casing Type	Diameter	From	End	Slotted?
91385200	Steel	6 inch	0ft	20ft	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	**0ft**	**3 igpm**	**1hr**	**18ft**	**3 igpm**	**No**	**0 igpm**
	(BTC - Below top of casing)						

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
Bleach (Javex)
Qty **1.0 ig**

Pump Installed
Submersible
Intake Setting (BTC)
190ft

Driller's Log

Well Log	From	End	Colour	Rock Type
91385200	0ft	12ft	Brown	Till
91385200	12ft	210ft	Red and grey	Granite and Sandstone

Overall Well Depth
210ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
91385200	128ft	1.5 igpm
91385200	185ft	1.5 igpm

Setbacks

There is no Setback information.

New Nouveau Brunswick

Environment

Report Number **91387300**

Well Driller's Report

Date printed **4/15/2018**

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**New Well (NEW WELL)**	**Rotary (ROTARY)**	**02/06/1999**

Casing Information

Casing above ground **2ft** Drive Shoe Used? **Yes**

Well Log	Casing Type	Diameter	From	End	Slotted?
91387300	Steel	6 inch	0ft	20ft	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	**0ft**	**25 igpm**	**1hr**	**18ft**	**20 igpm**	**No**	**0 igpm**

(BTC - Below top of casing)

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
Bleach (Javex)
Qty **1.0 ig**

Pump Installed
Submersible
Intake Setting (BTC)
80ft

Driller's Log

Well Log	From	End	Colour	Rock Type
91387300	0ft	14ft	Brown	Till
91387300	14ft	105ft	Grey	Slate

Overall Well Depth
105ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
91387300	65ft	4 igpm
91387300	80ft	16 igpm

Setbacks

There is no Setback information.

(24)

New Nouveau Brunswick

Environment

Report Number **91543200**

Well Driller's Report

Date printed **4/15/2018**

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**New Well (NEW WELL)**	**Rotary (ROTARY)**	**09/30/1999**

Casing Information

Casing above ground **2ft** Drive Shoe Used? **Yes**

Well Log	Casing Type	Diameter	From	End	Slotted?
91543200	Steel	6 Inch	0ft	20ft	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	**0ft**	**50 igpm**	**2hrs**	**0ft**	**50 igpm**	**No**	**0 igpm**

(BTC - Below top of casing)

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
N/A

Qty **0 ig**

Pump Installed
Submersible
Intake Setting (BTC)
0ft

Driller's Log

Well Log	From	End	Colour	Rock Type
91543200	0ft	10ft	Brown	Till
91543200	10ft	125ft	Grey	Shale

Overall Well Depth
125ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
91543200	110ft	50 igpm

Setbacks

There is no Setback information.

New Nouveau Brunswick

Environment

Report Number **91643100**

Well Driller's Report

Date printed **4/15/2018**

Drilled by			
Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**New Well (NEW WELL)**	**Rotary (ROTARY)**	**05/19/2000**

Casing Information

Casing above ground **1ft 4in** Drive Shoe Used? **Yes**

Well Log	Casing Type	Diameter	From	End	Slotted?
91643100	Steel	6 inch	0ft	30ft	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	**6ft** *(BTC - Below top of casing)*	**5 igpm**	**1hr**	**0ft**	**2 igpm**	**No**	**0 igpm**

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
Bleach (Javex)
Qty **4.0 ig**

Pump Installed
Jet
Intake Setting (BTC)
120ft

Driller's Log

Well Log	From	End	Colour	Rock Type
91643100	0ft	3ft	Brown	Gravel
91643100	3ft	8ft	Brown	Till
91643100	8ft	24ft	Red	Sandstone
91643100	24ft	140ft	Grey	Sandstone

Overall Well Depth
140ft

Bedrock Level
8ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
91643100	90ft	1 igpm
91643100	120ft	1 igpm

Setbacks

There is no Setback information.

(26)

New Nouveau Brunswick

Environment

Report Number **91805700**

Well Driller's Report

Date printed **4/15/2018**

Drilled by			
Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**New Well (NEW WELL)**	**Rotary (ROTARY)**	**10/24/1999**

Casing Information

Casing above ground **2ft** — Drive Shoe Used? **Yes**

Well Log	Casing Type	Diameter	From	End	Slotted?
91805700	Steel	6 inch	0ft	20ft	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	**0ft**	**1 igpm**	**1hr**	**18ft**	**1 igpm**	**No**	**0 igpm**

(BTC - Below top of casing)

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
N/A

Qty **0 ig**

Pump Installed
Submersible
Intake Setting (BTC)
180ft

Driller's Log

Well Log	From	End	Colour	Rock Type
91805700	0ft	4ft	Brown	Till
91805700	4ft	210ft	Grey	Granite

Overall Well Depth
210ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
91805700	60ft	1 igpm

Setbacks

There is no Setback information.

(23)

New Nouveau Brunswick

Environment

Report Number **91863400**

Well Driller's Report

Date printed **4/15/2018**

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**Deepened ~~(DEEPENED)~~**	**Rotary (ROTARY)**	**11/24/2000**

Casing Information	Casing above ground **0ft**	Drive Shoe Used? **Yes**
There is no casing information.		

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	**0ft** *(BTC - Below top of casing)*	**3 igpm**	**1hr**	**18ft**	**3 igpm**	**No**	**0 igpm**

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
Bleach (Javex)
Qty **0 ig**

Pump Installed
Submersible
Intake Setting (BTC)
210ft

Driller's Log

There is no rock layer information.

Overall Well Depth
0ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
91863400	230ft	3 igpm

Setbacks

There is no Setback information.

(28)

New Nouveau Brunswick

Environment

Report Number **91996000**

Well Driller's Report

Date printed **4/15/2018**

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**New Well (NEW WELL)**	**Rotary (ROTARY)**	**07/28/2000**

Casing Information

Casing above ground **2ft** | Drive Shoe Used? **Yes**

Well Log	Casing Type	Diameter	From	End	Slotted?
91996000	Steel	6 inch	0ft	20ft	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	**0ft**	**4 igpm**	**1hr**	**0ft**	**4 igpm**	**No**	**0 igpm**

(BTC - Below top of casing)

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
N/A

Qty **0 ig**

Pump Installed
N/A

Intake Setting (BTC)
100ft

Driller's Log

Well Log	From	End	Colour	Rock Type
91996000	0ft	17ft	Brown	Till
91996000	17ft	125ft	Grey	Granite

Overall Well Depth
125ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
91996000	26ft	0.5 igpm
91996000	80ft	1 igpm
91996000	108ft	3 igpm

Setbacks

There is no Setback information.

(29)

New Nouveau Brunswick

Environment

Report Number **91997700**

Well Driller's Report

Date printed **4/15/2018**

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**New Well (NEW WELL)**	**Rotary (ROTARY)**	**05/08/2000**

Casing Information

Casing above ground **2ft** Drive Shoe Used? **Yes**

Well Log	Casing Type	Diameter	From	End	Slotted?
91997700	Steel	6 inch	0ft	37ft	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	**0ft**	**2 igpm**	**0hr**	**18ft**	**2 igpm**	**No**	**0 igpm**

(BTC - Below top of casing)

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
N/A

Qty **0 ig**

Pump Installed
Submersible

Intake Setting (BTC)
200ft

Driller's Log

Well Log	From	End	Colour	Rock Type
91997700	0ft	35ft	Brown	Till
91997700	35ft	230ft	Grey	Granite

Overall Well Depth
230ft

Bedrock Level
0ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
91997700	200ft	2 igpm

Setbacks

There is no Setback information.

(30)

New Nouveau Brunswick

Environment

Report Number **92017600**

Well Driller's Report

Date printed **4/15/2018**

Drilled by			
Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**New Well (NEW WELL)**	**Rotary (ROTARY)**	**11/09/2000**

Casing Information

Casing above ground **1ft 6in** — Drive Shoe Used? **Yes**

Well Log	Casing Type	Diameter	From	End	Slotted?
92017600	Steel	6 inch	0ft	32ft	

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
Air	**0ft**	**8 igpm**	**1hr**	**10ft**	**8 igpm**	**No**	**0 igpm**

(BTC - Below top of casing)

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
Bleach (Javex)
Qty **1.0 ig**

Pump Installed
N/A
Intake Setting (BTC)
60ft

Driller's Log

Well Log	From	End	Colour	Rock Type
92017600	17ft	22ft	Soft brown	Shale
92017600	0ft	3ft	Brown	Gravel
92017600	3ft	4ft	Grey	Slate and Clay
92017600	4ft	17ft	Brown	Clay
92017600	22ft	60ft	Grey	Sandstone
92017600	60ft	61ft	Brown	Sandstone
92017600	61ft	80ft	Grey	Sandstone

Overall Well Depth
80ft

Bedrock Level
17ft

Water Bearing Fracture Zone

Well Log	Depth	Rate
92017600	60ft	8 igpm

Setbacks

There is no Setback information.

(30)

New Nouveau Brunswick

Environment

Report Number **99200028**

Well Driller's Report

Date printed **4/15/2018**

Drilled by

Well Use	Work Type	Drill Method	Work Completed
Drinking Water, Domestic	**New Well**		**01/01/1999**

Casing Information — Casing above ground **0ft** — Drive Shoe Used? **Yes**

There is no casing information.

Aquifer Test/Yield

Method	Initial Water Level (BTC)	Pumping Rate	Duration	Final Water Level (BTC)	Estimated Safe Yield	Flowing Well?	Rate
	0ft	**0 igpm**	**0hr**	**0ft**	**0 igpm**	**No**	**0 igpm**

(BTC - Below top of casing)

Well Grouting

There is no Grout information.

Drilling Fluids Used
None

Disinfectant
N/A

Qty **0 ig**

Pump Installed
N/A

Intake Setting (BTC)
0ft

Driller's Log

There is no rock layer information.

Overall Well Depth
0ft

Bedrock Level
0ft

Water Bearing Fracture Zone

There is no water bearing fracture zone information.

Setbacks

There is no Setback information.

Appendix B – Geophysical Survey Report

McAdam Water Search by VLF-EM

LINES

Lines were established through the woods using a thread chain (Hip Chain) and Suunto dial compass. Part of Line 1 was along an old woods road. Orange ribbons, marked with distance by felt pen, were tied on tree branches each 25 meters, and blue ribbons at 12.5 meter intermediate points. Both colours were tied at each 100 meter interval. Satellite locations were recorded at a few places along each line using two Garmin GPS 12 XL receivers.

EM-16

"Very low frequency " (24.0 kilohertz) radio waves from the US Naval Station at Cutler, Maine were the energy source which is capable of inducing an electrical field around any conductive body in the rocks underfoot. The Geonics EM-16 instrument we used to detect such fields has two antenaes. The larger antenae is tilted in a direction at right angles to the direction to Cutler, until that the windings in the antenna parallel the electrical field, thus locating a "null". The percent slope at the null signal gives a measure of in-phase field orientation. The second, shorter antennae is then at maximum coupling with the energy field, and the electronics within the instrument determine the strength of the portion of the energy field that is 1/4 wavelength offset from the original signal from Cutler. This measure is called the "out-of-phase", or more accurately, the "quadrature" reading. The in-phase is a simple measure of the geometry of the electrical field, while the quadrature is a record of the retardation of the secondary field induced in any conductor in the ground. The profile of a typical conductive response is shown in the legend of the graphic plot sheet. Good electrical conducors in the ground will have low quadrature readings. Less conductive bodies will have greater retardation and the quadrature values will be larger. Faintly conductive water, and clays with some attached ions would be expected to cause larger quadrature values than would a metallic conductive body. In the past, elsewhere, some clay-filled fractures have produced quite prominent profiles, not always accompanied by water.

Readings with the EM-16 were taken each 12.5 meters, with fill-in readings at 6.25 meters in only a few spots. The operator faced west (a key bit of information for choosing which parts of the plot to choose as a conductor). Interpretations of the readings in the field determined where to place stakes marked "Conductor" and were surrounded by numerous ribbons in blue, orange, pink on the stakes and nearby branches. Satellite locations were taken at each chosen conductor.

The plotted profiles and the table of satellite readings both show the chosen conductor locations. The conductor axis is chosen at the mid point of steepest part of the in-phase plot. In this , that is where the plot drops toward the north (based on the west facing operator). The land at each side is smooth and near level, and easily reached with machinery.

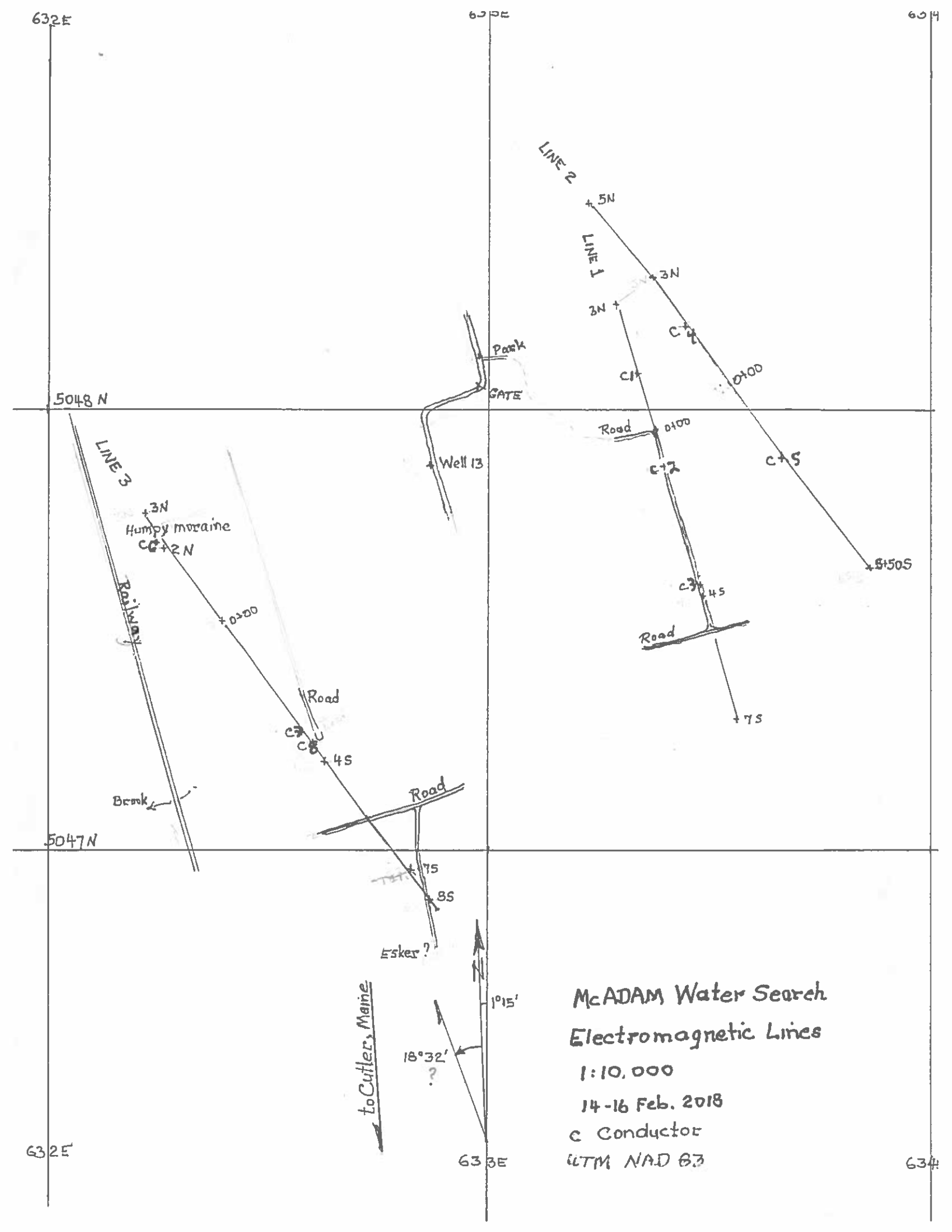
RESULTS

On Lines 1 and 2 each conductor has a strong in-phase profile, with only mild quadrature, raising the possibility of clay filled fractures. The proportion of signals caused by the presence of water is not easily determined from this style of survey. Resistivity surveys can provide more subtle interpretations. The two most northerly conductors probably connect line to line.

Line 3 has a similar conductor at about 2+20 North. The land appears to be a hummocky glacial moraine with multi-meter sized granite blocks. The geological map suggests this location is northwest of the faulted bounary of the Carboniferous rocks, but outcops appear lacking, so the location of the boundary should be considered quite uncertain. The point on the line is on a steep
side hill, but just 15 meters to the west ther is a level spot.

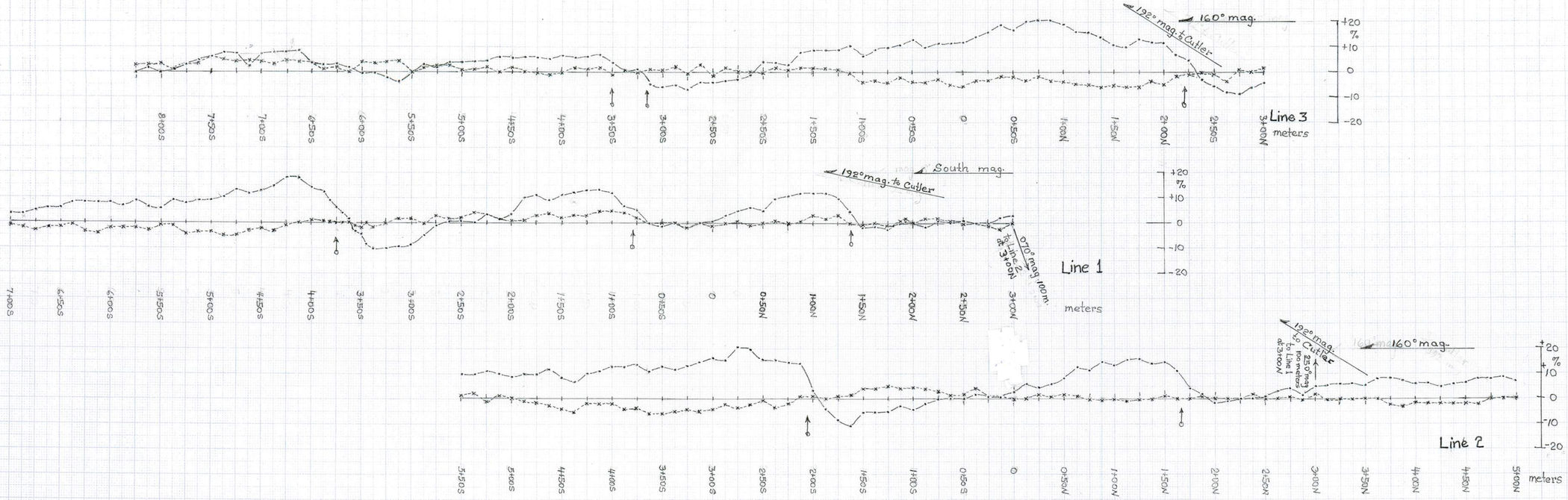
Stakes were placed at 3+19 and 3+50 South on Line 3. The south tip of a woods road is immediately east of 3+50 S. These are weaker features with low qudrature. Another similar one at 6+56 S was not marked in the field. It is on a gentle south slope, less than 50 meters west a woods road.

Donald Hattie 22 Feb., 2018

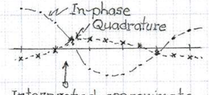

632E
633E
634
LINE 2
5N
LINE 1
3N
3N
C+4
0+00
C1+
Road
0+00
C+2
C+5
Pond
GATE
5048 N
Well 13
LINE 3
3N
Humpy moraine
C+2 N
0+00
C+3
4S
5+50S
Railway
Road
C3
C8
4S
Road
Brook
5047N
7S
8S
7S
Esker?
N
1°15'
18°32'
?
toCutler, Maine
McADAM Water Search
Electromagnetic Lines
1:10,000
14-16 Feb. 2018
c Conductor
UTM NAD 83
632E
633E
634

GPS cordinates for McAdam water supply NAD 83

Point			East	North	Probable error
Line 1	3+00N	end	633291	5048238	5 meters
	1+37N	Conductor 1	633334	5048080	6
	0+00		633378	5047956	6
	0+80S	Conductor 2	633397	5047877	5
	3+75S	Conductor 3	633486	5047600	6
	4+00S		633493	5047580	4
	7+00S	end	633567	5047298	10
Line 2	5+00N	end	633246	5048465	14
	1+66N	Conductor 4	633447	5048188	5
	0+00		633543	5048057	7
	2+05S	Conductor 5	633664	5047894	9
	5+50S	end	633863	5047634	5
Car park			632978	5048117	6
Well 13			632869	5047873	6
Line 3	3+00N	end	632220	5047761	7
	2+20N	Conductor 6	632264	5047695	14
	2+00N		632275	5047682	6
	0+00		632392	5047519	?
	3+19S	Conductor 7	632579	5047268	5
	3+50S	Conductor 8	632599	5047244	5
	4+00S		632627	5047205	4
	7+00S		632829	5046970	8
	8+00S		632864	5046889	5
	8+25S	end	–	–	



Typical conductor:



Energy source:

US Naval Station at Cutler, Maine 24.0 kHz

Operator faced ~282° mag.

EM-16 read by Mark Connell 14-16 Feb 2018

Plotted by Don Hathie 21 Feb 2018

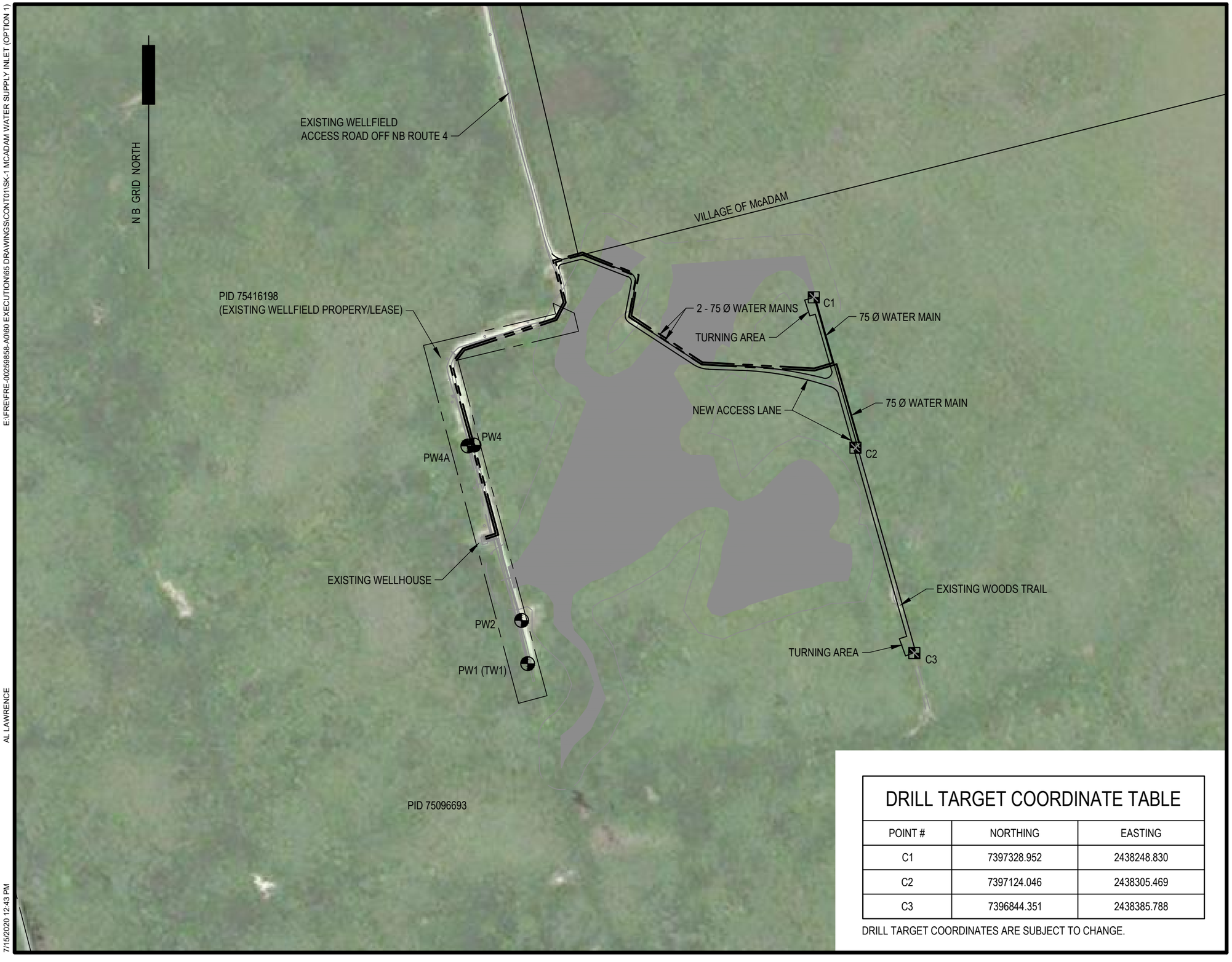
McAdam Water Search

Electromagnetic Profiles

VLF-EM (Geonics EM-16)

Serial No. 13667

Appendix C –
Preliminary Project Drawings



DRILL TARGET COORDINATE TABLE		
POINT #	NORTHING	EASTING
C1	7397328.952	2438248.830
C2	7397124.046	2438305.469
C3	7396844.351	2438385.788

DRILL TARGET COORDINATES ARE SUBJECT TO CHANGE.

EXP Services Inc.
t: +1.506.452.9000 | f: +1.506.459.3954
1133 Regent Street, Suite 300
Fredericton, NB, E3B 3Z2
CANADA
www.exp.com

BUILDINGS · EARTH & ENVIRONMENT · ENERGY · INDUSTRIAL · INFRASTRUCTURE · SUSTAINABILITY

No.	Issue	Date

No.	Revision	Date

FOR INFORMATION ONLY

Drawn By:	ARL
Dwg Standards Ckd By:	
Designed By:	MF
Design Checked By:	
Scale:	1:5000

Project Title

VILLAGE OF McADAM WATER SUPPLY UPGRADE

Dwg. Title

McADAM WATER SUPPLY INLET (OPTION 1)

Project No.

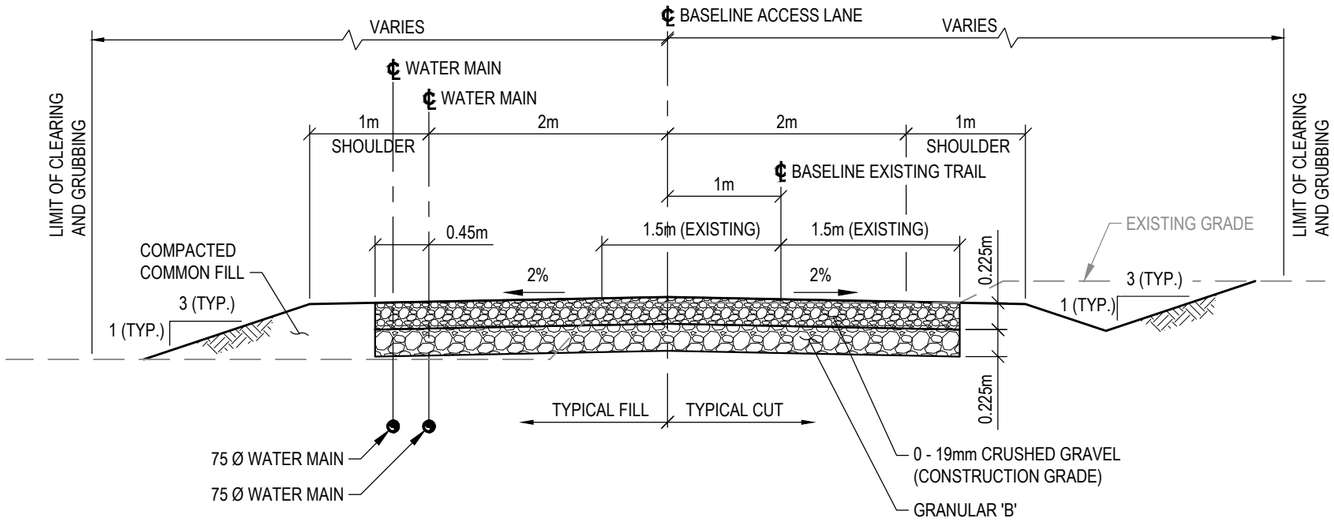
FRE-00259858-A0

Dwg. No. **SK-1**

Rev. No. ----

AL LAWRENCE

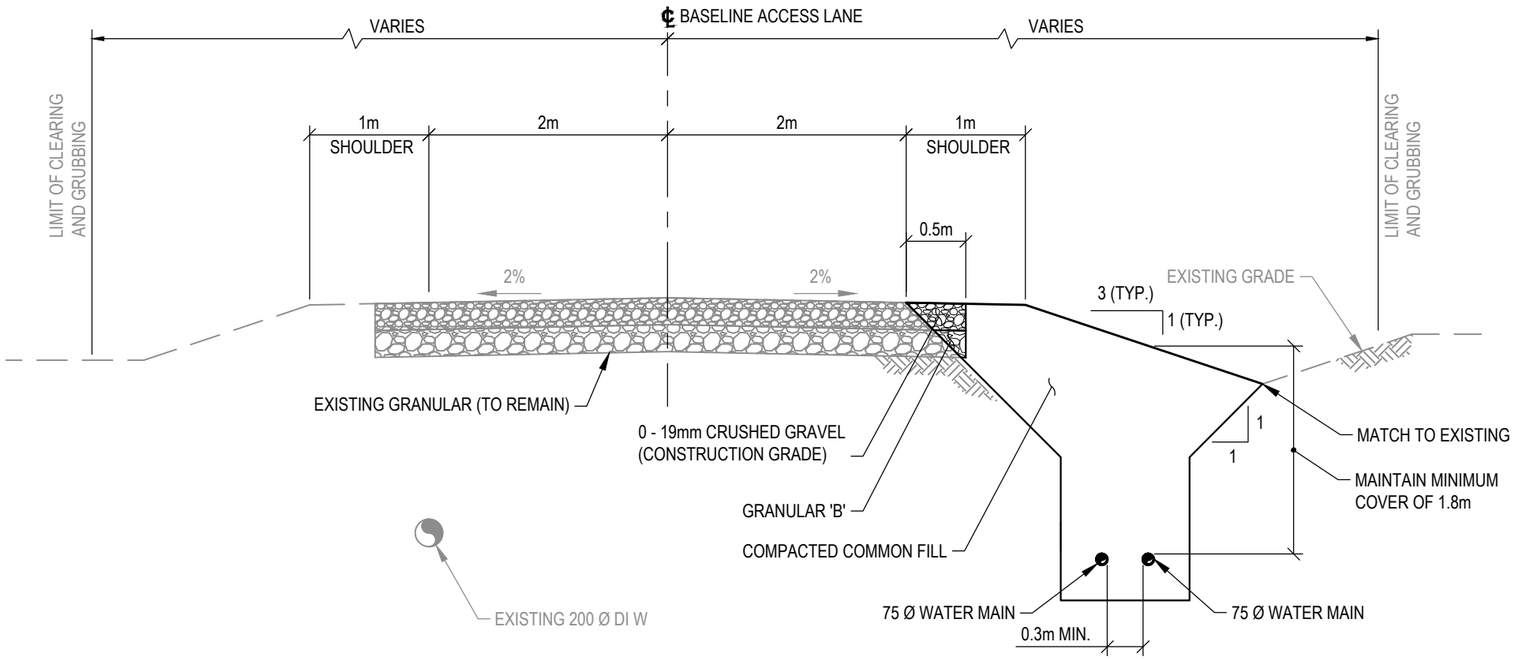
7/15/2020 12:43 PM



TYPICAL SECTION

ACCESS LANE

NOT TO SCALE



TYPICAL SECTION

EXISTING WELLFIELD ACCESS ROAD

NOT TO SCALE

AL LAWRENCE

7/15/2020 12:45 PM

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No.	Issue	Date

No.	Revision	Date

FOR INFORMATION ONLY

Drawn By:	ARL
Dwg Standards Ckd By:	
Designed By:	MF
Design Checked By:	
Scale:	AS SHOWN

Project Title

VILLAGE OF McADAM
WATER SUPPLY
UPGRADE

Dwg. Title

TYPICAL SECTIONS

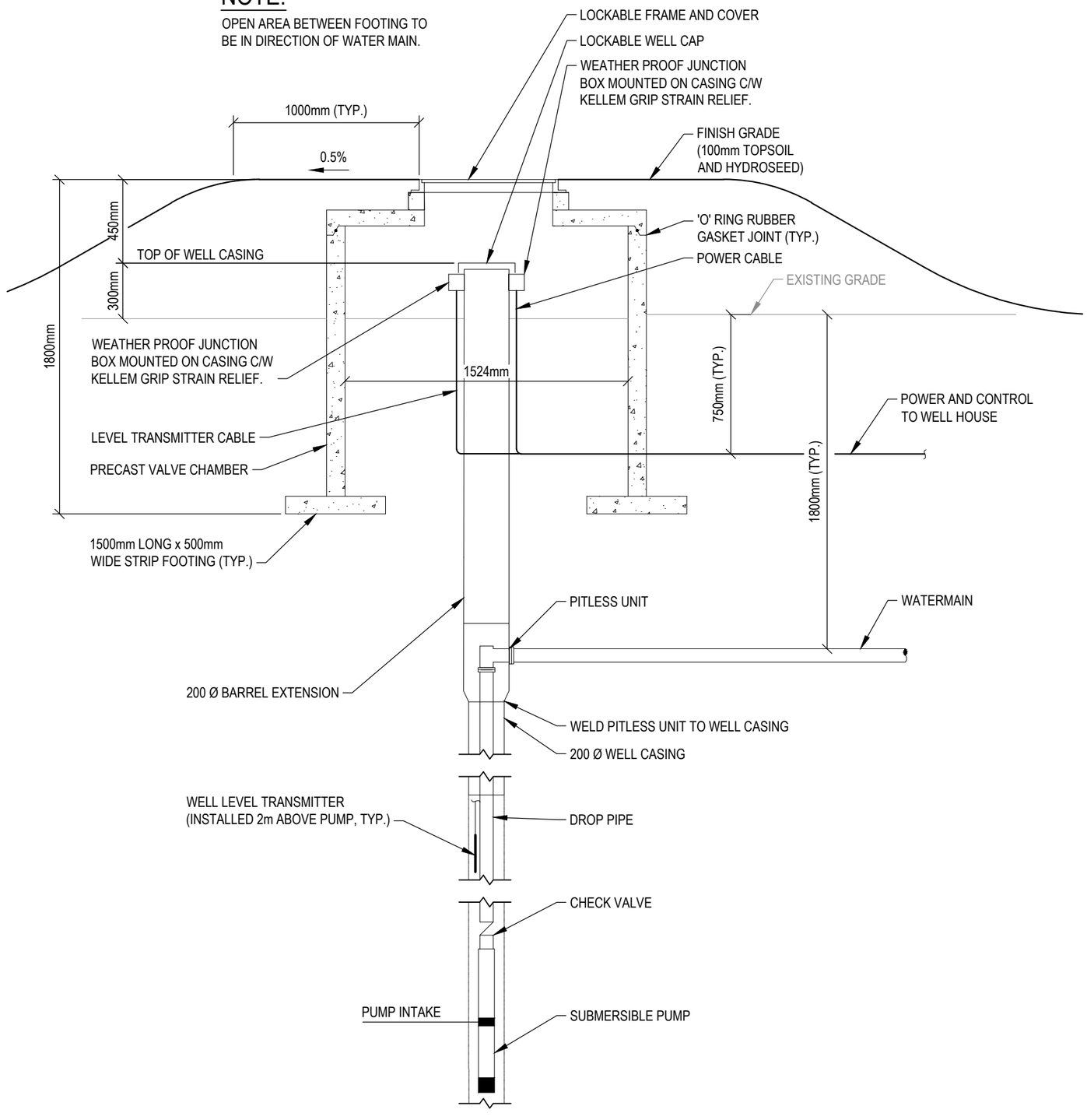
Project No.

FRE-00259858-A0

Dwg. No.	Rev. No.
SK-3	**----**

NOTE:

OPEN AREA BETWEEN FOOTING TO BE IN DIRECTION OF WATER MAIN.



TYPICAL DETAIL

WELL

NOT TO SCALE

AL LAWRENCE

7/8/2020 4:13 PM

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No.	Issue	Date

No.	Revision	Date

FOR INFORMATION ONLY

Drawn By:	ARL
Dwg Standards Ckd By:	
Designed By:	MF
Design Checked By:	
Scale:	AS SHOWN

Project Title

VILLAGE OF McADAM WATER SUPPLY UPGRADE

Dwg. Title

TYPICAL WELL DETAIL

Project No.

FRE-00259858-A0

Dwg. No.	Rev. No.
SK-4	----

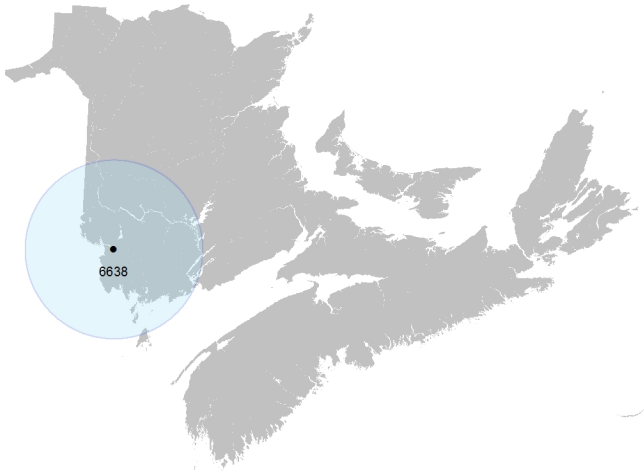
Appendix D –
Results of ACCDC Database Search

Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada atlantique

DATA REPORT 6638: McAdam, NB

Prepared 23 June 2020
by C. Robicheau, Data Manager

CONTENTS OF REPORT



Map 1. A 100 km buffer around the study area

1.0 PREFACE

The Atlantic Canada Conservation Data Centre (AC CDC; www.accdc.com) is part of a network of NatureServe data centres and heritage programs serving 50 states in the U.S.A, 10 provinces and 1 territory in Canada, plus several Central and South American countries. The NatureServe network is more than 30 years old and shares a common conservation data methodology. The AC CDC was founded in 1997, and maintains data for the jurisdictions of New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador. Although a non-governmental agency, the AC CDC is supported by 6 federal agencies and 4 provincial governments, as well as through outside grants and data processing fees.

Upon request and for a fee, the AC CDC queries its database and produces customized reports of the rare and endangered flora and fauna known to occur in or near a specified study area. As a supplement to that data, the AC CDC includes locations of managed areas with some level of protection, and known sites of ecological interest or sensitivity.

1.1 DATA LIST

Included datasets:

Filename	Contents
McadamNB_6638ob.xls	Rare and legally protected Flora and Fauna in your study area
McadamNB_6638ob100km.xls	A list of Rare and legally protected Flora and Fauna within 100 km of your study area
McadamNB_6638sa.xls	Significant Natural Areas in your study area
McadamNB_6638ff.xls	Rare and common Freshwater Fish in your study area (DFO database)

1.2 RESTRICTIONS

The AC CDC makes a strong effort to verify the accuracy of all the data that it manages, but it shall not be held responsible for any inaccuracies in data that it provides. By accepting AC CDC data, recipients assent to the following limits of use:

a) Data is restricted to use by trained personnel who are sensitive to landowner interests and to potential threats to rare and/or endangered flora and fauna posed by the information provided.
b) Data is restricted to use by the specified Data User; any third party requiring data must make its own data request.
c) The AC CDC requires Data Users to cease using and delete data 12 months after receipt, and to make a new request for updated data if necessary at that time.
d) AC CDC data responses are restricted to the data in our Data System at the time of the data request.
e) Each record has an estimate of locational uncertainty, which must be referenced in order to understand the record's relevance to a particular location. Please see attached Data Dictionary for details.
f) AC CDC data responses are not to be construed as exhaustive inventories of taxa in an area.
g) The absence of a taxon cannot be inferred by its absence in an AC CDC data response.

1.3 ADDITIONAL INFORMATION

The accompanying Data Dictionary provides metadata for the data provided.

Please direct any additional questions about AC CDC data to the following individuals:

Plants, Lichens, Ranking Methods, All other Inquiries
Sean Blaney, Senior Scientist, Executive Director
Tel: (506) 364-2658
sean.blaney@accdc.ca

Animals (Fauna)
John Klymko, Zoologist
Tel: (506) 364-2660
john.klymko@accdc.ca

Plant Communities
Sarah Robinson, Community Ecologist
Tel: (506) 364-2664
sarah.robinson@accdc.ca

Data Management, GIS
James Churchill, Data Manager
Tel: (902) 679-6146
james.churchill@accdc.ca

Billing
Jean Breau
Tel: (506) 364-2657
jean.breau@accdc.ca

Questions on the biology of Federal Species at Risk can be directed to AC CDC: (506) 364-2658, with questions on Species at Risk regulations to: Samara Eaton, Canadian Wildlife Service (NB and PE): (506) 364-5060 or Julie McKnight, Canadian Wildlife Service (NS): (902) 426-4196.

For provincial information about rare taxa and protected areas, or information about game animals, deer yards, old growth forests, archeological sites, fish habitat etc., in New Brunswick, please contact Hubert Askanas, Energy and Resource Development: (506) 453-5873.

For provincial information about rare taxa and protected areas, or information about game animals, deer yards, old growth forests, archeological sites, fish habitat etc., in Nova Scotia, please contact Donna Hurlburt, NS DLF: (902) 679-6886. To determine if location-sensitive species (section 4.3) occur near your study site please contact a NS DLF Regional Biologist:

Western: Emma Vost
(902) 670-8187
Duncan.Bayne@novascotia.ca

Western: Sarah Spencer
(902) 634-7555
Sarah.Spencer@novascotia.ca

Central: Shavonne Meyer
(902) 893-6350
Shavonne.Meyer@novascotia.ca

Central: Kimberly George
(902) 890-1046
Kimberly.George@novascotia.ca

Eastern: Lisa Doucette
(902) 863-4513
Lisa.Doucette@novascotia.ca

Eastern: Terry Power
(902) 563-3370
Terrance.Power@novascotia.ca

For provincial information about rare taxa and protected areas, or information about game animals, fish habitat etc., in Prince Edward Island, please contact Garry Gregory, PEI Dept. of Communities, Land and Environment: (902) 569-7595.

2.0 RARE AND ENDANGERED SPECIES

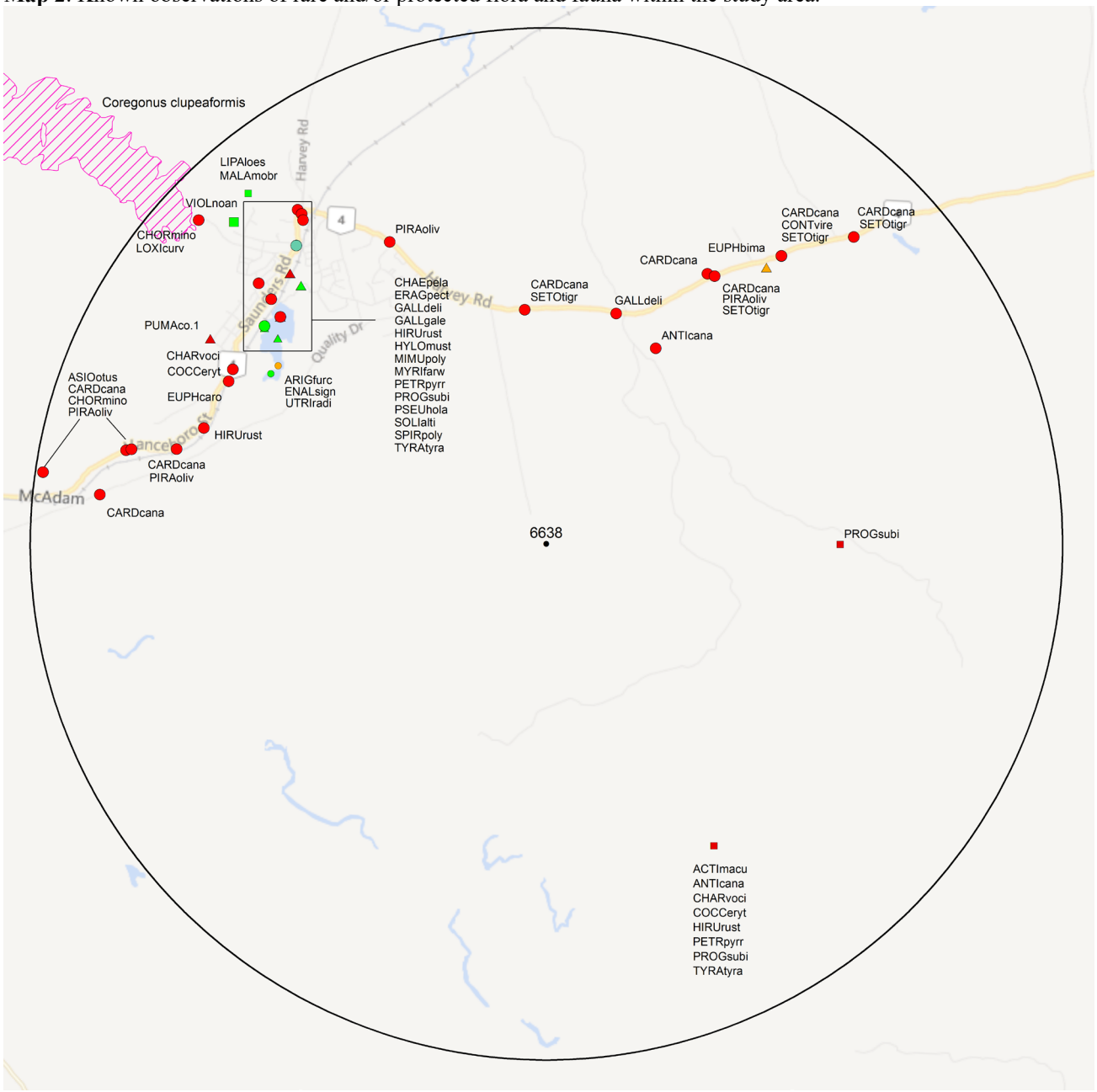
2.1 FLORA

The study area contains 14 records of 8 vascular and 1 record of 1 nonvascular flora (Map 2 and attached: *ob.xls).

2.2 FAUNA

The study area contains 79 records of 23 vertebrate and 3 records of 3 invertebrate fauna (Map 2 and attached data files - see 1.1 Data List). Please see section 4.3 to determine if “location-sensitive” species occur near your study site.

Map 2: Known observations of rare and/or protected flora and fauna within the study area.



RESOLUTION

- 4.7 within 50s of kilometers
- 4.0 within 10s of kilometers
- 3.7 within 5s of kilometers
- 3.0 within kilometers
- 2.7 within 500s of meters
- 2.0 within 100s of meters
- 1.7 within 10s of meters

HIGHER TAXON

- vertebrate fauna
- invertebrate fauna
- vascular flora
- nonvascular flora

3.0 SPECIAL AREAS

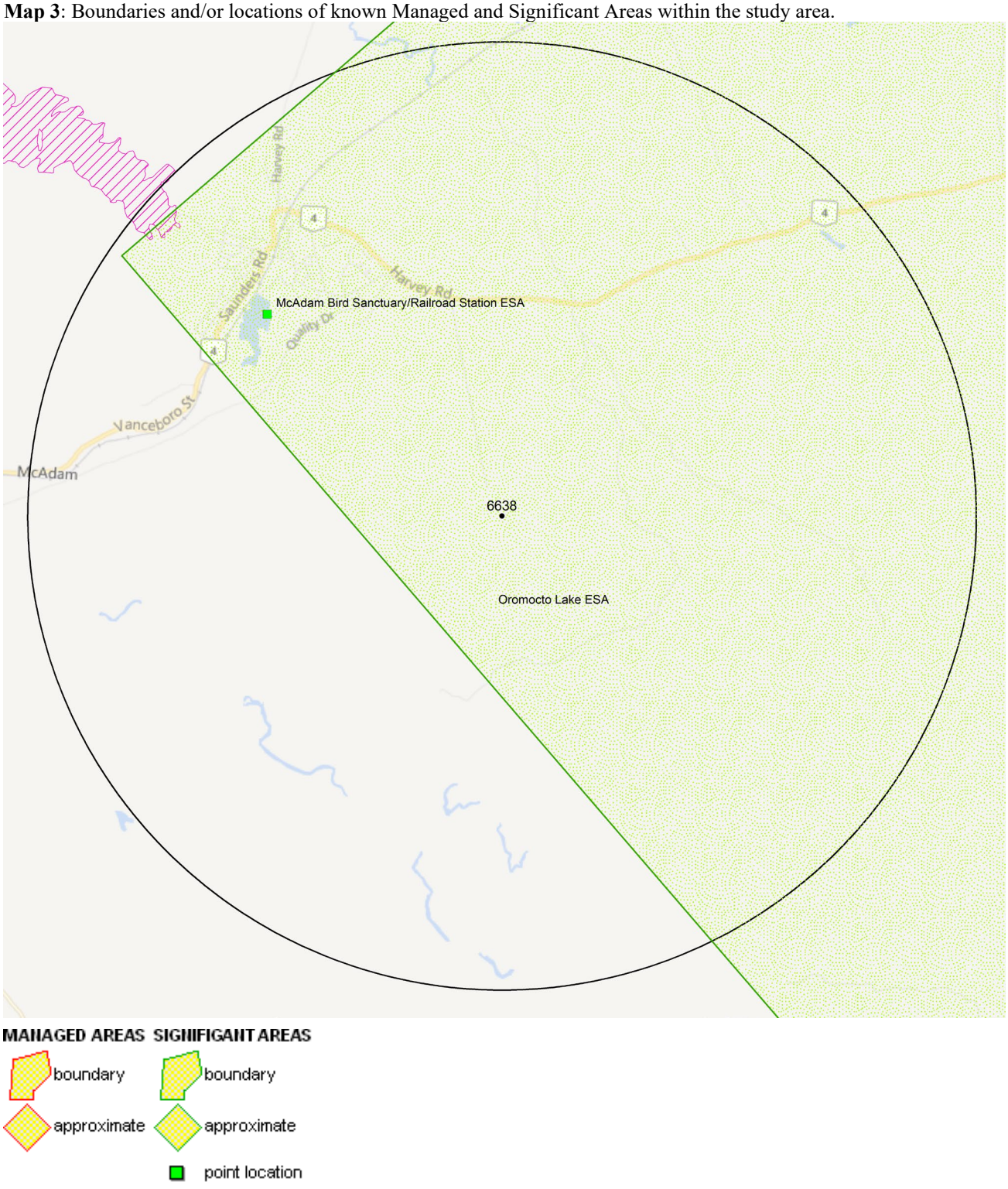
3.1 MANAGED AREAS

The GIS scan identified no managed areas in the vicinity of the study area (Map 3 and attached file: *ma*.xls).

3.2 SIGNIFICANT AREAS

The GIS scan identified 2 biologically significant sites in the vicinity of the study area (Map 3 and attached file: *sa*.xls).

Map 3: Boundaries and/or locations of known Managed and Significant Areas within the study area.



4.0 RARE SPECIES LISTS

Rare and/or endangered taxa (excluding "location-sensitive" species, section 4.3) within the study area listed in order of concern, beginning with legally listed taxa, with the number of observations per taxon and the distance in kilometers from study area centroid to the closest observation (± the precision, in km, of the record). [P] = vascular plant, [N] = nonvascular plant, [A] = vertebrate animal, [I] = invertebrate animal, [C] = community. Note: records are from attached files *ob.xls/*ob.shp only.

4.1 FLORA

	Scientific *Name*	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)
N	*Pseudocyphellaria holarctica*	Yellow Specklebelly Lichen				S3S4	3 Sensitive	1	3.8 ± 0.0
P	*Malaxis monophyllos var. brachypoda*	North American White Adder's-mouth				S1	2 May Be At Risk	1	4.5 ± 5.0
P	*Viola novae-angliae*	New England Violet				S2	3 Sensitive	1	4.3 ± 10.0
P	*Solidago altissima*	Tall Goldenrod				S2S3	4 Secure	1	3.4 ± 0.0
P	*Eragrostis pectinacea*	Tufted Love Grass				S2S3	4 Secure	1	3.5 ± 1.0
P	*Myriophyllum farwellii*	Farwell's Water Milfoil				S3	4 Secure	7	3.3 ± 0.0
P	*Utricularia radiata*	Little Floating Bladderwort				S3	4 Secure	1	3.1 ± 0.0
P	*Liparis loeselii*	Loesel's Twayblade				S3	4 Secure	1	4.5 ± 5.0
P	*Spirodela polyrhiza*	great duckweed				S3S4	4 Secure	1	3.5 ± 0.0

4.2 FAUNA

	Scientific *Name*	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)
A	*Hylocichla mustelina*	Wood Thrush	Threatened	Threatened	Threatened	S1S2B,S1S2M	2 May Be At Risk	1	3.6 ± 1.0
A	*Hirundo rustica*	Barn Swallow	Threatened	Threatened	Threatened	S2B,S2M	3 Sensitive	7	3.3 ± 7.0
A	*Chaetura pelagica*	Chimney Swift	Threatened	Threatened	Threatened	S2S3B,S2M	1 At Risk	5	3.4 ± 0.0
A	*Cardellina canadensis*	Canada Warbler	Threatened	Threatened	Threatened	S3B,S3M	1 At Risk	18	2.3 ± 0.0
A	*Euphagus carolinus*	Rusty Blackbird	Special Concern	Special Concern	Special Concern	S3B,S3M	2 May Be At Risk	1	3.5 ± 0.0
A	*Chordeiles minor*	Common Nighthawk	Special Concern	Threatened	Threatened	S3B,S4M	1 At Risk	3	4.1 ± 0.0
A	*Contopus virens*	Eastern Wood-Pewee	Special Concern	Special Concern	Special Concern	S4B,S4M	4 Secure	1	3.6 ± 0.0
A	*Puma concolor pop. 1*	Eastern Cougar	Data Deficient		Endangered	SNA	5 Undetermined	1	3.8 ± 1.0
A	*Gallinula galeata*	Common Gallinule				S1B,S1M	3 Sensitive	1	3.4 ± 0.0
A	*Antigone canadensis*	Sandhill Crane				S1B,S1M	8 Accidental	2	2.2 ± 0.0
A	*Progne subis*	Purple Martin				S1B,S1M	2 May Be At Risk	4	2.8 ± 7.0
A	*Mimus polyglottos*	Northern Mockingbird				S2B,S2M	3 Sensitive	4	3.9 ± 0.0
A	*Asio otus*	Long-eared Owl				S2S3	5 Undetermined	2	4.1 ± 0.0
A	*Petrochelidon pyrrhonota*	Cliff Swallow				S2S3B,S2S3M	3 Sensitive	5	3.3 ± 7.0
A	*Loxia curvirostra*	Red Crossbill				S3	4 Secure	1	4.6 ± 0.0
A	*Charadrius vociferus*	Killdeer				S3B,S3M	3 Sensitive	2	3.3 ± 7.0
A	*Coccyzus erythropthalmus*	Black-billed Cuckoo				S3B,S3M	4 Secure	3	3.3 ± 7.0
A	*Piranga olivacea*	Scarlet Tanager				S3B,S3M	4 Secure	7	3.1 ± 0.0
A	*Molothrus ater*	Brown-headed Cowbird				S3B,S3M	2 May Be At Risk	1	3.4 ± 1.0
A	*Setophaga tigrina*	Cape May Warbler				S3B,S4S5M	4 Secure	5	2.3 ± 0.0
A	*Tyrannus tyrannus*	Eastern Kingbird				S3S4B,S3S4M	3 Sensitive	2	3.3 ± 7.0
A	*Actitis macularius*	Spotted Sandpiper				S3S4B,S5M	4 Secure	1	3.3 ± 7.0
A	*Gallinago delicata*	Wilson's Snipe				S3S4B,S5M	4 Secure	2	2.3 ± 0.0
I	*Arigomphus furcifer*	Lilypad Clubtail				S1	5 Undetermined	1	3.1 ± 0.0
I	*Euphyes bimacula*	Two-spotted Skipper				S3	4 Secure	1	3.4 ± 1.0
I	*Enallagma signatum*	Orange Bluet				S3	4 Secure	1	3.1 ± 0.0

4.3 LOCATION SENSITIVE SPECIES

The Department of Natural Resources in each Maritimes province considers a number of species "location sensitive". Concern about exploitation of location-sensitive species precludes inclusion of precise coordinates in this report. Those intersecting your study area are indicated below with "YES".

New Brunswick

Scientific *Name*	Common Name	SARA	Prov Legal Prot	Known within the Study Site?
Chrysemys picta picta	Eastern Painted Turtle			No
Chelydra serpentina	**Snapping Turtle**	**Special Concern**	**Special Concern**	**YES**
Glyptemys insculpta	Wood Turtle	Threatened	Threatened	No
Haliaeetus leucocephalus	Bald Eagle		Endangered	No
Falco peregrinus pop. 1	Peregrine Falcon - anatum/tundrius pop.	Special Concern	Endangered	No
Cicindela marginipennis	Cobblestone Tiger Beetle	Endangered	Endangered	No
Coenonympha nipisiquit	Maritime Ringlet	Endangered	Endangered	No
Bat Hibernaculum		**[Endangered][1]**	**[Endangered][1]**	**YES**

1 *Myotis lucifugus* (Little Brown Myotis), *Myotis septentrionalis* (Long-eared Myotis), and *Perimyotis subflavus* (Tri-colored Bat or Eastern Pipistrelle) are all Endangered under the Federal Species at Risk Act and the NB Species at Risk Act.

4.4 SOURCE BIBLIOGRAPHY

The recipient of these data shall acknowledge the AC CDC and the data sources listed below in any documents, reports, publications or presentations, in which this dataset makes a significant contribution.

# recs	CITATION
37	Pardieck, K.L. & Ziolkowski Jr., D.J.; Hudson, M.-A.R. 2014. North American Breeding Bird Survey Dataset 1966 - 2013, version 2013.0. U.S. Geological Survey, Patuxent Wildlife Research Center <www.pwrc.usgs.gov/BBS/RawData/>.
27	Lepage, D. 2014. Maritime Breeding Bird Atlas Database. Bird Studies Canada, Sackville NB, 407,838 recs.
7	Hinds, H.R. 1986. Notes on New Brunswick plant collections. Connell Memorial Herbarium, unpubl, 739 recs.
6	eBird. 2014. eBird Basic Dataset. Version: EBD_relNov-2014. Ithaca, New York. Nov 2014. Cornell Lab of Ornithology, 25036 recs.
6	Erskine, A.J. 1992. Maritime Breeding Bird Atlas Database. NS Museum & Nimbus Publ., Halifax, 82,125 recs.
3	Klymko, J.J.D. 2018. 2017 field data. Atlantic Canada Conservation Data Centre.
2	Benedict, B. Connell Herbarium Specimens. University New Brunswick, Fredericton. 2003.
2	Clayden, S.R. 1998. NBM Science Collections databases: vascular plants. New Brunswick Museum, Saint John NB, 19759 recs.
2	Erskine, A.J. 1999. Maritime Nest Records Scheme (MNRS) 1937-1999. Canadian Wildlife Service, Sackville, 313 recs.
2	Tims, J. & Craig, N. 1995. Environmentally Significant Areas in New Brunswick (NBESA). NB Dept of Environment & Nature Trust of New Brunswick Inc.
1	Benedict, B. Connell Herbarium Specimen Database Download 2004. Connell Memorial Herbarium, University of New Brunswick. 2004.
1	Benedict, B. Connell Herbarium Specimens (Data) . University New Brunswick, Fredericton. 2003.
1	Cronin, P. et.al. 1998. Fish Species Management Plans (draft). NB DNRE Internal Report. Fredericton, 164pp.
1	Dept of Fisheris & Oceans, source unspecified.
1	e-Butterfly. 2016. Export of Maritimes records and photos. Maxim Larrivee, Sambo Zhang (ed.) e-butterfly.org.
1	iNaturalist. 2020. iNaturalist Data Export 2020. iNaturalist.org and iNaturalist.ca, Web site: 128728 recs.
1	Scott, Fred W. 1998. Updated Status Report on the Cougar (Puma Concolor couguar) [Eastern population]. Committee on the Status of Endangered Wildlife in Canada, 298 recs.

5.0 RARE SPECIES WITHIN 100 KM

A 100 km buffer around the study area contains 21,447 records of 152 vertebrate and 1617 records of 84 invertebrate fauna; 10,944 records of 366 vascular and 459 records of 140 nonvascular flora (attached: *ob100km.xls).

Taxa within 100 km of the study site that are rare and/or endangered in the province in which the study site occurs (including "location-sensitive" species). All ranks correspond to the province in which the study site falls, even for out-of-province records. Taxa are listed in order of concern, beginning with legally listed taxa, with the number of observations per taxon and the distance in kilometers from study area centroid to the closest observation (± the precision, in km, of the record).

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
A	*Myotis lucifugus*	Little Brown Myotis	Endangered	Endangered	Endangered	S1	1 At Risk	47	21.6 ± 100.0	NB
A	*Myotis septentrionalis*	Northern Long-eared Myotis	Endangered	Endangered	Endangered	S1	1 At Risk	11	66.7 ± 1.0	NB
A	*Perimyotis subflavus*	Eastern Pipistrelle	Endangered	Endangered	Endangered	S1	1 At Risk	2	96.6 ± 0.0	NB
A	*Eubalaena glacialis*	North Atlantic Right Whale	Endangered	Endangered	Endangered	S1		2	66.8 ± 1.0	NB
A	*Osmerus mordax pop. 2*	Lake Utopia Smelt large-bodied pop.	Endangered	Threatened	Threatened	S1		2	59.1 ± 10.0	NB
A	*Sterna dougallii*	Roseate Tern	Endangered	Endangered	Endangered	S1?B,S1?M	1 At Risk	2	57.0 ± 5.0	NB
A	*Charadrius melodus melodus*	Piping Plover melodus ssp	Endangered	Endangered	Endangered	S1B,S1M	1 At Risk	6	82.8 ± 0.0	NB
A	*Dermochelys coriacea (Atlantic pop.)*	Leatherback Sea Turtle - Atlantic pop.	Endangered	Endangered	Endangered	S1S2N	1 At Risk	2	89.5 ± 0.0	NB
A	*Salmo salar pop. 1*	Atlantic Salmon - Inner Bay of Fundy pop.	Endangered	Endangered	Endangered	S2	2 May Be At Risk	9	66.5 ± 50.0	NB
A	*Calidris canutus rufa*	Red Knot rufa ssp	Endangered	Endangered	Endangered	S2M	1 At Risk	38	55.8 ± 0.0	NB
A	*Pagophila eburnea*	Ivory Gull	Endangered	Endangered		SNA	8 Accidental	2	78.4 ± 14.0	NB
A	*Melanerpes erythrocephalus*	Red-headed Woodpecker	Endangered	Threatened		SNA	8 Accidental	2	15.2 ± 7.0	NB
A	*Empidonax virescens*	Acadian Flycatcher	Endangered	Endangered		SNA	8 Accidental	2	63.6 ± 0.0	NB
A	*Protonotaria citrea*	Prothonotary Warbler	Endangered	Endangered		SNA	8 Accidental	2	96.3 ± 3.0	NB
A	*Icteria virens*	Yellow-Breasted Chat	Endangered	Endangered		SNA	8 Accidental	5	68.5 ± 0.0	NB
A	*Salmo salar pop. 7*	Atlantic Salmon - Outer Bay of Fundy pop.	Endangered		Endangered	SNR		316	98.4 ± 0.0	NB
A	*Rangifer tarandus pop. 2*	Woodland Caribou (Atlantic-Gasp ├⌐sie pop.)	Endangered	Endangered	Extirpated	SX	0.1 Extirpated	2	20.2 ± 1.0	NB
A	*Colinus virginianus*	Northern Bobwhite	Endangered	Endangered				4	94.7 ± 7.0	NB
A	*Sturnella magna*	Eastern Meadowlark	Threatened	Threatened	Threatened	S1B,S1M	2 May Be At Risk	31	12.2 ± 7.0	NB
A	*Ixobrychus exilis*	Least Bittern	Threatened	Threatened	Threatened	S1S2B,S1S2M	1 At Risk	28	59.9 ± 7.0	NB
A	*Hylocichla mustelina*	Wood Thrush	Threatened	Threatened	Threatened	S1S2B,S1S2M	2 May Be At Risk	184	3.6 ± 1.0	NB
A	*Antrostomus vociferus*	Eastern Whip-Poor-Will	Threatened	Threatened	Threatened	S2B,S2M	1 At Risk	81	10.2 ± 7.0	NB
A	*Hirundo rustica*	Barn Swallow	Threatened	Threatened	Threatened	S2B,S2M	3 Sensitive	790	3.3 ± 7.0	NB
A	*Catharus bicknelli*	Bicknell's Thrush	Threatened	Threatened	Threatened	S2B,S2M	1 At Risk	7	67.4 ± 7.0	NB
A	*Glyptemys insculpta*	Wood Turtle	Threatened	Threatened	Threatened	S2S3	1 At Risk	975	15.9 ± 0.0	NB
A	*Chaetura pelagica*	Chimney Swift	Threatened	Threatened	Threatened	S2S3B,S2M	1 At Risk	317	3.4 ± 0.0	NB
A	*Riparia riparia*	Bank Swallow	Threatened	Threatened		S2S3B,S2S3M	3 Sensitive	461	8.6 ± 7.0	NB
A	*Acipenser oxyrinchus*	Atlantic Sturgeon	Threatened		Threatened	S3	4 Secure	1	66.5 ± 1.0	NB
A	*Cardellina canadensis*	Canada Warbler	Threatened	Threatened	Threatened	S3B,S3M	1 At Risk	923	2.3 ± 0.0	NB
A	*Dolichonyx oryzivorus*	Bobolink	Threatened	Threatened	Threatened	S3B,S3M	3 Sensitive	646	8.6 ± 7.0	NB
A	*Limosa haemastica*	Hudsonian Godwit	Threatened			S3S4M	4 Secure	27	84.6 ± 1.0	NB
A	*Anguilla rostrata*	American Eel	Threatened		Threatened	S4	4 Secure	40	18.1 ± 0.0	NB
A	*Coturnicops noveboracensis*	Yellow Rail	Special Concern	Special Concern	Special Concern	S1?B,SUM	2 May Be At Risk	3	89.0 ± 7.0	NB
A	*Histrionicus histrionicus pop. 1*	Harlequin Duck - Eastern pop.	Special Concern	Special Concern	Endangered	S1B,S1S2N,S2M	1 At Risk	123	57.5 ± 0.0	NB
A	*Asio flammeus*	Short-eared Owl	Special Concern	Special Concern	Special Concern	S2B,S2M	3 Sensitive	15	61.9 ± 7.0	NB
A	*Bucephala islandica (Eastern pop.)*	Barrow's Goldeneye - Eastern pop.	Special Concern	Special Concern	Special Concern	S2M,S2N	3 Sensitive	44	40.4 ± 0.0	NB
A	*Balaenoptera physalus*	Fin Whale	Special Concern	Special Concern		S2S3		13	58.4 ± 3.0	NB
A	*Acipenser brevirostrum*	Shortnose Sturgeon	Special Concern	Special Concern	Special Concern	S3	3 Sensitive	3	54.5 ± 10.0	NB
A	*Chelydra serpentina*	Snapping Turtle	Special Concern	Special Concern	Special Concern	S3	3 Sensitive	56	3.5 ± 0.0	NB
A	*Euphagus carolinus*	Rusty Blackbird	Special Concern	Special Concern	Special Concern	S3B,S3M	2 May Be At Risk	146	3.5 ± 0.0	NB
A	*Contopus cooperi*	Olive-sided Flycatcher	Special Concern	Threatened	Threatened	S3B,S3M	1 At Risk	424	6.6 ± 0.0	NB
A	*Coccothraustes vespertinus*	Evening Grosbeak	Special Concern	Special Concern		S3B,S3S4N,SUM	3 Sensitive	195	8.6 ± 7.0	NB
A	*Chordeiles minor*	Common Nighthawk	Special Concern	Threatened	Threatened	S3B,S4M	1 At Risk	347	4.1 ± 0.0	NB
A	*Phalaropus lobatus*	Red-necked Phalarope	Special Concern	Special Concern		S3M	3 Sensitive	72	56.6 ± 0.0	NB
A	*Phocoena phocoena pop. 1*	Harbour Porpoise - Northwest Atlantic pop.	Special Concern		Special Concern	S4		150	33.1 ± 100.0	NB
A	*Chrysemys picta picta*	Eastern Painted Turtle	Special Concern			S4	4 Secure	62	8.7 ± 0.0	NB
A	*Contopus virens*	Eastern Wood-Pewee	Special Concern	Special Concern	Special Concern	S4B,S4M	4 Secure	517	3.6 ± 0.0	NB
A	*Podiceps auritus*	Horned Grebe	Special Concern	Special Concern	Special Concern	S4N,S4M	4 Secure	126	49.6 ± 3.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
A	*Calidris subruficollis*	Buff-breasted Sandpiper	Special Concern	Special Concern		SNA	8 Accidental	19	84.3 ± 0.0	NB
A	*Anarhichas lupus*	Atlantic Wolffish	Special Concern	Special Concern	Special Concern	SNR		1	75.3 ± 0.0	NB
A	*Falco peregrinus pop. 1*	Peregrine Falcon - anatum/tundrius	Not At Risk	Special Concern	Endangered	S1B,S3M	1 At Risk	205	29.0 ± 5.0	NB
A	*Bubo scandiacus*	Snowy Owl	Not At Risk			S1N,S2S3M	4 Secure	7	51.8 ± 0.0	NB
A	*Accipiter cooperii*	Cooper's Hawk	Not At Risk			S1S2B,S1S2M	2 May Be At Risk	16	22.2 ± 7.0	NB
A	*Fulica americana*	American Coot	Not At Risk			S1S2B,S1S2M	3 Sensitive	6	60.8 ± 0.0	NB
A	*Sorex dispar*	Long-tailed Shrew	Not At Risk			S2	3 Sensitive	2	83.5 ± 5.0	NB
A	*Buteo lineatus*	Red-shouldered Hawk	Not At Risk			S2B,S2M	2 May Be At Risk	50	12.2 ± 0.0	NB
A	*Chlidonias niger*	Black Tern	Not At Risk			S2B,S2M	3 Sensitive	340	11.7 ± 0.0	NB
A	*Globicephala melas*	Long-finned Pilot Whale	Not At Risk			S2S3		1	77.0 ± 1.0	NB
A	*Lynx canadensis*	Canadian Lynx	Not At Risk		Endangered	S3	1 At Risk	23	23.0 ± 5.0	NB
A	*Desmognathus fuscus (Quebec/New Brunswick pop.)*	Northern Dusky Salamander (Quebec/New Brunswick pop.)	Not At Risk			S3	3 Sensitive	96	41.0 ± 1.0	NB
A	*Megaptera novaeangliae*	Humpback Whale (NW Atlantic pop.)	Not At Risk			S3		13	60.3 ± 1.0	NB
A	*Sterna hirundo*	Common Tern	Not At Risk			S3B,SUM	3 Sensitive	217	7.9 ± 0.0	NB
A	*Podiceps grisegena*	Red-necked Grebe	Not At Risk			S3M,S2N	3 Sensitive	194	41.9 ± 0.0	NB
A	*Haliaeetus leucocephalus*	Bald Eagle	Not At Risk		Endangered	S4	1 At Risk	1017	10.9 ± 7.0	NB
A	*Canis lupus*	Gray Wolf	Not At Risk		Extirpated	SX	0.1 Extirpated	2	29.2 ± 1.0	NB
A	*Puma concolor pop. 1*	Eastern Cougar	Data Deficient		Endangered	SNA	5 Undetermined	46	3.8 ± 1.0	NB
A	*Morone saxatilis*	Striped Bass	E,SC			S3	2 May Be At Risk	10	44.1 ± 1.0	NB
A	*Salmo salar*	Atlantic Salmon	E,T,SC			S2S3	2 May Be At Risk	43	25.5 ± 50.0	NB
A	*Thryothorus ludovicianus*	Carolina Wren				S1	8 Accidental	45	54.6 ± 0.0	NB
A	*Vireo flavifrons*	Yellow-throated Vireo				S1?B,S1?M	8 Accidental	14	69.6 ± 0.0	NB
A	*Tringa melanoleuca*	Greater Yellowlegs				S1?B,S5M	4 Secure	348	52.9 ± 0.0	NB
A	*Aythya americana*	Redhead				S1B,S1M	8 Accidental	4	85.0 ± 7.0	NB
A	*Gallinula galeata*	Common Gallinule				S1B,S1M	3 Sensitive	28	3.4 ± 0.0	NB
A	*Antigone canadensis*	Sandhill Crane				S1B,S1M	8 Accidental	4	2.2 ± 0.0	NB
A	*Bartramia longicauda*	Upland Sandpiper				S1B,S1M	3 Sensitive	38	53.4 ± 7.0	NB
A	*Phalaropus tricolor*	Wilson's Phalarope				S1B,S1M	3 Sensitive	38	63.9 ± 7.0	NB
A	*Leucophaeus atricilla*	Laughing Gull				S1B,S1M	3 Sensitive	42	41.0 ± 0.0	NB
A	*Progne subis*	Purple Martin				S1B,S1M	2 May Be At Risk	204	2.8 ± 7.0	NB
A	*Oxyura jamaicensis*	Ruddy Duck				S1B,S2S3M	4 Secure	25	66.9 ± 5.0	NB
A	*Uria aalge*	Common Murre				S1B,S3N,S3M	4 Secure	66	62.3 ± 0.0	NB
A	*Aythya affinis*	Lesser Scaup				S1B,S4M	4 Secure	128	45.6 ± 0.0	NB
A	*Aythya marila*	Greater Scaup				S1B,S4M,S2N	4 Secure	33	58.4 ± 2.0	NB
A	*Eremophila alpestris*	Horned Lark				S1B,S4N,S5M	2 May Be At Risk	29	29.5 ± 7.0	NB
A	*Sterna paradisaea*	Arctic Tern				S1B,SUM	2 May Be At Risk	48	57.0 ± 5.0	NB
A	*Fratercula arctica*	Atlantic Puffin				S1B,SUN,SUM	3 Sensitive	70	61.6 ± 0.0	NB
A	*Chroicocephalus ridibundus*	Black-headed Gull				S1N,S2M	3 Sensitive	30	62.3 ± 0.0	NB
A	*Branta bernicla*	Brant				S1N,S2S3M	4 Secure	42	56.3 ± 1.0	NB
A	*Butorides virescens*	Green Heron				S1S2B,S1S2M	3 Sensitive	24	41.9 ± 7.0	NB
A	*Nycticorax nycticorax*	Black-crowned Night-heron				S1S2B,S1S2M	3 Sensitive	19	14.8 ± 0.0	NB
A	*Empidonax traillii*	Willow Flycatcher				S1S2B,S1S2M	3 Sensitive	85	27.0 ± 2.0	NB
A	*Stelgidopteryx serripennis*	Northern Rough-winged Swallow				S1S2B,S1S2M	2 May Be At Risk	29	14.7 ± 7.0	NB
A	*Troglodytes aedon*	House Wren				S1S2B,S1S2M	5 Undetermined	28	15.7 ± 0.0	NB
A	*Rissa tridactyla*	Black-legged Kittiwake				S1S2B,S4N,S5M	4 Secure	48	66.8 ± 4.0	NB
A	*Calidris bairdii*	Baird's Sandpiper				S1S2M	3 Sensitive	20	85.4 ± 1.0	NB
A	*Cistothorus palustris*	Marsh Wren				S2B,S2M	3 Sensitive	391	45.8 ± 0.0	NB
A	*Mimus polyglottos*	Northern Mockingbird				S2B,S2M	3 Sensitive	87	3.9 ± 0.0	NB
A	*Toxostoma rufum*	Brown Thrasher				S2B,S2M	3 Sensitive	92	12.2 ± 7.0	NB
A	*Pooecetes gramineus*	Vesper Sparrow				S2B,S2M	2 May Be At Risk	60	12.2 ± 7.0	NB
A	*Mareca strepera*	Gadwall				S2B,S3M	4 Secure	63	58.4 ± 3.0	NB
A	*Alca torda*	Razorbill				S2B,S3N,S3M	4 Secure	54	65.9 ± 0.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
A	*Pinicola enucleator*	Pine Grosbeak				S2B,S4S5N,S4S5M	3 Sensitive	48	19.6 ± 7.0	NB
A	*Tringa solitaria*	Solitary Sandpiper				S2B,S5M	4 Secure	130	30.0 ± 0.0	NB
A	*Oceanodroma leucorhoa*	Leach's Storm-Petrel				S2B,SUM	3 Sensitive	17	62.3 ± 0.0	NB
A	*Anser caerulescens*	Snow Goose				S2M	4 Secure	6	47.9 ± 5.0	NB
A	*Phalacrocorax carbo*	Great Cormorant				S2N,S2M	4 Secure	114	54.2 ± 0.0	NB
A	*Somateria spectabilis*	King Eider				S2N,S2M	4 Secure	10	59.3 ± 0.0	NB
A	*Larus hyperboreus*	Glaucous Gull				S2N,S2M	4 Secure	99	55.7 ± 0.0	NB
A	*Asio otus*	Long-eared Owl				S2S3	5 Undetermined	18	4.1 ± 0.0	NB
A	*Picoides dorsalis*	American Three-toed Woodpecker				S2S3	3 Sensitive	14	14.7 ± 7.0	NB
A	*Spatula clypeata*	Northern Shoveler				S2S3B,S2S3M	4 Secure	69	58.4 ± 3.0	NB
A	*Myiarchus crinitus*	Great Crested Flycatcher				S2S3B,S2S3M	3 Sensitive	322	8.6 ± 7.0	NB
A	*Petrochelidon pyrrhonota*	Cliff Swallow				S2S3B,S2S3M	3 Sensitive	371	3.3 ± 7.0	NB
A	*Pluvialis dominica*	American Golden-Plover				S2S3M	3 Sensitive	50	58.2 ± 0.0	NB
A	*Calcarius lapponicus*	Lapland Longspur				S2S3N,SUM	3 Sensitive	14	66.0 ± 0.0	NB
A	*Cepphus grylle*	Black Guillemot				S3	4 Secure	350	48.1 ± 7.0	NB
A	*Loxia curvirostra*	Red Crossbill				S3	4 Secure	96	4.6 ± 0.0	NB
A	*Spinus pinus*	Pine Siskin				S3	4 Secure	159	7.6 ± 0.0	NB
A	*Prosopium cylindraceum*	Round Whitefish				S3	4 Secure	3	8.6 ± 10.0	NB
A	*Salvelinus namaycush*	Lake Trout				S3	3 Sensitive	7	37.6 ± 0.0	NB
A	*Sorex maritimensis*	Maritime Shrew				S3	4 Secure	1	48.6 ± 1.0	NB
A	*Eptesicus fuscus*	Big Brown Bat				S3	3 Sensitive	43	29.2 ± 1.0	NB
A	*Cathartes aura*	Turkey Vulture				S3B,S3M	4 Secure	244	8.6 ± 7.0	NB
A	*Rallus limicola*	Virginia Rail				S3B,S3M	3 Sensitive	266	8.6 ± 7.0	NB
A	*Charadrius vociferus*	Killdeer				S3B,S3M	3 Sensitive	505	3.3 ± 7.0	NB
A	*Tringa semipalmata*	Willet				S3B,S3M	3 Sensitive	18	25.7 ± 7.0	NB
A	*Coccyzus erythropthalmus*	Black-billed Cuckoo				S3B,S3M	4 Secure	155	3.3 ± 7.0	NB
A	*Vireo gilvus*	Warbling Vireo				S3B,S3M	4 Secure	250	8.6 ± 7.0	NB
A	*Piranga olivacea*	Scarlet Tanager				S3B,S3M	4 Secure	240	3.1 ± 0.0	NB
A	*Passerina cyanea*	Indigo Bunting				S3B,S3M	4 Secure	117	8.6 ± 0.0	NB
A	*Molothrus ater*	Brown-headed Cowbird				S3B,S3M	2 May Be At Risk	191	3.4 ± 1.0	NB
A	*Icterus galbula*	Baltimore Oriole				S3B,S3M	4 Secure	187	12.2 ± 7.0	NB
A	*Somateria mollissima*	Common Eider				S3B,S4M,S3N	4 Secure	700	43.7 ± 5.0	NB
A	*Setophaga tigrina*	Cape May Warbler				S3B,S4S5M	4 Secure	122	2.3 ± 0.0	NB
A	*Anas acuta*	Northern Pintail				S3B,S5M	3 Sensitive	44	63.1 ± 7.0	NB
A	*Mergus serrator*	Red-breasted Merganser				S3B,S5M,S4S5N	4 Secure	105	6.1 ± 1.0	NB
A	*Arenaria interpres*	Ruddy Turnstone				S3M	4 Secure	125	55.8 ± 0.0	NB
A	*Phalaropus fulicarius*	Red Phalarope				S3M	3 Sensitive	19	60.4 ± 0.0	NB
A	*Melanitta americana*	Black Scoter				S3M,S1S2N	3 Sensitive	197	49.4 ± 16.0	NB
A	*Bucephala albeola*	Bufflehead				S3M,S2N	3 Sensitive	511	41.9 ± 15.0	NB
A	*Calidris maritima*	Purple Sandpiper				S3M,S3N	4 Secure	133	53.4 ± 9.0	NB
A	*Uria lomvia*	Thick-billed Murre				S3N,S3M	5 Undetermined	40	66.6 ± 0.0	NB
A	*Synaptomys cooperi*	Southern Bog Lemming				S3S4	4 Secure	12	62.3 ± 1.0	NB
A	*Tyrannus tyrannus*	Eastern Kingbird				S3S4B,S3S4M	3 Sensitive	573	3.3 ± 7.0	NB
A	*Actitis macularius*	Spotted Sandpiper				S3S4B,S5M	4 Secure	611	3.3 ± 7.0	NB
A	*Gallinago delicata*	Wilson's Snipe				S3S4B,S5M	4 Secure	815	2.3 ± 0.0	NB
A	*Larus delawarensis*	Ring-billed Gull				S3S4B,S5M	4 Secure	239	27.0 ± 2.0	NB
A	*Setophaga striata*	Blackpoll Warbler				S3S4B,S5M	4 Secure	43	39.4 ± 7.0	NB
A	*Pluvialis squatarola*	Black-bellied Plover				S3S4M	4 Secure	175	52.9 ± 0.0	NB
A	*Calidris pusilla*	Semipalmated Sandpiper				S3S4M	4 Secure	372	52.9 ± 0.0	NB
A	*Calidris melanotos*	Pectoral Sandpiper				S3S4M	4 Secure	123	58.8 ± 0.0	NB
A	*Calidris alba*	Sanderling				S3S4M,S1N	3 Sensitive	158	57.9 ± 0.0	NB
A	*Morus bassanus*	Northern Gannet				SHB,S5M	4 Secure	409	42.2 ± 0.0	NB
C	*Quercus macrocarpa - Acer rubrum / Onoclea sensibilis - Carex arcta Forest*	Bur Oak - Red Maple / Sensitive Fern - Northern Clustered Sedge Forest				S2		1	93.1 ± 0.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
C	*Acer saccharinum / Onoclea sensibilis - Lysimachia terrestris Forest*	Silver Maple / Sensitive Fern - Swamp Yellow Loosestrife Forest				S3		1	56.8 ± 0.0	NB
C	*Acer saccharum - Fraxinus americana / Gymnocarpium dryopteris - Deparia acrostichoides Forest*	Sugar Maple - White Ash / Common Oak Fern - Silvery Glade Fern Forest				S3		2	94.7 ± 0.0	NB
C	*Acer saccharum - Fraxinus americana / Polystichum acrostichoides Forest*	Sugar Maple - White Ash / Christmas Fern Forest				S3S4		1	37.9 ± 0.0	NB
I	*Cicindela marginipennis*	Cobblestone Tiger Beetle	Endangered	Endangered	Endangered	S1	1 At Risk	123	80.8 ± 0.0	NB
I	*Gomphus ventricosus*	Skillet Clubtail	Endangered	Endangered	Endangered	S1S2	2 May Be At Risk	57	62.6 ± 0.0	NB
I	*Danaus plexippus*	Monarch	Endangered	Special Concern	Special Concern	S3B,S3M	3 Sensitive	118	10.4 ± 0.0	NB
I	*Bombus affinis*	Rusty-patched Bumble Bee	Endangered	Endangered		SH		1	66.9 ± 5.0	NB
I	*Ophiogomphus howei*	Pygmy Snaketail	Special Concern	Special Concern	Special Concern	S2	2 May Be At Risk	17	16.0 ± 0.0	NB
I	*Alasmidonta varicosa*	Brook Floater	Special Concern	Special Concern	Special Concern	S2	3 Sensitive	1	16.0 ± 0.0	NB
I	*Lampsilis cariosa*	Yellow Lampmussel	Special Concern	Special Concern	Special Concern	S2	3 Sensitive	79	53.6 ± 1.0	NB
I	*Bombus terricola*	Yellow-banded Bumblebee	Special Concern	Special Concern		S3?	3 Sensitive	28	18.8 ± 0.0	NB
I	*Coccinella transversoguttata richardsoni*	Transverse Lady Beetle	Special Concern			SH	2 May Be At Risk	1	89.7 ± 0.0	NB
I	*Appalachina sayana*	Spike-lip Crater	Not At Risk			S3?		1	55.5 ± 0.0	NB
I	*Conotrachelus juglandis*	a Weevil				S1		3	65.8 ± 0.0	NB
I	*Haematopota rara*	Shy Cleg				S1	5 Undetermined	1	62.3 ± 1.0	NB
I	*Lycaena dorcas*	Dorcas Copper				S1	2 May Be At Risk	20	24.3 ± 0.0	NB
I	*Erora laeta*	Early Hairstreak				S1	2 May Be At Risk	8	27.8 ± 7.0	NB
I	*Somatochlora septentrionalis*	Muskeg Emerald				S1	2 May Be At Risk	1	37.7 ± 1.0	NB
I	*Arigomphus furcifer*	Lilypad Clubtail				S1	5 Undetermined	22	3.1 ± 0.0	NB
I	*Polites origenes*	Crossline Skipper				S1?	5 Undetermined	8	48.4 ± 0.0	NB
I	*Plebejus saepiolus*	Greenish Blue				S1S2	4 Secure	3	53.5 ± 0.0	NB
I	*Ophiogomphus colubrinus*	Boreal Snaketail				S1S2	2 May Be At Risk	38	16.0 ± 0.0	NB
I	*Cicindela ancocisconensis*	Appalachian Tiger Beetle				S2	5 Undetermined	2	83.4 ± 0.0	NB
I	*Encyclops caerulea*	a Longhorned Beetle				S2		3	64.8 ± 0.0	NB
I	*Scaphinotus viduus*	a Ground Beetle				S2	2 May Be At Risk	2	87.8 ± 0.0	NB
I	*Brachyleptura circumdata*	a Longhorned Beetle				S2		6	76.6 ± 0.0	NB
I	*Satyrium calanus*	Banded Hairstreak				S2	3 Sensitive	28	53.6 ± 0.0	NB
I	*Satyrium calanus falacer*	Banded Hairstreak				S2	4 Secure	1	68.0 ± 1.0	NB
I	*Strymon melinus*	Grey Hairstreak				S2	4 Secure	4	54.3 ± 2.0	NB
I	*Aeshna clepsydra*	Mottled Darner				S2	3 Sensitive	18	12.3 ± 0.0	NB
I	*Somatochlora tenebrosa*	Clamp-Tipped Emerald				S2	5 Undetermined	11	17.3 ± 0.0	NB
I	*Ladona exusta*	White Corporal				S2	5 Undetermined	10	29.2 ± 0.0	NB
I	*Hetaerina americana*	American Rubyspot				S2	3 Sensitive	36	16.0 ± 0.0	NB
I	*Coenagrion interrogatum*	Subarctic Bluet				S2	3 Sensitive	1	44.7 ± 0.0	NB
I	*Ischnura posita*	Fragile Forktail				S2	2 May Be At Risk	15	22.2 ± 0.0	NB
I	*Hybomitra frosti*	a Horse Fly				S2S3	5 Undetermined	1	17.4 ± 0.0	NB
I	*Tabanus vivax*	a Horse Fly				S2S3	4 Secure	1	9.6 ± 0.0	NB
I	*Callophrys henrici*	Henry's Elfin				S2S3	4 Secure	15	26.4 ± 2.0	NB
I	*Celithemis martha*	Martha's Pennant				S2S3	5 Undetermined	8	41.0 ± 0.0	NB
I	*Sphaeroderus nitidicollis*	a Ground Beetle				S3	4 Secure	1	87.3 ± 0.0	NB
I	*Orthosoma brunneum*	a Longhorned Beetle				S3		1	96.3 ± 5.0	NB
I	*Elaphrus americanus*	a Ground Beetle				S3	4 Secure	1	76.9 ± 0.0	NB
I	*Semanotus terminatus*	A Long-horned Beetle				S3		1	56.7 ± 0.0	NB
I	*Desmocerus palliatus*	Elderberry Borer				S3		3	65.2 ± 0.0	NB
I	*Agonum excavatum*	a Ground Beetle				S3	4 Secure	1	76.9 ± 0.0	NB
I	*Clivina americana*	a Ground Beetle				S3	4 Secure	1	76.9 ± 0.0	NB
I	*Olisthopus parmatus*	a Ground Beetle				S3	4 Secure	1	87.3 ± 0.0	NB
I	*Paratachys scitulus*	a Ground Beetle				S3	5 Undetermined	1	76.9 ± 0.0	NB
I	*Hippodamia parenthesis*	Parenthesis Lady Beetle				S3	4 Secure	2	56.7 ± 0.0	NB
I	*Stenocorus vittiger*	a Longhorned Beetle				S3		1	76.9 ± 0.0	NB

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I	*Badister neopulchellus*	a Ground Beetle				S3	4 Secure	1	76.9 ± 0.0	NB
I	*Gonotropis dorsalis*	A Fungus Weevil				S3		1	56.7 ± 0.0	NB
I	*Naemia seriata*	a Ladybird beetle				S3	3 Sensitive	2	58.3 ± 0.0	NB
I	*Ceruchus piceus*	a Stag Beetle				S3		1	62.7 ± 0.0	NB
I	*Saperda lateralis*	a Longhorned Beetle				S3		2	85.3 ± 0.0	NB
I	*Hesperia sassacus*	Indian Skipper				S3	4 Secure	21	13.9 ± 7.0	NB
I	*Euphyes bimacula*	Two-spotted Skipper				S3	4 Secure	24	3.4 ± 1.0	NB
I	*Lycaena hyllus*	Bronze Copper				S3	3 Sensitive	22	17.5 ± 0.0	NB
I	*Satyrium acadica*	Acadian Hairstreak				S3	4 Secure	18	22.9 ± 7.0	NB
I	*Callophrys polios*	Hoary Elfin				S3	4 Secure	13	13.9 ± 7.0	NB
I	*Plebejus idas*	Northern Blue				S3	4 Secure	1	80.0 ± 0.0	NB
I	*Plebejus idas empetri*	Crowberry Blue				S3	4 Secure	24	72.9 ± 2.0	NB
I	*Speyeria aphrodite*	Aphrodite Fritillary				S3	4 Secure	23	41.5 ± 7.0	NB
I	*Boloria bellona*	Meadow Fritillary				S3	4 Secure	75	16.3 ± 2.0	NB
I	*Polygonia satyrus*	Satyr Comma				S3	4 Secure	19	27.8 ± 7.0	NB
I	*Polygonia gracilis*	Hoary Comma				S3	4 Secure	6	13.9 ± 7.0	NB
I	*Nymphalis l-album*	Compton Tortoiseshell				S3	4 Secure	15	27.8 ± 7.0	NB
I	*Gomphus vastus*	Cobra Clubtail				S3	3 Sensitive	79	43.2 ± 0.0	NB
I	*Gomphus abbreviatus*	Spine-crowned Clubtail				S3	4 Secure	45	12.3 ± 0.0	NB
I	*Gomphaeschna furcillata*	Harlequin Darner				S3	5 Undetermined	17	17.7 ± 1.0	NB
I	*Dorocordulia lepida*	Petite Emerald				S3	4 Secure	25	10.7 ± 1.0	NB
I	*Somatochlora cingulata*	Lake Emerald				S3	4 Secure	9	19.0 ± 0.0	NB
I	*Somatochlora forcipata*	Forcipate Emerald				S3	4 Secure	21	25.0 ± 0.0	NB
I	*Williamsonia fletcheri*	Ebony Boghaunter				S3	4 Secure	18	18.7 ± 0.0	NB
I	*Lestes eurinus*	Amber-Winged Spreadwing				S3	4 Secure	11	11.3 ± 1.0	NB
I	*Lestes vigilax*	Swamp Spreadwing				S3	3 Sensitive	41	10.7 ± 1.0	NB
I	*Enallagma geminatum*	Skimming Bluet				S3	5 Undetermined	25	27.9 ± 0.0	NB
I	*Enallagma signatum*	Orange Bluet				S3	4 Secure	38	3.1 ± 0.0	NB
I	*Stylurus scudderi*	Zebra Clubtail				S3	4 Secure	69	46.0 ± 1.0	NB
I	*Alasmidonta undulata*	Triangle Floater				S3	3 Sensitive	16	16.9 ± 1.0	NB
I	*Leptodea ochracea*	Tidewater Mucket				S3	4 Secure	133	42.3 ± 0.0	NB
I	*Striatura ferrea*	Black Striate				S3		1	63.3 ± 1.0	NB
I	*Neohelix albolabris*	Whitelip				S3		2	19.5 ± 0.0	NB
I	*Spurwinkia salsa*	Saltmarsh Hydrobe				S3		23	28.5 ± 0.0	NB
I	*Pantala hymenaea*	Spot-Winged Glider				S3B,S3M	4 Secure	8	14.7 ± 0.0	NB
I	*Satyrium liparops*	Striped Hairstreak				S3S4	4 Secure	13	32.9 ± 7.0	NB
I	*Cupido comyntas*	Eastern Tailed Blue				S3S4	4 Secure	49	10.4 ± 0.0	NB
N	*Erioderma pedicellatum (Atlantic pop.)*	Boreal Felt Lichen - Atlantic pop.	Endangered	Endangered	Endangered	SH	1 At Risk	1	80.5 ± 1.0	NB
N	*Pannaria lurida*	Wrinkled Shingle Lichen	Threatened	Threatened		S1?	2 May Be At Risk	7	30.1 ± 0.0	NB
N	*Anzia colpodes*	Black-foam Lichen	Threatened	Threatened		S1S2	5 Undetermined	3	51.2 ± 0.0	NB
N	*Fuscopannaria leucosticta*	White-rimmed Shingle Lichen	Threatened			S2	2 May Be At Risk	69	14.1 ± 0.0	NB
N	*Pectenia plumbea*	Blue Felt Lichen	Special Concern	Special Concern	Special Concern	S1	2 May Be At Risk	1	80.8 ± 5.0	NB
N	*Pseudevernia cladonia*	Ghost Antler Lichen	Not At Risk			S2S3	5 Undetermined	10	49.0 ± 2.0	NB
N	*Bryum muehlenbeckii*	Muehlenbeck's Bryum Moss				S1	2 May Be At Risk	1	92.1 ± 1.0	NB
N	*Sphagnum macrophyllum*	Sphagnum				S1	2 May Be At Risk	4	57.2 ± 0.0	NB
N	*Atrichum angustatum*	Lesser Smoothcap Moss				S1?	2 May Be At Risk	1	68.3 ± 2.0	NB
N	*Calliergon trifarium*	Three-ranked Moss				S1?	2 May Be At Risk	1	91.8 ± 0.0	NB
N	*Catoscopium nigritum*	Black Golf Club Moss				S1?	2 May Be At Risk	1	94.1 ± 1.0	NB
N	*Dichelyma falcatum*	a Moss				S1?	2 May Be At Risk	2	68.0 ± 10.0	NB
N	*Dicranum bonjeanii*	Bonjean's Broom Moss				S1?	2 May Be At Risk	1	65.5 ± 1.0	NB
N	*Eurhynchium hians*	Light Beaked Moss				S1?	2 May Be At Risk	2	66.7 ± 1.0	NB
N	*Racomitrium ericoides*	a Moss				S1?	2 May Be At Risk	1	24.6 ± 3.0	NB
N	*Splachnum pennsylvanicum*	Southern Dung Moss				S1?	2 May Be At Risk	2	37.8 ± 0.0	NB
N	*Platylomella lescurii*	a Moss				S1?	5 Undetermined	1	36.0 ± 1.0	NB
N	*Heterodermia squamulosa*	Scaly Fringe Lichen				S1?	5 Undetermined	1	81.3 ± 0.0	NB
N	*Peltigera venosa*	Fan Pelt Lichen				S1?	5 Undetermined	1	53.5 ± 0.0	NB

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N	*Pallavicinia lyellii*	Lyell's Ribbonwort				S1S2	6 Not Assessed	1	95.6 ± 0.0	NB
N	*Reboulia hemisphaerica*	Purple-margined Liverwort				S1S2	6 Not Assessed	1	50.3 ± 1.0	NB
N	*Brachythecium acuminatum*	Acuminate Ragged Moss				S1S2	5 Undetermined	2	66.7 ± 10.0	NB
N	*Bryum salinum*	a Moss				S1S2	2 May Be At Risk	1	78.5 ± 1.0	NB
N	*Campylium radicale*	Long-stalked Fine Wet Moss				S1S2	5 Undetermined	1	66.7 ± 1.0	NB
N	*Ditrichum pallidum*	Pale Cow-hair Moss				S1S2	2 May Be At Risk	3	37.1 ± 1.0	NB
N	*Drummondia prorepens*	a Moss				S1S2	2 May Be At Risk	1	82.6 ± 1.0	NB
N	*Fissidens taxifolius*	Yew-leaved Pocket Moss				S1S2	2 May Be At Risk	4	45.1 ± 0.0	NB
N	*Seligeria brevifolia*	a Moss				S1S2	3 Sensitive	1	70.9 ± 1.0	NB
N	*Sphagnum platyphyllum*	Flat-leaved Peat Moss				S1S2	5 Undetermined	3	27.2 ± 0.0	NB
N	*Tomentypnum falcifolium*	Sickle-leaved Golden Moss				S1S2	2 May Be At Risk	1	85.3 ± 1.0	NB
N	*Pseudotaxiphyllum distichaceum*	a Moss				S1S2	2 May Be At Risk	2	65.1 ± 1.0	NB
N	*Cystocoleus ebeneus*	Rockgossamer Lichen				S1S2		1	99.4 ± 0.0	NB
N	*Cephaloziella elachista*	Spurred Threadwort				S1S3	6 Not Assessed	1	92.0 ± 5.0	NB
N	*Porella pinnata*	Pinnate Scalewort				S1S3	6 Not Assessed	1	12.0 ± 1.0	NB
N	*Amphidium mougeotii*	a Moss				S2	3 Sensitive	1	45.3 ± 8.0	NB
N	*Anomodon viticulosus*	a Moss				S2	2 May Be At Risk	2	96.5 ± 0.0	NB
N	*Cirriphyllum piliferum*	Hair-pointed Moss				S2	3 Sensitive	1	57.3 ± 1.0	NB
N	*Cynodontium strumiferum*	Strumose Dogtooth Moss				S2	3 Sensitive	1	45.3 ± 8.0	NB
N	*Didymodon ferrugineus*	a moss				S2	3 Sensitive	2	70.2 ± 0.0	NB
N	*Anomodon tristis*	a Moss				S2	2 May Be At Risk	1	22.7 ± 1.0	NB
N	*Hypnum pratense*	Meadow Plait Moss				S2	3 Sensitive	3	92.8 ± 1.0	NB
N	*Isopterygiopsis pulchella*	Neat Silk Moss				S2	3 Sensitive	1	92.8 ± 1.0	NB
N	*Isothecium myosuroides*	Slender Mouse-tail Moss				S2	3 Sensitive	2	73.6 ± 0.0	NB
N	*Meesia triquetra*	Three-ranked Cold Moss				S2	2 May Be At Risk	1	42.9 ± 0.0	NB
N	*Physcomitrium immersum*	a Moss				S2	3 Sensitive	6	58.7 ± 0.0	NB
N	*Platydictya jungermannioides*	False Willow Moss				S2	3 Sensitive	1	77.5 ± 0.0	NB
N	*Sphagnum centrale*	Central Peat Moss				S2	3 Sensitive	1	27.2 ± 0.0	NB
N	*Sphagnum lindbergii*	Lindberg's Peat Moss				S2	3 Sensitive	4	78.5 ± 1.0	NB
N	*Tetraplodon mnioides*	Entire-leaved Nitrogen Moss				S2	3 Sensitive	3	78.5 ± 1.0	NB
N	*Ulota phyllantha*	a Moss				S2	3 Sensitive	3	73.9 ± 0.0	NB
N	*Anomobryum filiforme*	a moss				S2	5 Undetermined	1	66.7 ± 1.0	NB
N	*Leptogium corticola*	Blistered Jellyskin Lichen				S2	2 May Be At Risk	2	49.7 ± 1.0	NB
N	*Leptogium milligranum*	Stretched Jellyskin Lichen				S2	5 Undetermined	1	91.9 ± 0.0	NB
N	*Nephroma laevigatum*	Mustard Kidney Lichen				S2	2 May Be At Risk	1	98.3 ± 0.0	NB
N	*Peltigera lepidophora*	Scaly Pelt Lichen				S2	5 Undetermined	2	53.5 ± 0.0	NB
N	*Anomodon minor*	Blunt-leaved Anomodon Moss				S2?	2 May Be At Risk	1	79.0 ± 1.0	NB
N	*Brachythecium digastrum*	a Moss				S2?	3 Sensitive	2	66.7 ± 1.0	NB
N	*Bryum pallescens*	Pale Bryum Moss				S2?	5 Undetermined	1	54.3 ± 1.0	NB
N	*Dichelyma capillaceum*	Hairlike Dichelyma Moss				S2?	3 Sensitive	2	24.6 ± 4.0	NB
N	*Dicranum spurium*	Spurred Broom Moss				S2?	3 Sensitive	3	49.0 ± 2.0	NB
N	*Schistostega pennata*	Luminous Moss				S2?	3 Sensitive	2	66.7 ± 1.0	NB
N	*Seligeria campylopoda*	a Moss				S2?	3 Sensitive	1	70.3 ± 0.0	NB
N	*Seligeria diversifolia*	a Moss				S2?	3 Sensitive	1	99.2 ± 0.0	NB
N	*Sphagnum angermanicum*	a Peatmoss				S2?	3 Sensitive	2	57.0 ± 1.0	NB
N	*Collema leptaleum*	Crumpled Bat's Wing Lichen				S2?	5 Undetermined	5	58.2 ± 0.0	NB
N	*Physcia subtilis*	Slender Rosette Lichen				S2?	5 Undetermined	1	16.4 ± 0.0	NB
N	*Bryum uliginosum*	a Moss				S2S3	3 Sensitive	1	73.9 ± 0.0	NB
N	*Buxbaumia aphylla*	Brown Shield Moss				S2S3	3 Sensitive	2	37.1 ± 15.0	NB
N	*Calliergonella cuspidata*	Common Large Wetland Moss				S2S3	3 Sensitive	1	68.5 ± 10.0	NB
N	*Campylium polygamum*	a Moss				S2S3	3 Sensitive	1	10.8 ± 1.0	NB
N	*Didymodon rigidulus*	Rigid Screw Moss				S2S3	3 Sensitive	3	35.6 ± 8.0	NB
N	*Ephemerum serratum*	a Moss				S2S3	3 Sensitive	1	58.8 ± 0.0	NB
N	*Fissidens bushii*	Bush's Pocket Moss				S2S3	3 Sensitive	5	67.9 ± 1.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
N	*Neckera complanata*	a Moss				S2S3	2 May Be At Risk	2	96.5 ± 0.0	NB
N	*Orthotrichum speciosum*	Showy Bristle Moss				S2S3	5 Undetermined	4	28.3 ± 4.0	NB
N	*Racomitrium fasciculare*	a Moss				S2S3	3 Sensitive	1	48.7 ± 0.0	NB
N	*Scorpidium scorpioides*	Hooked Scorpion Moss				S2S3	3 Sensitive	2	88.8 ± 1.0	NB
N	*Sphagnum subfulvum*	a Peatmoss				S2S3	2 May Be At Risk	4	30.5 ± 0.0	NB
N	*Taxiphyllum deplanatum*	Imbricate Yew-leaved Moss				S2S3	3 Sensitive	2	70.1 ± 0.0	NB
N	*Zygodon viridissimus*	a Moss				S2S3	2 May Be At Risk	2	41.8 ± 5.0	NB
N	*Schistidium agassizii*	Elf Bloom Moss				S2S3	3 Sensitive	2	41.8 ± 5.0	NB
N	*Punctelia caseana*					S2S3		3	96.6 ± 0.0	NB
N	*Cynodontium tenellum*	Delicate Dogtooth Moss				S3	3 Sensitive	1	78.5 ± 1.0	NB
N	*Hypnum curvifolium*	Curved-leaved Plait Moss				S3	3 Sensitive	2	41.8 ± 5.0	NB
N	*Tortella fragilis*	Fragile Twisted Moss				S3	3 Sensitive	1	91.4 ± 0.0	NB
N	*Schistidium maritimum*	a Moss				S3	4 Secure	4	73.6 ± 0.0	NB
N	*Collema nigrescens*	Blistered Tarpaper Lichen				S3	3 Sensitive	6	91.4 ± 0.0	NB
N	*Solorina saccata*	Woodland Owl Lichen				S3	5 Undetermined	1	53.5 ± 0.0	NB
N	*Cladonia strepsilis*	Olive Cladonia Lichen				S3	4 Secure	1	49.0 ± 2.0	NB
N	*Hypotrachyna catawbiensis*	Powder-tipped Antler Lichen				S3	5 Undetermined	1	49.0 ± 2.0	NB
N	*Leptogium lichenoides*	Tattered Jellyskin Lichen				S3	5 Undetermined	1	53.5 ± 0.0	NB
N	*Nephroma resupinatum*	a lichen				S3	3 Sensitive	3	91.5 ± 0.0	NB
N	*Usnea strigosa*	Bushy Beard Lichen				S3	5 Undetermined	1	98.4 ± 0.0	NB
N	*Leptogium laceroides*	Short-bearded Jellyskin Lichen				S3	3 Sensitive	2	91.4 ± 0.0	NB
N	*Peltigera membranacea*	Membranous Pelt Lichen				S3	5 Undetermined	3	41.9 ± 0.0	NB
N	*Cladonia deformis*	Lesser Sulphur-cup Lichen				S3	4 Secure	1	49.0 ± 2.0	NB
N	*Aulacomnium androgynum*	Little Groove Moss				S3?	4 Secure	6	38.5 ± 1.0	NB
N	*Dicranella rufescens*	Red Forklet Moss				S3?	5 Undetermined	2	37.5 ± 4.0	NB
N	*Sphagnum lescurii*	a Peatmoss				S3?	5 Undetermined	1	27.5 ± 1.0	NB
N	*Sphagnum inundatum*	a Sphagnum				S3?	5 Undetermined	1	88.4 ± 0.0	NB
N	*Leptogium subtile*	Appressed Jellyskin Lichen				S3?	5 Undetermined	6	49.0 ± 2.0	NB
N	*Rostania occultata*	Crusted Tarpaper Lichen				S3?	5 Undetermined	1	58.2 ± 0.0	NB
N	*Anomodon rugelii*	Rugel's Anomodon Moss				S3S4	3 Sensitive	3	28.1 ± 2.0	NB
N	*Barbula convoluta*	Lesser Bird's-claw Beard Moss				S3S4	4 Secure	1	35.6 ± 8.0	NB
N	*Brachythecium velutinum*	Velvet Ragged Moss				S3S4	4 Secure	6	28.1 ± 2.0	NB
N	*Dicranella cerviculata*	a Moss				S3S4	3 Sensitive	3	58.9 ± 6.0	NB
N	*Dicranum majus*	Greater Broom Moss				S3S4	4 Secure	5	37.1 ± 15.0	NB
N	*Fissidens bryoides*	Lesser Pocket Moss				S3S4	4 Secure	3	28.3 ± 4.0	NB
N	*Helodium blandowii*	Wetland-plume Moss				S3S4	4 Secure	3	92.8 ± 1.0	NB
N	*Heterocladium dimorphum*	Dimorphous Tangle Moss				S3S4	4 Secure	1	47.5 ± 2.0	NB
N	*Isopterygiopsis muelleriana*	a Moss				S3S4	4 Secure	6	24.6 ± 3.0	NB
N	*Myurella julacea*	Small Mouse-tail Moss				S3S4	4 Secure	1	45.3 ± 8.0	NB
N	*Physcomitrium pyriforme*	Pear-shaped Urn Moss				S3S4	3 Sensitive	7	58.7 ± 0.0	NB
N	*Pogonatum dentatum*	Mountain Hair Moss				S3S4	4 Secure	2	59.5 ± 0.0	NB
N	*Sphagnum torreyanum*	a Peatmoss				S3S4	4 Secure	4	27.7 ± 1.0	NB
N	*Sphagnum austinii*	Austin's Peat Moss				S3S4	4 Secure	2	68.6 ± 1.0	NB
N	*Tetraphis geniculata*	Geniculate Four-tooth Moss				S3S4	4 Secure	5	77.5 ± 0.0	NB
N	*Tetraplodon angustatus*	Toothed-leaved Nitrogen Moss				S3S4	4 Secure	1	78.5 ± 1.0	NB
N	*Tomentypnum nitens*	Golden Fuzzy Fen Moss				S3S4	4 Secure	1	44.0 ± 3.0	NB
N	*Weissia controversa*	Green-Cushioned Weissia				S3S4	4 Secure	1	58.8 ± 0.0	NB
N	*Abietinella abietina*	Wiry Fern Moss				S3S4	4 Secure	2	12.5 ± 0.0	NB
N	*Trichostomum tenuirostre*	Acid-Soil Moss				S3S4	4 Secure	5	41.8 ± 5.0	NB
N	*Limprichtia revolvens*	a Moss				S3S4	4 Secure	2	45.8 ± 0.0	NB
N	*Rauiella scita*	Smaller Fern Moss				S3S4	3 Sensitive	4	30.4 ± 1.0	NB
N	*Pannaria rubiginosa*	Brown-eyed Shingle Lichen				S3S4	3 Sensitive	12	29.9 ± 0.0	NB
N	*Pseudocyphellaria holarctica*	Yellow Specklebelly Lichen				S3S4	3 Sensitive	42	3.8 ± 0.0	NB
N	*Leptogium teretiusculum*	Beaded Jellyskin Lichen				S3S4	5 Undetermined	1	54.6 ± 0.0	NB
N	*Cladonia terrae-novae*	Newfoundland Reindeer				S3S4	4 Secure	3	49.0 ± 2.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
		Lichen								
N	*Vahliella leucophaea*	Shelter Shingle Lichen				S3S4	5 Undetermined	8	40.2 ± 0.0	NB
N	*Montanelia panniformis*	Shingled Camouflage Lichen				S3S4	5 Undetermined	1	99.4 ± 0.0	NB
N	*Nephroma parile*	Powdery Kidney Lichen				S3S4	4 Secure	4	53.5 ± 0.0	NB
N	*Protopannaria pezizoides*	Brown-gray Moss-shingle Lichen				S3S4	4 Secure	6	28.2 ± 0.0	NB
N	*Usnea subrubicunda*	Reddish Beard Lichen				S3S4		1	49.0 ± 2.0	NB
N	*Fuscopannaria sorediata*	a Lichen				S3S4	5 Undetermined	5	18.7 ± 0.0	NB
N	*Pannaria conoplea*	Mealy-rimmed Shingle Lichen				S3S4	3 Sensitive	15	28.6 ± 0.0	NB
N	*Anaptychia palmulata*	Shaggy Fringed Lichen				S3S4	3 Sensitive	1	99.3 ± 0.0	NB
N	*Peltigera neopolydactyla*	Undulating Pelt Lichen				S3S4	5 Undetermined	1	49.0 ± 2.0	NB
N	*Dermatocarpon luridum*	Brookside Stippleback Lichen				S3S4	4 Secure	11	28.5 ± 0.0	NB
N	*Leucodon brachypus*	a Moss				SH	2 May Be At Risk	3	41.8 ± 100.0	NB
N	*Orthotrichum gymnostomum*	a Moss				SH	2 May Be At Risk	1	83.1 ± 10.0	NB
P	*Juglans cinerea*	Butternut	Endangered	Endangered	Endangered	S1	1 At Risk	533	34.3 ± 1.0	NB
P	*Polemonium vanbruntiae*	Van Brunt's Jacob's-ladder	Threatened	Threatened	Threatened	S1	1 At Risk	74	59.7 ± 1.0	NB
P	*Fraxinus nigra*	Black Ash	Threatened			S4S5	4 Secure	681	5.7 ± 0.0	NB
P	*Symphyotrichum praealtum*	Willow-leaved Aster	Threatened	Threatened		SNA	7 Exotic	1	56.2 ± 1.0	NB
P	*Isoetes prototypus*	Prototype Quillwort	Special Concern	Special Concern	Endangered	S2	1 At Risk	22	31.0 ± 0.0	NB
P	*Symphyotrichum anticostense*	Anticosti Aster	Special Concern	Special Concern	Endangered	S2S3	1 At Risk	34	55.4 ± 0.0	NB
P	*Pterospora andromedea*	Woodland Pinedrops			Endangered	S1	1 At Risk	33	49.7 ± 0.0	NB
P	*Cryptotaenia canadensis*	Canada Honewort				S1	2 May Be At Risk	3	62.5 ± 1.0	NB
P	*Sanicula trifoliata*	Large-Fruited Sanicle				S1	2 May Be At Risk	22	49.1 ± 0.0	NB
P	*Antennaria parlinii ssp. fallax*	Parlin's Pussytoes				S1		2	23.4 ± 0.0	NB
P	*Antennaria howellii ssp. petaloidea*	Pussy-Toes				S1	2 May Be At Risk	1	89.6 ± 1.0	NB
P	*Bidens discoidea*	Swamp Beggarticks				S1	2 May Be At Risk	3	86.3 ± 0.0	NB
P	*Helianthus decapetalus*	Ten-rayed Sunflower				S1	2 May Be At Risk	21	48.9 ± 0.0	NB
P	*Hieracium paniculatum*	Panicled Hawkweed				S1	2 May Be At Risk	2	41.8 ± 1.0	NB
P	*Symphyotrichum laeve*	Smooth Aster				S1	5 Undetermined	3	44.1 ± 1.0	NB
P	*Canadanthus modestus*	Great Northern Aster				S1	2 May Be At Risk	12	80.1 ± 0.0	NB
P	*Andersonglossum boreale*	Northern Wild Comfrey				S1	2 May Be At Risk	14	70.9 ± 1.0	NB
P	*Cardamine parviflora*	Small-flowered Bittercress				S1	2 May Be At Risk	8	70.5 ± 1.0	NB
P	*Cardamine concatenata*	Cut-leaved Toothwort				S1	2 May Be At Risk	14	31.2 ± 0.0	NB
P	*Draba arabisans*	Rock Whitlow-Grass				S1	2 May Be At Risk	4	81.3 ± 0.0	NB
P	*Draba cana*	Lance-leaved Draba				S1	2 May Be At Risk	10	68.4 ± 0.0	NB
P	*Draba glabella*	Rock Whitlow-Grass				S1	2 May Be At Risk	3	56.1 ± 1.0	NB
P	*Mononeuria groenlandica*	Greenland Stitchwort				S1	2 May Be At Risk	2	78.3 ± 0.0	NB
P	*Chenopodiastrum simplex*	Maple-leaved Goosefoot				S1	2 May Be At Risk	7	58.1 ± 1.0	NB
P	*Blitum capitatum*	strawberry-blite				S1	2 May Be At Risk	2	64.7 ± 6.0	NB
P	*Callitriche terrestris*	Terrestrial Water-Starwort				S1	5 Undetermined	1	30.5 ± 0.0	NB
P	*Hypericum virginicum*	Virginia St. John's-wort				S1	2 May Be At Risk	7	29.6 ± 0.0	NB
P	*Viburnum acerifolium*	Maple-leaved Viburnum				S1	2 May Be At Risk	11	46.5 ± 0.0	NB
P	*Drosera anglica*	English Sundew				S1	2 May Be At Risk	1	42.9 ± 0.0	NB
P	*Drosera linearis*	Slender-Leaved Sundew				S1	2 May Be At Risk	1	42.9 ± 0.0	NB
P	*Vaccinium boreale*	Northern Blueberry				S1	2 May Be At Risk	1	67.7 ± 0.0	NB
P	*Vaccinium corymbosum*	Highbush Blueberry				S1	3 Sensitive	9	12.3 ± 0.0	NB
P	*Hylodesmum glutinosum*	Large Tick-trefoil				S1	2 May Be At Risk	8	46.4 ± 1.0	NB
P	*Lespedeza capitata*	Round-headed Bush-clover				S1	2 May Be At Risk	5	98.4 ± 0.0	NB
P	*Gentiana rubricaulis*	Purple-stemmed Gentian				S1	2 May Be At Risk	15	9.4 ± 0.0	NB
P	*Lomatogonium rotatum*	Marsh Felwort				S1	2 May Be At Risk	3	82.6 ± 0.0	NB
P	*Ribes cynosbati*	Prickly Gooseberry				S1	2 May Be At Risk	1	69.9 ± 0.0	NB
P	*Proserpinaca pectinata*	Comb-leaved Mermaidweed				S1	2 May Be At Risk	1	68.0 ± 0.0	NB
P	*Decodon verticillatus*	Swamp Loosestrife				S1	2 May Be At Risk	4	38.9 ± 0.0	NB
P	*Polygala verticillata*	Whorled Milkwort				S1	5 Undetermined	2	54.6 ± 0.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
P	*Lysimachia hybrida*	Lowland Yellow Loosestrife				S1	2 May Be At Risk	16	27.4 ± 0.0	NB
P	*Lysimachia quadrifolia*	Whorled Yellow Loosestrife				S1	2 May Be At Risk	8	84.8 ± 1.0	NB
P	*Hepatica acutiloba*	Sharp-lobed Hepatica				S1	2 May Be At Risk	11	99.1 ± 0.0	NB
P	*Ranunculus sceleratus*	Cursed Buttercup				S1	2 May Be At Risk	8	44.3 ± 1.0	NB
P	*Crataegus jonesiae*	Jones' Hawthorn				S1	2 May Be At Risk	5	57.5 ± 1.0	NB
P	*Geum fragarioides*	Barren Strawberry				S1	2 May Be At Risk	27	44.5 ± 0.0	NB
P	*Galium brevipes*	Limestone Swamp Bedstraw				S1	2 May Be At Risk	4	22.7 ± 1.0	NB
P	*Agalinis tenuifolia*	Slender Agalinis				S1	2 May Be At Risk	9	65.9 ± 0.0	NB
P	*Agalinis purpurea var. parviflora*	Small-flowered Purple False Foxglove				S1	2 May Be At Risk	7	64.8 ± 0.0	NB
P	*Gratiola lutea*	Golden Hedge-hyssop				S1	3 Sensitive	2	82.2 ± 0.0	NB
P	*Pedicularis canadensis*	Canada Lousewort				S1	2 May Be At Risk	23	42.2 ± 0.0	NB
P	*Viola canadensis*	Canada Violet				S1	2 May Be At Risk	85	67.0 ± 0.0	NB
P	*Viola sagittata*	Arrow-Leaved Violet				S1	2 May Be At Risk	1	33.3 ± 0.0	NB
P	*Viola sagittata var. ovata*	Arrow-Leaved Violet				S1	2 May Be At Risk	14	15.5 ± 0.0	NB
P	*Alisma subcordatum*	Southern Water Plantain				S1	5 Undetermined	7	11.6 ± 0.0	NB
P	*Carex annectens*	Yellow-Fruited Sedge				S1	2 May Be At Risk	1	70.6 ± 0.0	NB
P	*Carex backii*	Rocky Mountain Sedge				S1	2 May Be At Risk	5	68.1 ± 1.0	NB
P	*Carex blanda*	Eastern Woodland Sedge				S1	2 May Be At Risk	1	70.6 ± 0.0	NB
P	*Carex cephaloidea*	Thin-leaved Sedge				S1	2 May Be At Risk	23	43.7 ± 0.0	NB
P	*Carex merritt-fernaldii*	Merritt Fernald's Sedge				S1	2 May Be At Risk	2	52.3 ± 0.0	NB
P	*Carex waponahkikensis*	Dawn-land Sedge				S1	5 Undetermined	1	81.6 ± 0.0	NB
P	*Carex sterilis*	Sterile Sedge				S1	2 May Be At Risk	12	53.6 ± 0.0	NB
P	*Carex grisea*	Inflated Narrow-leaved Sedge				S1	2 May Be At Risk	4	61.1 ± 1.0	NB
P	*Carex saxatilis*	Russet Sedge				S1	2 May Be At Risk	2	99.2 ± 10.0	NB
P	*Cyperus diandrus*	Low Flatsedge				S1	2 May Be At Risk	7	57.5 ± 0.0	NB
P	*Cyperus lupulinus*	Hop Flatsedge				S1	2 May Be At Risk	17	88.3 ± 0.0	NB
P	*Cyperus lupulinus ssp. macilentus*	Hop Flatsedge				S1	2 May Be At Risk	20	93.0 ± 1.0	NB
P	*Eleocharis flavescens var. olivacea*	Bright-green Spikerush				S1	2 May Be At Risk	3	35.8 ± 1.0	NB
P	*Rhynchospora capillacea*	Slender Beakrush				S1	2 May Be At Risk	3	56.0 ± 0.0	NB
P	*Sisyrinchium angustifolium*	Narrow-leaved Blue-eyed-grass				S1	2 May Be At Risk	6	16.6 ± 0.0	NB
P	*Juncus greenei*	Greene's Rush				S1	2 May Be At Risk	1	70.2 ± 0.0	NB
P	*Juncus subtilis*	Creeping Rush				S1	2 May Be At Risk	1	93.3 ± 5.0	NB
P	*Allium canadense*	Canada Garlic				S1	2 May Be At Risk	10	49.2 ± 5.0	NB
P	*Goodyera pubescens*	Downy Rattlesnake-Plantain				S1	2 May Be At Risk	3	65.1 ± 0.0	NB
P	*Malaxis monophyllos var. brachypoda*	North American White Adder's-mouth				S1	2 May Be At Risk	12	4.5 ± 5.0	NB
P	*Platanthera flava*	Southern Rein-Orchid				S1	2 May Be At Risk	1	47.2 ± 1.0	NB
P	*Platanthera flava var. herbiola*	Pale Green Orchid				S1	2 May Be At Risk	13	37.1 ± 0.0	NB
P	*Platanthera macrophylla*	Large Round-Leaved Orchid				S1	2 May Be At Risk	4	50.6 ± 0.0	NB
P	*Spiranthes casei*	Case's Ladies'-Tresses				S1	2 May Be At Risk	6	62.0 ± 0.0	NB
P	*Bromus pubescens*	Hairy Wood Brome Grass				S1	5 Undetermined	6	92.9 ± 0.0	NB
P	*Cinna arundinacea*	Sweet Wood Reed Grass				S1	2 May Be At Risk	20	42.4 ± 0.0	NB
P	*Danthonia compressa*	Flattened Oat Grass				S1	2 May Be At Risk	4	30.1 ± 0.0	NB
P	*Dichanthelium dichotomum*	Forked Panic Grass				S1	2 May Be At Risk	19	40.8 ± 0.0	NB
P	*Elymus hystrix*	Spreading Wild Rye				S1	2 May Be At Risk	31	45.3 ± 0.0	NB
P	*Festuca subverticillata*	Nodding Fescue				S1	2 May Be At Risk	12	79.1 ± 0.0	NB
P	*Glyceria obtusa*	Atlantic Manna Grass				S1	2 May Be At Risk	6	39.5 ± 0.0	NB
P	*Sporobolus compositus*	Rough Dropseed				S1	2 May Be At Risk	17	53.7 ± 0.0	NB
P	*Potamogeton friesii*	Fries' Pondweed				S1	2 May Be At Risk	6	64.5 ± 5.0	NB
P	*Potamogeton nodosus*	Long-leaved Pondweed				S1	2 May Be At Risk	17	67.2 ± 1.0	NB
P	*Xyris difformis*	Bog Yellow-eyed-grass				S1	5 Undetermined	3	90.4 ± 0.0	NB
P	*Dryopteris clintoniana*	Clinton's Wood Fern				S1	2 May Be At Risk	2	53.7 ± 0.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
P	*Sceptridium oneidense*	Blunt-lobed Moonwort				S1	2 May Be At Risk	8	57.4 ± 0.0	NB
P	*Sceptridium rugulosum*	Rugulose Grapefern				S1	2 May Be At Risk	5	18.3 ± 1.0	NB
P	*Schizaea pusilla*	Little Curlygrass Fern				S1	2 May Be At Risk	22	87.2 ± 0.0	NB
P	*Polygonum aviculare ssp. neglectum*	Narrow-leaved Knotweed				S1?	5 Undetermined	7	42.1 ± 0.0	NB
P	*Galium trifidum ssp. subbiflorum*	Three-petaled Bedstraw				S1?	5 Undetermined	1	80.3 ± 1.0	NB
P	*Carex laxiflora*	Loose-Flowered Sedge				S1?	5 Undetermined	2	78.0 ± 0.0	NB
P	*Carex appalachica*	Appalachian Sedge				S1?	5 Undetermined	1	75.0 ± 0.0	NB
P	*Sisyrinchium mucronatum*	Michaux's Blue-eyed-grass				S1?	5 Undetermined	3	72.5 ± 0.0	NB
P	*Wolffia columbiana*	Columbian Watermeal				S1?	2 May Be At Risk	6	65.9 ± 0.0	NB
P	*Micranthes virginiensis*	Early Saxifrage				S1S2	2 May Be At Risk	14	49.6 ± 0.0	NB
P	*Potamogeton bicupulatus*	Snailseed Pondweed				S1S2	2 May Be At Risk	5	52.8 ± 0.0	NB
P	*Selaginella rupestris*	Rock Spikemoss				S1S2	2 May Be At Risk	7	53.9 ± 0.0	NB
P	*Coryphopteris simulata*	Bog Fern				S1S2	2 May Be At Risk	1	86.6 ± 0.0	NB
P	*Cuscuta cephalanthi*	Buttonbush Dodder				S1S3	2 May Be At Risk	1	99.7 ± 0.0	NB
P	*Spiranthes arcisepala*	Appalachian Ladies'-tresses				S1S3		6	53.7 ± 0.0	NB
P	*Neottia bifolia*	Southern Twayblade			Endangered	S2	1 At Risk	15	29.4 ± 0.0	NB
P	*Osmorhiza longistylis*	Smooth Sweet Cicely				S2	3 Sensitive	6	57.2 ± 0.0	NB
P	*Sanicula odorata*	Clustered Sanicle				S2	2 May Be At Risk	23	48.7 ± 0.0	NB
P	*Solidago racemosa*	Racemose Goldenrod				S2	2 May Be At Risk	23	47.4 ± 1.0	NB
P	*Ionactis linariifolia*	Flax-leaved Aster				S2	3 Sensitive	1	66.1 ± 0.0	NB
P	*Symphyotrichum racemosum*	Small White Aster				S2	3 Sensitive	9	11.3 ± 1.0	NB
P	*Pseudognaphalium macounii*	Macoun's Cudweed				S2	3 Sensitive	11	11.5 ± 0.0	NB
P	*Impatiens pallida*	Pale Jewelweed				S2	2 May Be At Risk	6	65.1 ± 0.0	NB
P	*Alnus serrulata*	Smooth Alder				S2	3 Sensitive	62	11.7 ± 0.0	NB
P	*Betula minor*	Dwarf White Birch				S2	3 Sensitive	1	62.7 ± 0.0	NB
P	*Boechera stricta*	Drummond's Rockcress				S2	3 Sensitive	7	53.7 ± 0.0	NB
P	*Sagina nodosa*	Knotted Pearlwort				S2	3 Sensitive	8	70.4 ± 0.0	NB
P	*Sagina nodosa ssp. borealis*	Knotted Pearlwort				S2	3 Sensitive	1	94.4 ± 0.0	NB
P	*Stellaria longifolia*	Long-leaved Starwort				S2	3 Sensitive	5	66.7 ± 10.0	NB
P	*Atriplex glabriuscula var. franktonii*	Frankton's Saltbush				S2	4 Secure	3	56.2 ± 1.0	NB
P	*Oxybasis rubra*	Red Goosefoot				S2	3 Sensitive	2	94.3 ± 1.0	NB
P	*Hypericum x dissimulatum*	Disguised St. John's-wort				S2	3 Sensitive	2	61.1 ± 0.0	NB
P	*Triosteum aurantiacum*	Orange-fruited Tinker's Weed				S2	3 Sensitive	181	44.3 ± 1.0	NB
P	*Viburnum lentago*	Nannyberry				S2	4 Secure	133	15.8 ± 0.0	NB
P	*Viburnum recognitum*	Northern Arrow-Wood				S2	4 Secure	184	8.2 ± 0.0	NB
P	*Astragalus eucosmus*	Elegant Milk-vetch				S2	2 May Be At Risk	8	46.1 ± 1.0	NB
P	*Oxytropis campestris*	Field Locoweed				S2	3 Sensitive	2	57.7 ± 0.0	NB
P	*Oxytropis campestris var. johannensis*	Field Locoweed				S2	3 Sensitive	11	43.4 ± 1.0	NB
P	*Quercus macrocarpa*	Bur Oak				S2	2 May Be At Risk	73	49.6 ± 0.0	NB
P	*Gentiana linearis*	Narrow-Leaved Gentian				S2	3 Sensitive	5	67.0 ± 5.0	NB
P	*Myriophyllum humile*	Low Water Milfoil				S2	3 Sensitive	14	10.3 ± 0.0	NB
P	*Proserpinaca palustris*	Marsh Mermaidweed				S2	3 Sensitive	32	15.8 ± 0.0	NB
P	*Hedeoma pulegioides*	American False Pennyroyal				S2	4 Secure	13	38.3 ± 2.0	NB
P	*Nuphar x rubrodisca*	Red-disk Yellow Pond-lily				S2	3 Sensitive	15	30.8 ± 0.0	NB
P	*Aphyllon uniflorum*	One-flowered Broomrape				S2	3 Sensitive	12	51.9 ± 1.0	NB
P	*Polygaloides paucifolia*	Fringed Milkwort				S2	3 Sensitive	13	40.9 ± 0.0	NB
P	*Polygala senega*	Seneca Snakeroot				S2	3 Sensitive	34	44.4 ± 1.0	NB
P	*Persicaria amphibia var. emersa*	Long-root Smartweed				S2	3 Sensitive	29	15.2 ± 0.0	NB
P	*Persicaria careyi*	Carey's Smartweed				S2	3 Sensitive	7	40.7 ± 1.0	NB
P	*Podostemum ceratophyllum*	Horn-leaved Riverweed				S2	3 Sensitive	47	38.8 ± 0.0	NB
P	*Anemone multifida*	Cut-leaved Anemone				S2	3 Sensitive	5	54.5 ± 0.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
P	*Hepatica americana*	Round-lobed Hepatica				S2	3 Sensitive	63	41.1 ± 0.0	NB
P	*Ranunculus flabellaris*	Yellow Water Buttercup				S2	4 Secure	24	37.5 ± 0.0	NB
P	*Crataegus scabrida*	Rough Hawthorn				S2	3 Sensitive	2	83.4 ± 0.0	NB
P	*Crataegus succulenta*	Fleshy Hawthorn				S2	3 Sensitive	1	66.7 ± 5.0	NB
P	*Cephalanthus occidentalis*	Common Buttonbush				S2	3 Sensitive	69	10.2 ± 0.0	NB
P	*Galium kamtschaticum*	Northern Wild Licorice				S2	3 Sensitive	2	85.1 ± 0.0	NB
P	*Salix candida*	Sage Willow				S2	3 Sensitive	12	39.8 ± 1.0	NB
P	*Agalinis neoscotica*	Nova Scotia Agalinis				S2	3 Sensitive	9	65.9 ± 0.0	NB
P	*Castilleja septentrionalis*	Northeastern Paintbrush				S2	3 Sensitive	3	82.3 ± 0.0	NB
P	*Euphrasia randii*	Rand's Eyebright				S2	2 May Be At Risk	13	70.3 ± 0.0	NB
P	*Scrophularia lanceolata*	Lance-leaved Figwort				S2	3 Sensitive	8	48.9 ± 0.0	NB
P	*Dirca palustris*	Eastern Leatherwood				S2	2 May Be At Risk	67	53.4 ± 1.0	NB
P	*Phryma leptostachya*	American Lopseed				S2	3 Sensitive	85	46.3 ± 0.0	NB
P	*Verbena urticifolia*	White Vervain				S2	2 May Be At Risk	33	43.6 ± 1.0	NB
P	*Viola novae-angliae*	New England Violet				S2	3 Sensitive	6	4.3 ± 10.0	NB
P	*Symplocarpus foetidus*	Eastern Skunk Cabbage				S2	3 Sensitive	47	25.5 ± 0.0	NB
P	*Carex comosa*	Bearded Sedge				S2	2 May Be At Risk	8	86.7 ± 0.0	NB
P	*Carex granularis*	Limestone Meadow Sedge				S2	3 Sensitive	8	49.3 ± 5.0	NB
P	*Carex gynocrates*	Northern Bog Sedge				S2	3 Sensitive	45	17.2 ± 0.0	NB
P	*Carex hirtifolia*	Pubescent Sedge				S2	3 Sensitive	72	46.3 ± 0.0	NB
P	*Carex livida*	Livid Sedge				S2	3 Sensitive	5	86.0 ± 0.0	NB
P	*Carex plantaginea*	Plantain-Leaved Sedge				S2	3 Sensitive	143	37.9 ± 0.0	NB
P	*Carex prairea*	Prairie Sedge				S2	3 Sensitive	35	52.2 ± 0.0	NB
P	*Carex rostrata*	Narrow-leaved Beaked Sedge				S2	3 Sensitive	9	45.6 ± 0.0	NB
P	*Carex sprengelii*	Longbeak Sedge				S2	3 Sensitive	49	46.5 ± 0.0	NB
P	*Carex tenuiflora*	Sparse-Flowered Sedge				S2	2 May Be At Risk	33	15.0 ± 0.0	NB
P	*Carex albicans var. emmonsii*	White-tinged Sedge				S2	3 Sensitive	2	82.8 ± 0.0	NB
P	*Cyperus squarrosus*	Awned Flatsedge				S2	3 Sensitive	33	66.7 ± 0.0	NB
P	*Eriophorum gracile*	Slender Cottongrass				S2	2 May Be At Risk	14	83.3 ± 0.0	NB
P	*Elodea nuttallii*	Nuttall's Waterweed				S2	3 Sensitive	12	38.7 ± 0.0	NB
P	*Juncus vaseyi*	Vasey Rush				S2	3 Sensitive	1	65.4 ± 0.0	NB
P	*Allium tricoccum*	Wild Leek				S2	2 May Be At Risk	20	48.8 ± 1.0	NB
P	*Najas gracillima*	Thread-Like Naiad				S2	3 Sensitive	11	45.4 ± 0.0	NB
P	*Calypso bulbosa*	Calypso				S2	2 May Be At Risk	1	28.9 ± 0.0	NB
P	*Calypso bulbosa var. americana*	Calypso				S2	2 May Be At Risk	33	64.5 ± 1.0	NB
P	*Coeloglossum viride*	Long-bracted Frog Orchid				S2	2 May Be At Risk	4	56.1 ± 5.0	NB
P	*Cypripedium parviflorum var. makasin*	Small Yellow Lady's-Slipper				S2	2 May Be At Risk	12	21.0 ± 1.0	NB
P	*Galearis spectabilis*	Showy Orchis				S2	2 May Be At Risk	56	48.3 ± 1.0	NB
P	*Goodyera oblongifolia*	Menzies' Rattlesnake-plantain				S2	3 Sensitive	1	97.6 ± 0.0	NB
P	*Spiranthes lucida*	Shining Ladies'-Tresses				S2	3 Sensitive	16	46.9 ± 0.0	NB
P	*Spiranthes ochroleuca*	Yellow Ladies'-tresses				S2	2 May Be At Risk	3	16.4 ± 5.0	NB
P	*Agrostis mertensii*	Northern Bent Grass				S2	2 May Be At Risk	2	63.6 ± 0.0	NB
P	*Dichanthelium linearifolium*	Narrow-leaved Panic Grass				S2	3 Sensitive	12	41.0 ± 0.0	NB
P	*Elymus canadensis*	Canada Wild Rye				S2	2 May Be At Risk	24	45.5 ± 1.0	NB
P	*Leersia virginica*	White Cut Grass				S2	2 May Be At Risk	42	58.6 ± 1.0	NB
P	*Piptatheropsis canadensis*	Canada Ricegrass				S2	3 Sensitive	6	15.3 ± 5.0	NB
P	*Puccinellia phryganodes ssp. neoarctica*	Creeping Alkali Grass				S2	3 Sensitive	9	45.9 ± 10.0	NB
P	*Puccinellia nutkaensis*	Alaska Alkaligrass				S2	3 Sensitive	7	68.5 ± 0.0	NB
P	*Schizachyrium scoparium*	Little Bluestem				S2	3 Sensitive	35	46.7 ± 1.0	NB
P	*Zizania aquatica var. aquatica*	Eastern Wild Rice				S2	5 Undetermined	3	44.5 ± 0.0	NB
P	*Potamogeton vaseyi*	Vasey's Pondweed				S2	3 Sensitive	11	24.8 ± 0.0	NB

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P	*Asplenium trichomanes*	Maidenhair Spleenwort				S2	3 Sensitive	8	41.6 ± 0.0	NB
P	*Anchistea virginica*	Virginia chain fern				S2	3 Sensitive	29	9.3 ± 0.0	NB
P	*Selaginella selaginoides*	Low Spikemoss				S2	3 Sensitive	3	84.9 ± 6.0	NB
P	*Toxicodendron radicans var. radicans*	Eastern Poison Ivy				S2?	3 Sensitive	10	58.6 ± 1.0	NB
P	*Symphyotrichum novi-belgii var. crenifolium*	New York Aster				S2?	5 Undetermined	2	63.4 ± 1.0	NB
P	*Humulus lupulus var. lupuloides*	Common Hop				S2?	3 Sensitive	5	56.0 ± 0.0	NB
P	*Rubus x recurvicaulis*	arching dewberry				S2?	4 Secure	1	55.5 ± 1.0	NB
P	*Galium obtusum*	Blunt-leaved Bedstraw				S2?	4 Secure	5	48.9 ± 1.0	NB
P	*Salix myricoides*	Bayberry Willow				S2?	3 Sensitive	12	26.1 ± 0.0	NB
P	*Carex vacillans*	Estuarine Sedge				S2?	3 Sensitive	3	49.3 ± 10.0	NB
P	*Platanthera huronensis*	Fragrant Green Orchid				S2?	5 Undetermined	3	17.2 ± 1.0	NB
P	*Solidago altissima*	Tall Goldenrod				S2S3	4 Secure	45	3.4 ± 0.0	NB
P	*Callitriche hermaphroditica*	Northern Water-starwort				S2S3	4 Secure	4	33.0 ± 0.0	NB
P	*Lonicera oblongifolia*	Swamp Fly Honeysuckle				S2S3	3 Sensitive	143	9.4 ± 0.0	NB
P	*Elatine americana*	American Waterwort				S2S3	3 Sensitive	5	29.0 ± 0.0	NB
P	*Bartonia paniculata ssp. iodandra*	Branched Bartonia				S2S3	3 Sensitive	16	68.8 ± 0.0	NB
P	*Geranium robertianum*	Herb Robert				S2S3	4 Secure	4	53.1 ± 0.0	NB
P	*Myriophyllum quitense*	Andean Water Milfoil				S2S3	4 Secure	28	87.9 ± 0.0	NB
P	*Epilobium coloratum*	Purple-veined Willowherb				S2S3	3 Sensitive	13	18.7 ± 1.0	NB
P	*Rumex pallidus*	Seabeach Dock				S2S3	3 Sensitive	7	68.6 ± 1.0	NB
P	*Rumex occidentalis*	Western Dock				S2S3	2 May Be At Risk	1	58.9 ± 1.0	NB
P	*Amelanchier gaspensis*	Gasp ├ Serviceberry				S2S3	5 Undetermined	1	70.5 ± 0.0	NB
P	*Rubus pensilvanicus*	Pennsylvania Blackberry				S2S3	4 Secure	13	25.4 ± 0.0	NB
P	*Galium labradoricum*	Labrador Bedstraw				S2S3	3 Sensitive	115	14.8 ± 0.0	NB
P	*Valeriana uliginosa*	Swamp Valerian				S2S3	3 Sensitive	52	36.3 ± 0.0	NB
P	*Carex adusta*	Lesser Brown Sedge				S2S3	4 Secure	3	56.9 ± 10.0	NB
P	*Juncus brachycephalus*	Small-Head Rush				S2S3	3 Sensitive	6	45.7 ± 0.0	NB
P	*Corallorhiza maculata var. occidentalis*	Spotted Coralroot				S2S3	3 Sensitive	8	24.7 ± 10.0	NB
P	*Corallorhiza maculata var. maculata*	Spotted Coralroot				S2S3	3 Sensitive	4	63.5 ± 0.0	NB
P	*Neottia auriculata*	Auricled Twayblade				S2S3	3 Sensitive	9	21.7 ± 0.0	NB
P	*Spiranthes cernua*	Nodding Ladies'-Tresses				S2S3	3 Sensitive	14	16.4 ± 5.0	NB
P	*Eragrostis pectinacea*	Tufted Love Grass				S2S3	4 Secure	13	3.5 ± 1.0	NB
P	*Stuckenia filiformis*	Thread-leaved Pondweed				S2S3	3 Sensitive	4	84.7 ± 0.0	NB
P	*Potamogeton praelongus*	White-stemmed Pondweed				S2S3	4 Secure	14	24.5 ± 0.0	NB
P	*Isoetes tuckermanii ssp. acadiensis*	Acadian Quillwort				S2S3	3 Sensitive	10	24.8 ± 1.0	NB
P	*Botrychium tenebrosum*	Swamp Moonwort				S2S3	3 Sensitive	1	26.6 ± 0.0	NB
P	*Ophioglossum pusillum*	Northern Adder's-tongue				S2S3	3 Sensitive	11	19.1 ± 1.0	NB
P	*Panax trifolius*	Dwarf Ginseng				S3	3 Sensitive	13	62.8 ± 0.0	NB
P	*Arnica lanceolata*	Lance-leaved Arnica				S3	4 Secure	6	89.9 ± 0.0	NB
P	*Artemisia campestris ssp. caudata*	Tall Wormwood				S3	4 Secure	50	43.5 ± 1.0	NB
P	*Artemisia campestris*	Field Wormwood				S3	4 Secure	15	57.4 ± 0.0	NB
P	*Erigeron hyssopifolius*	Hyssop-leaved Fleabane				S3	4 Secure	22	49.0 ± 1.0	NB
P	*Nabalus racemosus*	Glaucous Rattlesnakeroot				S3	4 Secure	31	42.0 ± 0.0	NB
P	*Tanacetum bipinnatum ssp. huronense*	Lake Huron Tansy				S3	4 Secure	33	43.5 ± 1.0	NB
P	*Tanacetum bipinnatum*	Lake Huron Tansy				S3	4 Secure	1	83.1 ± 0.0	NB
P	*Symphyotrichum boreale*	Boreal Aster				S3	3 Sensitive	160	12.3 ± 0.0	NB
P	*Betula pumila*	Bog Birch				S3	4 Secure	44	16.2 ± 0.0	NB
P	*Turritis glabra*	Tower Mustard				S3	5 Undetermined	6	44.5 ± 1.0	NB
P	*Arabis pycnocarpa*	Cream-flowered Rockcress				S3	4 Secure	11	55.0 ± 1.0	NB

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P	*Cardamine maxima*	Large Toothwort				S3	4 Secure	108	49.2 ± 0.0	NB
P	*Subularia aquatica ssp. americana*	American Water Awlwort				S3	4 Secure	18	24.1 ± 5.0	NB
P	*Lobelia cardinalis*	Cardinal Flower				S3	4 Secure	406	9.3 ± 0.0	NB
P	*Stellaria humifusa*	Saltmarsh Starwort				S3	4 Secure	6	50.9 ± 0.0	NB
P	*Ceratophyllum echinatum*	Prickly Hornwort				S3	3 Sensitive	15	16.6 ± 0.0	NB
P	*Hudsonia tomentosa*	Woolly Beach-heath				S3	4 Secure	3	75.3 ± 0.0	NB
P	*Cornus obliqua*	Silky Dogwood				S3	3 Sensitive	207	10.1 ± 0.0	NB
P	*Crassula aquatica*	Water Pygmyweed				S3	4 Secure	2	88.2 ± 1.0	NB
P	*Rhodiola rosea*	Roseroot				S3	4 Secure	32	59.9 ± 1.0	NB
P	*Penthorum sedoides*	Ditch Stonecrop				S3	4 Secure	55	27.9 ± 0.0	NB
P	*Elatine minima*	Small Waterwort				S3	4 Secure	62	10.3 ± 0.0	NB
P	*Astragalus alpinus*	Alpine Milk-vetch				S3	4 Secure	2	58.8 ± 0.0	NB
P	*Astragalus alpinus var. brunetianus*	Alpine Milk-Vetch				S3	4 Secure	13	42.2 ± 0.0	NB
P	*Hedysarum americanum*	Alpine Hedysarum				S3	4 Secure	33	74.3 ± 0.0	NB
P	*Gentianella amarella ssp. acuta*	Northern Gentian				S3	4 Secure	9	28.1 ± 0.0	NB
P	*Geranium bicknellii*	Bicknell's Crane's-bill				S3	4 Secure	5	43.4 ± 1.0	NB
P	*Myriophyllum farwellii*	Farwell's Water Milfoil				S3	4 Secure	22	3.3 ± 0.0	NB
P	*Myriophyllum heterophyllum*	Variable-leaved Water Milfoil				S3	4 Secure	42	83.8 ± 0.0	NB
P	*Myriophyllum verticillatum*	Whorled Water Milfoil				S3	4 Secure	18	27.6 ± 0.0	NB
P	*Stachys hispida*	Smooth Hedge-Nettle				S3	3 Sensitive	14	54.9 ± 0.0	NB
P	*Utricularia radiata*	Little Floating Bladderwort				S3	4 Secure	80	3.1 ± 0.0	NB
P	*Nuphar microphylla*	Small Yellow Pond-lily				S3	4 Secure	27	52.5 ± 0.0	NB
P	*Epilobium hornemannii*	Hornemann's Willowherb				S3	4 Secure	3	79.1 ± 0.0	NB
P	*Epilobium strictum*	Downy Willowherb				S3	4 Secure	60	10.2 ± 0.0	NB
P	*Polygala sanguinea*	Blood Milkwort				S3	3 Sensitive	22	33.2 ± 0.0	NB
P	*Persicaria arifolia*	Halberd-leaved Tearthumb				S3	4 Secure	23	39.3 ± 0.0	NB
P	*Persicaria punctata*	Dotted Smartweed				S3	4 Secure	14	10.2 ± 0.0	NB
P	*Fallopia scandens*	Climbing False Buckwheat				S3	4 Secure	35	30.4 ± 1.0	NB
P	*Littorella americana*	American Shoreweed				S3	4 Secure	34	11.7 ± 0.0	NB
P	*Primula mistassinica*	Mistassini Primrose				S3	4 Secure	13	53.8 ± 1.0	NB
P	*Pyrola minor*	Lesser Pyrola				S3	4 Secure	1	83.0 ± 0.0	NB
P	*Clematis occidentalis*	Purple Clematis				S3	4 Secure	32	25.1 ± 0.0	NB
P	*Ranunculus gmelinii*	Gmelin's Water Buttercup				S3	4 Secure	45	48.4 ± 0.0	NB
P	*Thalictrum confine*	Northern Meadow-rue				S3	4 Secure	84	43.5 ± 0.0	NB
P	*Amelanchier canadensis*	Canada Serviceberry				S3	4 Secure	16	15.0 ± 1.0	NB
P	*Rosa palustris*	Swamp Rose				S3	4 Secure	106	8.0 ± 0.0	NB
P	*Rubus occidentalis*	Black Raspberry				S3	4 Secure	140	9.3 ± 0.0	NB
P	*Galium boreale*	Northern Bedstraw				S3	4 Secure	10	43.5 ± 1.0	NB
P	*Salix nigra*	Black Willow				S3	3 Sensitive	112	23.2 ± 0.0	NB
P	*Salix pedicellaris*	Bog Willow				S3	4 Secure	79	18.7 ± 0.0	NB
P	*Salix interior*	Sandbar Willow				S3	4 Secure	40	53.6 ± 1.0	NB
P	*Parnassia glauca*	Fen Grass-of-Parnassus				S3	4 Secure	8	44.8 ± 10.0	NB
P	*Limosella australis*	Southern Mudwort				S3	4 Secure	1	42.3 ± 5.0	NB
P	*Boehmeria cylindrica*	Small-spike False-nettle				S3	3 Sensitive	159	26.2 ± 0.0	NB
P	*Pilea pumila*	Dwarf Clearweed				S3	4 Secure	55	37.4 ± 5.0	NB
P	*Viola adunca*	Hooked Violet				S3	4 Secure	4	12.5 ± 1.0	NB
P	*Viola nephrophylla*	Northern Bog Violet				S3	4 Secure	65	48.7 ± 0.0	NB
P	*Carex arcta*	Northern Clustered Sedge				S3	4 Secure	52	11.7 ± 0.0	NB
P	*Carex capillaris*	Hairlike Sedge				S3	4 Secure	6	75.9 ± 0.0	NB
P	*Carex chordorrhiza*	Creeping Sedge				S3	4 Secure	79	10.0 ± 0.0	NB
P	*Carex conoidea*	Field Sedge				S3	4 Secure	15	22.6 ± 1.0	NB
P	*Carex eburnea*	Bristle-leaved Sedge				S3	4 Secure	7	80.1 ± 0.0	NB
P	*Carex exilis*	Coastal Sedge				S3	4 Secure	103	42.9 ± 0.0	NB
P	*Carex garberi*	Garber's Sedge				S3	3 Sensitive	5	54.8 ± 1.0	NB
P	*Carex haydenii*	Hayden's Sedge				S3	4 Secure	55	49.6 ± 1.0	NB

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P	*Carex lupulina*	Hop Sedge				S3	4 Secure	111	16.4 ± 1.0	NB
P	*Carex michauxiana*	Michaux's Sedge				S3	4 Secure	48	29.3 ± 1.0	NB
P	*Carex ormostachya*	Necklace Spike Sedge				S3	4 Secure	23	17.6 ± 0.0	NB
P	*Carex rosea*	Rosy Sedge				S3	4 Secure	233	43.9 ± 1.0	NB
P	*Carex tenera*	Tender Sedge				S3	4 Secure	46	16.6 ± 0.0	NB
P	*Carex tuckermanii*	Tuckerman's Sedge				S3	4 Secure	90	17.0 ± 0.0	NB
P	*Carex vaginata*	Sheathed Sedge				S3	3 Sensitive	17	9.6 ± 0.0	NB
P	*Carex wiegandii*	Wiegand's Sedge				S3	4 Secure	34	9.5 ± 0.0	NB
P	*Carex recta*	Estuary Sedge				S3	4 Secure	7	49.3 ± 0.0	NB
P	*Cyperus dentatus*	Toothed Flatsedge				S3	4 Secure	100	18.3 ± 0.0	NB
P	*Cyperus esculentus*	Perennial Yellow Nutsedge				S3	4 Secure	8	89.4 ± 0.0	NB
P	*Cyperus esculentus var. leptostachyus*	Perennial Yellow Nutsedge				S3	4 Secure	60	45.4 ± 1.0	NB
P	*Eleocharis intermedia*	Matted Spikerush				S3	4 Secure	7	28.0 ± 0.0	NB
P	*Eleocharis quinqueflora*	Few-flowered Spikerush				S3	4 Secure	25	45.7 ± 0.0	NB
P	*Rhynchospora capitellata*	Small-headed Beakrush				S3	4 Secure	25	50.9 ± 0.0	NB
P	*Rhynchospora fusca*	Brown Beakrush				S3	4 Secure	45	25.3 ± 0.0	NB
P	*Trichophorum clintonii*	Clinton's Clubrush				S3	4 Secure	28	38.1 ± 10.0	NB
P	*Bolboschoenus fluviatilis*	River Bulrush				S3	3 Sensitive	35	75.3 ± 0.0	NB
P	*Schoenoplectus torreyi*	Torrey's Bulrush				S3	4 Secure	32	27.6 ± 0.0	NB
P	*Lemna trisulca*	Star Duckweed				S3	4 Secure	1	95.8 ± 0.0	NB
P	*Triantha glutinosa*	Sticky False-Asphodel				S3	4 Secure	42	44.1 ± 0.0	NB
P	*Cypripedium reginae*	Showy Lady's-Slipper				S3	3 Sensitive	126	17.2 ± 0.0	NB
P	*Liparis loeselii*	Loesel's Twayblade				S3	4 Secure	26	4.5 ± 5.0	NB
P	*Platanthera blephariglottis*	White Fringed Orchid				S3	4 Secure	56	25.4 ± 0.0	NB
P	*Platanthera grandiflora*	Large Purple Fringed Orchid				S3	3 Sensitive	45	15.5 ± 0.0	NB
P	*Bromus latiglumis*	Broad-Glumed Brome				S3	3 Sensitive	25	55.3 ± 0.0	NB
P	*Calamagrostis pickeringii*	Pickering's Reed Grass				S3	4 Secure	104	56.3 ± 0.0	NB
P	*Dichanthelium depauperatum*	Starved Panic Grass				S3	4 Secure	15	58.2 ± 0.0	NB
P	*Muhlenbergia richardsonis*	Mat Muhly				S3	4 Secure	28	55.5 ± 0.0	NB
P	*Heteranthera dubia*	Water Stargrass				S3	4 Secure	39	43.0 ± 0.0	NB
P	*Potamogeton obtusifolius*	Blunt-leaved Pondweed				S3	4 Secure	38	24.8 ± 0.0	NB
P	*Potamogeton richardsonii*	Richardson's Pondweed				S3	3 Sensitive	22	25.3 ± 0.0	NB
P	*Xyris montana*	Northern Yellow-Eyed-Grass				S3	4 Secure	21	30.1 ± 0.0	NB
P	*Zannichellia palustris*	Horned Pondweed				S3	4 Secure	3	89.9 ± 0.0	NB
P	*Adiantum pedatum*	Northern Maidenhair Fern				S3	4 Secure	357	32.0 ± 0.0	NB
P	*Asplenium viride*	Green Spleenwort				S3	4 Secure	8	93.6 ± 0.0	NB
P	*Dryopteris fragrans*	Fragrant Wood Fern				S3	4 Secure	8	47.0 ± 0.0	NB
P	*Dryopteris goldiana*	Goldie's Woodfern				S3	3 Sensitive	213	32.0 ± 0.0	NB
P	*Equisetum palustre*	Marsh Horsetail				S3	4 Secure	10	57.7 ± 0.0	NB
P	*Isoetes tuckermanii ssp. tuckermanii*	Tuckerman's Quillwort				S3	4 Secure	17	15.9 ± 1.0	NB
P	*Isoetes tuckermanii*	Tuckerman's Quillwort				S3	4 Secure	1	23.9 ± 0.0	NB
P	*Diphasiastrum x sabinifolium*	Savin-leaved Ground-cedar				S3	4 Secure	9	22.1 ± 1.0	NB
P	*Sceptridium dissectum*	Dissected Moonwort				S3	4 Secure	52	42.3 ± 0.0	NB
P	*Botrychium lanceolatum ssp. angustisegmentum*	Narrow Triangle Moonwort				S3	3 Sensitive	21	16.6 ± 0.0	NB
P	*Botrychium simplex*	Least Moonwort				S3	4 Secure	15	9.4 ± 0.0	NB
P	*Polypodium appalachianum*	Appalachian Polypody				S3	4 Secure	48	18.0 ± 0.0	NB
P	*Utricularia resupinata*	Inverted Bladderwort				S3?	4 Secure	16	48.1 ± 0.0	NB
P	*Crataegus submollis*	Quebec Hawthorn				S3?	3 Sensitive	14	16.9 ± 0.0	NB
P	*Mertensia maritima*	Sea Lungwort				S3S4	4 Secure	25	57.5 ± 1.0	NB
P	*Lobelia kalmii*	Brook Lobelia				S3S4	4 Secure	38	25.1 ± 1.0	NB
P	*Suaeda calceoliformis*	Horned Sea-blite				S3S4	4 Secure	5	57.3 ± 5.0	NB
P	*Myriophyllum sibiricum*	Siberian Water Milfoil				S3S4	4 Secure	15	38.1 ± 0.0	NB
P	*Stachys pilosa*	Hairy Hedge-Nettle				S3S4	5 Undetermined	4	57.6 ± 0.0	NB
P	*Utricularia gibba*	Humped Bladderwort				S3S4	4 Secure	39	10.9 ± 0.0	NB

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
P	*Rumex fueginus*	Tierra del Fuego Dock				S3S4	4 Secure	1	69.2 ± 1.0	NB
P	*Drymocallis arguta*	Tall Wood Beauty				S3S4	4 Secure	51	15.4 ± 0.0	NB
P	*Rubus chamaemorus*	Cloudberry				S3S4	4 Secure	70	67.6 ± 1.0	NB
P	*Geocaulon lividum*	Northern Comandra				S3S4	4 Secure	8	77.1 ± 1.0	NB
P	*Juniperus horizontalis*	Creeping Juniper				S3S4	4 Secure	18	65.6 ± 1.0	NB
P	*Cladium mariscoides*	Smooth Twigrush				S3S4	4 Secure	101	12.3 ± 0.0	NB
P	*Eriophorum russeolum*	Russet Cottongrass				S3S4	4 Secure	4	5.5 ± 0.0	NB
P	*Triglochin gaspensis*	Gasp ├⌐ Arrowgrass				S3S4	4 Secure	15	49.0 ± 2.0	NB
P	*Spirodela polyrhiza*	great duckweed				S3S4	4 Secure	41	3.5 ± 0.0	NB
P	*Corallorhiza maculata*	Spotted Coralroot				S3S4	3 Sensitive	10	37.8 ± 1.0	NB
P	*Calamagrostis stricta*	Slim-stemmed Reed Grass				S3S4	4 Secure	1	89.6 ± 2.0	NB
P	*Potamogeton oakesianus*	Oakes' Pondweed				S3S4	4 Secure	35	26.6 ± 0.0	NB
P	*Montia fontana*	Water Blinks				SH	2 May Be At Risk	1	81.0 ± 1.0	NB
P	*Solidago ptarmicoides*	Upland White Goldenrod				SX	0.1 Extirpated	3	67.3 ± 1.0	NB
P	*Celastrus scandens*	Climbing Bittersweet				SX	0.1 Extirpated	4	45.6 ± 100.0	NB

5.1 SOURCE BIBLIOGRAPHY (100 km)

The recipient of these data shall acknowledge the AC CDC and the data sources listed below in any documents, reports, publications or presentations, in which this dataset makes a significant contribution.

# recs	CITATION
5017	eBird. 2014. eBird Basic Dataset. Version: EBD_relNov-2014. Ithaca, New York. Nov 2014. Cornell Lab of Ornithology, 25036 recs.
4996	Lepage, D. 2014. Maritime Breeding Bird Atlas Database. Bird Studies Canada, Sackville NB, 407,838 recs.
2572	Erskine, A.J. 1992. Maritime Breeding Bird Atlas Database. NS Museum & Nimbus Publ., Halifax, 82,125 recs.
1696	Berrigan, L. 2019. Maritimes Marsh Monitoring Project 2013, 2014, 2016, 2017, and 2018 data. Bird Studies Canada, Sackville, NB.
1419	Morrison, Guy. 2011. Maritime Shorebird Survey (MSS) database. Canadian Wildlife Service, Ottawa, 15939 surveys. 86171 recs.
1352	Blaney, C.S.; Mazerolle, D.M.; Belliveau, A.B. 2014. Atlantic Canada Conservation Data Centre Fieldwork 2014. Atlantic Canada Conservation Data Centre, # recs.
1030	Blaney, C.S. & Mazerolle, D.M. 2011. NB WTF Fieldwork on Magaguadavic & Lower St Croix Rivers. Atlantic Canada Conservation Data Centre, 4585 recs.
885	Pardieck, K.L. & Ziolkowski Jr., D.J.; Hudson, M.-A.R. 2014. North American Breeding Bird Survey Dataset 1966 - 2013, version 2013.0. U.S. Geological Survey, Patuxent Wildlife Research Center <www.pwrc.usgs.gov/BBS/RawData/>.
884	iNaturalist. 2020. iNaturalist Data Export 2020. iNaturalist.org and iNaturalist.ca, Web site: 128728 recs.
784	Askanas, H. 2016. New Brunswick Wood Turtle Database. New Brunswick Department of Energy and Resource Development.
773	Blaney, C.S.; Mazerolle, D.M.; Belliveau, A.B. 2015. Atlantic Canada Conservation Data Centre Fieldwork 2015. Atlantic Canada Conservation Data Centre, # recs.
671	Wallace, S. 2020. Stewardship Department species occurrence data on NTNB preserves. Nature Trust of New Brunswick.
654	Benedict, B. Connell Herbarium Specimens. University New Brunswick, Fredericton. 2003.
638	Goltz, J.P. 2012. Field Notes, 1989-2005. , 1091 recs.
450	Blaney, C.S.; Mazerolle, D.M.; Belliveau, A.B. 2013. Atlantic Canada Conservation Data Centre Fieldwork 2013. Atlantic Canada Conservation Data Centre, 9000+ recs.
409	Clayden, S.R. 1998. NBM Science Collections databases: vascular plants. New Brunswick Museum, Saint John NB, 19759 recs.
409	Hicks, Andrew. 2009. Coastal Waterfowl Surveys Database, 2000-08. Canadian Wildlife Service, Sackville, 46488 recs (11149 non-zero).
388	Blaney, C.S.; Mazerolle, D.M. 2009. Fieldwork 2009. Atlantic Canada Conservation Data Centre. Sackville NB, 13395 recs.
382	Brunelle, P.-M. (compiler). 2009. ADIP/MDDS Odonata Database: data to 2006 inclusive. Atlantic Dragonfly Inventory Program (ADIP), 24200 recs.
377	Benedict, B. Connell Herbarium Specimens (Data) . University New Brunswick, Fredericton. 2003.
336	Blaney, C.S.; Mazerolle, D.M.; Klymko, J; Spicer, C.D. 2006. Fieldwork 2006. Atlantic Canada Conservation Data Centre. Sackville NB, 8399 recs.
319	Tims, J. & Craig, N. 1995. Environmentally Significant Areas in New Brunswick (NBESA). NB Dept of Environment & Nature Trust of New Brunswick Inc, 6042 recs.
316	Epworth, W. 2016. Species at Risk records, 2014-2016. Fort Folly Habitat Recovery Program, 38 recs.
277	Blaney, C.S.; Mazerolle, D.M. 2008. Fieldwork 2008. Atlantic Canada Conservation Data Centre. Sackville NB, 13343 recs.
267	Wisniowski, C. & Dowding, A. 2019. NB species occurrence data for 2016-2018. Nature Trust of New Brunswick.
258	Blaney, C.S. 2000. Fieldwork 2000. Atlantic Canada Conservation Data Centre. Sackville NB, 1265 recs.
244	Sollows, M.C,. 2008. NBM Science Collections databases: mammals. New Brunswick Museum, Saint John NB, download Jan. 2008, 4983 recs.
229	Chapman, C.J. 2019. Atlantic Canada Conservation Data Centre 2019 botanical fieldwork. Atlantic Canada Conservation Data Centre, 11729 recs.
217	Hinds, H.R. 1986. Notes on New Brunswick plant collections. Connell Memorial Herbarium, unpubl, 739 recs.
211	Blaney, C.S. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre. Sackville NB, 1042 recs.
194	Blaney, C.S. 2019. Sean Blaney 2019 field data. Atlantic Canada Conservation Data Centre, 4407 records.
192	Churchill, J.L.; Klymko, J.D. 2016. Bird Species at Risk Inventory on the Acadia Research Forest, 2016. Atlantic Canada Conservation Data Centre, 1043 recs.
191	Mazerolle, D.M. 2018. Atlantic Canada Conservation Data Centre botanical fieldwork 2018. Atlantic Canada Conservation Data Centre, 13515 recs.

# recs	CITATION
184	Blaney, C.S. & Mazerolle, D.M. 2011. Field data from NCC properties at Musquash Harbour NB & Goose Lake NS. Atlantic Canada Conservation Data Centre, 1739 recs.
181	Klymko, J. 2018. Maritimes Butterfly Atlas database. Atlantic Canada Conservation Data Centre.
175	eBird. 2020. eBird Basic Dataset. Version: EBD_relNov-2019. Ithaca, New York. Nov 2019, Cape Breton Bras d'Or Lakes Watershed subset. Cornell Lab of Ornithology.
170	Sollows, M.C,. 2009. NBM Science Collections databases: molluscs. New Brunswick Museum, Saint John NB, download Jan. 2009, 6951 recs (2957 in Atlantic Canada).
168	Anonymous. 2017. Observations from protected sources. Atlantic Canada Conservation Data Centre.
165	Tranquilla, L. 2015. Maritimes Marsh Monitoring Project 2015 data. Bird Studies Canada, Sackville NB, 5062 recs.
153	Blaney, C.S.; Spicer, C.D.; Mazerolle, D.M. 2005. Fieldwork 2005. Atlantic Canada Conservation Data Centre. Sackville NB, 2333 recs.
143	Blaney, C.S.; Mazerolle, D.M. 2012. Fieldwork 2012. Atlantic Canada Conservation Data Centre, 13,278 recs.
137	Klymko, J. 2020. Atlantic Canada Conservation Data Centre zoological fieldwork 2019. Atlantic Canada Conservation Data Centre.
135	Sollows, M.C. 2008. NBM Science Collections databases: herpetiles. New Brunswick Museum, Saint John NB, download Jan. 2008, 8636 recs.
128	Benedict, B. Connell Herbarium Specimen Database Download 2004. Connell Memorial Herbarium, University of New Brunswick. 2004.
127	MacDougall, A.; Bishop, G.; et al. 1998. 1997 Appalachian Hardwood Field Data. Nature Trust of New Brunswick, 4473 recs.
122	Belliveau, A.G. 2016. Atlantic Canada Conservation Data Centre Fieldwork 2016. Atlantic Canada Conservation Data Centre, 10695 recs.
114	Bishop, G. & Papoulias, M.; Arnold (Chaplin), M. 2005. Grand Lake Meadows field notes, Summer 2005. New Brunswick Federation of Naturalists, 1638 recs.
112	Clayden, S.R. 2007. NBM Science Collections databases: vascular plants. New Brunswick Museum, Saint John NB, download Mar. 2007, 6914 recs.
112	Wisniowski, C. & Dowding, A. 2020. NB species occurrence data for 2020. Nature Trust of New Brunswick.
105	Blaney, C.S.; Spicer, C.D.; Popma, T.M.; Hanel, C. 2002. Fieldwork 2002. Atlantic Canada Conservation Data Centre. Sackville NB, 2252 recs.
103	Klymko, J. 2019. Atlantic Canada Conservation Data Centre zoological fieldwork 2018. Atlantic Canada Conservation Data Centre.
100	Boyne, A.W. 2000. Tern Surveys. Canadian Wildlife Service, Sackville, unpublished data. 168 recs.
100	Churchill, J.L. 2018. Atlantic Canada Conservation Data Centre Fieldwork 2017. Atlantic Canada Conservation Data Centre, 2318 recs.
94	Bateman, M.C. 2001. Coastal Waterfowl Surveys Database, 1965-2001. Canadian Wildlife Service, Sackville, 667 recs.
87	Klymko, J.J.D. 2018. 2017 field data. Atlantic Canada Conservation Data Centre.
85	Sabine, M. 2016. Black Ash records from the NB DNR Forest Development Survey. New Brunswick Department of Natural Resources.
82	Paquet, Julie. 2018. Atlantic Canada Shorebird Survey (ACSS) database 2012-2018. Environment Canada, Canadian Wildlife Service.
78	Bagnell, B.A. 2001. New Brunswick Bryophyte Occurrences. B&B Botanical, Sussex, 478 recs.
78	Beardmore, T. 2017. Wood turtle data: observations May 2017. Nashwaaksis Stream, NB. Natural Resources Canada, 78 records.
77	Sabine, D.L. 2005. 2001 Freshwater Mussel Surveys. New Brunswick Dept of Natural Resources & Energy, 590 recs.
76	Robinson, S.L. 2015. 2014 field data.
75	Blaney, C.S.; Spicer, C.D. 2001. Fieldwork 2001. Atlantic Canada Conservation Data Centre. Sackville NB, 981 recs.
72	Thomas, A.W. 1996. A preliminary atlas of the butterflies of New Brunswick. New Brunswick Museum.
69	Cowie, Faye. 2007. Surveyed Lakes in New Brunswick. Canadian Rivers Institute, 781 recs.
68	Erskine, A.J. 1999. Maritime Nest Records Scheme (MNRS) 1937-1999. Canadian Wildlife Service, Sackville, 313 recs.
67	Haughian, S.R. 2018. Description of Fuscopannaria leucosticta field work in 2017. New Brunswick Museum, 314 recs.
66	iNaturalist. 2018. iNaturalist Data Export 2018. iNaturalist.org and iNaturalist.ca, Web site: 11700 recs.
65	Belland, R.J. Maritimes moss records from various herbarium databases. 2014.
65	Blaney, C.S.; Spicer, C.D.; Rothfels, C. 2004. Fieldwork 2004. Atlantic Canada Conservation Data Centre. Sackville NB, 1343 recs.
63	Chapman, C.J. 2018. Atlantic Canada Conservation Data Centre botanical fieldwork 2018. Atlantic Canada Conservation Data Centre, 11171 recs.
58	Wilhelm, S.I. et al. 2011. Colonial Waterbird Database. Canadian Wildlife Service, Sackville, 2698 sites, 9718 recs (8192 obs).
56	Neily, T. H. 2018. Lichen and Bryophyte records, AEI 2017-2018. Tom Neily; Atlantic Canada Conservation Data Centre.
53	Mazerolle, D.M. 2016. Atlantic Canada Conservation Data Centre Fieldwork 2017. Atlantic Canada Conservation Data Centre.
53	Speers, L. 2008. Butterflies of Canada database: New Brunswick 1897-1999. Agriculture & Agri-Food Canada, Biological Resources Program, Ottawa, 2048 recs.
50	e-Butterfly. 2016. Export of Maritimes records and photos. Maxim Larrivee, Sambo Zhang (ed.) e-butterfly.org.
49	Nussey, Pat & NCC staff. 2019. AEI tracked species records, 2016-2019. Chapman, C.J. (ed.) Atlantic Canada Conservation Data Centre, 333.
46	McAlpine, D.F. 1998. NBM Science Collections: Wood Turtle records. New Brunswick Museum, Saint John NB, 329 recs.
46	Scott, Fred W. 1998. Updated Status Report on the Cougar (Puma Concolor couguar) [Eastern population]. Committee on the Status of Endangered Wildlife in Canada, 298 recs.
43	Mills, E. Connell Herbarium Specimens, 1957-2009. University New Brunswick, Fredericton. 2012.
41	Klymko, J. 2016. Atlantic Canada Conservation Data Centre Fieldwork 2016. Atlantic Canada Conservation Data Centre.
40	McAlpine, D.F. 1998. NBM Science Collections databases to 1998. New Brunswick Museum, Saint John NB, 241 recs.
36	Spicer, C.D. 2002. Fieldwork 2002. Atlantic Canada Conservation Data Centre. Sackville NB, 211 recs.
35	Mazerolle, D.M. 2017. Atlantic Canada Conservation Data Centre Fieldwork 2017. Atlantic Canada Conservation Data Centre.
32	Blaney, C.S.; Mazerolle, D.M.; Oberndorfer, E. 2007. Fieldwork 2007. Atlantic Canada Conservation Data Centre. Sackville NB, 13770 recs.
32	Honeyman, K. 2019. Unique Areas Database, 2018. J.D. Irving Ltd.
26	Doucet, D.A. 2008. Fieldwork 2008: Odonata. ACCDC Staff, 625 recs.
26	Sabine, M. 2016. NB DNR staff incidental Black Ash observations. New Brunswick Department of Natural Resources.
26	Stewart, J.I. 2010. Peregrine Falcon Surveys in New Brunswick, 2002-09. Canadian Wildlife Service, Sackville, 58 recs.
25	Benedict, B. Connell Herbarium Specimens, Digital photos. University New Brunswick, Fredericton. 2005.
24	Blaney, C.S.; Mazerolle, D.M. 2010. Fieldwork 2010. Atlantic Canada Conservation Data Centre. Sackville NB, 15508 recs.
22	Belliveau, A.G. 2018. Atlantic Canada Conservation Data Centre Fieldwork 2017. Atlantic Canada Conservation Data Centre.
22	Doucet, D.A. & Edsall, J.; Brunelle, P.-M. 2007. Miramichi Watershed Rare Odonata Survey. New Brunswick ETF & WTF Report, 1211 recs.

# recs	CITATION
20	Klymko, J.J.D. 2016. 2014 field data. Atlantic Canada Conservation Data Centre.
20	Webster, R.P. Database of R.P. Webster butterfly collection. 2017.
19	Hinds, H.R. 1999. Connell Herbarium Database. University New Brunswick, Fredericton, 131 recs.
19	Sabine, M. 2016. Black Ash records from NB DNR permanent forest sampling Plots. New Brunswick Department of Natural Resources, 39 recs.
19	Stantec. 2014. Energy East Pipeline Corridor Species Occurrence Data. Stantec Inc., 4934 records.
18	Kennedy, Joseph. 2010. New Brunswick Peregrine records, 2009. New Brunswick Dept Natural Resources, 19 recs (14 active).
18	Manthorne, A. 2014. MaritimesSwiftwatch Project database 2013-2014. Bird Studies Canada, Sackville NB, 326 recs.
18	Shortt, R. Connell Herbarium Black Ash specimens. University New Brunswick, Fredericton. 2019.
16	Benedict, B. Connell Herbarium Specimens. University New Brunswick, Fredericton. 2000.
16	Edsall, J. 2001. Lepidopteran records in New Brunswick, 1997-99. , Pers. comm. to K.A. Bredin. 91 recs.
15	Tingley, S. (compiler). 2001. Butterflies of New Brunswick. , Web site: www.geocities.com/Yosemite/8425/buttrfly. 142 recs.
14	Spicer, C.D. 2001. Powerline Corridor Botanical Surveys, Charlotte & Saint John Counties. A M E C International, 1269 recs.
13	Edsall, J. 2007. Personal Butterfly Collection: specimens collected in the Canadian Maritimes, 1961-2007. J. Edsall, unpubl. report, 137 recs.
12	NatureServe Canada. 2019. iNaturalist Maritimes Butterfly Records. iNaturalist.org and iNaturalist.ca.
12	Pike, E., Tingley, S. & Christie, D.S. 2000. Nature NB Listserve. University of New Brunswick, listserv.unb.ca/archives/naturenb. 68 recs.
11	Klymko, J. Dataset of butterfly records at the New Brunswick Museum not yet accessioned by the museum. Atlantic Canada Conservation Data Centre. 2016.
11	Webster, R.P. 2004. Lepidopteran Records for National Wildlife Areas in New Brunswick. Webster, 1101 recs.
10	Noseworthy, J. 2013. Van Brunt's Jacob's-ladder observations along tributary of Dipper Harbour Ck. Nature Conservancy of Canada, 10 recs.
10	Wisniowski, C. 2018. Optimizing wood turtle conservation in New Brunswick through collaboration, strategic planning, and landowner outreach. Nature Trust of New Brunswick, 10 records.
8	Bateman, M.C. 2000. Waterfowl Brood Surveys Database, 1990-2000 . Canadian Wildlife Service, Sackville, unpublished data. 149 recs.
8	Downes, C. 1998-2000. Breeding Bird Survey Data. Canadian Wildlife Service, Ottawa, 111 recs.
8	Munro, Marian K. Nova Scotia Provincial Museum of Natural History Herbarium Database. Nova Scotia Provincial Museum of Natural History, Halifax, Nova Scotia. 2013.
8	Sollows, M.C,. 2009. NBM Science Collections databases: Coccinellid & Cerambycid Beetles. New Brunswick Museum, Saint John NB, download Feb. 2009, 569 recs.
8	Webster, R.P. Atlantic Forestry Centre Insect Collection, Maritimes butterfly records. Natural Resources Canada. 2014.
7	Clayden, S.R. 2012. NBM Science Collections databases: vascular plants. New Brunswick Museum, Saint John NB, 57 recs.
7	Goltz, J.P. & Bishop, G. 2005. Confidential supplement to Status Report on Prototype Quillwort (Isoetes prototypus). Committee on the Status of Endangered Wildlife in Canada, 111 recs.
7	Goltz, J.P. 1994. In the Footsteps of Our Ancestors. NB Naturalists, 21 (2-4): 20. 8 recs.
7	Klymko, J.J.D. 2012. Insect fieldwork & submissions, 2003-11. Atlantic Canada Conservation Data Centre. Sackville NB, 1337 recs.
7	Patrick, A.; Horne, D.; Noseworthy, J. et. al. 2017. Field data for Nova Scotia and New Brunswick, 2015 and 2017. Nature Conservancy of Canada.
7	Popma, T.M. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre. Sackville NB, 113 recs.
7	Richardson, D., Anderson, F., Cameron, R, Pepper, C., Clayden, S. 2015. Field Work Report on the Wrinkled Shingle lichen (Pannaria lurida). COSEWIC.
6	Brunelle, P.-M. (compiler). 2010. ADIP/MDDS Odonata Database: NB, NS Update 1900-09. Atlantic Dragonfly Inventory Program (ADIP), 935 recs.
6	Clayden, S.R. 2005. Confidential supplement to Status Report on Ghost Antler Lichen (Pseudevernia cladonia). Committee on the Status of Endangered Wildlife in Canada, 27 recs.
6	Cowie, F. 2007. Electrofishing Population Estimates 1979-98. Canadian Rivers Institute, 2698 recs.
6	Cronin, P. & Ayer, C.; Dubee, B.; Hooper, W.C.; LeBlanc, E.; Madden, A.; Pettigrew, T.; Seymour, P. 1998. Fish Species Management Plans (draft). NB DNRE Internal Report. Fredericton, 164pp.
6	Dowding, A.; Mandula, M. 2017. Observation of Hepatica acutiloba in New Brunswick. Nature Trust New Brunswick.
6	Kennedy, Joseph. 2010. New Brunswick Peregrine records, 2010. New Brunswick Dept Natural Resources, 16 recs (11 active).
6	Speers, L. 2001. Butterflies of Canada database. Agriculture & Agri-Food Canada, Biological Resources Program, Ottawa, 190 recs.
6	Webster, R.P. 2006. Survey for Suitable Salt Marshes for the Maritime Ringlet, New Populations of the Cobblestone Tiger Beetle, & New Localities of Three Rare Butterfly Species. New Brunswick WTF Report, 28 recs.
5	Beardmore, T. 2017. 2017 Butternut observations. Natural Resources Canada.
5	e-Butterfly. 2019. Export of Maritimes records and photos. McFarland, K. (ed.) e-butterfly.org.
4	Bredin, K.A. 2003. NB Freshwater Mussel Fieldwork. Atlantic Canada Conservation Data Centere, 20 recs.
4	Chaput, G. 2002. Atlantic Salmon: Maritime Provinces Overview for 2001. Dept of Fisheries & Oceans, Atlantic Region, Science Stock Status Report D3-14. 39 recs.
4	Christie, D.S. 2000. Christmas Bird Count Data, 1997-2000. Nature NB, 54 recs.
4	Doucet, D.A. 2007. Lepidopteran Records, 1988-2006. Doucet, 700 recs.
4	Goltz, J.P. 2001. Botany Ramblings April 29-June 30, 2001. N.B. Naturalist, 28 (2): 51-2. 8 recs.
4	Klymko, J.J.D. 2012. Odonata specimens & observations, 2010. Atlantic Canada Conservation Data Centre, 425 recs.
4	Layberry, R.A. 2012. Lepidopteran records for the Maritimes, 1974-2008. Layberry Collection, 1060 recs.
4	Marshall, L. 1998. Atlantic Salmon: Southwest New Brunswick outer-Fundy SFA 23. Dept of Fisheries & Oceans, Atlantic Region, Science. Stock Status Report D3-13. 6 recs.
4	NatureServe Canada. 2018. iNaturalist Butterfly Data Export . iNaturalist.org and iNaturalist.ca.
4	Newell, R.E. 2000. E.C. Smith Herbarium Database. Acadia University, Wolfville NS, 7139 recs.
4	Sabine, D.L. 2011. Dorcas Copper records from 2001 Fieldwork. New Brunswick Dept of Natural Resources, 4 recs.
4	Simpson, D. Collection sites for Black Ash seed lots preserved at the National Tree Seed Centre in Fredericton NB. National Tree Seed Centre, Canadian Forest Service. 2016.
3	Basquill, S.P. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre, Sackville NB, 69 recs.
3	Bishop, G., Bagnell, B.A. 2004. Site Assessment of Musquash Harbour, Nature Conservancy of Canada Property - Preliminary Botanical Survey. B&B Botanical, 12pp.
3	Blaney, C.S.; Mazerolle, D.M. 2011. Fieldwork 2011. Atlantic Canada Conservation Data Centre. Sackville NB.
3	Clayden, S.R. 2006. Pseudevernia cladonia records. NB Museum. Pers. comm. to S. Blaney, Dec, 4 recs.
3	Forbes, G. 2001. Bog Lemming, Phalarope records, NB. , Pers. comm. to K.A. Bredin. 6 recs.

# recs	CITATION
3	Klymko, J.J.D. 2012. Insect fieldwork & submissions, 2011. Atlantic Canada Conservation Data Centre. Sackville NB, 760 recs.
3	Lautenschlager, R.A. 2005. Survey for Species at Risk on the Canadian Forest Service's Acadia Research Forest near Fredericton, New Brunswick. Atlantic Canada Conservation Data Centre, 6. 3 recs.
3	Richardson, D., Anderson, F., Cameron, R, McMullin, T., Clayden, S. 2014. Field Work Report on Black Foam Lichen (Anzia colpodes). COSEWIC.
2	Anon. 2017. Export of Maritimes Butterfly records. Global Biodiversity Information Facility (GBIF).
2	Basquill, S.P., Porter, C. 2019. Bryophyte and lichen specimens submitted to the E.C. Smith Herbarium. NS Department of Lands and Forestry.
2	Bishop, G. 2012. Field data from September 2012 Anticosti Aster collection trip. , 135 rec.
2	Boyne, A.W. 2000. Harlequin Duck Surveys. Canadian Wildlife Service, Sackville, unpublished data. 5 recs.
2	Brunelle, P.-M. 2005. Wood Turtle observations. Pers. comm. to S.H. Gerriets, 21 Sep. 3 recs, 3 recs.
2	e-Butterfly. 2018. Selected Maritimes butterfly records from 2016 and 2017. Maxim Larrivee, Sambo Zhang (ed.) e-butterfly.org.
2	Edsall, J. 1993. Spring 1993 Report. New Brunswick Bird Info Line, 3 recs.
2	Goltz, J. 2017. Harlequin Duck observations. New Brunswick Department of Agriculture, Aquaculture and Fisheries.
2	Goltz, J.P. 2002. Botany Ramblings: 1 July to 30 September, 2002. N.B. Naturalist, 29 (3):84-92. 7 recs.
2	Hay, G.U. 1883. Botany of the Upper St. John. Bulletin of the Natural History Society of New Brunswick, 2:21-31. 2 recs.
2	Hinds, H.R. 1999. A Vascular Plant Survey of the Musquash Estuary in New Brunswick. , 12pp.
2	Klymko, J.J.D.; Robinson, S.L. 2014. 2013 field data. Atlantic Canada Conservation Data Centre.
2	Litvak, M.K. 2001. Shortnose Sturgeon records in four NB rivers. UNB Saint John NB. Pers. comm. to K. Bredin, 6 recs.
2	Lovit, M. 2015. Rare Passamaquoddy Flora of Grand Manan. New Brunswick Museum, Florence M. Christie Grant in Botany, 32 pp.
2	Manthorne, A. 2019. Incidental aerial insectivore observations. Birds Canada.
2	McAlpine, D.F. 1983. Status & Conservation of Solution Caves in New Brunswick. New Brunswick Museum, Publications in Natural Science, no. 1, 28pp.
2	McIntosh, W. 1904. Supplementary List of the Lepidoptera of New Brunswick. Bulletin of the Natural History Society of New Brunswick, 23: 355-357.
2	Toner, M. 2005. Lynx Records 1996-2005. NB Dept of Natural Resources, 48 recs.
2	Walker, E.M. 1942. Additions to the List of Odonates of the Maritime Provinces. Proc. Nova Scotian Inst. Sci., 20. 4: 159-176. 2 recs.
2	Webster, R.P. Email to John Klymko detailing records of butterflies collected by Reggie Webster in June 2017. Webster, R.P. 2017.
2	Webster, R.P. Reggie Webster's records of Encyclops caerulea . pers. collection. 2018.
1	Amirault, D.L. 1997-2000. Unpublished files. Canadian Wildlife Service, Sackville, 470 recs.
1	Belliveau, A.G. E.C. Smith Herbarium Specimen Database 2019. E.C. Smith Herbarium, Acadia University. 2019.
1	Benedict, B. 2006. Argus annotation: Salix pedicellaris. Pers. comm to C.S. Blaney, June 21, 1 rec.
1	Blaney, C.S. 2018. Atlantic Canada Conservation Data Centre Fieldwork 2018. Atlantic Canada Conservation Data Centre.
1	Brunton, D.F. 2016. Record of Potamogeton vaseyi in Joslin Creek, NB. pers. comm., 1 record.
1	Clayden, S.R. 2003. NS lichen ranks, locations. Pers. comm to C.S. Blaney. 1p, 5 recs, 5 recs.
1	Clayden, S.R. 2007. NBM Science Collections. Pers. comm. to D. Mazerolle, 1 rec.
1	Dadswell, M.J. 1979. Status Report on Shortnose Sturgeon (Acipenser brevirostrum) in Canada. Committee on the Status of Endangered Wildlife in Canada, 15 pp.
1	DeMerchant, A. 2019. Bank Swallow colony observation. NB Department of Energy and Resource Development, Pers. comm. to J.L. Churchill.
1	Edsall, J. 1992. Summer 1992 Report. New Brunswick Bird Info Line, 2 recs.
1	Goltz, J.P. 2016. Email to Sean Blaney re: discovery of Carex waponahkikensis at Campobello Island. pers. comm., 1 record.
1	Hicklin, P.W. 1990. Shorebird Concentration Sites (unpubl. data). Canadian Wildlife Service, Sackville, 296 sites, 30 spp.
1	Hinds, H.R. 2000. Flora of New Brunswick (2nd Ed.). University New Brunswick, 694 pp.
1	Holder, M. & Kingsley, A.L. 2000. Peatland Insects in NB & NS: Results of surveys in 10 bogs during summer 2000. Atlantic Canada Conservation Data Centre, Sackville, 118 recs.
1	Jessop, B. 2004. Acipenser oxyrinchus locations. Dept of Fisheries & Oceans, Atlantic Region, Pers. comm. to K. Bredin. 1 rec.
1	Jolicoeur, G. 2008. Anticosti Aster at Chapel Bar, St John River. QC DOE? Pers. comm. to D.M. Mazerolle, 1 rec.
1	Klymko, J. Henry Hensel's Butterfly Collection Database. Atlantic Canada Conservation Data Centre. 2016.
1	Klymko, J. Univeriste de Moncton insect collection butterfly record dataset. Atlantic Canada Conservation Data Centre. 2017.
1	Klymko, J., Sabine, D. 2015. Verification of the occurrence of Bombus affinis (Hymenoptera: Apidae) in New Brunswick, Canada. Journal of and Acadian Entomological Society, 11: 22-25.
1	Maass, W.S.G. & Yetman, D. 2002. Assessment and status report on the boreal felt lichen (Erioderma pedicellatum) in Canada. Committee on the Status of Endangered Wildlife in Canada, 1 rec.
1	MacFarlane, Wayne. 2018. Skunk Cabbage observation on Long Island, Kings Co. NB. Pers. comm., 1 records.
1	Madden, A. 1998. Wood Turtle records in northern NB. New Brunswick Dept of Natural Resources & Energy, Campbellton, Pers. comm. to S.H. Gerriets. 16 recs.
1	Mandula, M. 2017. Nature Trust of New Brunswick Site Report: Jackson Falls, NB – new rare plant station. Nature Trust of New Brunswick, 2 pp.
1	McAlpine, D.F. & Cox, S.L., McCabe, D.A., Schnare, J.-L. 2004. Occurrence of the Long-tailed Shrew (Sorex dispar) in the Nerepis Hills NB. Northeastern Naturalist, vol 11 (4) 383-386. 1 rec.
1	NatureServe Canada. 2018. iNaturalist Maritimes Butterfly Records. iNaturalist.org and iNaturalist.ca.
1	Newell, R.E. 2005. E.C. Smith Digital Herbarium. E.C. Smith Herbarium, Irving Biodiversity Collection, Acadia University, Web site: http://luxor.acadiau.ca/library/Herbarium/project/. 582 recs.
1	Norton, Barb. 2010. Personal communication concerning Botrychium oneidense near Ayers Lake, NB. , One record.
1	Ogden, K. Nova Scotia Museum butterfly specimen database. Nova Scotia Museum. 2017.
1	Parkinson, K. 2017. Wood Turtle record in the Meduxnekeag Valley Nature Preserve. Pers. comm. to AC CDC.
1	Sabine, D.L. & Goltz, J.P. 2006. Discovery of Utricularia resupinata at Little Otter Lake, CFB Gagetown. Pers. comm. to D.M. Mazerolle, 1 rec.
1	Sabine, D.L. 2004. Specimen data: Whittaker Lake & Marysville NB. Pers. comm. to C.S. Blaney, 2pp, 4 recs.
1	Sabine, D.L. 2012. Bronze Copper records, 2003-06. New Brunswick Dept of Natural Resources, 5 recs.
1	Sabine, D.L. 2013. Dwaine Sabine butterfly records, 2009 and earlier.
1	Singleton, J. 2004. Primula mistassinica record for Nashwaak NB. Pers. comm. to C.S. Blaney, 1 rec.

# recs	CITATION
1	Taylor, Eric B. 1997. Status of the Sympatric Smelt (genus Osmerus) Populations of Lake Utopia, New Brunswick. Committee on the Status of Endangered Wildlife in Canada, 1 rec.
1	Toner, M. 2001. Lynx Records 1973-2000. NB Dept of Natural Resources, 29 recs.
1	Toner, M. 2005. Listera australis population at Bull Pasture Plains. NB Dept of Natural Resources. Pers. comm. to S. Blaney, 8 recs.
1	Toner, M. 2009. Wood Turtle Sightings. NB Dept of Natural Resources. Pers. comm. to S. Gerriets, Jul 13 & Sep 2, 2 recs.
1	Toner, M. 2011. Wood Turtle sighting. NB Dept of Natural Resources. Pers. com. to S. Gerriets, Sep 2, photo, 1 rec.
1	Torenvliet, Ed. 2010. Wood Turtle roadkill. NB Dept of Transport. Pers. com. to R. Lautenschlager, Aug. 20, photos, 1 rec.
1	Webster, R.P. & Edsall, J. 2007. 2005 New Brunswick Rare Butterfly Survey. Environmental Trust Fund, unpublished report, 232 recs.

Appendix E –
Correspondence with First Nation Communities

Table E.1 – First Nation Consultation Record – McAdam Wellfield Expansion Project

Date	Activity	Comments
June 24, 2020	Sent out Notice of Pending EIA Registration – McAdam Wellfield Expansion Project to Sitansisk (St. Mary's) First Nation	-The notice provided project background information (location, scope of work), a site location and development plan and proponent contact information. The notice further indicated that the First Nation community can ask questions or express concerns about the project. -To date, the proponent has not received any response to this notice from this First Nation community.
June 24, 2020	Sent out Notice of Pending EIA Registration – McAdam Wellfield Expansion Project to Welamukotuk (Oromocto) First Nation	-The notice provided project background information (location, scope of work), a site location and development plan and proponent contact information. The notice further indicated that the First Nation community can ask questions or express concerns about the project. -The proponent received an e-mail from Fred Sabattis (Oromocto First Nation Consultation Coordinator) on June 24, 2020 wherein Mr. Sabattis indicated that he did not see any problem with the project as long as the Wolastoqey Nation in New Brunswick (includes all of the First Nations engaged for the proposed project) EIA Coordinator (Gordon Grey) is satisfied with the project EIA. It is noted that each of the engaged First Nation communities will receive a copy of the project EIA registration document when complete. -To date, the proponent has not received any other responses to this notice from this First Nation community.
June 24, 2020	Sent out Notice of Pending EIA Registration – McAdam Wellfield Expansion Project to Pilick (Kingsclear) First Nation	-The notice provided project background information (location, scope of work), a site location and development plan and proponent contact information. The notice further indicated that the First Nation community can ask questions or express concerns about the project. -To date, the proponent has not received any response to this notice from this First Nation community.
June 24, 2020	Sent out Notice of Pending EIA Registration – McAdam Wellfield Expansion Project to Peskotomuhkati Nation at Skutik	-The notice provided project background information (location, scope of work), a site location and development plan and proponent contact information. The notice further indicated that the First Nation community can ask questions or express concerns about the project. -To date, the proponent has not received any response to this notice from this First Nation community.

June 24, 2020 FRE-00259858-A0

Welamukotuk First Nation
4 Hiawatha Court
PO Box 417, RPO Oromocto Mall
Oromocto, NB
E2V 2J2

Attention : Chief Shelley Sabattis

Re: Notice of Pending Environmental Impact Assessment Registration – McAdam Wellfield Expansion Project, McAdam, NB

On behalf of the Village of McAdam, please see the attached notice concerning the McAdam Wellfield Expansion Project. The proposed work will be completed near the existing McAdam Wellfield which is situated approximately 2.5 km southeast of the Village on a portion of the undeveloped wooded Crown Land parcel identified as PID 75096693.

The project will be registered under the provincial Environmental Impact Assessment (EIA) regulation under the *Clean Environment Act* in the near future. First Nation and public consultation regarding this project is being conducted in accordance with provincial EIA requirements.

If you have any questions concerning this matter, please contact me at 506-857-8889 or robert.gallagher@exp.com.

Sincerely,

Robert S. Gallagher

_____

Robert S. Gallagher, M.Sc.Eng., P. Eng.
EXP Services Inc.

cc. Shyla O'Donnell - Shyla.Odonnell@wolastoqey.ca
Gillian Paul - Gillian.Paul@wolastoqey.ca
Gorden Grey - Gordon.Grey@wolstoqey.ca
Fred Sabattis – tamagun@rogers.com

NOTICE OF PENDING ENVIRONMENTAL IMPACT ASSESSMENT REGISTRATION - MCADAM WELLFIELD EXPANSION PROJECT

The Village of McAdam, NB intends to increase the capacity of its existing municipal groundwater supply source which consists of four production wells. In recent years, the Village has experienced considerable growth, which has resulted in their current requirement for additional groundwater supply capacity. This increase in water demand has been exacerbated by a decrease in the yield and water quality of one its four existing production wells. As such, the Village wishes to develop additional municipal production wells with a combined yield that will permit the replacement/decommissioning of the problematic well while still resulting in a net increase in the existing groundwater supply capacity. Ideally, the combined yield of the new production wells will be 700 m^3/day (107 Igpm) or greater which will result in a minimum increase of 35% in the yield of the existing wellfield. The existing wellfield and surrounding area are subject to protective land use restrictions in accordance with NB Regulation 2000-47 under the *Clean Water Act*.

A site plan which illustrates the approximate areal extent of the EIA assessment area in addition to the locations of the existing municipal production wells, the wellfield protected areas and the target drilling locations has been attached to this notice. In general, the scope of work for the proposed project will include widening/upgrading an existing woods trail to provide access to target drilling locations C2 and C3; constructing a new road between the existing woods trail and C1 to provide access to the latter target drilling location; and completion of test well drilling and pump testing at up to three (3) of the above noted target drilling locations in accordance with the New Brunswick Department of the Environment and Local Government (NBDELG) requirements. Pending favorable results of the test well drilling and pump testing program, the Village intends to construct up to two (2) new municipal production wells and connect these wells to the existing municipal water distribution system. This would involve the construction of a new water transmission main to connect the new wells to the existing wellhouse/water treatment building and the completion of some infrastructure upgrades to this existing building.

The proposed project will take place on a portion of the Crown Land identified as PID 75096693 which is situated adjacent to the existing wellfield property identified as PID 75416198. The latter property is also Crown Land that is currently leased by the Village from the New Brunswick Department of Natural Resources and Energy Development (NBERD).

The project will be registered for review with NBDELG under the Environmental Impact Assessment Regulation, *Clean Environment Act* in the near future. All First Nation communities in the province and key project stakeholders will be notified of the project once the registration document has been posted to the NBDELG website for public viewing.

As part of the EIA process, individuals may ask questions or raise concerns related to any potential environmental impacts associated with the project. Questions and comments may be submitted to the project proponent (Village of McAdam) to the attention of Ken Stannix at the following mailing address: 146 Saunders Road, McAdam, NB E6J 1L2. Comments may also be sent by e-mail directly to kstannix@mcadamnb.com. However, interested parties are informed that public comments under the EIA review process must be submitted to the proponent no later than 25 days following project registration.

Dated: June 24, 2020

2437000 2437500 2438000 2438500 2439000

7397500

7397000

7396500

N

Existing Wellfield Access Roadoff NB Route 4

Village of McAdam

PID 75416198
(Existing Wellfield Property/Lease)

C1

Existing Woods Trail

PW13 PW12

C2

Existing Wellhouse

PW11

PW10

C3

Approximate Limits of Assessment Area

Railway Line

McAdam

Chemin Saunders

Vanceboro Rd

4

Legend

Approximate Limits of Assessment Area

Crown Lands (Portion of PID 75096693)

Legend

Municipal Boundary

Drill Targets

McAdam Wells

NBHN Watercourses

Property Parcels

Protected Wellfields

Zone

A

B

C

1:6,000

0 50 100 200 300

Meters

exp.

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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